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Final Reports of Principal Investigators

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OUTER CONTINENTAL SHELF

ENVIRONMENTAL ASSESSMENT PROGRAM

FINAL REPORTS OF PRINCIPAL INVESTIGATORS

Volume 55

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U.S. DEPARTMENT OF COMMERCE
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Anchorage, Alaska

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Outer Continental Shelf Environmental Assessment Program

Final Reports of Principal Investigators

VOLUME 55 JULY 1988

CONTENTS

FISH USE OF INSHORE HABITATS NORTH OF THE ALASKA PENINSULA

JUNE - SEPTEMBER 1984 and JUNE - JULY 1985

by

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Final Report
Outer Continental Shelf Environmental Assessment Program
Research Unit 659

November 1986

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

Figure

LIST OF FIGURES (Continued)

Figure

LIST OF TABLES

Table

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This study was funded (wholly or in part, whichever is appropriate) by the Minerals Management Service, Department of the Interior through an Interagency Agreement with the National Oceanic and Atmospheric Administration, Department of Commerce, as part of the Alaska Outer Continental Shelf Environmental Assessment Program. This program could not have been completed without the commitment and energy of the three major organizations involved: NOAA, Dames & Moore, and the University of Washington, Fisheries Research Institute (FRI). Participants in the field program who endured small boat life under difficult circumstances included: Greg Blair, Greg Erickson, Peter Hagen, Jeff Haymes, Russell Ladley, Kevin Latorra, Jeff Moore, Pat Poe, Greg Polkinghorn, Tom Rogers, and Greg Ruggerone. Added field assistance came from Robert D. Paulus, skipper of the R. V. Kittiwake, whose past fisheries experience and local knowledge allowed much of the field program to succeed.

External to the study team but of major importance to the field success was the support of Peter Pan Seafoods at Naknek and Port Moller. Don Rawlinson and Dexter Lall, who manage the Naknek and Port Moller operations, respectively, proved very helpful. Ray Earl, Port Moller Beach Boss in 1984, was also extremely helpful during several boat mechanical failures.

On the analytical side, William Driskell, consultant to Dames & Moore, and Mike McDowell of Dames & Moore deserve special credit for designing data forms, data entry programs, and manipulating catch data. Stephen Jewett and Michael Dell each contributed reviews and analyses of historic data.

Finally, the free use of FRI gear (whaler, outboards, etc.) and field stations (Wood River, Chignik) between cruises in 1984 allowed the work to be completed at a reduced cost.

1.0 EXECUTIVE SUMMARY

1.1 OBJECTIVES

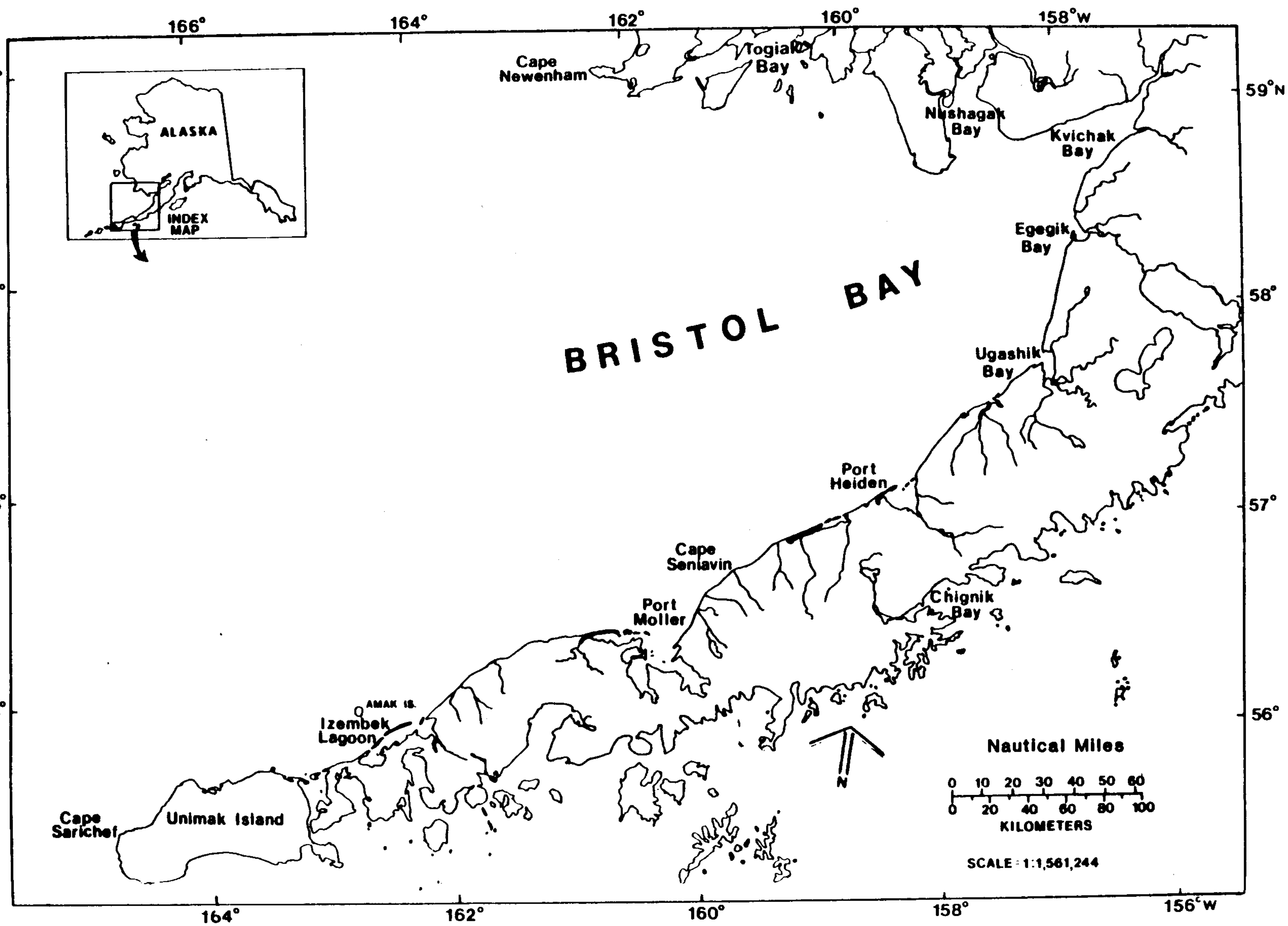
The Bering Sea as a whole produces a substantial fraction of the world's annual harvest of seafoods, with major fisheries for salmon, large shellfish, and groundfish. Anticipation of upcoming oil and gas lease sales in the eastern Bering Sea Basin established a need for a greater understanding of the interrelationship of various components of the marine ecosystem of the Bering Sea. Over the past several years, the National Oceanic and Atmospheric Administration (NOAA) Outer Continental Shelf Environmental Assessment Program (OCSEAP) has sponsored studies of many of these Bering Sea ecosystem components in an effort to provide the data necessary to permit informed decision making in the region. Recent syntheses of this data base identified a major information need for understanding of the importance of the nearshore zone and embayments along the north side of the Alaska Peninsula for fish, especially for the many millions of juvenile salmon migrating from area rivers each spring.

This research (Research Unit 659) was designed to provide the baseline descriptions of fish assemblages needed to assess potential and actual impacts of oil and gas development on natural resources of the study area (Figure 1). Primary objectives were to:

- Describe the species composition of demersal and pelagic fish assemblages in poorly-studied nearshore, intertidal, and estuarine habitats of the study area.

- Determine relative abundances of species by habitat, area, and season (spring, summer, and fall).

- Describe changes in distributions of adults and juveniles occurring over time scales of tide cycles to seasons, including inshore-offshore migrations and directed migrations through the study area.



Study Area

Figure 1

Dames & Moore

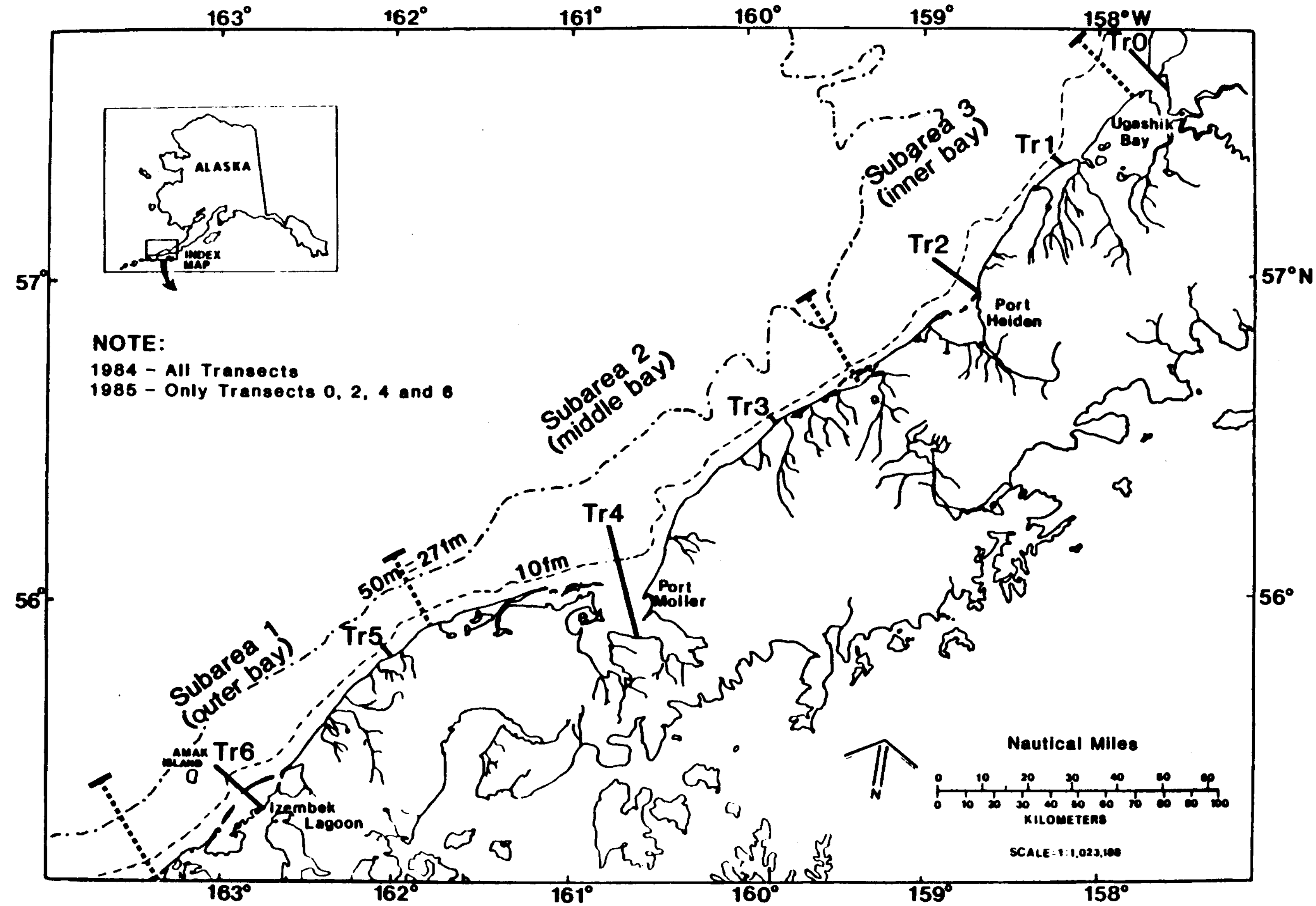
Assessments of potential impacts on salmon and other pelagic and demersal finfish of OCS oil and gas exploration and development on the North Aleutian shelf and basin have been made by NOAA (Thorsteinson 1984), MMS (1985), and Bax (1985). In the case of juvenile salmonids, these assessments were based primarily on syntheses and broad generalizations of distribution and movement patterns from data collected in the late 1960s and early 1970s (generally at 20 m or greater depths), and variously reported by Straty (1974, 1975, 1981) and Straty and Jaenike (1980). A major goal of the study reported here was to provide information to confirm or deny the validity of many of these generalizations for waters closer to the shoreline.

This 2-year study was conducted by Dames & Moore in association with Fisheries Research Institute (FRI), University of Washington, and was performed under NOAA Contract 84-ABC-00122.

1.2 GENERAL APPROACH

The general approach of this study was to carefully allocate the limited resources of sampling effort and time in order to maximize the collection of new information on the movement and abundance of commercially significant finfish in inshore habitats (e.g., within 50-m isobath) that are considered to be most vulnerable to perturbation from OCS development.

In 1984, our study area extended from False Pass to Ugashik Bay in waters to about 30 m deep (Figure 2). It encompassed two estuaries (Port Heiden and Port Moller) and a coastal lagoon (Izembek Lagoon), as well as exposed coastal and inshore habitats. The estuarine systems are representative of those in inner Bristol Bay. Izembek Lagoon deserves special attention due to its highly productive character. Sampling was also conducted in Ugashik Bay as a matter of opportunity (while seeking refuge from unworkable weather conditions outside the Bay). Sampling was focused at depth-stratified stations on six transects spaced throughout the study area to include three with associated embayments and three from exposed beaches (Figure 2). Depending on station characteristics, each was sampled by one or more of the following gear types:



Study Subareas and Transect Locations

Dames & Moore

Figure 2

purse seine or tow net (targeting pelagic species); otter trawl and beam trawl (targeting demersal fish); beach seine (targeting littoral fish assemblages).

In 1985, our study area covered the same area along the Alaska Peninsula as in 1984, except that Ugashik (Transect 0) was added as a formal transect and a new outside station (numbered 0) was added at all transects to extend sampling to 15 nautical miles offshore. Only Transects 0, 2, 4, and 6 were sampled (the so-called "bay transects"); Transects 1, 3, and 5 (the "open-coast transects") were dropped to allow greater sampling replication at remaining transects (Figure 2). An additional offshore sampling difference was that the three stations farthest offshore (numbered 0, 1, and 2) were stratified by distance offshore at 24, 16, and 8 km (15, 10, and 5 nautical miles) in 1985, versus the depth stratification approach of 1984. Due to this distance stratification in 1985, sampling depths at the outside station (numbered 0) ranged from 30 to over 50 m. For the most part, nearshore or bay sampling stations in 1985 remained the same as in 1984. In contrast to the 1984 sampling with 5 gear types, 3 gear types (otter trawl, beam trawl, and tow net) were dropped in 1985 and a new gear type added (small purse seine). Thus, only the beach seine, purse seine, and small purse seine were used in 1985. The gear-type selection in 1985 was made to place more emphasis on pelagic species, especially juvenile salmon.

Three sampling cruises were undertaken in 1984 (late June to mid-July, late July to mid-August, late August to mid-September). In 1985, one 6-week cruise occurred from mid-June to the end of July. Sampling was conducted using a 55-foot, a 29-foot, and two smaller vessels. A total of 277 sets of all gear types was made in 1984, while 172 sets were made in 1985.

All fish captured were either processed on board or preserved for later analysis.

1.3 RESULTS AND CONCLUSIONS

Weather and surface sea temperatures were strikingly different between 1984 and 1985. For the three cruises in 1984, generally poor to harsh weather was experienced, while for the single extended cruise in 1985, much calmer weather was generally present in the study area. Sea surface temperatures for similar areas and times of year were from 1 to 2°C colder in 1985 than in 1984. Salinities for comparable areas and times were quite similar between these two years.

The main difference in 1984 and 1985 results was the change in catch ratios of demersal to pelagic fish assemblages due to dropping the otter and beam trawls and starting earlier in the 1985 effort. While juvenile salmonids made up less than 1 percent of all fish caught in 1984, these fish made up 52 percent of the total catch in 1985. Over 88,400 fish were caught by 277 sets of all five gear types deployed in 1984. In 1985, almost 30,000 fish were caught by 172 sets of the three gear types deployed. These catches represented 54 taxa, including all five species of Pacific salmon common in the eastern Pacific.

1.3.1 Salmonids

1984 - Cruises 1, 2, and 3

Despite the fact that over half of our 1984 sampling effort (158 of 277 sets; Table 1a) was with gear types selected to catch juvenile salmon, this group represented only about 1 percent of all fish captured. For example, our average catch of juvenile salmonids in purse seines was only 8.21 per set (standardized to 10 minutes). Catches were very patchy and the conclusions stated below regarding catch patterns are correspondingly weak. Cruise 1 (late June to mid-July) purse seine catch of salmonids (8.60 per set) was dominated numerically by coho juveniles (78 percent; primarily because of one large catch on Transect 2) off Port Heiden, followed by sockeye (23 percent), and chums (<1 percent). Cruise 2 (late July to mid-August) purse seine catch (9.86 per set) was dominated by sockeye (54 percent) and chum salmon (34 percent). Catch rate was up markedly for both species. Juvenile coho (7

TABLE 1a

TOTAL CATCH SUMMARY - 1984[a]

Common Species Name	RAW CATCH BY SPECIES Purse Seine	Beach Seine	20x9 Townet	Otter Trawl	Beam Trawl	Total All Gear
Alaska Plaice	1	54(8)		460(6)	5	520 (9)
Arctic Cod	1			1		2
Arctic Flounder		7	3			10
Arctic Lamprey	9		4			13
Bering Poacher	2	19		357(7)	2	380
Brightbelly Sculpin				5		5
Butter Sole				20		20
Capelin		1				1
Chinook Salmon Juv.	21	2	3			26
Chum Adult	30	17				47
Chum Salmon Juv.	288(6)	22	32(4)			342
Coho Adult		1				1
Coho Salmon Juv.	195(8)	27				222
Crescent Gunnel	7			12	1	20
Crested Sculpin	10	1	1	1		13
Dolly Varden Adult	2	4				6
Eulachon		13		9		22
Flathead Sole			1	4		5
Great Sculpin		1		1		2
Kelp Greenling		1		6		7
Liparis SP			1	5		6
Longhead Dab		2		164	1	167
Ninespine Stickleback	19	3	24(6)			46
Pacific Cod	3007(1)	83(6)	4	3666(2)	1	6761(4)
Pacific Halibut		1		64	1	66
Pacific Herring	4	3	742(3)	1		750(7)
Pacific Sandfish	292(5)	5	28(5)	44		369
Pacific Sand Lance	1102(2)	33177(1)	20043(1)	954(4)		55277(1)
Padded Sculpin				3		3
Pink Adult	6					6
Pink Salmon Juv.	5					5
Plain Sculpin		4	1	2		7
Pleuronectidae	2		1			3
Pond Smelt		27				27
Rainbow Smelt	34	948(2)	7020(2)	285(10)	5	8292(3)
Ribbed Sculpin				11		11
Rock Sole	5	29		1487(3)	26(3)	1547(6)
Sailfin Sculpin				2		2
Sculpin D		3		5		8
Silverspotted Sculpin	6			2		8
Snake Prickleback	3	4	5(9)	356(8)	40(2)	408(10)
Sockeye Adult	87(10)	1				88
Sockeye Salmon Juv.	262(7)	33(10)	8			303
Staghorn Sculpin		159(4)		40		199
Starry Flounder	5	106(5)	15(8)	77	2	205
Sturgeon Poacher	1	1		39		41
Surf Smelt	1	216(3)		1		218
Threaded Sculpin		7		318(9)	7	332
Threespine Stickleback	3	4				7
Tidepool Sculpin				1		1
Tubenose Poacher		14	1	174	3	192
Unid.Cods	163(9)					163
Unid.Smelt	31	14	15(8)	2		62
Walleye Pollock	557(4)			31		588(8)
Whitespotted Greenling	1090(3)	35(9)	7(10)	615(5)	3	1750(5)
Wolf-eel	6					6
Yellowfin Sole	19	74(7)	20(7)	8657(1)	79(1)	8849(2)
Totals	7276	35122	27979	17882	177	88436
All Juvenile Salmonids	771	84	43			898
Number of Hauls	71	47	40	117	2	277

[a] Numbers in parentheses ( ) represent ranking of catches.

TABLE 1b

TOTAL CATCH SUMMARY - 1985[a]

Common Species Name	RAW CATCH BY SPECIES Small Seine	Purse Seine	Beach Seine	Total All Gear
Alaska Plaice			52	52
Arctic Flounder			94	94
Arctic Lamprey	2	7		9
Capelin	3	106		109
Chinook Salmon Juv.	2	2	2	6
Chum Salmon Adult		23	2	25
Chum Salmon Juv.	758(2)	403(3)	3970(2)	5131(3)
Cod Unid.			4	4
Coho Salmon Juv.	52	178(5)	61	291(8)
Dolly Varden Adult		7	2	9
Dolly Varden Juv.		40		40
Great Sculpin		1	3	4
Greenling Unid.		1		1
Ninespine Stickleback			2	2
Pacific Cod		10	2	12
Pacific Herring	15	27	13	55
Pacific Sandfish	1	81		82
Pacific Sandlance	336(4)	1006(2)	8308(1)	9650(1)
Pink Salmon Adult		4		4
Pink Salmon Juv.	115(5)	5	832(4)	952(5)
Pond Smelt			96	96
Rainbow Smelt	700(3)	13	2033(3)	2746(4)
Rock Sole			13	13
Saddleback Gunnel			3	3
Sculpin Unid.			1	1
Smelt Unid.		6		6
Snake Prickleback	1		77	78
Sockeye Salmon Adult		386(4)		386(7)
Sockeye Salmon Juv.	738(1)	8498(1)	5	9241(2)
Staghorn Sculpin	2	1	49	52
Starry Flounder		6	610(5)	616(6)
Sturgeon Poacher		1	3	4
Threaded Sculpin			1	1
Threespine Stickleback	2	33	3	38
Tubenose Poacher				0
Walleye Pollock		15	2	17
Whitespotted Greenling	4	121	3	128(9)
Yellowfin Sole		7	20	27
Totals	2732	10988	16266	29986

[a] Numbers in parentheses ( ) represent ranking of catches.

percent) and chinook (4.6 percent) were also common during Cruise 2. Pink salmon juveniles were only taken in Cruise 2, Transect 4 (Port Moller), Station 1. Purse seine catch rate (5.82 per set) in the third cruise was substantially lower than in the second, despite one very large catch (Transect 1). Chum salmon juveniles dominated this single large catch and, hence, dominated the total catch numerically (94 percent of all juvenile salmon). Sockeye followed (6.9 percent) with the remainder comprised of coho and chinook juveniles.

Stations 1 and 3 (27 m, 11 m) had a higher overall purse seine catch rate for juvenile salmonids (all species, cruises, and transects combined) than did the intermediate Station 2 (20 m), primarily because no single large catch was made in any of the sets at Station 2. During Cruise 2, when the most complete purse seining coverage was achieved (3 stations on each of 5 transects sampled), there was a steady increase in the numbers of juvenile salmon with distance offshore. Geographically, the overall purse seine catch rate (all species and stations combined) was greatest during Cruises 1 and 3 at the inner Bristol Bay transects (1 and 2), declining at middle-bay transects (3 and 4), and declining further at the outer transects (5 and 6). During Cruise 2, strong catches of chums and sockeye on Transect 3 altered this picture somewhat; however, catch rates on Transects 1 and 3 greatly exceeded those on Transects 4 through 6. Length-frequency evaluations made for the small sample of juvenile sockeye and chum salmon taken in 1984 showed reasonable patterns of growth and movement through the study area.

Our low catch rate for juvenile salmonids in 1984 (compared to that of earlier studies) was attributed to smaller seine size and to our late start which likely missed peak sockeye migrations. It was also thought that our catch rates (e.g., Cruise 2 purse seine results) might reflect less preference for shoreline areas (which are extremely dynamic in the Bering Sea) than is the case for other areas.

1985 - Cruises 4a and 4b

Systematic coverage of the study area from mid-June through July 1985 revealed that large numbers of juvenile salmonids seasonally occupy the nearshore waters of the North Aleutian Shelf (NAS). A total of 15,619 juvenile salmonids was captured in 97 large purse seine sets, 34 small seine sets, and 41 beach seine sets (Table 1b, p. 22). Approximately 59 percent of all salmonids were sockeye, 33 percent were chum, 6 percent were pink, 2 percent were coho, and < 0.1 percent were chinook.

Strong trends in relative abundance were apparent in the sockeye catch data. High mean large purse seine CPUE (88.5 fish/set) compared to those for small seine (22.4) and beach seine (0.1) describe a coastal distribution for sockeye with relatively little use of littoral habitats. Purse seine CPUE declined with distance down the Alaska Peninsula, distance offshore, and time. Comparatively larger catches of sockeye juveniles at inner bay transects (Ugashik and Port Heiden) suggested a narrow migration corridor less than about 15 nautical miles (nm) wide, whereas smaller catches at outer bay transects indicated that the migration band either dispersed or was displaced offshore between Port Heiden and Izembek Lagoon.

Small numbers of juvenile coho salmon were taken routinely, but not consistently, at all locations in 1985. Mean CPUE for the survey (all gear combined) was 1.7 fish per set. Abundance generally increased over time and with distance out of Bristol Bay. Coho were rare or absent in beach seine and small seine catches at Ugashik and Port Heiden at all times, but were common in all gear and at all times at Port Moller. The consistency of catches at all times and in all habitats suggests that Port Moller is an important secondary rearing area for juvenile coho salmon.

Juvenile chum salmon were present only in intertidal habitats inside Port Moller during the first half of the 1985 survey period (Cruise 4a; June 16 to July 7), but became relatively abundant throughout the study area in the second half (Cruise 4b; July 8 to 28). Mean CPUE for chums was 30.5 fish per set (all gear combined), although much of this was due to a single beach seine catch of nearly 3,300 fish. A shift from intertidal to subtidal and offshore habitats was evident from changes in CPUE of each gear type over time. The pattern of habitat utilization in Port Moller clearly shows this estuary to be an important nursery area for local chum salmon stocks.

Pink salmon were not widely distributed in the study area in 1985. Mean CPUE for this species was 5.7 fish per set (all gear combined). Juvenile pink salmon were taken only at Port Moller, with the exception of two migrants captured in purse seine sets at Ugashik on the last days of the survey. The low incidence of migrating juvenile pink salmon in purse seine catches probably was due to the termination of sampling early in summer before Bristol Bay pinks had arrived in the study area.

Only six juvenile chinook were taken by all gear during the 1985 survey. Four of the six were taken near Ugashik Bay, which is known to support a run of adults. It is possible that juvenile chinook migrated out of the study area earlier, perhaps at depths inaccessible to the purse seine, so that small catches do not accurately reflect the relative abundance of this species in the NAS study area.

Sockeye Salmon Scale Pattern Analysis

Statistical evaluation of differences in fish growth by analysis of scale patterns is frequently used to distinguish individual stocks comprising mixed-stock samples. Previous stock identification studies suggested that the growth patterns in scales of Bristol Bay sockeye salmon were measurably different between stocks. Resulting estimates of stock mixing proportions could provide additional information on migration rates and routes of particular sockeye stocks in the eastern Bering Sea. We conducted a similar study to identify the rivers of origin of juvenile sockeye in purse seine catches at the Ugashik and Port Heiden transects.

A linear discriminant function (LDF) analysis of scale measurement data revealed that differences in scale growth patterns were not as distinct in 1985 as had been expected. Known samples of the scale patterns specific to each of the five major Bristol Bay stocks were assembled from scales collected in each system during the period of smolt outmigration in 1985. Statistical comparisons of scale patterns within and between these "training" samples established the accuracy of the LDF in assigning stock membership to the scales of unknown origin (captured in this survey at Ugashik and Port Heiden). Unfortunately, Ugashik, Naknek, and Wood River scales were virtually indistinguishable. It is noteworthy that the size of Wood River smolts in 1985 was the second largest since 1954, which undoubtedly masked the expected distinction between this stock and the others. Resultant classification accuracies achieved were 60.3 percent for a Wood River-excluded LDF and 64.3 percent for a Ugashik-excluded LDF. (These exclusions were made based on known migration timing characteristics.)

In view of the poor separability of scale patterns in 1985, stock classification of the 318 scales of unknown origin was not very meaningful. The LDF analysis suggested that catches in all time periods, from June 19 and 20 to July 27 and 28, were predominantly Naknek sockeye. Although stock composition estimates were not completely unrealistic, their poor reliability precluded any conclusive statements regarding stock composition of catches at Ugashik and Port Heiden.

Adult Salmonids

Adult salmon were not specifically targeted in this survey because their numbers and distributions in the NAS study area are documented by commercial catch and escapement records maintained by the Alaska Department of Fish and Game (ADF&G). These records showed that nearly 4.6 million salmon were caught or escaped to spawning grounds within the boundaries of our study area in 1985. Sockeye were most abundant (3.4 million), followed by chum (0.9 million), coho (0.3 million), chinook (37,000) and pink (4,900). Port Moller and Bear River areas formed the center of salmon abundance. Adult sockeye captured off Ugashik Bay were found to be aggressively feeding on euphausiids on June 20 and on July 12, 1985. Evidence of feeding within the influence of freshwater was unexpected, although the ultimate destination of feeding fish could not be determined.

Discussion of 1984 and 1985 Results

It is more appropriate to view the results of 1984 sampling as an extension of 1985 activities rather than to compare results across years. Virtually all of Cruise 4 (1985) was completed in water temperatures lower than those recorded at the beginning of Cruise 1 in 1984. The relative climatological (and, presumably, biological) timing of 1984 and 1985 sampling periods was almost without overlap. Therefore, the results of the 1985 survey should be viewed as representative of conditions that may have existed in 1984 before our sampling activity began. Similarly, the 1984 results may be representative of conditions that may have existed in 1985 after the termination of sampling activity.

The 1985 results disproved one of our originally proposed (Houghton et al. 1985) explanations for low salmonid CPUE in 1984 and confirms another. As a result of consistently small catches of juvenile salmonids in 1984, it was suggested that either the survey had missed peak abundances of juvenile sockeye in the study area, or that nearshore and estuarine habitats in the NAS study area were not heavily utilized by juvenile salmonids. Since sampling began much earlier in 1985 relative to peak migratory activity of juvenile sockeye salmon, it was confirmed that peak abundances of sockeye undoubtedly had occurred in the study area in 1984 prior to start-up of survey activities. Further, comparatively large catches of salmonids in 1985 demonstrate that nearshore and estuarine waters are very important rearing and migration habitats for juvenile salmonids, especially sockeye and chum salmon.

The model of sockeye salmon migration proposed by Straty (1974) is largely supported by the present results, to the extent that the surveys overlap. The intensive inshore coverage in the present study complements the extensive offshore sampling of the earlier survey. Major trends in the migration patterns of juvenile sockeye in 1984-1985 were nearly identical in many cases to those documented by Straty — for example, the strong shoreward bias of catches off Port Heiden.

We would amend the Straty model only to point out, as noted above, that interannual variation in the factors influencing the time/space pattern of migration can be quite pronounced; thus, they may substantially modify details of the general migration patterns concluded from that survey.

As for the other species of salmon, new data accumulated in course of R.U. 659 indicate that coastal embayments in the NAS study zone are highly important for juvenile chum, pink, and coho salmon. Data for chinook salmon are inconclusive on this point, but we know that locally important runs of adults return to both the Nushagak and Ugashik systems. Port Moller supports impressive numbers of juvenile salmon, especially pinks and chums, and appears to be more important in this respect than other embayments along the north side of the peninsula.

1.3.2 Nonsalmonids

1984 - Cruises 1, 2, and 3

Of the 88,436 fish captured in the 1984 sampling, 99 percent, representing 47 taxa, were nonsalmonids (Table 1a). By far the most dominant species was Pacific sand lance, which comprised 62.5 percent of all fish captured. Sand lance were the most abundant species in both the beach seine and tow net and ranked second (to Pacific cod) in purse seines and fourth in otter trawls. These results seem to confirm this species' role as one of, if not the most, important forage fish in this part of the Bering Sea. Densities appeared greater in the inshore waters (inside the 6-m isobath fished by the beach seine and tow net) during the first two cruises. Sand lance were widely yet irregularly distributed throughout the study area with significant concentrations encountered in beach seines in and outside of Port Moller during the first cruise (late June to mid-July), and in otter trawls in Izembek Lagoon during the third cruise (late August to mid-September). (Izembek Lagoon was not sampled in the first cruise.)

The second most abundant pelagic species in our 1984 catches was the rainbow smelt, which comprised 9.4 percent of the total catch (ranked second in both the beach seines and tow nets). Like the sand lance, rainbow smelt were most abundant in nearshore gear.

The third most abundant fish taken in the pelagic habitat in 1984 was Pacific cod, which ranked first in purse seine and second in otter trawl catches. This distribution demonstrates the preference of juvenile cod for offshore pelagic as well as demersal habitats. Catches in the second and third cruises greatly exceeded those in the first cruise, partially, at least, due to recruitment to the gear. Whitespotted greenling (third in purse seine), Pacific herring (third in the tow net), and walleye pollock (fourth in the purse seine) rounded out the most abundant nonsalmonids encountered in the pelagic habitat.

Otter trawl catches (mean fish weight per trawl) displayed no clear north-south trends, with Transects 1 and 6 having the highest values (all species and offshore stations combined). Of the offshore stations (at 6, 11, and 20 m) the 11-m station had the highest catch per unit effort (CPUE) on the three northern transects and the Izembek transect but was relatively lower on the remaining two transects. Stations inside Port Moller had much higher otter trawl catches than those outside, while the opposite was true for the Izembek transect.

Demersal fish communities sampled by otter trawl were dominated in order by yellowfin sole, Pacific cod, rock sole, Pacific sand lance, whitespotted greenling, and Alaska plaice. Yellowfin sole were widely distributed in the study area. The only apparent trend was for lower catches (numbers) in Izembek Lagoon compared to Port Moller. There was also a steady overall decline in catch through the sampling period. Rock sole likewise showed little geographic pattern but had a generally declining capture rate (numbers) over the sampling period.

Length-frequency evaluations were completed for the most important species and contributed to our overall understanding of the patterns of use of these areas by nonsalmonids.

1985 - Cruises 4a and 4b

Since otter trawling was not conducted in 1985, all but the incidental catch of demersal fish was eliminated. The 1985 sampling of nonsalmonids focused on pelagic fish assemblages that could be taken with the large or small purse seines and the littoral fish assemblages taken in both years with beach seines.

Of the 25 nonsalmonid species taken in 1985, only 6 species are considered pelagic. Despite this, pelagic fish species dominated the 1985 sampling effort. Pacific sand lance and rainbow smelt made up 41 percent of the total number of fish taken in 1985. While their numbers appeared to be fewer than in 1984, Pacific sand lance again were shown to be a very important forage fish in the study area. As in 1984, rainbow smelt was the second ranked nonsalmonid.

2.0 INTRODUCTION

2.1 PROJECT BACKGROUND AND OBJECTIVES

Anticipation of oil and gas lease sales in the North Aleutian Shelf (NAS), St. George Basin, and to a lesser extent the Navarin Basin, established a need for a greater understanding of the interrelationship of various components of the marine ecosystem of the Bering Sea. The Bering Sea as a whole produces a substantial fraction of the world's annual harvest of seafoods, with major fisheries for salmon, large shellfish (king and tanner crab), and groundfish (halibut, pollock, and cod). Lesser harvests of forage species (herring) and marine mammals (fur seals) also occur. Shellfish and finfish resources in the south-eastern Bering Sea and Bristol Bay support a substantial proportion of these commercial fisheries. Domestic harvests of salmon, crab, demersal fish, and groundfish stocks are valued at over $1 billion annually, with salmon and crab catches together accounting for over $400 million in recent years. In potential conflict with these living renewable resources is the need to explore and possibly develop deposits of petroleum and gas suspected to underlie the St. George Basin and the NAS.

The area of interest in this study, Bristol Bay from Cape Sarichef to Cape Newenham inside the 30- to 50-m isobath (Figure 1), is thought to be an integral part of the Bering Sea ecosystem as a whole; it supports concentrated use at various times of the year by a wide variety of organisms, including many that are of extreme commercial, ecological, and political importance. Because of the immense resource and ecological value of the area, there is a very high level of concern among the fishing industry, regional natives, conservation community, and the general public regarding the potential impacts of oil and gas development in the region.

OCSEAP has recognized the potential for conflict and the need for additional information upon which to base management decisions. A variety of research programs has been funded in the southern Bering Sea since 1975, culminating in the North Aleutian Shelf Synthesis Report

(Thorsteinson 1984) and the Environmental Characterization of the North Aleutian Shelf Nearshore Region (Kinnetic Laboratories, Inc. 1984). This latter document attempted to summarize all available information on the area and to describe the ecological processes which might support the observed biological distributions and productivities. This report also sought to develop an endemic trophic system model for the North Aleutian Peninsula nearshore zone and to identify research and assessment information needs. Kinnetic Laboratories, Inc. (1984) concluded that significant data needs remain. One of these needs was in the general understanding of the importance of the nearshore zone to important marine fishes (especially juvenile anadromous salmonids) and the vulnerabilities of these resources to potential OCS development impacts. Bax (1985) provided an assessment of some of these potential impacts on salmonids using the historical data of Straty (1974) and Hartt and Dell (1978).

Participants at the NOAA/MMS-sponsored NAS Synthesis Meeting (Thorsteinson 1984) were asked to evaluate the status of information on the distribution and abundance of commercially valuable fish resources in relation to oil and gas development in the proposed lease area. Particular attention was given to potential impacts on Pacific salmon, since both juveniles and adults of this valuable resource are known to seasonally occupy areas of the NAS expected to be most severely impacted by OCS development. However, larval and adult forms of other commercially significant finfish species also feed, mature, and reproduce in the nearshore marine waters of the NAS. The life functions of these species normally are limited in the time or space in which they may be performed successfully (e.g., reproduction usually is constrained to specific habitats and seasons, and young fish may require specialized nursery areas). These constraints on time and space are thought to influence in large part the mortality rate of larval forms of many fish species. It is assumed that a major risk in petroleum development is the potential introduction of a pollutant that may accentuate these natural constraints. Proceedings of the workshop (Thorsteinson 1984) confirmed that there were major information needs regarding seasonal abundance of pelagic and demersal fish in nearshore areas of the NAS vulnerable to perturbation by OCS development.

As a result of these information needs, impact analyses in the Environmental Impact Statement (EIS) for the North Aleutian Basin Sale 92 (MMS 1985) were based in the case of juvenile salmonids on a series of broad generalizations regarding timing and movement patterns derived from the earlier purse seining reported by Straty (1974, 1975, 1981) and the subsequent synthesis meeting (Thorsteinson 1984).

A major goal of the present study was to evaluate the applicability of these generalizations, based mostly on data from outside the 20-m isobath, to fish distributions nearer to shore in habitats more vulnerable to effects of spilled oil. Thus, the research was designed to provide the baseline descriptions of fish assemblages needed to assess with greater confidence potential and actual impacts of oil and gas development on natural resources of the study area (Figure 2). Specific objectives were to:

- Describe the species composition of demersal and pelagic fish assemblages in poorly studied nearshore, intertidal, and estuarine habitats of the study area.
- Determine relative abundances of species by habitat, area, and season (spring, summer, and fall).
- Describe changes in distributions of adults and juveniles occurring over time scales of tide cycles to seasons, including inshore-offshore migrations and directed migrations through the study area.
- Characterize habitats in terms of physical properties and fish assemblages.
- Review and update the existing information base on Bristol Bay and north Alaska Peninsula salmon stocks (for both adults and juveniles).

This program emphasized the need to extend sampling to habitats not considered in previous investigations of fish movements in the NAS lease area.

2.2 CURRENT STATE OF KNOWLEDGE

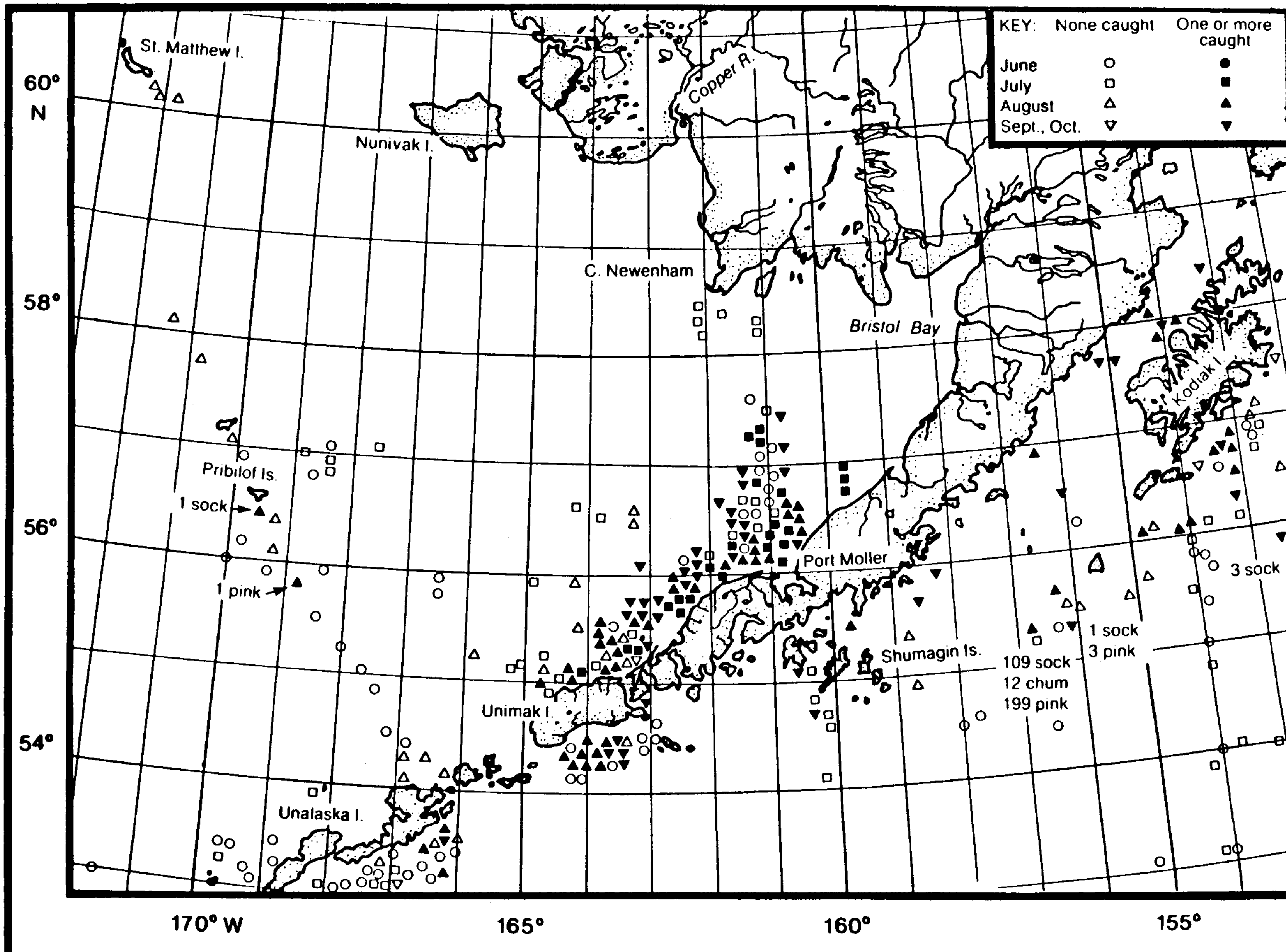
2.2.1 Juvenile Salmonids

Of the inner Bristol Bay sockeye salmon (Oncorhynchus nerka) producing river systems, the smolt outmigrations from the largest system, the Kvichak, and from the Wood River Lakes system in the Nushagak District have been routinely assessed by the Alaska Department of Fish and Game (ADF&G). Smolt outmigration information for the other major producers (Naknek, Egegik, and Ugashik) is much less consistent, but at present these systems are also being assessed annually. Information on smolts produced in peninsula systems southwest of Ugashik is very limited, although data are available on adult escapement to these systems (ADF&G unpublished data; A. Schaul, ADF&G, personal communication).

The freshwater life-history of juvenile salmonids has been reasonably well studied in many major Bristol Bay systems. However, even this aspect has been largely unexplored in many Alaska Peninsula streams. In response to proposed oil pipeline and proposed heavy metal mining activity, the U.S. Fish and Wildlife Services (USF&WS; Lanigan and Wagoner 1985) studied the 1984 distribution of salmonids and other fishes in the Meshik River, which drains into Port Heiden. Dlugokenski (1985) provided details of planned 1985 field studies by USF&WS in Port Moller and Izembek Lagoon. These studies focused on resident and anadromous fishes of local streams and adjacent marine areas. The results of those studies were not available as this text was written.

The early marine life-history of juvenile salmon in these inshore waters, in general, remained virtually unstudied. The significance of the inshore waters from Ugashik south for vast numbers of juvenile salmon from major systems in the inner bay is only hinted at by available data (e.g., Straty 1974; Hartt and Dell 1978; Figures 3 through 7 and Appendix F). Therefore, it can be concluded that the juvenile salmon resource at risk from the "lesser" systems close to areas of vulnerability to oil development is not thoroughly understood.

The abundances of juvenile salmon in the migrations from Bristol Bay were expected to be much different in 1984-85 than they were in 1969-70,



Locations of Purse Seine Sets in the Eastern Bering Sea and South of the Alaska Peninsula, by Month, 1956-1968, Plus Indication of Presence or Absence of Juvenile Salmon
Multiple sets not shown if symbols identical.

Source: Hartt and Dell 1978

Note: See Appendix F for species breakdown.

Dames & Moore

Figure 3

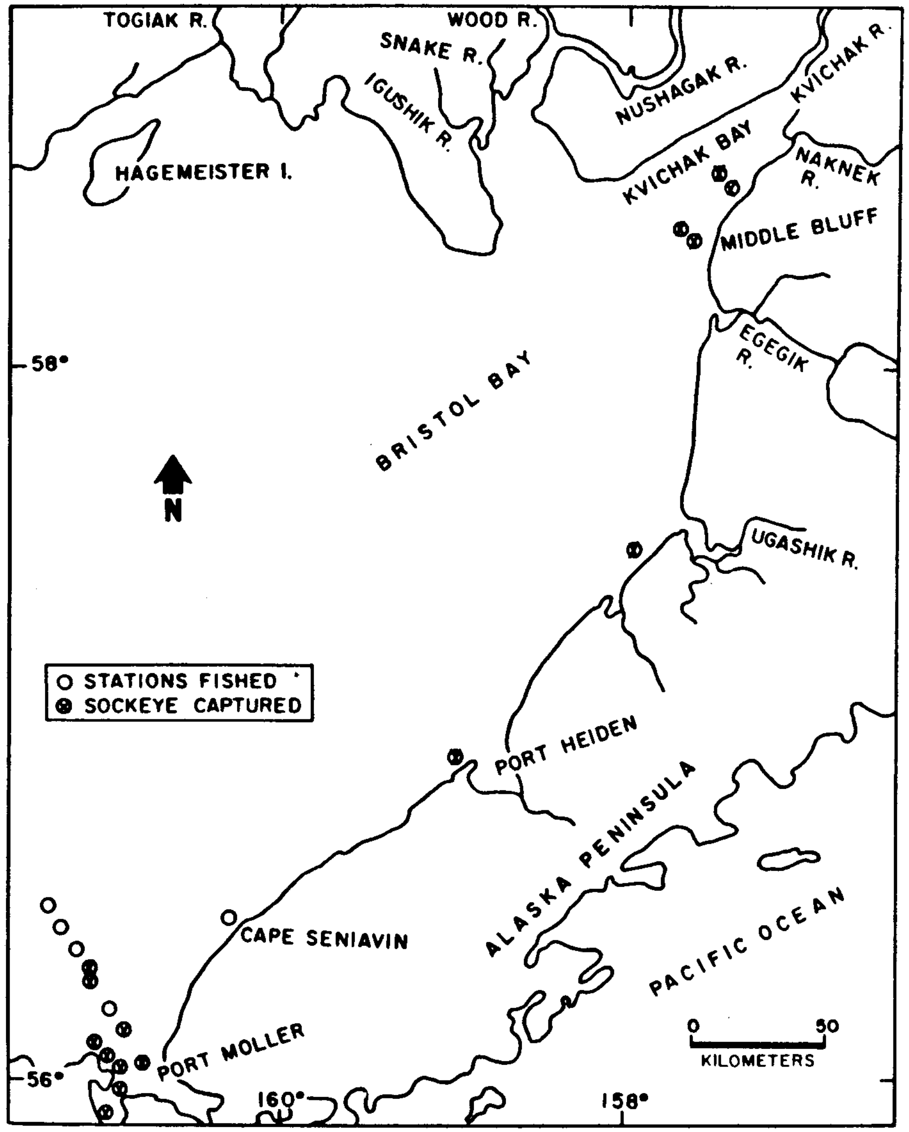


Fig. 4 Stations Fished by Lampara Seine and Locations of Capture of Seaward-Migrating Sockeye Salmon in Inner and Outer Bristol Bay, June-August 1967
Source: Straty 1974

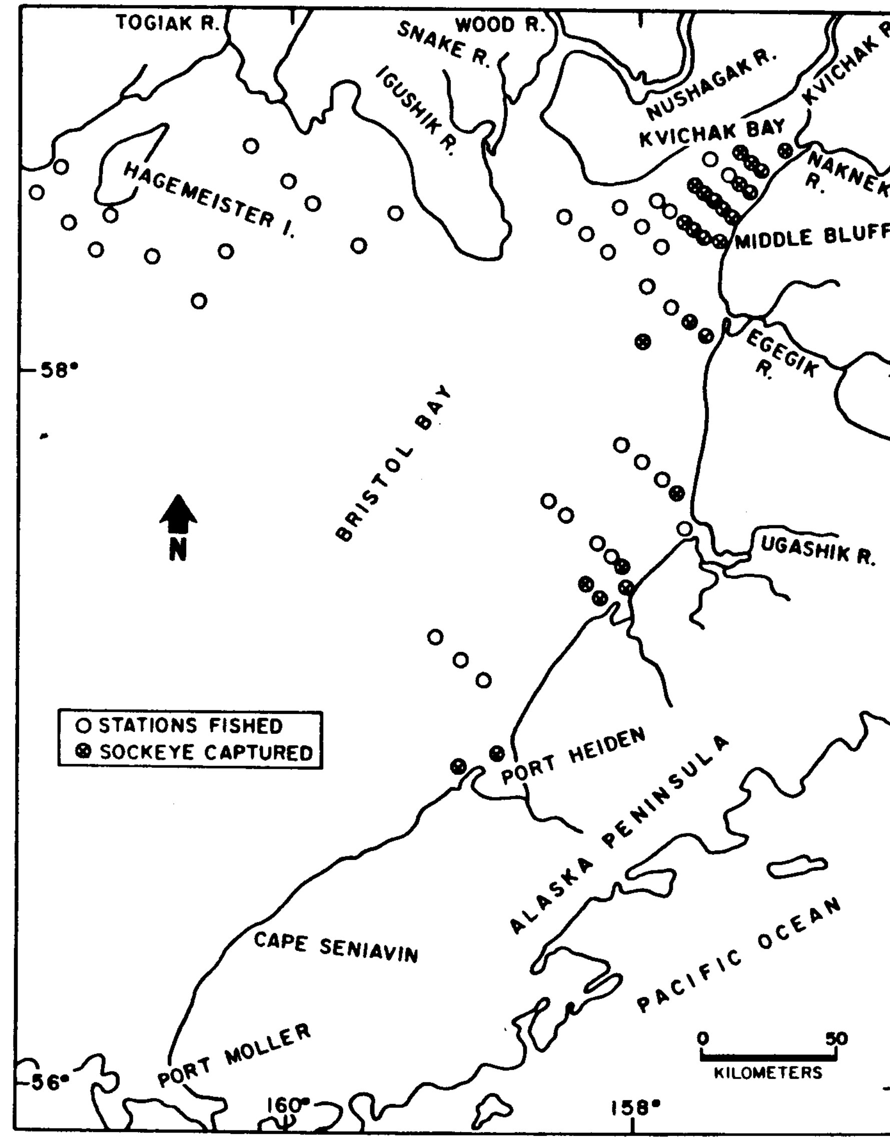
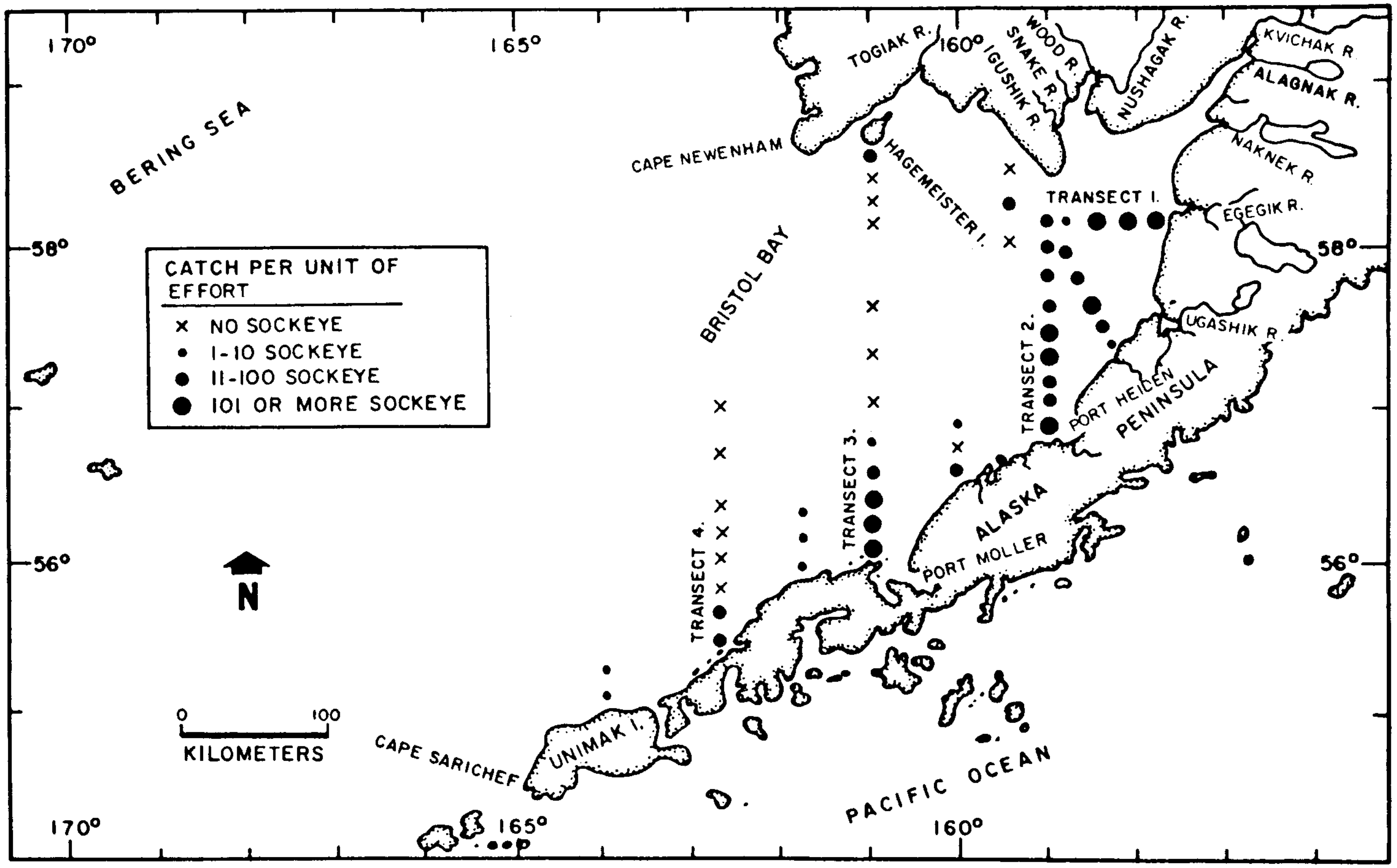


Fig. 5 Stations Fished by Tow Nets and Seining and Locations of Capture of Seaward-Migrating Sockeye Salmon in Inner Bristol Bay, June-September 1966

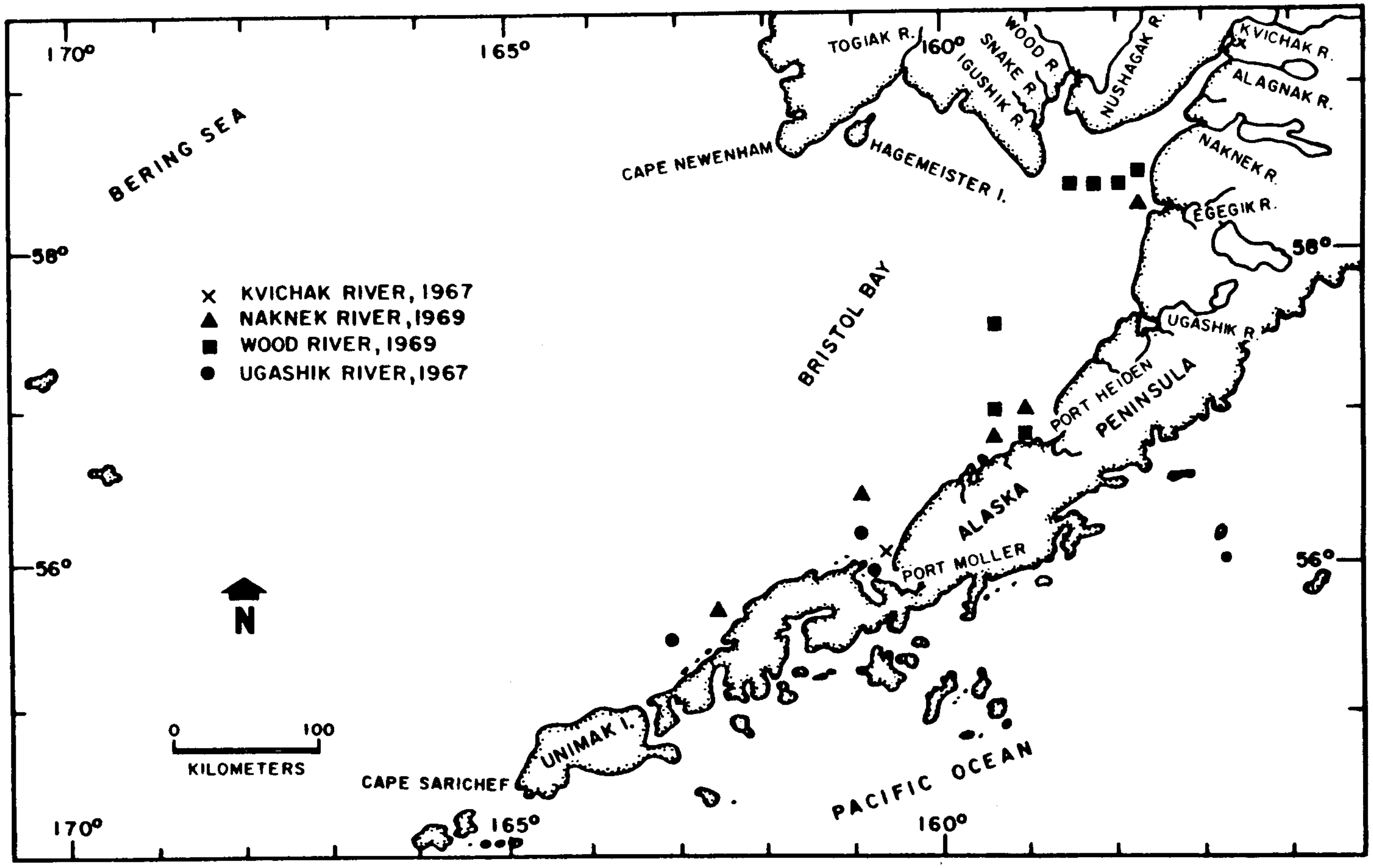


Relative Abundance (Catch per Unit Effort) of Seaward-Migrating Sockeye Salmon at 10 Mile Intervals on Four Transects Located in Inner and Outer Bristol Bay, June-August 1969.

Source: Straty 1974

Figure 6

Dames & Moore



Location of Capture of Marked Seaward-Migrating Sockeye Salmon, Bristol Bay, 1967 and 1969

Source: Straty 1974

Figure 7

as reported by Straty (1974; Figure 6). The parent escapements for the chum (O. keta) and chinook (O. tshawytscha) migrants in 1984 and 1985 were about double the escapements for the migrants in 1969-70. Coho (O. kisutch) abundance has increased since 1977, and although escapements are unknown, it is likely that there was a larger number of juveniles in 1984 and 1985 than there was in 1969-70. Pink salmon (O. gorbuscha) juveniles were expected to be scarce in 1984 since odd-year runs of adults are very small; however, they were expected to be abundant in 1985 since there was a good run of adult pinks in 1984. The parent sockeye salmon escapements for the smolt migrations in 1984-85 were about 22 percent larger than the parent escapements for the 1969-70 migrations; but more important is the fact that the distribution of the escapements among the Bristol Bay stocks was quite different between the 1969-70 migrants and those occurring in 1984-85. The Ugashik and Nushagak stocks should have produced a much greater number of smolts in the 1984-85 migrations than they did in the 1969-70 migrations, and the Naknek-Kvichak stocks should have produced fewer smolts in the 1984-85 migrations; however, they probably still produced more smolts than any of the other Bristol Bay stocks. Although smolt/fry outmigrant numbers from lower Alaska Peninsula streams are small, relative to the Kvichak and other larger systems, they are locally important and may be at higher risk due to their proximity to potential oil development areas.

Even though data from Straty (1974) and Hartt and Dell (1978) are pertinent to the more offshore regions of the study (e.g., greater than 15 nautical miles offshore; Figures 3 through 7), several important questions about the distribution of juvenile salmonids remain unanswered. The larger adult escapements and smolt/fry outmigrations in the mid-1980s may have altered the temporal and spatial distributions of juvenile salmon abundance relative to those seen in the years of earlier work. Furthermore, the fact that few chum or pink salmon juveniles were taken in purse seines may mean that the (presumably) smaller chum and pink fry escaped through the mesh, or that they simply were not offshore in the vicinity of sampling. A central question is whether juveniles of these species are more dispersed from nearshore areas, or are denser in nearshore areas. While quantitative comparisons are difficult with the level of effort available, we had at least hoped to conclude whether juvenile salmonid numbers are significant in the nearshore areas relative to the areas studied by Straty (1974) and Hartt and Dell (1978).

LGL Ecological Consultants (1985) provided limited information on juvenile salmon in the study area from their 1984 sampling effort, but few were taken in their catches because of gear selectivity and timing of sampling efforts in the pelagic environment. LGL (1985) did report some 95 chum salmon taken in Izembek Lagoon with gill nets and beach seines in July 1984, and from this effort and other studies, concluded that this species was a dominant summer transient in the lagoon. LGL (1985) also reported on the stomach contents of a total of 47 adult sockeye and chum salmon (June 1985), as well as 49 juvenile sockeye, pink, and chum salmon (July 1985). From these data, they derived some estimates of the quantities of prey species consumed in Bristol Bay by adult and juvenile salmon.

2.2.2 Pelagic and Demersal Marine Fishes

2.2.2.1 Previous Work

Information about the occurrence of approximately 64 marine and/or anadromous fishes within the nearshore (< 50 m) waters of Bristol Bay, from Cape Sarichef to Cape Newenham, is available from seven sources: McRoy and Peden (1964), Tack (1970), Baxter (1976), Stern et al. (1976), McMurray et al. (1984), Grabacki (1984), and LGL (1985) (Table 2). Approximately 54 species are strictly marine.

The fishes of Izembek Lagoon have been assessed in several separate studies using a variety of methods. McRoy and Peden (1964) sampled the lagoon in early August 1963 and late August 1964 using an otter trawl, a beach seine, and a gill net, in addition to rotenone. Collections by these means yielded 26 fish species (Table 2).

A small otter trawl and a push net were used to quantitatively sample the fishes of Izembek Lagoon during July and August 1968 (Tack 1970). Twenty-five species of fish belonging to 11 families were taken during this study (Table 2). Although the numbers of species taken by

TABLE 2

LIST OF FISHES WITHIN SHALLOW (<50 M) MARINE WATERS FROM CAPE SARICHEF TO CAPE NEWENHAM

Scientific Name[a]	Common Name[a]	Source[b]
Raja aleutica Gilbert	Aleutian skate	1
Clupea harengus pallasi Valenciennes	Pacific herring	2,3,8
Oncorhynchus gorbuscha (Walbaum)	pink salmon	4,5
Oncorhynchus keta (Walbaum)	chum salmon	3,4,5,7,8
Oncorhynchus kisutch (Walbaum)	coho salmon	4,5,8
Oncorhynchus nerka (Walbaum)	sockeye salmon	4,5
Oncorhynchus tshawytscha (Walbaum)	chinook salmon	4,8
Salmo gairdneri Richardson	steelhead	4
Salmo clarki Richardson	cutthroat trout	4
Salvelinus malma (Walbaum)	Dolly Varden	3,4,5,7
Osmerus dentex = O. mordax (Mitchill)	rainbow smelt	2,3,5,7,8
Hypomesus pretiosus (Girard)	surf smelt	3,5,7
Hypomesus olidus (Pallas)	pond smelt	8
Mallotus villosus (Muller)	capelin	1,2,5
Thaleichthys pacificus (Richardson	eulachon	8
Boreogadus saida (Lepechin)	Arctic cod	2
Eleginus gracilis (Tilesius)	saffron cod	3,8
Gadus macrocephalus (Tilesius)	Pacific cod	1,2,3,5,7,8 5
Theragra chalcogramma (Pallas)	walleye pollock	1,3
Gasterosteus aculeatus (Linneaus)	threespine stickleback	3,5
Pungitius pungitius (Linneaus)	ninespine stickleback	8
Trichodon trichodon (Tilesius)	Pacific sandfish	1,2,8
Stichaeidae	pricklebacks	1
Lumpenus mackayi?	prickleback	2
Lumpenus sagitta Wilimovsky	snake prickleback	2,8
Lumpenus fabricii (Valenciennes)	slender eelblenny	8
Pholis laeta (Cope)	crescent gunnel	3,5,8?
Anarhichas orientalis Pallas	Bering wolffish	2,8
Ammodytes hexapterus Pallas	Pacific sand lance	1,2,3,5,7,8
Hexagrammidae	greenlings	1
Hexagrammos stelleri Tilesius	whitespotted greenling	2,3,5,7,8
Hexagrammos octogrammus (Pallas)	masked greenling	3,5,8
Hexagrammos superciliosus = H. lagocephalus	rock greenling	5
Cottidae		
Blepsias bilobus Cuvier	crested sculpin	8
Leptocottus armatus Girard	Pacific staghorn sculpin	3,5,7

TABLE 2 (Continued)

Scientific Name[a]	Common Name[a]	Source[b]
Artediellus miacanthus?	sculpin	2
Artedius fenestralis Jordon & Gilbert	padded sculpin	5
Enophrys diceraus (Pallas)	antlered sculpin	8
Eurymen gyrinus? Gilbert & Burke	"smooth cheek" sculpin	8
Enophrys claviger?	sculpin	2
Gymnocanthus galeatus Bean	armorhead sculpin	2,8
Hemilepidotus jordani Bean	yellow Irish lord	1,5
Hemilepidotus hemilepidotus (Tilesius)	red Irish lord	5
Megalocottus platycephalus (Pallas)	belligerent sculpin	2,8
Microcottus sellaris (Gilbert)	brightbelly sculpin	1,2,3,8
Myoxocephalus axillaris?	sculpin	2
Myoxocephalus mednius?	sculpin	3
Myoxocephalus niger (Bean)	warthead sculpin	3
Myoxocephalus jaok (Cuvier)	plain sculpin	1,2,8
Myoxocephalus quadricornis (Linnaeus)	fourhorn sculpin	2
Myoxocephalus scorpius (Linnaeus)	shorthorn sculpin	2,8
Myoxocephalus polyacanthocephalus (Pallas)	great sculpin	5
Blepsias cirrhosus (Pallas)	silverspotted sculpin	3
Nautichthys pribilovius (Jordan & Gilbert)	eyeshade sculpin	2
Icelinus borealis Gilbert	northern sculpin	3
Triglops pingeli Reinhardt	ribbed sculpin	1,2,8
Agonidae	poachers	1
Agonus acipenserinus Tilesius	sturgeon poacher	1,2,3,5,8
Occella dodecaedron (Tilesius)	Bering poacher	1,2,5,8
Pallasina barbata (Steindachner)	tubenose poacher	2,3,5,7,8
Liparis cyclopus Gunther	ribbon snailfish	2,5,8
Liparis cyclostigma Gilbert	polka-dot snailfish	8
Liparis sp.	snailfish	2
Hippoglossus stenolepis Schmidt	Pacific halibut	1,5,7,8
Hippoglossoides elassodon (Jordan & Gilbert)	flathead sole	1,8
Limanda aspera (Pallas)	yellowfin sole	1,2,3,7,8
Limanda proboscidea Gilbert	longhead dab	1,2,3,8
Liopsetta glacialis (Pallas)	Arctic flounder	2
Lepidopsetta bilineata (Ayres)	rock sole	1,3,7,8
Platichthys stellatus (Pallas)	starry flounder	1,2,3,5,7,8
Pleuronectes quadrituberculatus Pallas	Alaska plaice	1,2,8
Glyptocephalus zachirus Lockington	Rex sole	8

[a] after Robins et al. 1980, except for species followed by "?".
[b] 1 = McMurray et al. 1984
2 = Baxter 1976
3 = Tack 1970
4 = Stern et al. 1976
5 = McRoy and Peden 1964
7 = LGL 1985
8 = Grabacki 1984

McRoy and Peden (1964) and Tack (1970) were similar, the composition was very different with a combined total from both studies of 37 species.

A third study in Izembek Lagoon, which focused on the osmoregulation of the fishes, was made during July and October 1970; April, August, and October 1971; and May 1972. A small otter trawl was used along with a beach seine, a gill net, a hoop net, and a push net (Smith and Paulson 1977). A total of 23 fish species was collected; only two species were not on the previous list of 37. The two new species, the sculpins, Arctic sculpin (Myoxocephalus scorpioides) and M. axillaris, are thought to be synonymous (R. Baxter, Bethel, AK, personal communication 1985).

Most of the fishes collected by Tack (1970) were juveniles. Four species were anadromous: chum salmon, Dolly Varden (Salvelinus malma), rainbow smelt (Osmerus mordax), and surf smelt (Hypomesus pretiosus). Eleven benthic, nine demersal, and five pelagic species were also taken. The 11 benthic species included five species of sculpins (Cottidae) and four species of flatfish (Pleuronectidae). The cods (Gadidae) and greenlings (Hexagrammidae) made up over half of the nine demersal species. The pelagic species were herring (Clupeidae), smelts (Osmeridae), and salmonids (Salmonidae). With the exception of the cods and the flatfishes, yellowfin sole (Limanda aspera), rock sole (Lepidopsetta bilineata), and all other benthic and demersal species are known primarily from waters less than 30 m deep (Tack 1970).

Three distinct communities were identified in Tack's study: (1) the eelgrass community dominated by the tubenose poacher (Pallasina barbata) and the masked greenling (Hexagrammos octogrammus); (2) the channel community dominated by whitespotted greenling (H. stelleri); and (3) the sand flat community dominated by the Pacific staghorn sculpin (Leptocottus armatus).

Of the fishes collected by Smith and Paulson (1977), seven were identified as nearly year-round residents of the lagoon: surf smelt, threespine stickleback (Gasterosteus aculeatus), whitespotted and masked greenlings, brightbelly sculpin (Microcottus sellaris), tubenose poacher, and _Myoxocephalus axillaris_. Four species occurred only in the summer: crescent gunnel (_Pholis laeta_), Pacific staghorn sculpin, rock sole, and starry flounder (_Platichthys stellatus_).

In 1984 and 1985, LGL (1985) conducted evaluations of Izembek Lagoon as part of a larger study, and based on their field studies and those of others, they summarized this lagoon's fish assemblages as follows: "The dominant residents are the tubenose poacher, whitespotted and masked greenlings, and surf smelt; the dominant summer transients are chum salmon juveniles and adults, sand lance, staghorn sculpin, pollock young-of-the-year, and Pacific cod. Herring and capelin may pass through the lagoon as well."

During August 1974 and June 1975, a resource assessment was made of the inshore (< 50 m) marine waters of northern Bristol Bay and lower Kuskokwim Bay (Baxter 1976). The resulting document provided information on the potential commercial fisheries within the 12-mile contiguous fishery zone of these two embayments. Only two organisms were recognized as being able to support a major commercial fishery, the Pacific herring (_Clupea harengus pallasi_) and the capelin (_Mallotus villosus_). Information on marine fishes was mainly obtained by demersal trawling, although longlining and intertidal surveys were also employed. A total of 32 fishes (31 marine species and 1 anadromous species [rainbow smelt]) were caught at 242 stations between Nushagak Bay and Cape Newenham (Table 2). The yellowfin sole was more than twice as abundant as any other species. Other common species, in decreasing order of abundance, were the brightbelly sculpin, the longhead dab (_Limanda proboscidea_), the armorhead sculpin (_Gymnocanthus galeatus_), the whitespotted greenling, and the plain sculpin (_Myoxocephalus jaok_).

Demersal trawling for juvenile king crab in Bristol Bay and along the NAS in the summer of 1983 yielded 23 incidentally caught marine fishes between depths of 20 and 50 m (McMurray et al. 1984) (Table 2). Common fishes, in decreasing order of abundance, included yellowfin sole, rock sole, Pacific halibut (_Hippoglossus stenolepis_), Alaska plaice (_Pleuronectes quadrituberculatus_), longhead dab, Pacific cod (_Gadus macrocephalus_), and miscellaneous sculpins.

In autumn 1983 and spring 1984, Dames & Moore (Grabacki 1984) completed test fishing with pair trawls, longlines, and crab pots in inner Bristol Bay and down the Alaska Peninsula as far as Port Heiden. This study, to evaluate fishing opportunities outside of the salmon season, produced catch and distribution data on 42 fish species, as well as an assortment of invertebrates (Table 2). Length-frequency information was collected for selected fish species of importance.

In 1984 and 1985, NOAA-sponsored studies (LGL 1985) were completed in waters inside the 50-m isobath from Cape Mordvinof (Unimak Island) to Cape Seniavin (midway between Port Moller and Port Heiden). The fish portion of this study found that "several dominant species characterize the fish communities in three coastal habitats:

1. Nearshore zone (0-10 m water depth): sand lance, herring, capelin, salmon, yellowfin sole, rock sole, smelt, greenling and others;

2. Pelagic zone (out to 50 m water depth): sand lance, pollock young-of-year, salmon; and

3. Demersal zone (out to 50 m water depth): yellowfin and rock sole, pollock, Pacific cod."

Juvenile flatfish are the primary component of the inshore demersal communitites. The dynamics of flatfish assemblages have not been studied in the Bristol Bay nursery areas. Examples of such studies can be found in the nursery grounds of Atlantic plaice and sole (Steele and Edwards 1970; Rauck and Zijlstra 1978), and English sole (Laroche and Holton 1979; Thornburgh 1979). Juvenile flatfish assemblages have been noted for a hierarchy in relative abundance; generally one or two species will dominate. The composition of the assemblages may vary with abiotic factors and with the structure of the benthic community (i.e., eelgrass beds or open coast sandy bottoms). The relative densities of the eight principal flatfish species expected in the project area may vary with these conditions, indicating the importance of a particular area as a nursery ground. The settlement and rearing areas of Pacific halibut were of particular interest because of its commercial importance and because relatively little is known. Previous sampling has indicated that juvenile halibut are likely to be encountered inshore and there is some indication of spatial segregation correlated with temperature (IPHC unpublished data). The juvenile cod, pollock, and other species were expected to vary with distributions in a similar manner from area to area. With the exception of limited in-lagoon or bay studies (Tack 1970; Smith et al. 1978) and a recent manuscript (Hagen 1983), nearshore (e.g., less than 20 meters water depth) and inshore (e.g., less than 10 meters depth) fish populations along the Alaska Peninsula have been poorly studied up to this point.

2.2.2.2 Dominant Species

Based upon the studies summarized in the previous section, the dominant nonsalmonid fish species, in terms of abundance, in the near-shore waters in Bristol Bay are yellowfin sole, Pacific herring, and capelin. Information on these species and other less dominant species is summarized below.

Yellowfin sole - *Limanda aspera*

Yellowfin sole is the species which most dominates demersal fishes, and perhaps all marine fishes (by weight), within the nearshore zone of the Bristol Bay system (Baxter 1976; Cable 1981; Walters and McPhail 1982; Walters 1983; Grabacki 1984; McMurray et al. 1984; LGL 1985).

Yellowfin sole juveniles were only occasionally taken in the channels of Izembek Lagoon during the summer of 1968 (Tack 1970). Studies in 1984 and 1985 did not report this species as dominant here (LGL 1985). However, this species was the most common fish taken in the trawls in northern Bristol Bay in August 1974 and June 1975 (Baxter 1976). It occurred in all 242 successful trawls. A total of 2,030 yellowfin sole averaged 136.8-mm fork length (range = 50 to 337 mm). A sample of 284 fish included 168 males and 116 females. Males matured at a smaller size (90 to 120 mm) than females (170 to 200 mm). Sexually ripe fish of both sexes were taken in trawls in 20 m of water on June 7.

Deeper and shallower trawls took mature fish, but the fish were not as ripe at these depths as at 20 m.

Demersal trawling in Bristol Bay and along the NAS in the summer of 1983 revealed that the most abundant incidentally caught fish between depths of 20 and 50 m was yellowfin sole (McMurray et al. 1984). No size, sex, or maturity information has been reported.

Bottom trawls in the outer bay inside of 50 m in May and September (1984) and January (1985) yielded high biomass per unit effort for yellowfin sole relative to rock sole, Pacific cod, and pollock (LGL 1985). The spring 1984 sampling by Dames & Moore yielded an average CPUE for this species of 150 (rock sole was 324) for a cod-flounder trawl and 628 (rock sole was 72) for a shrimp-smelt trawl for the Pilot Point to Port Heiden area (Grabacki 1984). This area's CPUEs for yellowfin sole were much higher than the adjacent region farther up the bay (from Naknek to Egegik) but about the same as CPUEs for the Dillingham to Togiak area (Grabacki 1984).

Similar findings of yellowfin sole dominance have been made from National Marine Fisheries Service trawl surveys. Numerical analyses of fishes and invertebrates in the eastern Bering Sea from the summer of 1971 through 1981 have delineated grouping relationships between all sampling locations, maps of these site groups, lists of the assemblages of species occurring within these groups, and their relative abundances (Walters and McPhail 1982; Walters 1983). Site groups were often identified in shallow nearshore regions from Cape Sarichef to Cape Newenham and, without exception, the fishes within these shallow site groups were always dominated by yellowfin sole. For example in 1981, a site group composed of seven stations in northern and southern Bristol Bay, at depths between 13 and 37 m, was dominated by yellowfin sole (Walters and McPhail 1982). Other fishes of less dominance that were often associated with _L. aspera_ in shallow waters were rock sole, Pacific cod, sculpins, Alaska plaice, starry flounder, and Pacific halibut.

Perhaps in response to the easing of fishing pressure, yellowfin sole populations have, since the mid-1970s, steadily approached and perhaps exceeded pristine stock levels. Recent biomass estimates for this species are in the 2 to 4 million metric ton (mt) range, making it the most common flatfish found on the shelf of the eastern Bering Sea, second only to walleye pollock in biomass (Bakkala 1981). In recent years, the Port Moller area has yielded approximately 35,000 mt of yellowfin sole to the commercial fishery (Bakkala et al. 1982).

Yellowfin sole migrate seasonally from outer continental shelf and slope waters (< 100 m) occupied in winter and early spring, to inner shelf waters (15 to 75 m) where spawning and intense feeding occurs during the summer (Bakkala 1981). The timing of spring inshore migrations is not well defined, although they have been observed starting from late April to mid-May over the three-year period of 1959 to 1961. Ice-induced delays to spring migrations are probably infrequent and of relatively short duration.

More than a million eggs are produced by each spawning female. Unlike the adults, the young remain in shallow nearshore nursery areas throughout their first few years of life. They begin to disperse to more offshore waters at 3 to 5 years of age (Fadeev 1970; Wakabayashi 1974).

The food and feeding habits of this species for a broader area, the eastern Bering Sea, have been summarized by Bakkala (1981) and are partially described here. Yellowfin sole are capable of feeding on a variety of animals, from strictly benthic forms such as clams and polychaete worms to zooplankton (mysids and euphausiids) and pelagic fishes (capelin and smelt). The kinds of organisms consumed vary by season, area, and size of fish. Contents of nearly 2,400 stomachs taken over a broad area of the eastern Bering Sea show that the primary food items, representing 65 percent of stomach contents by weight, were bivalves, amphipods, polychaete worms, and echiurid worms. Polychaetes and amphipods were the principal food items in smaller fish (10 to 20 cm); polychaetes, bivalves, echiurids and amphipods in larger fish (20 to 30 cm); and bivalves and echiurids in fish longer than 30 cm.

Although less is known about the food and feeding habits of the yellowfin sole in shallow waters, they are thought to be similar to those in deeper waters. Recent findings on the food of yellowfin sole in the southeastern Bering Sea along the Alaska Peninsula revealed that newly recruited surf clams (Spisula polynyma; 1 to 2 mm) were a favored prey (in the range of 100 to 500/stomach) in waters less than 30 m off Port Moller, while various groups of polychaete worms, benthic amphipods, and the sand dollar (Echinarachnius parma) dominated in depths of 30 to 50 m in Bristol Bay and greater than 30 m depths off Port Moller. King crab (Paralithodes camtschatica) glaucothoe larvae and Tanner crab (Chionoecetes bairdi) zoea were also taken as food in small quantities (Haflinger and McRoy 1983).

Food of yellowfin sole collected in Bristol Bay and along the NAS between 20 and 50 m in the summer of 1983 was diverse (McMurray et al. 1984). Prey items included sea cucumbers, miscellaneous clams, euphausiids, the crab Oregonia gracilis, heart urchins, brittle stars, ascidians, and Pacific sand lance (Ammodytes hexapterus).

On the basis of percent by weight of foods eaten by yellowfin sole in 1984 studies, LGL (1985) found the following patterns of prey dominants: during May at 20 m bivalves (42 percent), euphausiids (27 percent), and decapods (16 percent) dominated; in September at 20 m, bivalves and amphipods comprised 97 and 1 percent of the diet, respectively; in September at 3 to 10 m, decapods and amphipods made up 55 and 45 percent of the diet, respectively.

The only known natural predators of yellowfin sole in shallow coastal waters are sea otters (VTN Oregon 1984) and Pacific halibut (Novikov 1964).

Longhead Dab - Limanda proboscidea

The longhead dab was the second most abundant flatfish in the 1974-75 trawl surveys in northern Bristol Bay (Baxter 1976). The size of this fish averaged 124.1 mm and ranged from 53 to 296 mm (N = 456). Both sexes were encountered during June and August samplings. Average fork lengths for males and females were 121.7 mm (N = 76) and 140.9 mm (N = 25), respectively. Only a few transient juvenile longhead dab were caught in Izembek Lagoon in 1968 (Tack 1970). Longhead dabs were taken in the Dames & Moore studies from Bristol Bay down to the Port Heiden and Cinder River vicinity, but were not reported in any significant numbers (Grabacki 1984). This species is not mentioned in the LGL (1985) studies in the outer Bristol Bay area to water depths of 50 m. Nothing is known about the extent to which this species uses these nearshore waters.

Pacific Herring - Clupea harengus pallasi

Although yellowfin sole dominate the demersal marine fishes in the nearshore region in the vicinity of Bristol Bay, Pacific herring presumably dominate the pelagic marine fishes, at least seasonally. The abundance of herring in the eastern Bering Sea appears to have increased since 1978 in all major coastal areas. Total spawning biomass is estimated to have ranged from 187,210 to 334,723 mt in 1978, and from 258,079 to 637,583 mt in 1979, an approximate 27 percent increase at the lower range (Wespestad and Barton 1981). Studies have shown that Bristol Bay contains the largest assemblage of spawning herring within the entire State of Alaska: in 1983 about 127,000 mt of herring arrived to spawn in the Togiak region of Bristol Bay; 24,486 mt or 19.3 percent of the biomass was harvested (Fried and Whitmore 1983).

Herring usually spawn in areas where the shoreline morphology includes cliffs or bluffs with large jagged outcroppings. Spawning substrates consist primarily of rocks covered with rockweed (Fucus sp.). However, almost any substrate (e.g., Laminaria spp., bare rocks, gill nets) are used under conditions of dense spawning. Herring also spawn in shallow bays, beaches or slough areas where eelgrass (Zostera spp.), and roots of rye grass (Elymus spp.) and sedges (Carex spp.) are exposed at low tide. In northern Bristol Bay most spawning is confined to the intertidal zone down to depths of 5 meters. The main spawning area between Ugashik Bay and Cape Newenham are in Metervik Bay and along the coast west to the village of Togiak (Barton et al. 1977; Wespestad and Barton 1981). The primary spawning areas between Ugashik Bay and Cape Sarichef are Herendeen Bay, inner Port Moller, Port Heiden, and, to a lesser extent, the north coast of Unimak Island (Barton et al. 1977;

Wespestad and Barton 1981). Adult herring were commonly found in Izembek Lagoon during the summer of 1968 (Tack 1970).

Few herring were taken in studies that included the Port Moller/ Herendeen Bay area in 1984 and 1985 by LGL (1985). This was likely due to both the timing of cruises and gear used in sampling. Only 2 of 8 shrimp-smelt trawls in the spring 1984 sampling in the Pilot Point to Port Heiden area captured herring (12 fish) (Grabacki 1984) probably because of the locations, times, and gear fished. This same study did capture 2,516 herring in one spring 1984 shrimp-smelt trawl set in the Dillingham-to-Togiak area. Length-frequencies of a subsample of these herring are also reported (Grabacki 1984).

Most of the domestic herring harvest is taken with purse seines and gill nets in northern Bristol Bay between Cape Constantine and Cape Newenham. The majority of herring fishing by local residents in this area is for commercial purposes, although most fishermen retain a limited amount for subsistence needs (Dames & Moore 1978).

Herring eggs hatch in 10 to 21 days, depending on the temperature. Feeding begins after approximately two weeks when the yolk sac is absorbed. Evidence indicates that juvenile herring utilize the near-shore region of the Bristol Bay vicinity as nursery areas, but the duration of dependence on the nearshore waters is uncertain. Barton (1979) captured age 1 herring in June in Hagemeister Strait of northern Bristol Bay. Farther north in Port Clarence and inner Kotzebue Sound, juveniles (age not specified) have been found during the spring spawning period, suggesting that overwintering had occurred nearshore (Barton 1978). In the western Bering Sea, age 0 and 1 fish inhabit areas of lower temperatures nearer shore than adults (Prokhorov 1968). Ichthyoplankton studies in the southeastern Bering Sea in the summer and fall of 1975 and the summer of 1976 found a few herring larvae 200 km offshore near the 50-m isobath (Waldron 1981). These young individuals may be caught in offshore transport and presumably perish.

A summary of Pacific herring food and feeding habits from the Bering Sea is reported by Wespestad and Barton (1981) and is partially presented here. The first food of herring larvae is usually limited to small and relatively immobile planktonic organisms. Microscopic eggs sometimes make up more than half of the earliest food; other items include diatoms and nauplii of small copepods. Herring do not have a strong preference for specific prey, but feed on the comparatively large organisms that predominate in the plankton of a given area. Feeding generally occurs before spawning and intensifies afterward. During winter, feeding declines: it ceases in late winter.

In the eastern Bering Sea in August nearly 84 percent of the stomachs were filled with euphausiids, 8 percent with fish fry, 6 percent with calanoid copepods, and 2 percent with gammarid amphipods. Fish fry, in order of importance, were walleye pollock, smelt, capelin, and Pacific sand lance. In spring, food was mainly pelagic amphipods (Themisto spp.) and chaetognaths (Sagitta spp.). After spawning, the main diet was euphausiids, Calanus spp., and Sagitta spp. Nearly 75 percent of herring stomachs examined in the spring from Bristol Bay to Norton Sound either were empty or contained only traces of food. Only 25 percent of the stomachs examined were at least 25 percent or more full, and only 3.4 percent were completely full. Major food items were cladocerans, flatworms, copepods, and cirripeds.

Herring are important prey for marine mammals (i.e., harbor seals, sea lions, and beluga whales), sea birds (i.e., black-legged kittiwakes and glaucous gulls), and fishes (chinook and coho salmon) (Hart 1973; Wespestad and Barton 1981; Warner and Shafford 1977). Concentrations of flatfishes, particularly yellowfin sole, have been observed on the herring spawning ground in northern Bristol Bay (John Clark, ADF&G, personal communication, as cited in Wespestad and Barton 1981). Stomachs of flatfishes examined in this spawning area have revealed a high rate of herring egg consumption (Wespestad and Barton 1981).

Capelin - Mallotus villosus

In 1976, capelin was the most geographically widespread forage fish species encountered in the eastern Bering Sea and constituted the second-most abundant species, next to Pacific herring, captured at onshore stations between Ugashik Bay and Unimak Island (Barton et al. 1977). Capelin typically spawn from May through July along clean, fine gravel beaches; however, spawning has been documented at depths of 60 m (Barton et al. 1977; Musienko 1970; Warner and Shafford 1977). Barton et al. (1977) and Baxter (1976) reported that the only spawning areas that capelin have been observed to utilize between Ugashik Bay and Cape Newenham occur in Togiak Bay, north of Hagemeister Strait, and around Hagemeister Island. During spawning in June 1975, capelin were utilizing all the fine gravel beaches between Nushagak Peninsula and Cape Newenham (Baxter 1976). Spawning and schools of unspawned capelin were observed from May 30 to June 15, 1975. Spawning appeared to progress with time from the south to the north. Much of the region between Ugashik Bay and Cape Seniavin on Unimak Island is presumably suitable for spawning since capelin have been observed washed up on the beaches from Cape Krenitzen north to Smoky Point at Ugashik Bay (Barton et al. 1977).

Few capelin were taken in 1984 sampling between Unimak Island and Cape Seniavin inside of 50 m by LGL (1985). This was likely due to the locations, times, and gears fished. The spring 1984 Pilot Point-to-Port Heiden capelin catches by cod-flounder trawl and a shrimp-smelt trawl had CPUEs of 1 and 235 fish per hour of sampling, respectively (Grabacki 1984). In contrast, fewer capelin were taken in the same gear types during the same period in the Dillingham-Togiak area and no capelin were taken in the Naknek-Egegik area.

Subsistence utilization of capelin is minor, with some taken by dip net along the north side of Togiak Bay from near Togiak village to Tongue Point (Baxter 1976).

Little is known about the food and feeding habits of capelin in the shallow regions of Bristol Bay. Smith et al. (1978) examined the stomach contents of 135 feeding individuals from the southeastern Bering Sea. All specimens were captured from late spring to early fall, therefore, no information is available on seasonality of feeding in the Bering Sea. Only two phyla were represented among the food organisms, Arthropoda (all crustaceans) and Chaetognatha. The most numerous prey organisms were calanoid copepods, specifically the genus Calanus. Virtually all of the amphipods present were members of the pelagic family Hyperiidae. Identifiable euphausiid specimens were all of the genus Thysanoessa. The smallest food item, copepods, had its greatest volumetric and relative importance in the smallest fish. The same is true of the next smallest food items, the mysids.

Capelin are food for a variety of predators, including seabirds of the family Alcidae and fishes (e.g., chinook and coho salmon, arrowtooth flounder, walleye pollock, and Greenland halibut) (Hart 1973; Macy et al. 1978; Vesin et al. 1981).

Sculpins - Cottidae

Sculpins are the most diverse group of fishes (approximately 21 species - Table 2) within the study area, specifically among the gravel-rock substrates of northern Bristol Bay. Approximately 10 species have been taken from Izembek Lagoon.

The brightbelly sculpin was the most common sculpin in the 1974 and 1975 surveys (Baxter 1976). A sample of 490 fish had an average length and range of 81.2 mm and 43 to 141 mm, respectively. This species is considered to reside in Izembek Lagoon for most of the year (Smith and Paulson 1977).

In 1984 and 1985 studies in the nearshore habitats (0-10 m) from Unimak Island to Cape Seniavin, Pacific staghorn sculpin made up 33 percent by number (17 percent by weight) of 22 gillnet sets and 14 percent by number (54 percent by weight) of 38 beach seine sets (LGL 1985). In Izembek Lagoon (0-5 m), this sculpin made up 62 percent by number of all fish caught in 5 gillnet sets in this same study. Autumn 1983 and spring 1984 studies by Dames & Moore in inner Bristol Bay (down as far as Cinder River) took nine species of sculpins but not the Pacific staghorn sculpin (Grabacki 1984). Sculpin CPUEs were not described for spring 1984 sampling down the Alaska Peninsula in this study. However, sculpins ranked fourth in pounds of fish caught per hour in cod-flounder trawls and fifth in shrimp-smelt trawls in Autumn 1983 studies in the Dillingham-Togiak area (Grabacki 1984).

The armorhead sculpin that were sampled in northern Bristol Bay averaged 127.1 mm (range = 47 to 219 mm; N = 333) in fork length (Baxter 1976). This species is known to reach approximately 360 mm in length (Eschmeyer et al. 1983). Although it was commonly found among shallow rocky substrate, its habitat is reported to be on soft bottoms near shore to 167 m, and most commonly below 50 m (Eschmeyer et al. 1983). Other parameters of this species are not known.

The plain sculpin was the most abundant of the seven species of the genus Myoxocephalus taken by Baxter (1976). It occurred throughout the study area. Its average size was 146.1 mm (range = 45 to 548 mm; N = 276). Food items consumed by this sculpin in the study were dominated by fish, specifically flatfishes, and a sculpin (Gymnocanthus) (McMurray et al. 1984). Other food included jellyfish, crangonid shrimp, and the crab Telmessus cheiragonus. Little is known about the extent of dependence of this species upon the nearshore regions of Bristol Bay.

Cods - Gadidae

The catches of Pacific cod, Arctic cod (Boreogadus saida), saffron cod (Eleginus gracilis), and walleye pollock (Theragra chalcogramma) within the nearshore region of Bristol Bay have been limited to a few small individuals. A fishery for Pacific cod was reported to have once existed around the Walrus Islands in the spring soon after the ice moved out of Togiak Bay (Baxter 1976).

In 1984 studies of demersal habitats (10-50 m) from Unimak Island to Cape Seniavin, Pacific cod made up 13 percent by number (32 percent by weight) of the catch in 16 gillnet sets and 8 percent by number of 98 try net sets (LGL 1985). In nearshore habitats (0-10 m) in this same study, Pacific cod made up 14 percent by number (3 percent by weight) of 38 beach seine sets. Spring 1984 trawling by Dames & Moore in the Pilot Point to Port Heiden area had CPUEs of 14 cod per hour and 64 cod per hour in shrimp-smelt and cod-flounder trawls, respectively (Grabacki 1984).

Until documented by Baxter (1976), Arctic cod had not been reported to extend farther south in the Bering Sea than Norton Sound, preferring low temperatures (< 7°C) (Morrow 1980). Spawning of the Arctic cod takes place during the winter (mainly January-February) when dense schools of fish move inshore (Morrow 1980). It is a demersal species feeding on a variety of benthic prey.

Whitespotted Greenling - *Hexagrammos stelleri*

The whitespotted greenling, along with the masked greenling, is an abundant species within Izembek Lagoon (McRoy and Peden 1964; Tack 1970). Apparently, it is a nearly year-round resident of Izembek Lagoon (Smith and Paulson 1977). The size of the whitespotted greenling that were captured during 1974-75 averaged 156 mm and ranged between 68 to 308 mm in fork length (N = 319) (Baxter 1976). This species is reported to attain lengths to 480 mm and to occur in waters shallower than 46 m in rocky regions near eelgrass beds (Eschmeyer et al. 1983). In August, females appeared to be near spawning since many contained well developed, purple-tan eggs (Baxter 1976). (To the south, in British Columbia waters, spawning occurs in April [Hart 1973]). The food consists of worms, crustaceans (copepods, amphipods, decapod larvae, ostracods, and barnacle larvae), fish eggs, and tunicates (*Oikopleura*) (Hart 1973).

This greenling, along with the masked greenling, was reported with two other species (tubenose poacher and surf smelt) as dominant residents of 0-3 m habitats in Izembek Lagoon (LGL 1985). The whitespotted greenling was taken in the autumn 1983 and spring 1984 studies in inner Bristol Bay, but no CPUE data were reported due to the low commercial fisheries potential of this species (Grabacki 1984).

Rainbow Smelt - *Osmerus mordax*

Baxter (1976) found only a few anadromous rainbow smelt in northern Bristol Bay; the largest catches, consisting of spawned-out fish, were made in Nushagak Bay in June. However, good runs have been reported in Nushagak and Togiak Rivers in the spring after the ice goes out (Baxter 1976). These smelt, presumably juveniles, have also been observed in Izembek Lagoon (McRoy and Peden 1964; Tack 1970). Little else is known about the life-history aspects or the residence time of the fish while within the nearshore zone of Bristol Bay.

In the Unimak Island-to-Cape Seniavin demersal zone (10-50 m) and nearshore zone (0-10 m), rainbow smelt and sand lance were considered abundant in bottom trawls, especially in the shallower parts of the study area (LGL 1985). This smelt made up 10 percent by number of try net trawl catches (98 sets) in the demersal zone (LGL 1985). In nearshore habitats, rainbow smelt made up 42 percent by number (3 percent by weight) in 22 gill net sets, and 26 percent by number (11 percent by weight) in 38 beach seine sets (LGL 1985). Rainbow smelt ranked third behind yellowfin sole and capelin in shrimp-smelt trawl catches in the Pilot Point-to-Port Heiden area in spring 1984 sampling by Dames & Moore (Grabacki 1984).

There is a subsistence fishery for rainbow smelt consisting of a winter fishery at the mouth of the Togiak River. Local residents jig with hooks through the ice or along open leads (Baxter 1976). There also are fall and spring dip net or small seine fisheries in Nushagak and Togiak Bays.

3.0 METHODS AND MATERIALS

3.1 STUDY AREA AND SAMPLING DESIGN

A hypothetical oil spill scenario given as the context for discussion at the NAS Synthesis Meeting (Thorsteinson 1984) described the dispersion of oil eastward from a midsummer accident off Cape Seniavin or Amak Island. The plume resulting from a spill of 10,000 bbls over 5 days would probably extend 20 km in the direction of prevailing winds and currents and cover about 80 km^2. Water column concentrations of petroleum hydrocarbons would be diluted rapidly to below lethal levels at the perimeter of the plume. It is likely that the area immediately eastward of these hypothetical spill sites, in particular the nearshore, intertidal, and estuarine zones, would be most severely impacted.

While the longer term oil development risk is expected to be near shore (inside 10 to 25 m) and in bays, the majority of available juvenile salmon data (Straty 1974, Hartt and Dell 1978) were from farther offshore (e.g., greater than 15 nautical miles, nm). Thus, our study area initially extended from False Pass to Ugashik Bay in waters to about 30 m deep (Figure 2). It originally encompassed two estuaries (Port Heiden and Port Moller) and a coastal lagoon (Izembek Lagoon), as well as exposed coastal and inshore habitats. A third estuary (Ugashik Bay) was sampled during the second 1984 cruise and added as a permanent transect in 1985. The estuarine systems are representative of those in inner Bristol Bay. Izembek Lagoon deserves special attention due to its highly productive character.

Our focus on the Alaska Peninsula coast, between False Pass and Ugashik Bay and inshore of the 30- to 50-m depth contour (excluding the north shore of Bristol Bay), stemmed from the study results of Straty (1974) and Hartt and Dell (1978). Their data (Figures 3 through 7) suggest that the north shore rivers produce salmonid juveniles which migrate nearshore to the Naknek-Kvichak area before turning southwest and moving seaward along the north shore of the Alaska Peninsula. Since neither Straty (1974) nor Hartt and Dell (1978) found significant numbers of juvenile salmonids on the north shore of Bristol Bay, we concluded that the logistics and travel time required to survey both areas would consume time and resources out of proportion to the amount of new information gained, and would preclude a comprehensive assessment of fish assemblages most vulnerable to NAS development within the time and cost constraints specified.

In 1984, our study area was divided into three subareas (Figure 2) by Loran C coordinates. The Izembek Lagoon subarea extended from False Pass to north of Cape Leisko; the Port Moller subarea continued from there to the vicinity of the Seal Islands; and the Port Heiden subarea extended to Ugashik Bay. These divisions were drawn to include estuarine or lagoon systems in each subarea. Six transects within the area were aligned, to the extent possible, to be inshore extensions of transects occupied for CTD studies by Schumacher and Moen (1983), and for sediment characterization and trawling by VTN Oregon Inc. (1984). A seventh transect was added at Ugashik (Transect 0) in the second 1984 cruise. On each transect, offshore sampling with one or more gear types was planned at the beach and at 5-m, 10-m, 20-m and (purse seine only) 30-m stations. In practice, the 10-m station was moved to 11-m to keep the purse seine clear of the bottom. Sample stations in each embayment were selected based on local bathymetry and exposure (Appendix A, Figures A-1 through A-4). Habitats sampled included sheltered and exposed intertidal, estuarine and offshore pelagic, and the inshore and offshore demersal.

In 1985, the study focus was shifted to achieve more spatial coverage sampling with gear types targeting juvenile salmonids; the study subareas remained the same but the number of transects was modified (Figure 2). The open coast transects (1, 3, and 5) were dropped and the transect at Ugashik (number 0) in 1984 was included so that sampling occurred on transects 0, 2, 4, and 6 only. In contrast to the depth-stratified outside stations in 1984, the 1985 sampling was distance-stratified from shore for the two offshore stations, and Station 0 was added at the most distant offshore location of each transect. Thus, the three most offshore stations (Stations 0, 1, and 2) were 15, 10, and 5 nm offshore on each of the four transect lines. Stations 3 and 4, located between Station 2 and the beach, were left in their depth-stratified location as in 1984. No Station 3 was located on Transect 0 (Ugashik) since the water at Station 2 (5 nm from shore) was already at the 11-m depth. Station 4 on Transect 0 was used to designate an open-coast beach seine location.

3.2 SCHEDULE

In 1984, the three study subareas along the Alaska Peninsula were each alloted a 7-day sampling period for each of three 21-day cruises. However, actual sampling efforts accomplished were very much a function of weather conditions, which were severe during the summer-fall of 1984. Because of time required for contracting, gear procurement, and mobilization, field sampling did not begin until June 26, 1984. Subsequent 21-day cruises began on July 25 and August 26.

The 1985 schedule was designed to cover the study area as many times as weather and logistics would allow. Therefore, we started at Port Moller and proceeded up and down the coast without repeating the end transects. Thus, the transect sampling sequence was: 4, 2, 0, 2, 4, 6, 4, 2, 0, and so forth. This pattern was continued for 6 weeks from June 16 to July 28.

3.3 FIELD METHODS

3.3.1 Salmonids and Pelagic Species - 1984

Gear types (Table 3) and methods were chosen to include proven nets for capturing smaller juvenile salmonids (including pinks and chums) and other species in nearshore habitats. Some gear types (large seines primarily) used in the past may have caught few chums and pinks because larger mesh sizes allowed them to escape, although Straty and Jaeneke (1981) reported catching some pinks in the 65-mm size range.

The "offshore" component of this study employed a 55-foot fishing vessel with a biologist/skipper (Robert D. Paulus) fishing a 229- by 11-m (750- by 35-foot) purse seine. The net was patterned after that

TABLE 3

GEAR TYPES, HABITATS SAMPLED AND TARGETED FISH IN EACH HABITAT SURVEYED

Gear Type	Code	Habitat Type	Expected Fish Taxa
Beach seine (37-m; to 6-mm stretch mesh)	BS	Intertidal 1984 and 1985	Juvenile salmonids, demersal species
Tow net (6.1 x 3.1 m mouth; to 6-mm stretch mesh)	TN	Inshore/pelagic 1984 only	Juvenile salmonids, forage fish,
Beam trawl (3-m beam; 6-mm stretch mesh cod	BT	Inshore benthic 1984 only	Flatfish, other demersal fish
Try net (7.5-m mouth; 6-mm stretch mesh cod end)	OT	Demersal (inshore/offshore) 1984 only	Flatfish, other demersal fish
Purse seine (229 x 11-m; 19-mm stretch body; 13-mm stretch bunt)	PS	Offshore pelagic 1984 and 1985	Juvenile salmonids, forage fish
Small seine (67 x 4.6-m; 19-mm stretch body; 13-mm stretch bunt; 30.5-m attached lead panel of 19-mm stretch web)	SS	Inshore/pelagic 1985 only	Juvenile salmonids, forage fish

used and described by Johnsen and Sims (1973), and had a main body mesh size of 10-mm (3/8-inch) (bar) knotted nylon and a bunt of 6-mm (1/4-inch) (bar) knotless nylon, all dyed green. The net was set into the current in standard purse seine fashion and slowly towed (2 to 3 knots) for 10 minutes. Captured fish were brought aboard with a dip net and those surplus to sampling needs released with little damage. A minimum of two sets was planned at deeper (>10-m) stations on each transect in each sampling period.

The more "inshore" sampling effort in 1984 involved two smaller boats (30- and 16-foot) paired and pulling a surface tow net. Tow-net sampling was to be conducted only in 1984 concurrent with beach seine sampling when possible. The two-boat tow net was planned to sample neritic fish occurring in the upper 2.5 m of the water column at the 5-m and 10-m stations. Again, stations were moved to 6 m and 11 m to avoid bottom contact with the gear and to provide consistency with the purse seine stations. The tow net was 14.9 m long, 6.1 m wide, and 3.1 m deep at the mouth (49 x 20 x 10 feet), and made of green nylon. The stretch mesh sizes graded from 76-mm (3-inch) at the brail to 6-mm (1/4-inch) at the bag. The cod end had a zipper for opening and closing, and the foot rope and head rope had leads and floats, respectively, to ensure proper opening of the net. The net was attached to two vertical steel poles with a large float attached to each pole near the head rope connection to keep the net fishing upright at the surface. The net was towed at about 3.7 km/hr. Two 10-minute tows were planned at each station. One tow was planned with the prevailing tidal current along the shoreline, with the other tow planned in the opposite direction. In actual practice, with low success and limited time for tow nets in most areas, single tows were often made and vessel handling required most replicate sets to be towed in the same direction. Weather and wind often precluded any tow net activity.

When and where surf conditions permitted, beach seining was conducted using a 37-m (120-ft) floating beach seine, consisting of two wings with 3-cm (1-inch) stretch mesh joined to a 0.6-m x 2.4-m x 2.3-m (2- x 7.9- x 7.5-foot) bag with 6-mm (1/4-inch) stretch mesh. Replicate sets to sample fishes in the surface waters within 30 m of shore were made at each station and care was taken that the area swept by one set not be included in the replicate. The beach seine effort was expected to provide for two sets at each transect with replicated sets at, at least, two additional stations in each embayment. In reality, surf conditions permitted very little beach seining on exposed beaches.

The following was recorded for all sampling stations: location, date, time, weather conditions (wind force and direction, cloud cover, and general weather), sea surface temperature, salinity, sea state and secchi, depth, area sampled (beach seine), distance fished, sampling duration, compass heading, and current direction.

All information was recorded on computer data forms following National Oceanographic Data Center (NODC) codes and format. Unless otherwise noted, all names of fishes, both scientific and common, were based on the American Fisheries Society (AFS 1980) list.

Catches were processed immediately or bagged, labeled, and preserved for later processing. Any fish to be retained for other concurrent studies (e.g., salmonid identification, food habits, stomach analysis) were separated from the catch and preserved in 10-percent formalin immediately after processing. Generally, catches were processed in their entirety. However, where catches were too large for complete handling, the less abundant species were sorted from the catch, counted and saved if salmonids. The abundant species were thoroughly mixed and a known volume greater than or equal to 10 percent of the sample was removed and saved. The volume of the remaining sample was measured or weighed before the fish were discarded.

Incidental catches of fish larvae occurred even though our sampling gear was designed to sample larger fishes. Catches of larval forms were separated from the catch, preserved in 10-percent formalin immediately, and retained for further analysis if desired.

Fish samples were sorted to species and individuals counted, measured (fork length for salmonids, total length for others), and weighed (to the nearest 1 g wet weight). Problematic individuals, if any, were assigned a taxonomic designator and preserved for later taxonomic confirmation. If the number of individuals of a species in a sample exceeded 100, 50 or more individuals were counted, weighed, and measured; the remaining fish were counted and an aggregate weight taken, or the number was determined volumetrically. All information was recorded on computer data forms.

3.3.2 Salmonids and Pelagic Species - 1985

Gear types used in 1985 (Table 3) were selected based upon the 1984 experience to optimize capture of juvenile salmonids. With the low success of the tow net, it was replaced with the small purse seine in the "inshore" effort. For the most part, this small seine was fished in 1985 at stations where the tow net was used in 1984. The try net and beam trawls used in 1984 were dropped in 1985, reflecting the emphasis on pelagic species over demersal species. The large purse seine and the beach seine used in 1984 were fished in the same way in 1985, with one important exception. A 16-foot fiberglass seine skiff, using the same outboard engine used in 1984, was substituted for the 16-foot Boston Whaler used in 1984 as a skiff in the large purse seine operation. This "real" seine skiff allowed the offshore effort in 1985 to be much less influenced by both wind and tidal current direction than 1984. While severe wind and sea state conditions stopped sampling in both years, the direction of 1985 large purse seine sets (up- or down-bay) was not dictated by wind and tidal current direction as in 1984. The first priority in large purse seine sets was to make all sets facing up-bay on an ebb tide. If time and weather permitted, a delayed "replicate" was often taken at each station with the set facing down-bay on the following flood tide. Some real replicates with both sets in the same direction and in close proximity in time were also made. However, the "replicates" on most days had 4 to 6 hours between them, were set in opposing directions, or were on opposing tides.

The "inshore" effort employed the small seine at Stations 3, 4, and inside each of three bays (Ugashik, Port Moller, and Izembek Lagoon); Port Heiden did not have stations inside of Station 3 suited for this gear type. The small seine was used from the 30-foot boat using an outboard-powered 14-foot inflatable boat as the seine skiff. The small seine, with lead panel attached, totaled 97.5 m by 4.6 m (320 feet by 15 feet) in length with 30.5 m (100 foot) being the non-purseable lead panel. The lead panel and main panel web of this seine was of 10-mm (3/8-inch) (bar measure) knotless nylon with a bunt of 6-mm (1/4-inch) (bar) knotless nylon, all dyed green. The lead panel was always attached between the boat and the seine so that it left the boat last and was retrieved first in sets that were made. In the actual seining effort, the skiff pulled the seine off the stern of the 30-foot boat forming a U-shaped arc in the set facing into the tidal current direction. The set was held open for 10 minutes if no difficulties were encountered. The skiff and larger boat then met with the net closed in a circle. The lead panel of the seine was then pulled in over the stern of the larger boat. With both ends of the purseable seine aboard, the net was pursed and fish were removed by dip nets and placed in buckets containing sea water. After all fish were removed from the small seine, it was restacked on the larger boat's stern in preparation for the next set. The small seine fished an area about 40 percent of that fished by the large seine.

All fish processing and information handling in 1985 was completed as in 1984 with two differences. The first difference was that all fish, both salmonids and non-salmonids, were processed for live weight and length. In later examinations of some juvenile salmonids, FRI biologists took preserved weights and lengths, as well as scales for the scale pattern analyses completed in 1985. In 1984, salmonids were weighed and measured after a minimal preservation period and no live lengths or weights were taken. The other difference was that a portable computer and printer were operated on the 55-foot vessel in 1985 to allow all data entry and checking to be done in the field during the evenings, travel times, and on weather days. This proved to be very successful and saved several man-months of time that took place in 1984 in Seattle with a similar data set.

3.3.3 Demersal Species - 1984

The same sample design described above in Section 3.3.1 and shown on Figure 2 was used for sampling demersal species as well. Several different gear types (Table 3) were employed to target demersal fish. However, all other demersal marine fish taken as a part of the pelagic (salmonid) program in both years were recorded for use in this characterization.

The generally uniform, sandy bottom inshore area of Bristol Bay lends itself well to an "area swept" method of comparing relative densities from different habitats. Care was given concerning some of the assumptions involved with this method. The primary gear types for demersal fish were try net (otter trawl) and/or beam trawl, and the beach seine.

The otter trawl (try net) used had the following characteristics: 7.5-m (25-ft) opening, 10.8-m (35-ft) total length, 3.8-cm (1-1/2-in) mesh in the body of the net, and 6-mm (1/4-in) mesh liner in the cod end (all stretch measure). This gear was comparable to that used in the 1983 red king crab surveys off the R.V. Miller Freeman (McMurray et al. 1984). The second gear was a plumb staff beam trawl with a 3-m (10-ft beam), 2.5-cm stretch webbing in the body with a 6-mm stretch mesh liner in the cod end. This net was thought to provide a better quantitative sample because the mouth is kept at a constant width by the beam. However, the beam trawl proved difficult to sample for standard times (10 min.) since it would foul and stop when filled with mud/sand. Because of its greater ease of use, the otter trawl was the primary gear used at all stations.

As with the salmonid sampling program, at least two replicates were planned with the otter trawl at each transect station (6-, 11-, and 20-m) and at additional stations within the embayments.

Sample handling, fish processing, and data recording for demersal fish were as described for the pelagic sampling in Section 3.3.1, with bottom sea temperature substituted for surface values.

3.3.4 Demersal Species - 1985

With tow net and try net dropped in 1985, only the beach seine was targeted on shallow water fish including demersal fish species. The large and small purse seine activities took incidental catches of normally demeral species or pelagic life stages of demersal species. The beach seine was operated in 1985 as in 1984. As with salmonids and pelagic species in 1985, replication of sampling was de-emphasized in favor of covering all planned stations. However, if time and conditions permitted, a beach seine replicate was often taken.

With the exception of the field computer described in Section 3.3.2, all fish processing and information handling from beach seine sampling was completed in 1985 as in 1984.

3.4 DATA LIMITATIONS

3.4.1 1984

Field plans could not be followed in all cases in 1984 because weather (high winds) produced sea state conditions (high waves) which precluded safe sampling, especially at the outside stations (1-5). The desired coverage and station replication were not achieved in all cruises. Only during Cruise 3 were all six transects sampled. When possible, inside water (bay) studies replaced some of those planned for Stations 1-5. On occasion (e.g., Port Moller, Cruises 1 and 3), weather was so bad that even inside work was limited.

Field sample processing procedures also had several limitations. Weights were taken for nonsalmonids as live weights aboard the vessels. In all cases, spring scales were used; scales may have changed calibration during their field use. Weights measured in such a way on a moving vessel can not be assumed to be as accurate as laboratory measurements with more precise scales.

Juvenile salmonids (total catch or subsamples of catches over 100 individuals) were preserved in buffered 10-percent formalin and held at least 3 days before they were measured for length and weight. This follows a standard FRI practice. Total catch weights and individual fish lengths, therefore, have live values for nonsalmonids and preserved values for salmonids.

Some data recording errors likely occurred in the rush to process fish between sets or in late evenings after sets were made. Computer data files were twice proofed against field records before acceptance.

Distance of tows or sets, as required by NOAA, could only be estimated given the scale of charts existent for most transects and given the low level of Loran C reliability. We made our best estimates with the information available. Tide height could not be predicted as tidal prediction tables did not correspond to real tidal conditions. The stage was estimated in all cases from the tidal prediction tables, which also have inherent errors.

Locations indicated by Loran C based on available charts were often substantially at variance with reality. The Loran C numbers were encoded as a station note in the NOAA-formatted information so that a future investigator could return to the sites sampled. With Loran C limitations, few radar fixes, and the outdated bathymetric charts, we made the best estimates possible of stations sampled in 1984.

All juvenile salmon or subsamples of any single species catch over 100 fish were preserved for final verification of species.

Finally, outside (Stations 1-5) versus inside (Stations 6-11) station comparisons must be tempered by the fact that, while meeting depth criteria, Stations 3 and 4 on Transect 4 (Port Moller) were at least partially inside the bay, depending on how the bay is defined. Similarly, outside beach seine stations (Station 5) on Transects 2 (Port Heiden), 4 and 6 (Izembek Lagoon) are not true open-coast stations. They sit inside or in the mouth of each bay, but they do face the open ocean (Appendix A). These are quite different from Station 5 occupied on Transects 1, 3, and 5, which are truly on open coast with no protection.

3.4.2 1985

Weather still dictated much of our 1985 activity, but not to the extreme experienced in 1984. Our coverage of transects and stations on transects was about what we anticipated could be accomplished in the 6-week period.

Data entry errors in 1985 were likely reduced by the much shorter time between sample collection and data entry into computer files. The change in sample station criteria between 1984 and 1985 complicates somewhat interpretation and comparison of data sets: Transects 2, 4, and 6 in 1984 are on the same Loran C line as in 1985, but Stations 2 and 3 are at different depths and locations from shore in these two years. In 1984, these two stations were depth-stratified, while in 1985 they were distance-stratified. Transect 0 was not sampled outside Ugashik Bay in 1984 due to weather problems.

3.5 ANALYSIS

In the laboratory problematic species, including all juvenile salmon, were identified or confirmed and field data sheets revised accordingly. Key-to-disk entry was used to enter and verify data on 5-inch diskettes using an IBM PC microcomputer. In 1984, this occurred post-field season, while in 1985 this data input was completed aboard the 55-foot vessel.

All data collected were coded, reformatted (EDS File Type 123), placed on 7-track magnetic tape, and sent to EDS/NODC with full documentation as part of the OCSEAP data base.

Catch in units of numbers caught for juvenile salmonids, and weight and numbers for nonsalmonids, was the standard method of determining the relative abundance of species captured by various types of sampling gear. A single set, standardized to a 10-minute opening time, was the unit of effort for both large and small purse seining. Based on area fished, a catch of 1 fish per set in the small seine would be the equivalent of a catch of approximately 2.5 fish per set in the large seine, assuming both nets fished the same population density. A 10-minute tow was the unit of effort for tow net and otter trawl. A single set with constant area/volume fished was the unit of effort for beach seine data. Catch data were reported in terms of CPUE by season, location, and gear type. Length-frequency graphs were plotted for important species by season to aid interpretation of fish movements and growth in the study area.

To facilitate a temporal evaluation of fish caught in offshore operations primarily with the large purse seine, Cruise 4 in 1985 was somewhat artificially divided into two 3-week periods labeled 4a and 4b. These two cruise segments in 1985 equal the approximate 3-week lengths of Cruises 1, 2, and 3 in 1984.

3.6 SOCKEYE SALMON SCALE PATTERN ANALYSIS

The abundance of juvenile salmon at a given space and time in their migration path is dependent on the relative abundances, initial dates of migration, distances traveled, and rates of travel of stocks contributing to the migration. Since there appears to be a defined space and time progression of Bristol Bay sockeye stocks through the NAS study area (Straty 1974; this report), periodic, short-term oil mishaps or chronic, but localized, development-related perturbations could differentially affect some stocks more than others. Bax (1985) concluded on the basis of computer simulations that the severity of oil spill impacts would vary according to spill timing and trajectory relative to the timing and abundance of salmon in the migration corridor.

We attempted to determine the stock-specific migratory timing of juvenile sockeye in the NAS study area by discriminant function analysis of scale growth patterns. The scales of salmonids have long been used to age individual fish, but recently scale growth patterns have been used to identify origins of salmon taken in commercial and research catches in non-terminal fishing areas. Experimental applications of scale pattern analysis for distinguishing stocks of Bristol Bay sockeye in mixed-stock catches of adults on the open ocean (Cook 1979) and within Bristol Bay (Krasnowski and Bethe 1978) have shown that scale growth patterns may be sufficiently distinct between stocks to allow a high degree of accuracy in stock classification.

Discriminant function analysis requires a set of training samples from all groups expected to be present in the samples to be analyzed. Accordingly, we obtained training samples of up to 200 smolt scales from among those collected by ADF&G at the outlets of each major Bristol Bay river system during the 1985 outmigration. Samples of scales from juvenile sockeye of unknown origin also were taken from fish captured at the Ugashik and Port Heiden transects in 1985 large purse seine catches. Samples from the Port Moller and Izembek Lagoon transects were not included in the analysis because catches generally were too small, and because of the likelihood that they were contaminated by local sockeye stocks for which training samples were not available.

The methodology employed in scale pattern analysis is widely documented (e.g., Conrad 1983; Rogers et al. 1984; Knutsen 1985; and others). Scales taken from the "preferred area" (Clutter and Whitesel 1956) or near it on the fish's body were mounted between microscope slides and projected 210x to an electronic digitizing tablet. After identifying scale annuli, measurements were taken along a standardized axis from scale focus to margin. The coordinates of the scale characters being measured were entered with a hand-held free-cursor and processed by a microcomputer interfaced to the digitizing tablet. Scale measurements (numbers of circuli and intercircular distances to 0.001 inch) were formatted and recorded, along with corresponding biological identifiers, on floppy diskettes.

These data were used to construct a linear discriminant function (LDF) by which the relative proportions of each stock present in purse seine catches at Ugashik and Port Heiden could be estimated. The LDF analysis available in the BMDP computerized analysis series (BMDP7M; Dixon and Brown 1979) evaluated training sample scale data to select a linear combination of scale characters showing greatest between-stock variation relative to within-stock variation. The accuracy of the resulting allocation rule was assessed by reclassifying each individual scale in the training samples against all others. The tallied results gave the classification accuracy of the LDF and the probability of misclassification, which were then used to adjust estimates of stock membership of unknown scales.

4.0 RESULTS

4.1 GENERAL

4.1.1 1984

The 1984 sampling season was completed between June 26 and September 12, 1984, and involved 277 sets of five gear types (large purse seine - PS, beach seine - BS, tow net - TN, otter trawl - OT, and beam trawl - BT) (Table 4a). As shown in Table 4a, some transects were not sampled during some cruises (i.e., Cruise 1/Transects 1 and 6, Cruise 2/Transect 2). Effort was also low on some transects during some cruises (i.e., Cruise 3/Transect 5) due to weather interference. Transect 0 was a special case and was only sampled in Cruise 2.

All 1984 purse seine sets (71 total) were made at outside stations (1-3). For other gear types, the inside (Stations 6-11) versus outside (Stations 1-5) effort was 30 versus 17 beach seine sets, 18 versus 22 tow net hauls, and 27 versus 90 otter trawls, respectively. All effort on Transects 1, 3, and 5 was at outside stations since these transects lacked embayments. In all comparisons, the variability in sampling effort must be considered. Beam trawls were not further analyzed since only two 10-minute hauls were achieved without gear failure or bottom hangup.

An overview of all 1984 catches (unstandardized) from all cruises in total numbers of fish taken by species is presented in Table 1a. The ranking numbers in Table 1a (in parentheses) are the numerical rank of numbers caught by each gear type and for all gear types combined (last column). A total of over 88,400 fish representing some 53 taxa was captured in all 1984 sampling. The scientific and common names of those species captured and identified to date are provided in Table 5 and include eight species not previously reported nearshore in the study area (Table 2).

<u>TABLE 4a</u>

1984 SAMPLING EFFORT BY GEAR, TRANSECT, STATION, AND CRUISE

STATION NUMBER	TRANSECT NUMBER 0 (UGASHIK) CRUISE I	II	III	1 CRUISE I	II	III	2 (HEIDEN) CRUISE I	II	III	3 CRUISE I	II	III	4 (MOLLER) CRUISE I	II	III	5 CRUISE I	II	III	6 (MOFFET) CRUISE I	II	III	TOTALS BY CRUISE I	II	III	GRAND TOTALS
<u>Outside</u> 1(27m)					PS-2				PS-2 OT-2		PS-2		PS-3	PS-2			PS-2			PS-2		PS-3	PS-9	PS-2 OT-2	PS-14 OT-12 (27m)
2(20m)					PS-2 OT-2	PS-2 OT-2	PS-2 OT-2		PS-2 OT-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2 TN-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2			PS-2 OT-2	PS-1 OT-2	PS-8 OT-8 TN-2	PS-10 OT-10	PS-9 OT-10	PS-27 OT-28 TN-2 (20m)
3(12m)					PS-2 OT-2 TN-2	PS-2 OT-2	PS-2 OT-2		PS-2 OT-2	PS-2 OT-2 TN-2	PS-2 OT-2 TN-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2 TN-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2	PS-2 OT-2		PS-2 OT-2	PS-2 OT-2	PS-8 OT-8 TN-2	PS-10 OT-10 TN-6	PS-12 OT-12	PS-30 OT-30 TN-8 (12m)
4(6m)					OT-2 TN-2 BT-1	OT-2	OT-2		OT-2	OT-2 TN-2	OT-2 TN-2	OT-2	OT-2 TN-2 BT-1	OT-2 TN-2	OT-2 TN-2	OT-2	OT-2	OT-2		OT-2	OT-2	OT-8 TN-4 BT-1	OT-10 TN-6 BT-1	OT-12 TN-2	OT-30 TN-12 BT-2 (6m)
5(Beach)					BS-2					BS-2		BS-1	BS-2	BS-4	BS-2					BS-2	BS-2	BS-4	BS-8	BS-5	BS-17 (Out-side Beach)
<u>Inside</u> 6		BS-2					BS-2						BS-2	BS-2	BS-3					BS-3	BS-3	BS-4	BS-9	BS-6	BS-19
7		BS-2											OT-2 TN-2	OT-2 TN-2	OT-2 TN-2					OT-2	OT-2 TN-2	OT-2 TN-2	BS-2 OT-4 TN-2	OT-4 TN-4	BS-2 OT-10 TN-8
8		TN-2											BS-1							OT-2 TN-2	OT-2	BS-1	OT-2 TN-4	OT-2	BS-1 OT-4 TN-4
9													BS-1		BS-2					OT-2	OT-2	BS-1	OT-2	BS-2 OT-2	BS-3 OT-4
10													OT-1	OT-2 TN-2	OT-2					BS-3		OT-1	BS-3 OT-2 TN-2	OT-2	BS-3 OT-5 TN-2
11													OT-2 TN-2	OT-2 TN-2						BS-2		OT-2 TN-2	BS-2 OT-2 TN-2		BS-2 OT-4 TN-4
TOTALS		BS-4 TN-2			PS-6 BS-2 OT-6 TN-4 BT-1	PS-4 OT-6	PS-4 BS-2 OT-6		PS-6 OT-8	PS-4 BS-2 OT-6 TN-4	PS-6 OT-6 TN-4	PS-4 BS-1 OT-6	PS-7 BS-6 OT-11 TN-8 BT-1	PS-6 BS-8 OT-12 TN-10	PS-4 BS-7 OT-10 TN-4	PS-4 OT-6	PS-5 OT-6	PS-2 OT-4		PS-6 BS-10 OT-12 TN-2	PS-3 BS-5 OT-12 TN-2	PS-19 BS-10 OT-27 TN-12 BT-1	PS-29 BS-24 OT-42 TN-22 BT-1	PS-23 BS-13 OT-46 TN-6	
GRAND TOTALS		BS-4 TN-2			PS-10 BS-2 OT-12 TN-4 BT-1			PS-10 BS-2 OT-14			PS-14 BS-3 OT-18 TN-8			PS-17 BS-21 OT-33 TN-22			PS-11 OT-16			PS-9 BS-15 OT-24 TN-4					PS-71 BS-47 OT-117 TN-40 BT-2

<u>1/</u> Gear Codes: PS-Purse seine BS-Beach seine OT-Try net TN-Tow net BT-Beam trawl

TABLE 4b

1985 SAMPLING EFFORT BY GEAR, TRANSECT, STATION, AND CRUISE

STATION NUMBER	TRANSECT NUMBER 0 (UGASHIK) CRUISE		2 (HEIDEN) CRUISE		4 (MOLLER) CRUISE		6 (MOFFET) CRUISE		TOTALS BY CRUISE		GRAND TOTALS
	I	II	I	II	I	II	I	II	I	II	
Outside 0(15nm)	PS-3	PS-5	PS-1	PS-5	PS-3	PS-1	PS-2	PS-2	PS-9	PS-13	PS-22
1(10nm)	PS-3	PS-5	PS-1	PS-5	PS-4	PS-2	PS-2	PS-2	PS-10	PS-14	PS-24
2(5nm)	PS-3	PS-10	PS-2	PS-5	PS-4	PS-3	PS-2	PS-2	PS-11	PS-20	PS-31
3(12m)			PS-2 SS-3	PS-5	PS-5 SS-2	PS-4	PS-2	PS-2	PS-9 BS-5	PS-11	PS-20 SS-5
4(Beach at 0 only)		BS-2	SS-2	SS-1	SS-2	SS-4			SS-4	BS-2 SS-5	SS-9 BS-2
5(Beach)		BS-3		BS-3	BS-3	BS-5			BS-3	BS-11	BS-14
Inside 6(Beach)				BS-3	BS-5	BS-5		BS-2	BS-5	BS-10	BS-15
7		BS-2			SS-3	SS-4		BS-2	SS-3	SS-4 BS-4	SS-7 BS-4
8		SS-1			BS-1	BS-2			BS-1	SS-1 BS-2	SS-1 BS-3
9		SS-1			BS-1	BS-2			BS-1	SS-1 BS-2	SS-1 BS-3
10		SS-1						SS-2			SS-3
11								SS-1		SS-1	SS-1
12					SS-1	SS-2			SS-1	SS-2	SS-3
13					SS-1	SS-3			SS-1	SS-3	SS-4
TOTALS	PS-9	PS-20 SS-3 BS-7	PS-6 SS-5	PS-20 SS-1 BS-6	PS-16 SS-9 BS-10	PS-10 SS-13 BS-14	PS-8	PS-8 SS-3 BS-4	PS-39 SS-14 BS-10	PS-58 SS-20 BS-31	
GRAND TOTALS	PS-29 SS-3 BS-7		PS-26 SS-6 BS-6		PS-26 PS-22 BS-24		PS-16 SS-3 BS-4				PS-97 SS-34 BS-41

1/ Gear Codes: PS-Purse seine SS-Small seine BS-Beach seine

TABLE 5

COMMON AND SCIENTIFIC NAMES OF IDENTIFIED FISH TAXA
NORTH ALASKA PENINSULA, 1984-1985 (WITH NOAA TAXONOMIC CODE)[a]

NODC Taxon Code	Common Name	Scientific Name
8857041501	Alaska Plaice	Pleuronectes quadrituberculatus
8791030201	Arctic Cod	Boreogadus saida
8857041001	Arctic Flounder	Liopsetta glacialis
8603010201	Arctic Lamprey	Lampetra japonica
8831080901	Bering Poacher	Occella dodecaedron
8831022101	Brightbelly Sculpin	Microcottus sellaris
8857040701	Butter Sole	Isopsetta isolepis
8755030201	Capelin	Mallotus villosus
8755010206	Chinook Salmon	Oncorhynchus tshawytscha
8755010202	Chum Salmon	Oncorhynchus keta
8791030000	Cods (unid.)	Gadidae
8755010203	Coho Salmon	Oncorhynchus kisutch
8842130205	Crescent Gunnel	Pholis laeta
8831020601	Crested Sculpin[b]	Blepsias bilobus
8755010401	Dolly Varden	Salvelinus malma
8755030501	Eulachon	Thaleichthys pacificus
8857040000	Flounder (unid.)	Pleuronectidae
8857040601	Flathead Sole	Hippoglossoides elassodon
8831022204	Great Sculpin	Myoxocephalus polyacanthocephalus
8827010101	Kelp Greenling[b]	Hexagrammos decagrammus
8857040902	Longhead Dab	Limanda proboscidea
8818010201	Ninespine Stickleback[b]	Pungitius pungitius
8791030401	Pacific Cod	Gadus macrocephalus
8857041901	Pacific Halibut	Hippoglossus stenolepis
8747010201	Pacific Herring	Clupea harengus pallasi
8840010201	Pacific Sandfish	Trichodon trichodon
8845010101	Pacific Sand Lance	Ammodytes hexapterus
8831021801	Pacific Staghorn Sculpin	Leptocottus armatus
8831020401	Padded Sculpin	Artedius creaseri
8755010201	Pink Salmon	Oncorhynchus gorbuscha
8831022201	Plain Sculpin	Myoxocephalus jaok
8755030102	Pond Smelt[b]	Hypomesus olidus
8755030302	Rainbow Smelt	Osmerus mordax
8831023805	Ribbed Sculpin	Triglops pingeli
8857040801	Rock Sole	Lepidopsetta bilineata
8842130206	Saddleback Gunnel[b,d]	Pholis ornata
8831022301	Sailfin Sculpin[b]	Nautichthys oculofasciatus
8831020000	Sculpin (unid.)	Cottidae

TABLE 5 (Cont.)

NODC Taxon Code	Common Name	Scientific Name
8831020602	Silverspotted Sculpin	Blepsias cirrhosus
8755030000	Smelt (unid.)	Osmeridae
8831090000	Snailfish (unid.)	Liparis sp.
8842120902	Snake Prickleback	Lumpenus sagitta
8755010205	Sockeye Salmon	Oncorhynchus nerka
8857041401	Starry Flounder	Platichthys stellatus
8831080802	Sturgeon Poacher	Agonus acipenserinus
8755030101	Surf Smelt	Hypomesus pretiosus
8831021603	Threaded Sculpin[b]	Gymnocanthus pistilliger[c]
8818010101	Threespine Stickleback	Gasterosteus aculeatus
8831022401	Tidepool Sculpin[b]	Oligocottus maculosus
8831081101	Tubenose Poacher	Pallasina barbata
8791030701	Walleye Pollock	Theragra chalcogramma
8827010104	Whitespotted Greenling	Hexagrammos stelleri
8842020201	Wolf-eel[b]	Anarrhichthys ocellatus
8857040901	Yellowfin Sole	Limanda aspera

[a]Source: AFS, 1980, except as noted
[b]Not previously reported in the area, Table 2
[c]Wilimovsky 1958
[d]Taken only in 1985

Length-frequency evaluations were completed on those species where sufficient individuals were captured and measured in each of the three cruises.

A breakdown of 1984 catches by cruise, transect, and station for purse seine, tow net, beach seine, and otter trawl is provided in Appendices B through E, respectively. Species evaluations for 1984 that follow are divided into juvenile salmonids (Section 4.2) and non-salmonids (Section 4.5). Adult salmonids taken in 1984 (Table 1a) are not discussed further since sampling gear was not scaled to a size adequate to consistently sample adults.

4.1.2 1985

The 1985 sampling season was completed between June 16 and July 28, 1985, and involved 172 sets of three gear types (large purse seine - PS, small purse seine - SS, and beach seine - BS) as summarized in Table 4b (p. 74). To facilitate temporal assessment of the Cruise 4 data in 1985, the sampling season was divided into two subsets (4a and 4b). Cruise 4a ended on July 6 and Cruise 4b began on July 7, providing 3 weeks in each subsampling period. This division of Cruise 4 was made primarily for the large purse seine. For continuity of comparisons in 1985, the same dividing date was used for the small seine and the beach seine, even though these two gear types were initiated later in Cruise 4a than the large seine effort. Therefore, while this Cruise 4 division is fairly even for the large seine effort, there was less beach seine and small seine effort in Cruise 4a than Cruise 4b.

Of the 34 small seine sets made in 1985, 14 were made in outside locations and the remaining 20 sets were made in inside locations (Stations 7-13). Of the 41 beach seine sets, only 16 sets were made at outside locations (generally exposed to the open ocean) while the remaining 25 sets were made at the inside stations (6-9).

An overview of all catches (unstandardized) for all gear types in 1985, in terms of total numbers of fish taken by species, is presented in Table 1b. As in 1984, a numerical ranking of numbers caught by each gear type and by all gear types combined (last column) is shown in parentheses. A total of almost 30,000 fish representing some 30 identified taxa (Table 5) was captured in 1985. A single new species, the saddleback gunnel, *Pholis ornata*, was taken in 1985. This species joins the eight taken in 1984 that were not previously reported (Table 2) in the area. The total number of species taken in 1985 declined from the 53 taken in 1984 primarily due to dropping the otter trawl in the 1985 study.

In 1985, juvenile salmon (chinook, chum, coho, pink, and sockeye) made up 52 percent by number of fish taken (Table 1b). If the catches of two other pelagic species, Pacific sand lance and rainbow smelt, are combined with juvenile salmon, together they constitute 93 percent of the total 1985 catch.

Unlike the 1984 effort with the tow net targeting on pelagic species, the small purse seine proved more successful in capturing pelagic fish in nearshore and inside waters. As with the large seine operation in 1984, weather and tidal current direction dictated, to some degree, the small seine sampling capability in 1985. This was due to the use of an inflatable boat as a skiff.

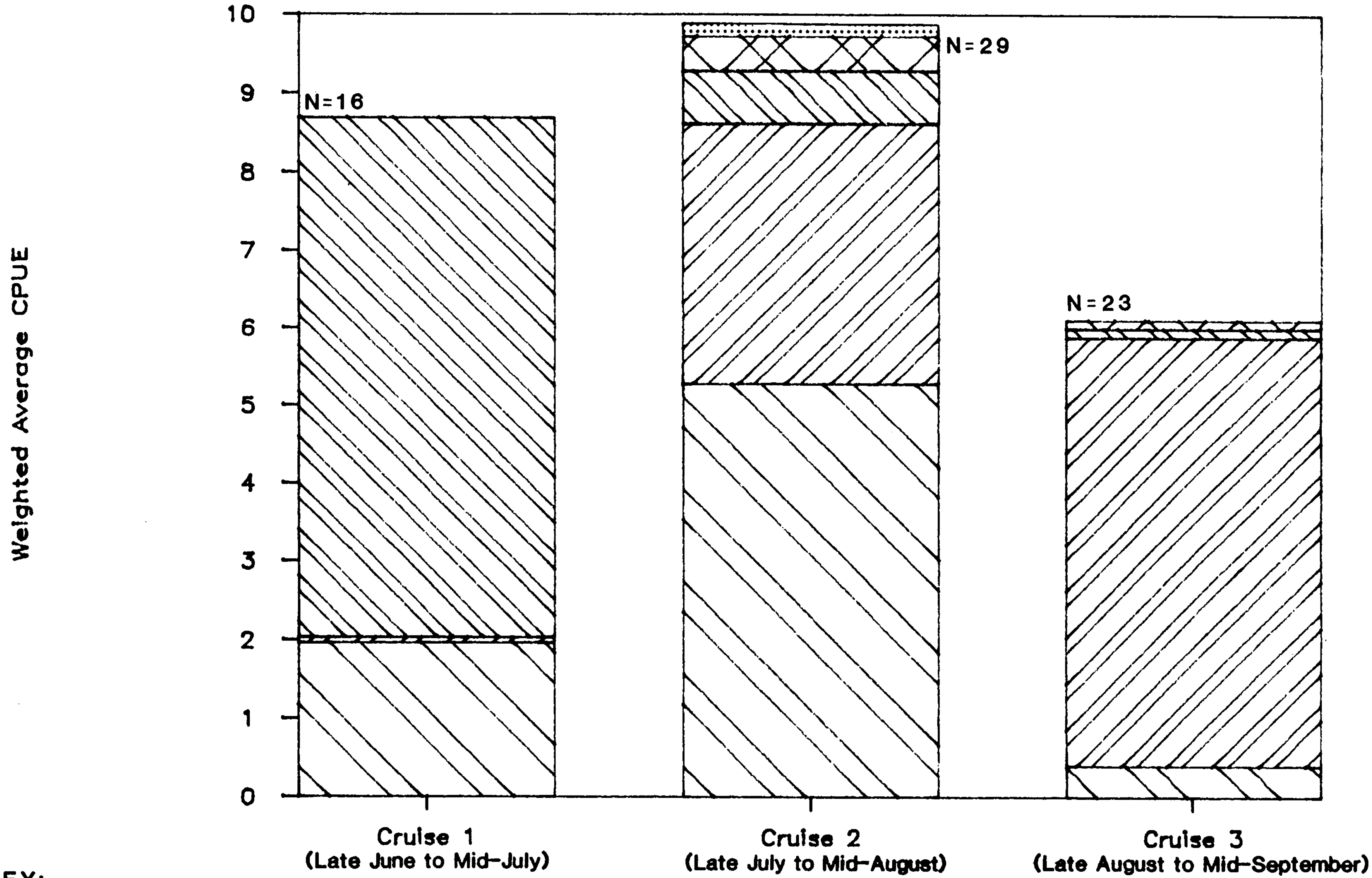
Statistical summaries of 1985 catches by cruise, transect, station, and gear are provided in Appendices G through I, respectively. Evaluations for 1985 that follow are divided into 1985 salmonids results (Section 4.3), a general discussion of juvenile salmonid distributions and movements (Section 4.4), 1985 nonsalmonids (Section 4.6), and comparisons of 1984 and 1985 catch data (Section 4.7).

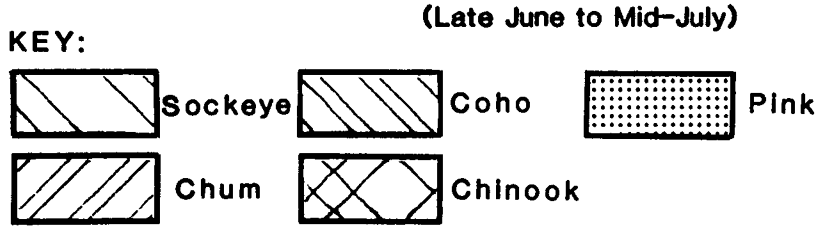
4.2 SALMONIDS - 1984

4.2.1 General Catch Patterns

The total raw catch of juvenile salmon across all gear types in 1984 was 898, or about 1 percent of all fish captured. Of this figure, 771 (86 percent) were captured in the purse seine, 84 (9 percent) in the beach seine and 43 (5 percent) in the tow net (Table 1a).

The purse seine CPUE of all juvenile salmon (all species, stations, and transects combined), was only 8.21 fish per set (weighted average, standardized for 10-minute set time). Purse seine CPUE was slightly greater in Cruise 2 (late July to mid-August; 9.86) than in Cruise 1 (late June to mid-July; 8.60) and dropped significantly by Cruise 3 (late August to mid-September; 5.82) (Figure 8; Table 6). This pattern is compared to the seasonal patterns of abundance of other major species caught by the purse seine in Figure 9. A comparison of the purse seine CPUE by subarea, summed over all cruises, showed a decreasing catch rate from the inner (Transects 1 and 2, 15.7 fish per set) to the middle (Transects 3 and 4, 8.2 fish per set) and outer bay (Transects 5 and 6, 0.7 fish per set) subareas (Figures 9 and 10).





1984 Purse Seine Catch of Juvenile Salmon by Cruise
(all transects and stations combined)

Dames & Moore

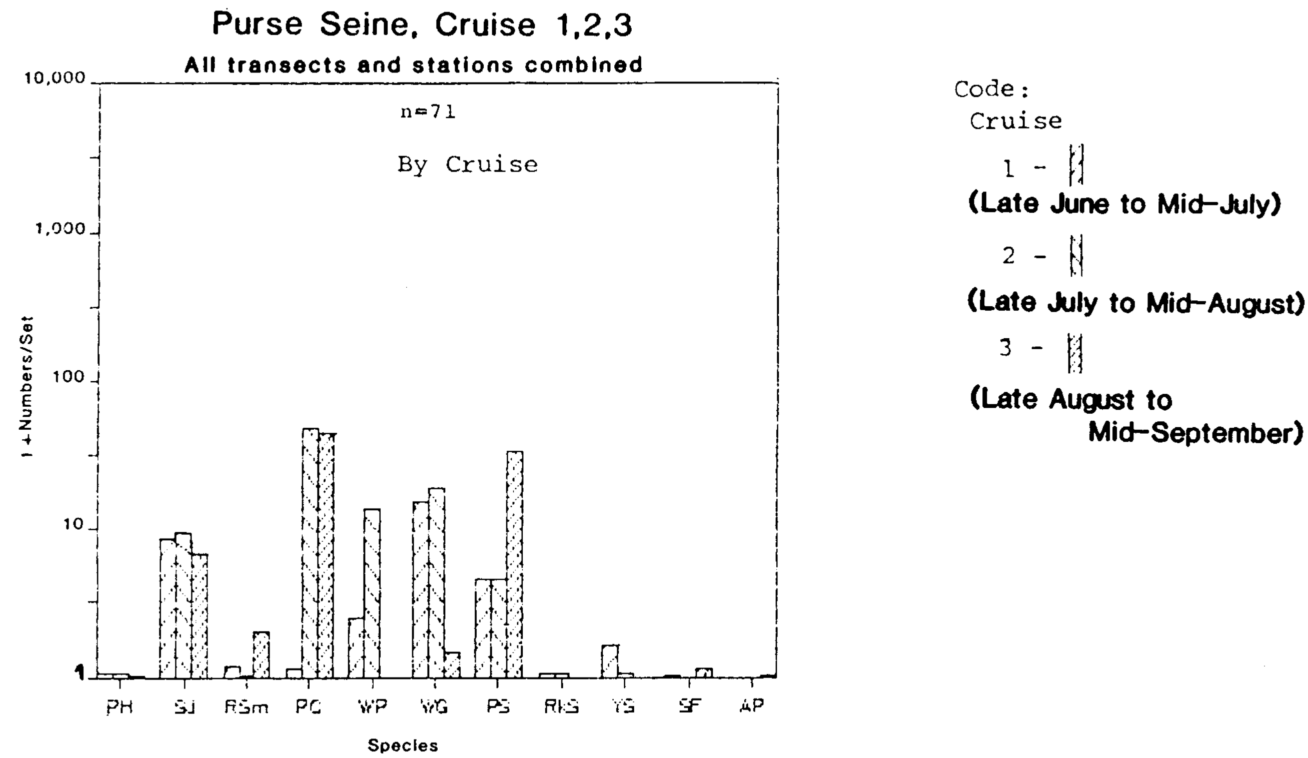
Figure 8

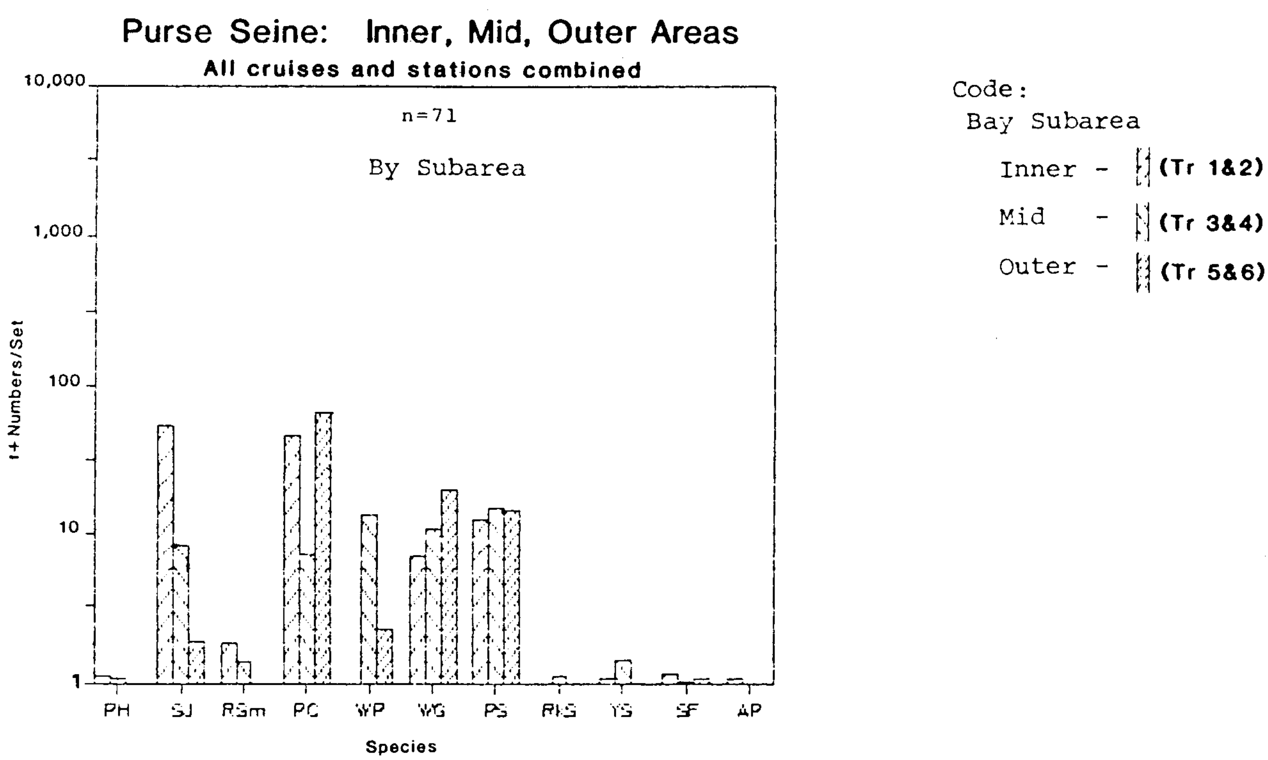
TABLE 6

1984 PURSE SEINE CATCH FOR ALL JUVENILE SALMONIDS COMBINED[a]

Cruise	1				2				3				All Cruises			
Station	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg
Transect:																
1					31.70	0.00	0.80	10.83		0.40	53.70	27.05	31.70	0.20	27.25	17.32
2		0.00	63.30	31.65					2.10	2.10	2.90	2.37	2.10	1.05	33.10	14.08
3		4.40	0.00	2.20	60.00	26.70	9.60	32.10		1.20	1.20	1.20	60.00	10.77	3.60	14.73
4	1.20	4.60	6.50	3.69	2.90	0.80	4.40	2.70		0.50	2.80	1.65	1.88	1.97	4.57	2.86
5		0.30	0.80	0.55	0.00	0.00	2.10	0.84			0.00	0.00	0.00	0.15	0.97	0.58
6					0.00	0.40	3.60	1.33		0.00	0.00	0.00	0.00	0.27	1.80	0.89
Weighted Averages:																
Station	1.20	2.33	17.65		21.02	5:58	4.10		2.10	0.93	10.10	All Trans	14.07	3.07	10.11	
Cruise				8.60				9.86				5.82	All Cruise Weighted Average			8.21

[a] Weighted averages of station means, standardized to 10-minute set times. Cruise 1: Late June to mid-July; Cruise 2: Late July to mid-August; Cruise 3: Late August to mid-September.



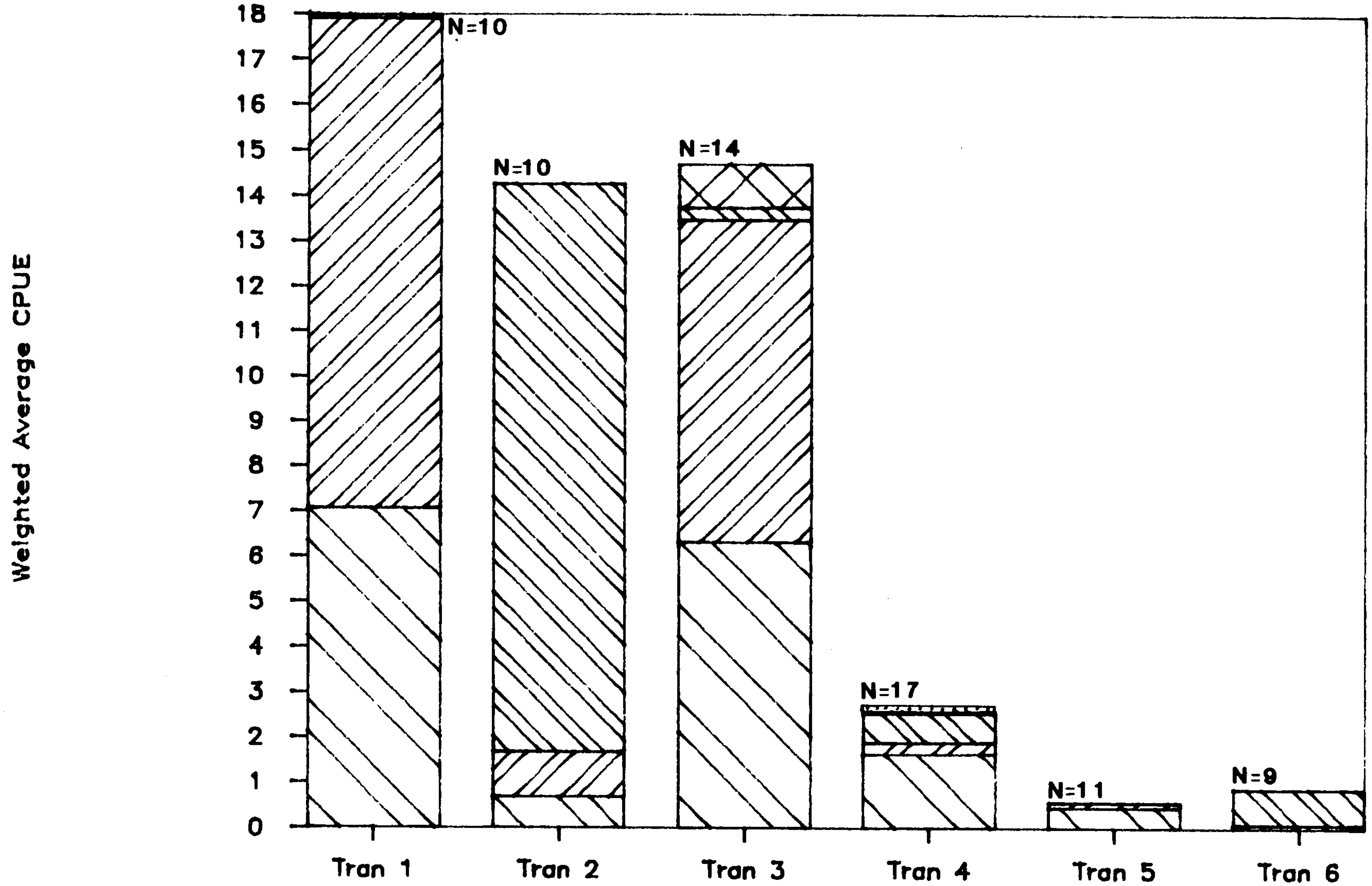


Species Code:
PH-Pacific herring
SJ-Salmon juveniles
RSm-Rainbow smelt
PC-Pacific cod
WG-Whitespotted greenling
PS-Pacific Sandlance
RkS-Rock sole
YS-Yellowfin sole
SF-Starry flounder
AP-Alaska plaice

Catch of Important Fish Species by Cruise (top) and by Subarea (bottom) with Purse Seine, 1984

Dames & Moore

Figure 9



KEY:

Sockeye Coho Pink

Chum Chinook

1984 Purse Seine Catch of Juvenile Salmon by Transect
(all cruises and stations combined)

Dames & Moore

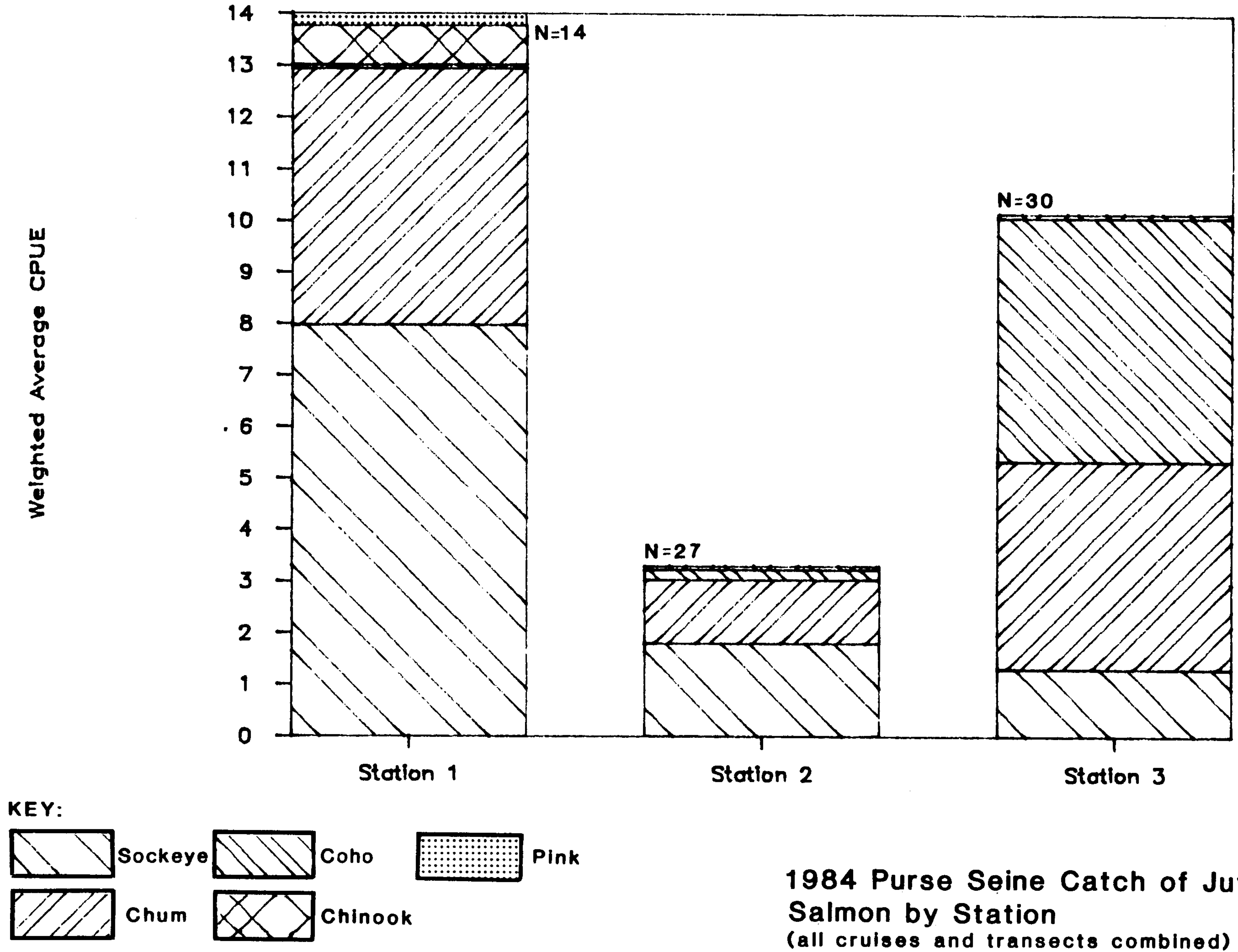
Figure 10

A comparison of CPUE by stations, all transects and cruises combined, indicated that Stations 1 and 3 (27 m and 12 m) had higher average catch rates than did the intermediate Station 2 (20 m) (Figure 11). This assertion is confounded by differences in sampling effort, since over twice as many sets were made at Stations 2 and 3 as at Station 1, and several large catches at Station 1 heavily influenced the data set. During Cruise 2 (late July to mid-August), where we had the most balanced effort (sampled all three stations on five transects), there was a sharp decrease in catch rate from Station 1 (21.0 fish per set) to Stations 2 (5.6 fish per set) and 3 (4.1 fish per set; Table 6) suggesting a preference for offshore vs. onshore habitats.

In Cruise 1, purse seine sampling was conducted on four days (June 29, July 1, 3, and 15). Transect 4 was sampled first, followed in order by Transects 3, 2, and 5. We made 19 hauls, of which 4 were empty sets and 11 (58 percent) caught juvenile salmonids. Catches ranged from 0 to 162 with a total raw catch of 221 and a mean standardized catch of 8.60 per set. As mentioned earlier, weather was a problem and prevented sampling on Transects 1 and 6 (Table 4).

In Cruise 2, purse seine sampling was conducted on six days (July 27, August 2, 3, 5, 10 and 12). Sampling began at Transect 1 followed by Transects 3, 5, 6, and 4. We made 29 hauls, of which none were empty sets and 15 (48 percent) caught juvenile salmonids. Catches ranged from 0 to 97 with a total raw catch of 382 and a standardized mean catch of 9.86 per set. Inclement weather prevented any sampling on Transect 2.

In Cruise 3, purse seine sampling was conducted on five days (September 2, 4, 8, 11, and 12). Sampling began at Transect 5 and progressed to Transects 6, 4, 3, 2, and 1. A total of 23 sets was made of which there were no empty sets and 16 of 23 (70 percent) caught juvenile salmonids. Catches ranged from 0 to 103 with a total raw catch of 168 and standardized mean catch of 5.82 per set. Coverage was good except for Transect 5 where only two sets were made.



1984 Purse Seine Catch of Juvenile Salmon by Station
(all cruises and transects combined)

Dames & Moore

Figure 11

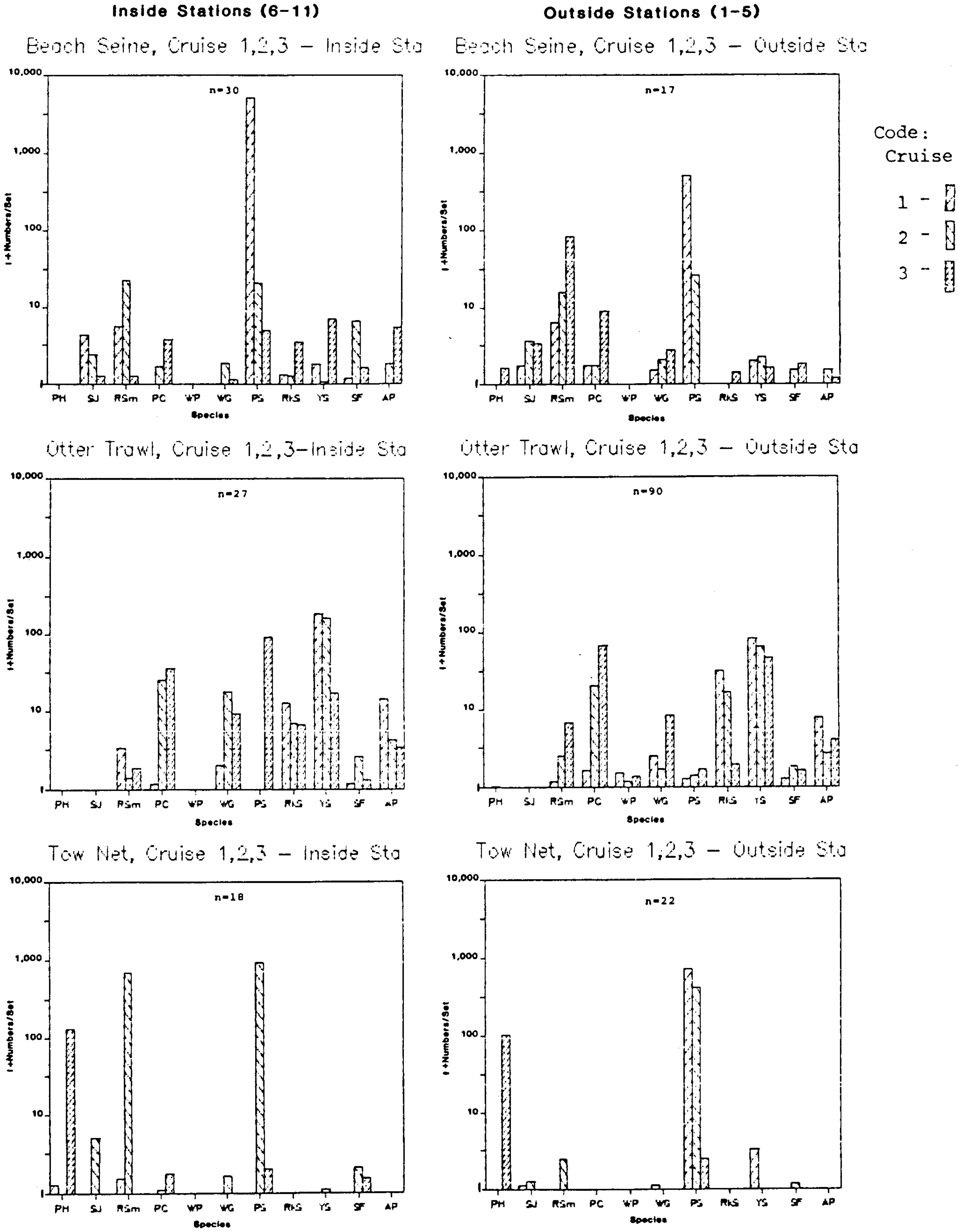
Tow net catches of juvenile salmonids were significant only on Cruise 2 (Figures 12 and 13; Appendix C). The majority of the tow net catch (71 percent) was from a station inside Ugashik Bay with a very few additional fish taken offshore on Transect 3, inside Port Moller, and inside Izembek Lagoon. Because of this low success rate, tow netting was de-emphasized in Cruise 3 (Table 4a).

Mean beach seine catches of juvenile salmonids generally decreased at protected stations through the sampling season but were greater in Cruises 2 and 3 on unprotected beaches (Figures 12 and 13; Appendix D). Of protected beaches, Port Moller stations had a higher average catch rate than other embayments, while on exposed beaches Transect 6 had the greatest catches (sampled Cruises 2 and 3 only). However, the "exposed" Transect 6 beach seine site is somewhat protected (see Appendix A, Figure A-4).

4.2.2 Sockeye Salmon

Juvenile sockeye salmon (*Oncorhynchus nerka*) were expected to be an overwhelming dominant in our catches based on the many millions of smolts known to leave Bristol Bay spawning systems each spring. Average purse seine catch (standardized to 10-minute sets) over the entire sampling season was only 2.8 fish per set (Table 7). In Cruise 1 (late June to mid-July) purse seine catches, sockeye were the most frequently caught juvenile, occurring in 8 of 19 sets. Highest mean catches (6.1 fish per set) were from stations outside Port Moller (Transect 4) and at Transect 3. In Cruise 2 (late July to mid-August), much higher catches, to 31.7 per set, were taken off Transects 1 and 3 (Transect 2 not sampled). Highest catches (all transects combined) were at Station 1 (11.6 fish per set; n = 9) with progressively fewer fish per set nearer shore at Stations 2 and 3 (3.0 and 1.8 per set, respectively). Very few sockeye juveniles were taken at outer bay Transects 4 through 6. By early September (Cruise 3), juvenile sockeye were taken only off Transects 1 and 2 (2.5 fish maximum standardized catch in any set).

Juvenile sockeye occurred in only two beach seine hauls during Cruise 1, both inside Port Moller. In Cruise 2 beach seines, sockeye

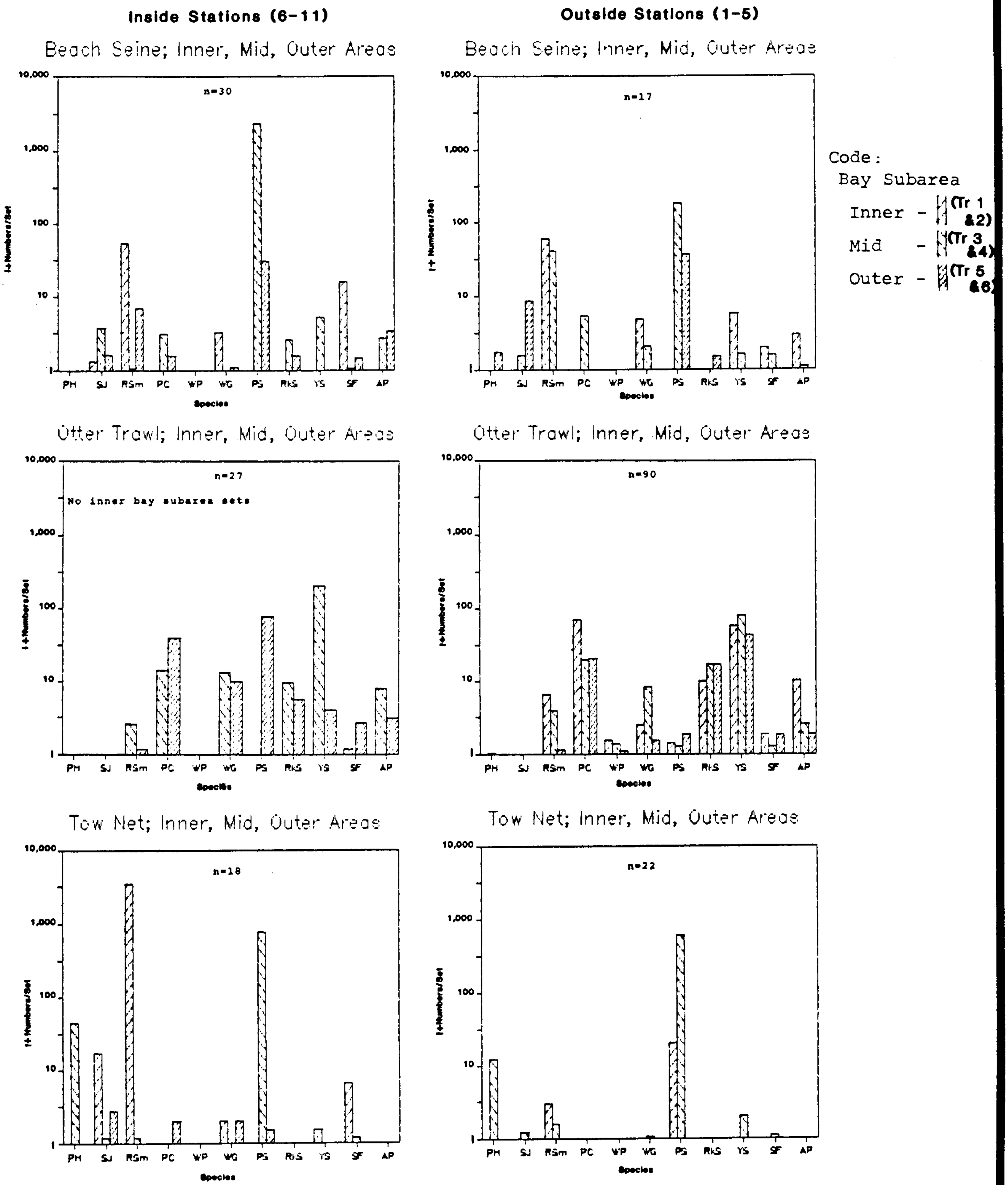


Species Code:
PH-Pacific herring
SJ-Salmon juveniles
RSm-Rainbow smelt
PC-Pacific cod
WG-Whitespotted greenling
PS-Pacific Sandlance
RkS-Rock sole
YS-Yellowfin sole
SF-Starry flounder
AP-Alaska plaice

Catch of Important Fish Species by Cruise with Beach Seine, Otter Trawl, and Tow Net, 1984 (all transects combined)

Dames & Moore

Figure 12



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YS-Yellowfin sole
SF-Starry flounder
AP-Alaska plaice

Catch of Important Fish Species by Inner, Mid, and Outer Bay Subareas with Beach Seine, Otter Trawl, and Tow Net, 1984 (all cruises combined)

Dames & Moore

Figure 13

TABLE 7

1984 PURSE SEINE CATCH FOR JUVENILE SOCKEYE[a]

Cruise	1				2				3					All Cruises			
Station	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg		1	2	3	Wtd Avg
Transect:																	
1					31.70	0.00	0.80	10.83		0.40	2.50	1.45		31.70	0.20	1.65	7.08
2		0.00	1.70	0.85					1.70	0.00	0.00	0.57		1.70	0.00	0.85	0.68
3		4.40	0.00	2.20	19.90	14.00	6.00	13.30		0.00	0.00	0.00		19.90	6.13	2.00	6.33
4	1.20	4.30	6.10	3.49	0.80	0.80	0.00	0.53		0.00	0.00	0.00		1.04	1.70	2.03	1.62
5		0.00	0.40	0.20	0.00	0.00	2.10	0.84			0.00	0.00		0.00	0.00	0.83	0.45
6					0.00	0.40	0.00	0.13		0.00	0.00	0.00		0.00	0.27	0.00	0.09
Weighted Averages:																	
Station	1.20	2.18	2.05		11.64	3.04	1.78		1.70	0.09	0.42		All Trans	7.99	1.80	1.31	
Cruise				1.97				5.28				0.40	All Cruise Weighted Average				2.81

[a] Weighted averages of station means, standardized to 10-minute set times.

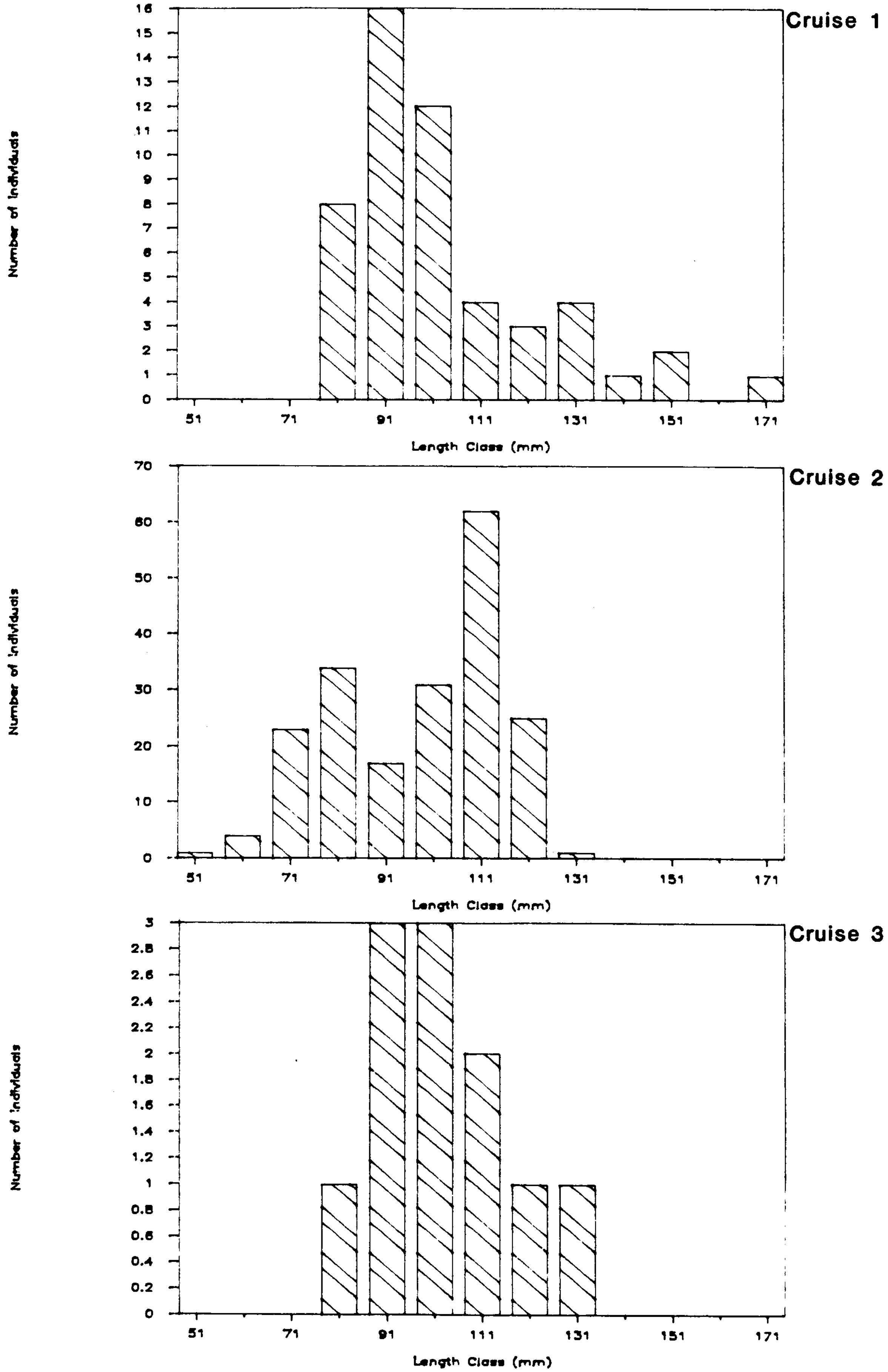
juveniles were taken in 7 of 24 sets on Transects 0, 1, 4 and 6 with peak catches (7 per set; n = 2) at Station 5, Transect 6, just inside the north entrance to Izembek Lagoon. Sockeye were also taken in tow nets (3.5 per set; n = 2) at Station 8 inside Izembek Lagoon during Cruise 2.

Sockeye juveniles were weakly bimodal in size during Cruise 1 with peaks at 91 to 100 mm (larger "1-check" outmigrants) and 131 to 140 mm (larger "2-check" outmigrants; Figure 14). In Cruise 2, sockeye size was strongly bimodal with peaks at 81 to 91 mm (smaller "1-check" outmigrants) and 111 to 120 mm (smaller "2-check" outmigrants). By Cruise 3, too few fish were measured to reveal size distribution patterns.

4.2.3 Chum Salmon

Chum salmon (O. keta) juveniles were taken in only two purse seine sets (one fish each) during Cruise 1 (late June to mid-July), both on Transect 5. During Cruise 2 (late July to mid-August), chum juveniles were only taken on Transect 3 where they were relatively abundant, ranging from 34.3 per set at the offshore Station 1 to 3.6 per set at the inner Station 3 (Table 8). During Cruise 3 (late August to mid-September), juvenile chums were surprisingly abundant in purse seine sets from Transect 4 north into the bay. Chum juveniles were caught in 72 percent (13 of 18 sets) of sets in this region with catches up to 50.8 fish (standardized) in two sets at Station 3 (11-m), Transect 1 on the last day of sampling. Only five chum juveniles were taken in beach seining in Cruise 1 (Transects 3 and 4) and none were taken in Cruise 3. During Cruise 2, scattered chum juveniles were taken in beach seines at Transects 4 and 6. No chum juveniles were taken in tow netting in Cruise 1 or 3, however, during Cruise 2, they were common (15 per set; n = 2) in catches inside Ugashik Bay (Transect 0).

Juvenile chum salmon spanned a wide range of sizes in Cruises 2 and 3 (Figure 15) with a significant increase in the size of the dominant mode between the two sampling periods.



Length-Frequency of Sockeye Salmon in Purse Seines, 1984
(all transects and stations combined)

Dames & Moore

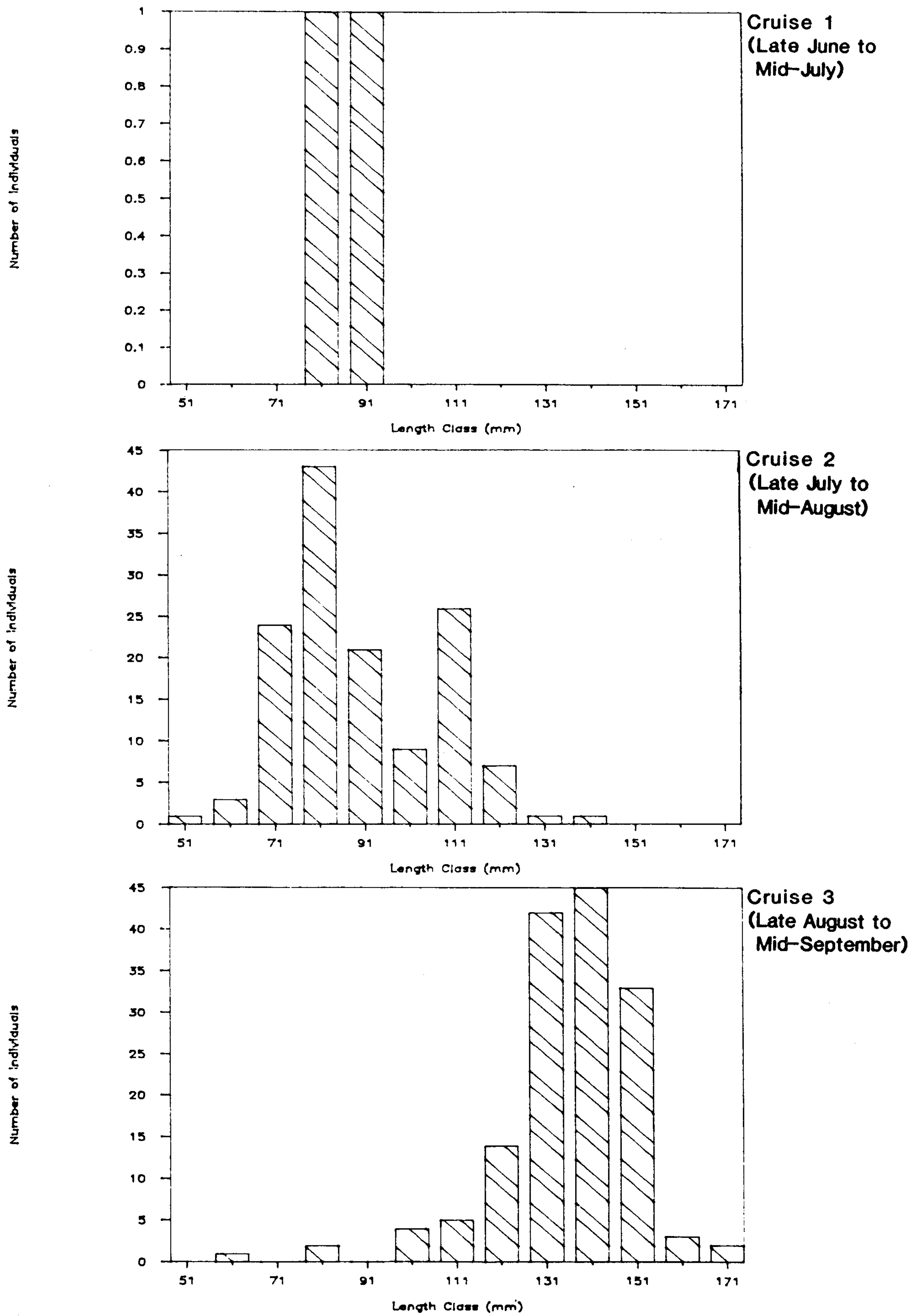
Figure 14

TABLE 8

1984 PURSE SEINE CATCH FOR JUVENILE CHUM[a]

Cruise	1				2				3				All Cruises			
Station	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg
Transect:																
1					0.00	0.00	0.00	0.00		3.40	50.80	27.10	0.00	1.70	25.40	10.84
2		0.00	0.00	0.00					0.40	1.70	2.90	1.67	0.40	0.85	1.45	1.00
3		0.00	0.00	0.00	34.30	10.50	3.60	16.13		0.80	0.80	0.80	34.30	3.77	1.47	7.14
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	2.30	1.15	0.00	0.00	0.77	0.27
5		0.30	0.40	0.35	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.15	0.13	0.13
6					0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weighted Averages:																
Station	0.00	0.08	0.10		7.62	2.10	0.72		0.40	1.31	9.47	All Trans	4.96	1.24	4.05	
Cruise				0.07				3.34				5.49	All Cruise Weighted Average			3.16

[a] Weighted averages of station means, standardized to 10-minute set times.



Length-Frequency of Chum Salmon in Purse Seines, 1984
(all transects and stations combined)

Dames & Moore

4.2.4 Coho Salmon

Surprisingly, coho (silver) salmon (*O. kisutch*) provided the largest mean standardized purse seine capture of juvenile salmonids in 1984: 62.6 fish in two July 3 (Cruise 1) sets on Station 3 of Transect 2 (Table 9). Apart from this station, a few juvenile coho occurred in scattered sets on Transects 2 and 3 (Cruise 3) Transect 4 (all cruises) and Transect 6, Station 3 (Cruise 2). Coho were the most common salmon juvenile caught in beach seines on Cruise 1 (Shingle Point, Herendeen Bay) and were the only juvenile salmon caught in Cruise 3 beach seines (Transect 4, Station 5 and Transect 6, Stations 5 and 6). The three juvenile coho in Cruise 2 beach seines all came from Transect 6, Stations 5 and 11. Coho juveniles were not taken in tow net sampling in any cruises.

4.2.5 Chinook Salmon

Single juvenile chinook salmon (*O. tshawytscha*) were taken in purse seine sets at the two outer stations (27- and 20-m) on Transect 3 during Cruise 2 and at 11-m stations on Transect 1, 2, and 4 in Cruise 3 (Table 10). The largest single catch was 10 fish on Transect 3, Station 1 on Cruise 2 (July 27). Only one juvenile chinook was taken in a beach seine; that was inside Ugashik Bay on Cruise 2.

4.2.6 Pink Salmon

Only five pink salmon (*O. gorbuscha*) juveniles were captured (on Transect 4, Station 1 in Cruise 2). This low catch rate was expected in an even-numbered year in this area.

4.2.7 Discussion of 1984 Salmonid Catches

Bristol Bay river-lake systems have the largest adult sockeye salmon runs in the North Pacific. Although there is considerable year to year variation, the annual runs since 1978 have all been greater than 25 million fish. The bay also supports annual runs of 2 to 3 million adult chum salmon and even larger runs of adult pink salmon in even-numbered years (about 16 million in 1978 and about 6 million in 1984)

TABLE 9

1984 PURSE SEINE CATCH FOR JUVENILE COHO[a]

Cruise	1				2				3				All Cruises				
Station	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg		1	2	3	Wtd Avg
Transect:																	
1					0.00	0.00	0.00	0.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00
2		0.00	62.60	31.30					0.00	0.40	0.00	0.13		0.00	0.20	31.30	12.60
3		0.00	0.00	0.00	0.40	1.10	0.00	0.50		0.40	0.00	0.20		0.40	0.50	0.00	0.27
4	0.00	0.30	0.40	0.20	0.00	0.00	4.40	1.47		0.50	0.00	0.25		0.00	0.27	1.60	0.66
5		0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00		0.00	0.00	0.00	0.00
6					0.00	0.00	3.60	1.20		0.00	0.00	0.00		0.00	0.00	1.80	0.80
Weighted Averages:																	
Station	0.00	0.08	15.75		0.09	0.22	1.60		0.00	0.29	0.00		All Trans	0.06	0.20	4.73	
Cruise				6.66				0.66				0.11	All Cruise Weighted Average				2.09

[a] Weighted averages of station means, standardized to 10-minute set times.

TABLE 10

1984 PURSE SEINE CATCH FOR JUVENILE CHINOOK[a]

Cruise	1				2				3				All Cruises			
Station	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg	1	2	3	Wtd Avg
Transect:																
1					0.00	0.00	0.00	0.00		0.00	0.40	0.20	0.00	0.00	0.20	0.08
2		0.00	0.00	0.00					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3		0.00	0.00	0.00	5.40	1.10	0.00	2.17		0.00	0.40	0.20	5.40	0.37	0.13	0.99
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.50	0.25	0.00	0.00	0.17	0.06
5		0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00	0.00	0.00	0.00	0.00	0.00
6					0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weighted Averages:																
Station	0.00	0.00	0.00		1.20	0.22	0.00		0.00	0.00	0.22	All Trans	0.77	0.08	0.09	
Cruise				0.00				0.45				0.11	All Cruise Weighted Average			0.22

[a] Weighted averages of station means, standardized to 10-minute set times.

(Table 11). The chum and pink adult salmon runs are concentrated in the west side of Bristol Bay (primarily Nushagak Bay), as are the less abundant runs of chinook and coho salmon.

The timing of the annual adult sockeye salmon runs to Bristol Bay is estimated by lagging the daily escapement counts back to the fishing district and adding the escapement to the catch. The lag time (i.e., the number of days it takes the fish to travel from the fishing district to the enumeration sites at the lake system outlets) has been estimated by comparing the timing of the annual catches with the timing of annual escapements. The method of estimating the timing of an annual run probably results in an error of one to two days, which is comparable to the variation in the estimated timing of the majority of the annual runs since 1960.

Late adult runs have been associated with cold spring weather, whereas early runs have generally followed warm spring weather. The latest run occurred in 1971 when 10 percent of the Nushagak run passed through the fishing district on July 5 (average date = June 28) and the mid-point of the run (50 percent) was on July 11 (average date = July 4). In that year, 10 percent of the Naknek-Kvichak run occurred on July 1 (average date = June 26) and the mid-point of the run was on July 8 (average date = July 2). The earliest run to begin was in 1979 when 10 percent of the Nushagak run occurred on June 23 and the Naknek-Kvichak run on June 21. The earliest mid-point of a run was in 1967, June 30 for the Nushagak, and June 28 for the Naknek-Kvichak.

Preliminary data obtained from ADF&G indicate that the 1984 adult run began earlier than average (10 percent on June 24 in the Nushagak and on June 25 in the Naknek-Kvichak), but the mid-point of the run was about average (July 3 in the Nushagak and July 4 in the Naknek-Kvichak).

The timing of the 1984 run was similar to the timing of the 1969 and 1970 Naknek-Kvichak runs but began about five days earlier than the 1969 and 1970 Nushagak runs. The 1984 run ended (90 percent) about July 12 to 13 (average July 11 for Nushagak and July 10 for Naknek-Kvichak) and was somewhat more prolonged than average.

TABLE 11

CATCHES AND ESCAPEMENTS OF SALMON IN BRISTOL BAY, THE NORTH ALASKA PENINSULA, AND THE SOUTH PENINSULA INTERCEPTION FISHERY 1980-1984[a]

		Year of Run				
		1980	1981	1982	1983	1984
Sockeye						
East side[b]	Catch	17.2	17.4	8.6	31.4	22.2
	Escape	29.8	5.7	4.7	6.4	14.4
West side	Catch	5.0	8.3	6.6	5.9	2.5
	Escape	8.8	3.1	2.3	2.1	2.0
No. Pen.	Catch	1.4	1.8	1.4	2.0	1.7
So. Pen.[c]	Catch	3.3	2.0	2.0	2.2	2.1
Chum						
East side	Catch	0.3	0.5	0.3	0.6	0.8
West side	Catch	1.1	1.0	0.6	0.9	1.0
	Escape	1.4	0.5	0.3	0.3	0.6
No. Pen.	Catch	0.7	0.7	0.3	0.3	0.8
So. Pen.[c]	Catch	0.5	0.5	0.7	0.5	0.5
Pink						
East side	Catch	0.3	+	0.1	+	0.2
West side	Catch	2.4	+	1.3	+	3.2
	Escape	2.8	+	1.7	+	3.0
No. Pen.	Catch	0.3	+	+	+	+
Coho						
East side	Catch	+	+	0.1	+	0.1
West side	Catch	0.3	0.3	0.5	0.1	0.4
No. Pen.	Catch	0.1	0.2	0.2	0.1	0.2

[a] Source: ADF&G unpublished statistics; numbers in millions; + = less than 100,000.

[b] East side is Naknek-Kvichak, Egegik, and Ugashik, and West side is Nushagak and Togiak.

[c] Catches in June.

Interannual timing of the adult runs of the other species of salmon is difficult to determine because the historical record is based largely on catch statistics alone. The Nushagak chinook run begins about June 5, reaches a peak about June 20, and continues at a low level through July. The timing of the chum salmon run is similar to the sockeye run except that chums begin a little earlier and end a little later. The pink salmon run in even-numbered years begins about mid July, peaks about July 25 and ends about August 15. The coho run begins about July 20 and peaks in early August (Nushagak) or late August (Togiak). The end of the coho run is difficult to determine because fishing usually ends by late August. Based on preliminary data from ADF&G, the timing of the 1984 runs appeared to be about average for pinks and a little earlier than average for chinook, chum and coho salmon.

Each summer as the adult salmon return to Bristol Bay, from 100 to 500 million juvenile salmon migrate seaward. The Bristol Bay smolt migrations have been sampled in the various rivers since the 1950s (by BCF, FRI and ADF&G); however, only the Kvichak sockeye salmon smolt migration has been sampled each year. The juveniles are generally thought to concentrate closer to the coast of the Alaska Peninsula than the incoming adults; therefore, juveniles may be more susceptible to impacts from possible oil spills. Straty (1974) studied the distribution of juvenile sockeye salmon by purse seine sampling and marking experiments in 1969 and 1970 (see Section 2.2.1); however, his sampling was less focused in nearshore waters and bays than that of the present study.

The main purpose of our 1984 sampling effort was to determine the relative abundance of juveniles in the nearshore waters and to compare the inshore/offshore distribution in 1984 with the offshore distribution in 1969 and 1970.

Our purse seine catches in 1984 were unexpectedly low. Whereas Hartt and Dell (1978) and Straty (1974) reported sets often taking hundreds and occasionally thousands of juveniles, our catches were usually less than 10, often zero, and only occasionally exceeded 100 juveniles. The purse seine used in 1984 was about 60 percent of the length of the seine used in 1969-1970, and was held open for only 10 minutes as opposed to 30 minutes used by Straty (U.S. National Marine Fisheries Service - NMFS, Juneau; personal communication 1985). However, the 1984 catches were much less than 20 percent (60 percent x 1/3) of Straty's 1969 and 1970 catches which for comparable stations fished in 1984 averaged over 200 juvenile sockeye per haul. The parent escapements for the sockeye salmon smolts in 1984 were somewhat larger than the escapements for the 1969 and 1970 migrations, and the sonar-sampling program by the Alaska Department of Fish and Game (ADF&G) indicated that over 400 million sockeye salmon smolts migrated to sea in 1984 (Tables 12 and 13).

To explore why our catches in 1984 were so small, we examined the smolt migration in 1984 (preliminary data provided by ADF&G) and compared the characteristics of that migration with the migrations in other years, especially with regard to the timing and stock composition of the migration.

The interannual variation in the timing of migrations (i.e., the onset) is related to spring temperatures to the extent that colder temperatures delay the migrations. Recent sockeye smolt migrations have been relatively early (except 1982). Some measurements of spring temperatures are shown in Figure 16. Conditions in 1970 and 1984 were very similar (warm), whereas conditions in 1969 were colder than average. The water temperatures in the rivers were especially warm in 1984.

The Kvichak sockeye stock, which in most years is the largest in Bristol Bay, usually migrates from Lake Iliamna in late May to early June. Variation in the annual timing of the smolt migration is associated with the spring weather and the dates of ice breakup in the upper and middle portions of the lake (Figure 17). When the lake has been clear of ice before May 10, the migrations have begun in mid-May, as in 1984 and 1970; in 1969 the migration was about 10 days later.

The Wood River (and presumably other Nushagak) sockeye smolt migrations are usually later than the east side (including Kvichak) migrations

TABLE 12

BRISTOL BAY SOCKEYE SALMON ESCAPEMENTS AND ADULT RETURNS FOR THE 1969 and 1970 SMOLT MIGRATIONS[a]

Smolt Migration Year	Lake System	Escapements (Millions) for Smolts of Age 1	Age 2	Percent Age 1 in Smolts	Adult Return (Millions)	Percent Age 1 in Return
1969	**East Side**					
	Kvichak	3.2	3.8	52	4.7	10
	Branch	0.2	0.2	--	0.3	94
	Naknek	0.8	1.0	60	1.3	55
	Egegik	0.6	0.8	--	1.4	16
	Ugashik	0.2	0.7	60	0.2	46
	Total	5.0	6.5		7.9	23
	West Side					
	Wood	0.5	1.2	91	0.7	89
	Igushik	0.3	0.2	--	0.2	89
	Nuyakuk	0.02	0.2	--	0.1	88
	Togiak	0.1	0.1	--	0.1	89
	Total	0.9	1.7		1.1	89
1970	**East Side**					
	Kvichak	2.6	3.2	38	1.0	27
	Branch	0.2	0.2	--	0.2	76
	Naknek	1.0	0.8	55	0.8	32
	Egegik	0.3	0.6	--	1.0	7
	Ugashik	0.1	0.2	58	0.1	25
	Total	4.2	5.0		3.1	25
	West Side					
	Wood	0.6	0.5	98	0.8	87
	Igushik	0.2	0.3	--	0.2	87
	Nuyakuk	0.1	0.02	--	0.2	96
	Togiak	0.1	0.1	--	0.2	80
	Total	1.0	0.9		1.4	

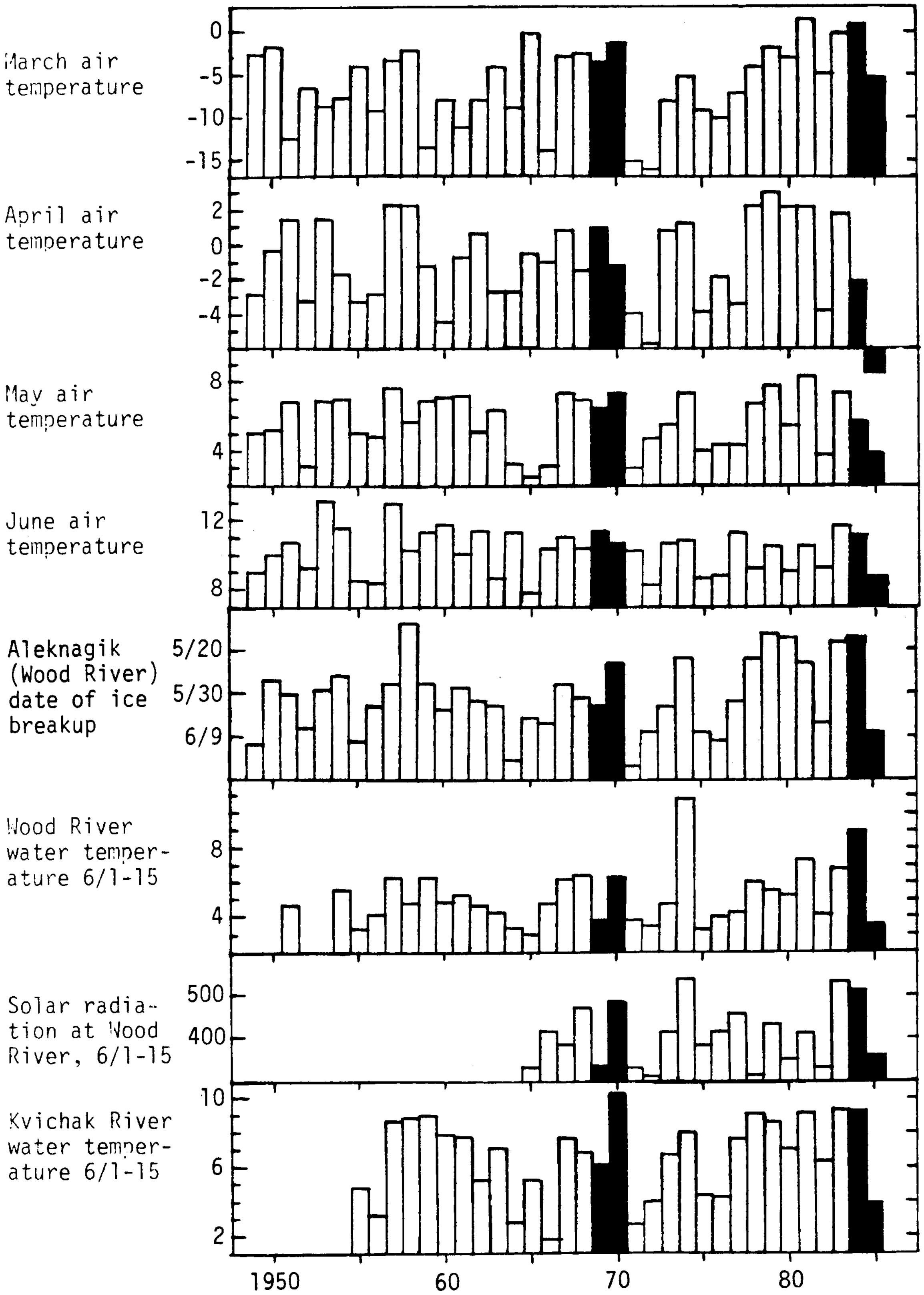
[a] Source: ADF&G, unpublished statistics

TABLE 13

BRISTOL BAY SOCKEYE SALMON ESCAPEMENTS FOR THE 1984 and 1985 SMOLT MIGRATIONS[a]

Smolt Migration Year	Lake System	Escapements (Millions) for Smolts of Age 1	Age 2	Number Migration (Millions)	Percent Age 1 in Migration
1984	East Side				
	Kvichak	1.1	1.8	90	58
	Branch	0.2	0.1	--	--
	Naknek	1.2	1.8	81	40
	Egegik	1.0	0.7	49	35
	Ugashik	1.2	1.3	158	48
	Total	4.7	5.7	378+	47
	West Side				
	Wood	1.0	1.2	24	94
	Igushik	0.4	0.6	--	--
	Nuyakuk	0.5	0.8	6	99
	Togiak	0.2	0.2	--	--
	Total	2.1	2.8		
1985	East Side				
	Kvichak	3.6	1.1		
	Branch	0.1	0.2		
	Naknek	0.9	1.2		
	Egegik	0.8	1.0		
	Ugashik	0.1	1.2		
	Total	6.4	4.7		
	West Side				
	Wood	1.4	1.0		
	Igushik	0.2	0.4		
	Nuyakuk	0.3	0.5		
	Togiak	0.2	0.2		
	Total	2.1	2.1		

[a] Source: ADF&G, unpublished statistics

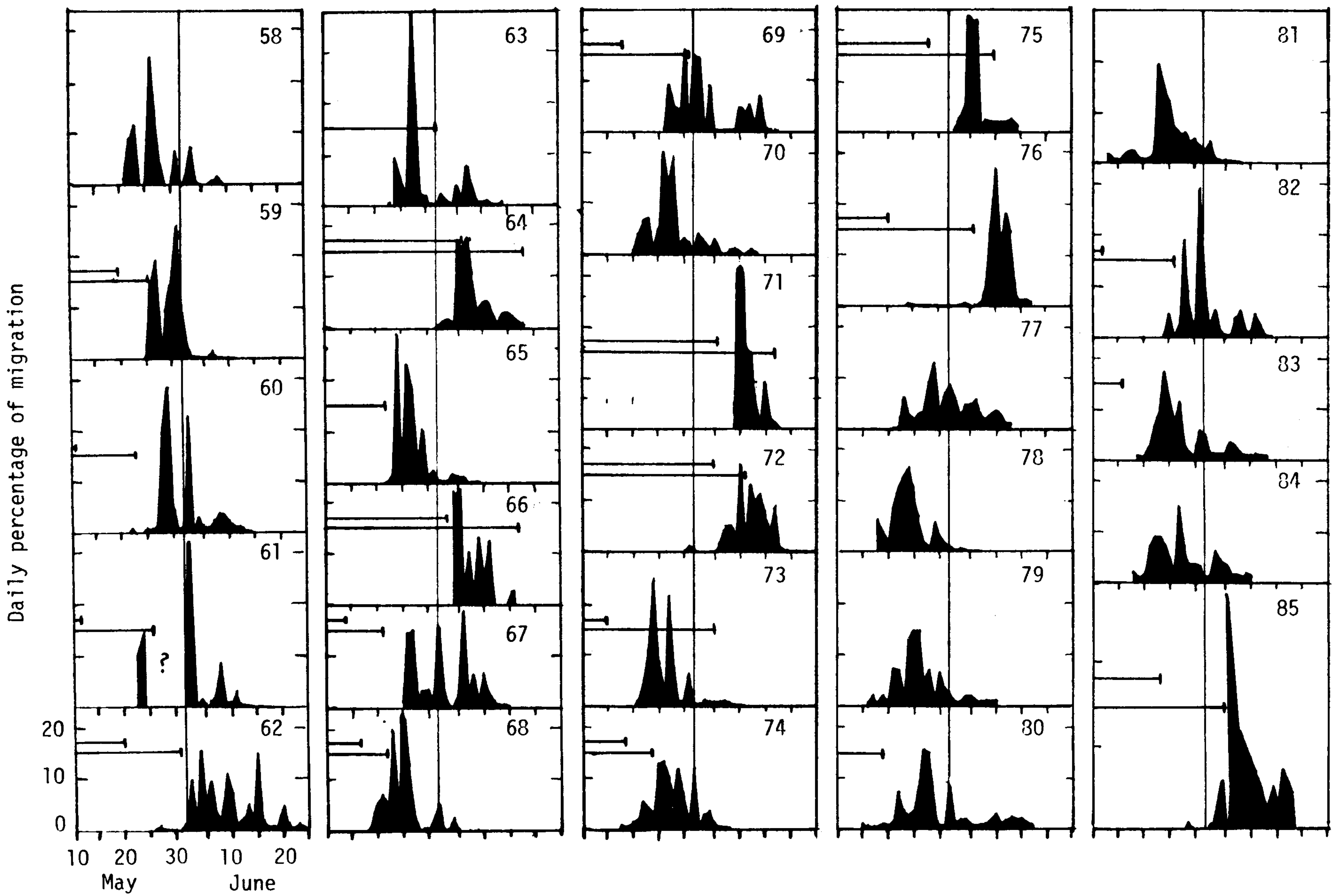


Comparisons of Spring Weather Conditions in Bristol Bay for 1969-70 and 1984-85 Smolt Migrations

(Source: FRI and ADF&G unpublished data: US Weather Bureau statistics.)

Dames & Moore

Figure 16



Timing of Kvichak Sockeye Smolt Migrations. Daily Percentage of Total Migration
Vertical line at 1 June. Horizontal lines indicate ice on upper and lower lake.
(Source: FRI and ADF&G, unpublished data.)

Dames & Moore

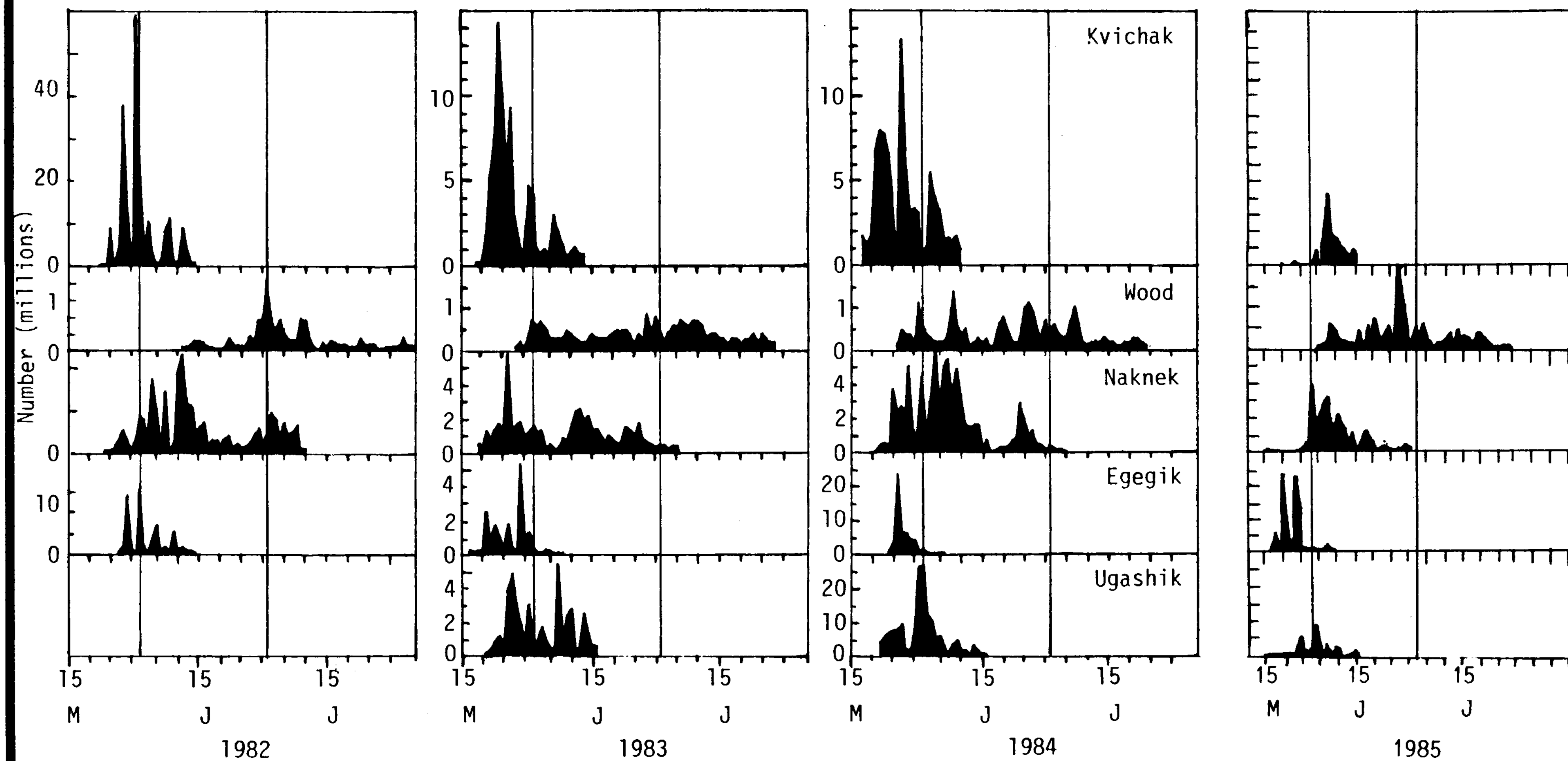
Figure 17

because ice breakup is later (Figure 18). The outmigrations from the Wood River and Naknek systems tend to be more prolonged than those from many systems because these are multi-lake systems.

Sockeye salmon juveniles can travel at sustained rates of 1 to 2 body lengths (b.l.) per second (Hoar and Randall 1978) or about 10 km per day for typical Bristol Bay smolts. Although precise migration speeds through Bristol Bay are unknown, the marking experiments by Straty (1974) indicated that a speed of 1 b.l./sec was certainly possible (Figure 19). Juveniles may slow their migration in outer Bristol Bay as indicated by the recovery of three marked Ugashik sockeye at Port Moller in mid-September 1970. At a constant migration speed of 1 b.l./sec these marked juveniles would have been well beyond Port Moller by mid-September.

The timing of past juvenile sockeye migrations at Port Heiden was examined with an assumed travel rate of 1 b.l./sec and nearly linear migration routes from the lake outlets. Ugashik (and presumably Egegik) juveniles hardly overlapped the distribution of Kvichak or Wood River fish; the distributions of these stocks only overlapped significantly in 1962 (Figure 20).

There was an exceptionally large migration from Ugashik and a rather small migration from Wood River in 1984 (Tables 14 and 15). The projected timing of the 1984 Bristol Bay sockeye salmon juvenile migration at Port Heiden is depicted in Figure 21. In this projection, the number of Wood River smolts was doubled to provide an estimate for smolts from the entire Nushagak District, and the timing was estimated assuming a migration rate of 10 km/day as well as 1 b.l./sec. Since our sampling did not begin until about the first of July it is likely that we missed most of the Ugashik and Egegik migrations in 1984. The estimated migrations in 1982 and 1983 are shown for comparisons in Figures 22 and 23. Clearly the distribution of juveniles can vary considerably from year to year depending on the magnitudes of the stocks, the size of the smolts and spring weather.

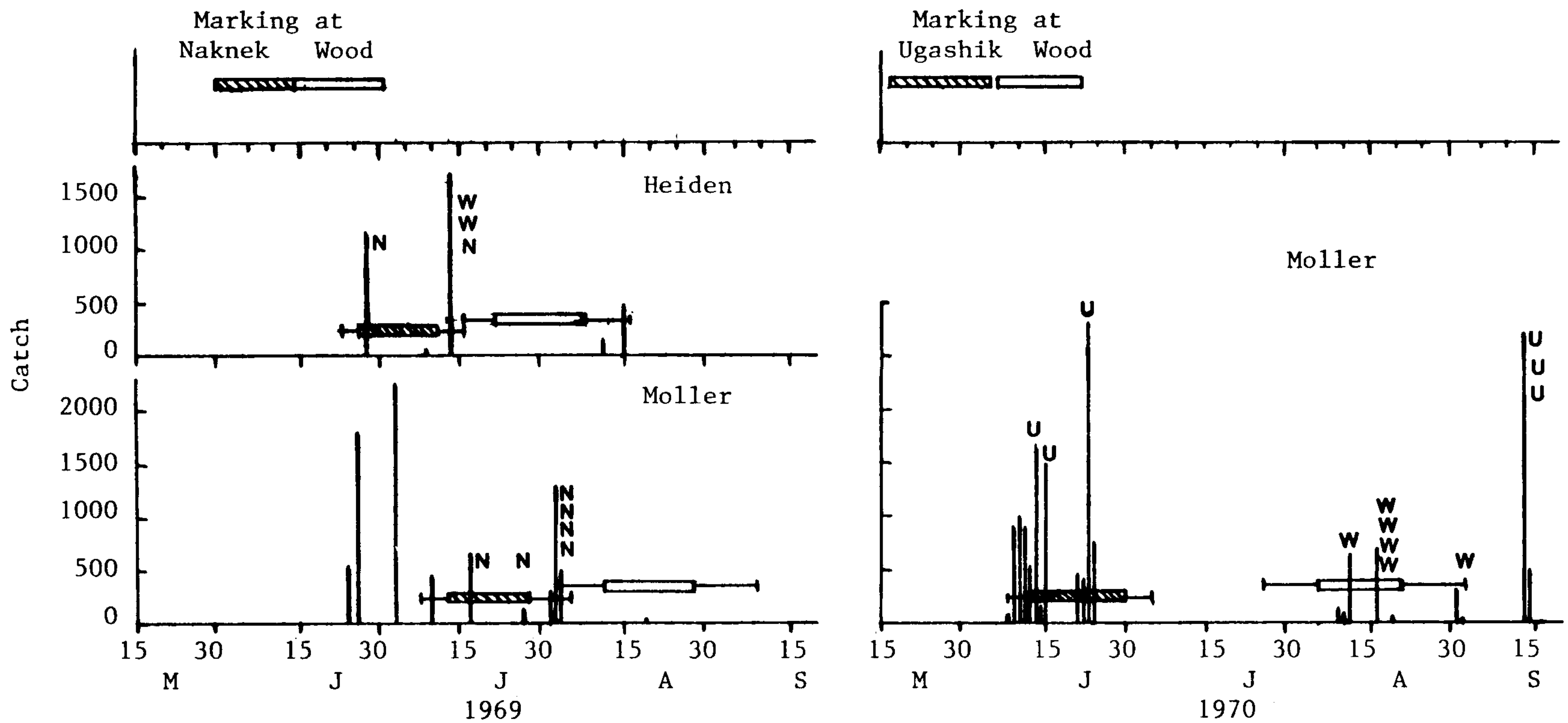


Daily Sockeye Salmon Smolt Migrations from Bristol Bay Lake Systems, 1982–1985

Vertical lines at June 1 and July 1. (Source: FRI and ADF&G, unpublished data.)

Dames & Moore

Figure 18

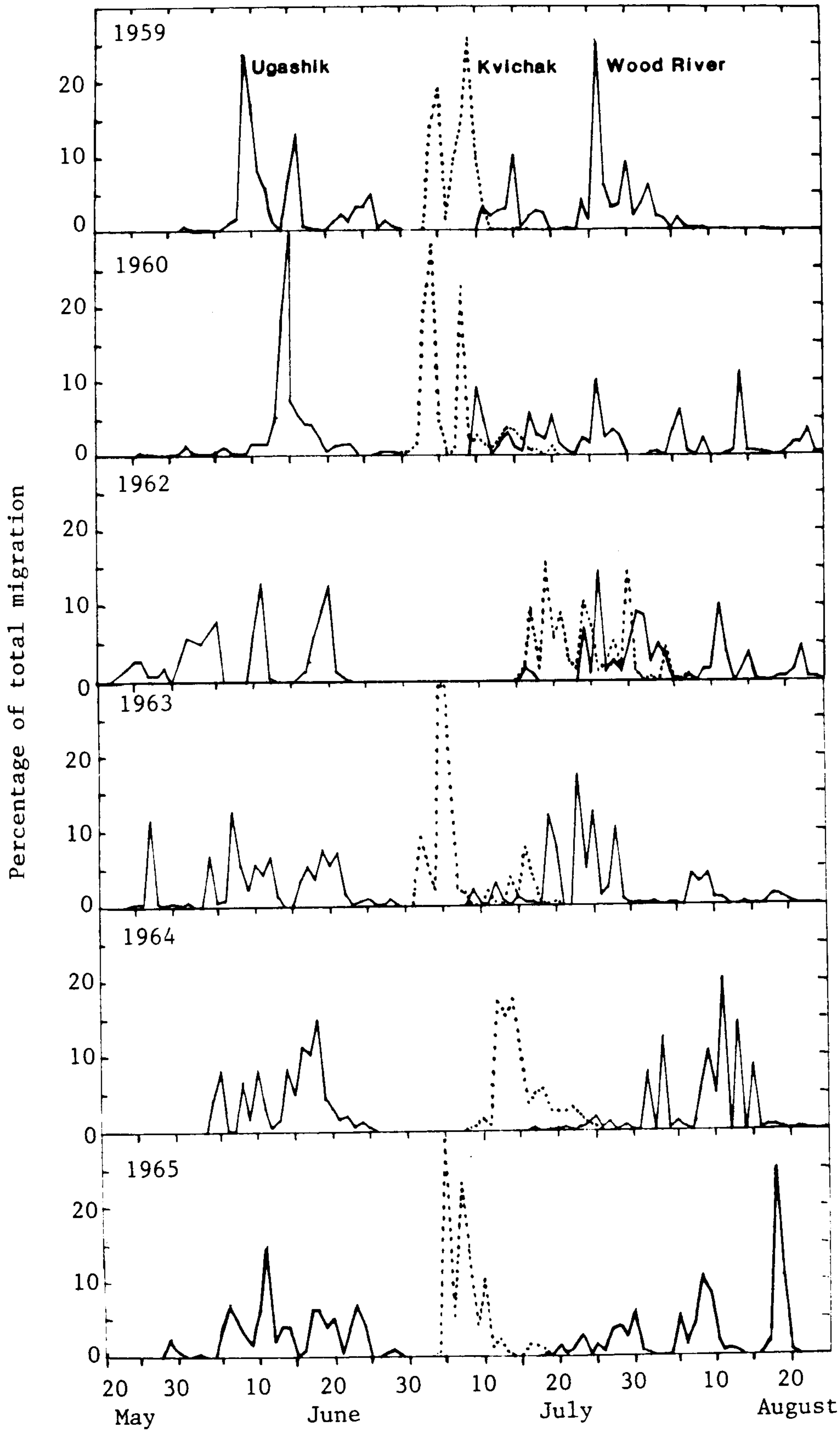


Periods of Sockeye Smolt Marking and Recovery of Marked Juveniles off Port Heiden and Port Moller Relative to the Number of Juveniles Caught and the Expected Migration Timing at One Body Length Per Second

(Horizontal bar and lines indicate expected time of arrival for fish of typical mean length and full size range, respectively.) (Source: Straty 1974, and Bureau of Commercial Fisheries catch statistics provided by H. Jaenicke).

Figure 19

Dames & Moore



Predicted Timing of Ugashik, Kvichak, and Wood River Sockeye Juveniles off Port Heiden Based on a Migration Rate of One Body Length Per Second, and Fyke Net Sampling at the Lake System Outlets, 1959-60 and 1962-65

(Source: FRI, Bureau of Commercial Fisheries, and ADF&G, unpublished statistics.)

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TABLE 14

BRISTOL BAY SOCKEYE SALMON SMOLT MIGRATION, 1984[a]

Lake system	Age I			Age II			Parent escapement (millions)	
	Number (millions)	Mean length (mm)	Mean wt. (g)	Number (millions)	Mean length (mm)	Mean wt. (g)	Age I (1982)	Age II (1981)
Kvichak	51.9	90.2	6.8	37.6	103.7	10.0	1.1	1.8
Naknek	32.1	97.0	8.8	48.8	107.7	11.4	1.2	1.8
Egegik	17.2	105.8	10.1	32.2	112.5	12.2	1.0	0.7
Ugashik	75.5	87.2	6.8	82.7	101.6	10.3	1.2	1.3
Wood	22.2	92.3	7.8	1.4	96.8	8.7	1.0	1.2
Nuyakuk	6.3	81.1	4.9	0.1	92.6	7.3	0.5	0.8
Igushik	--			--			0.4	0.6
Togiak	--			--			0.2	0.2

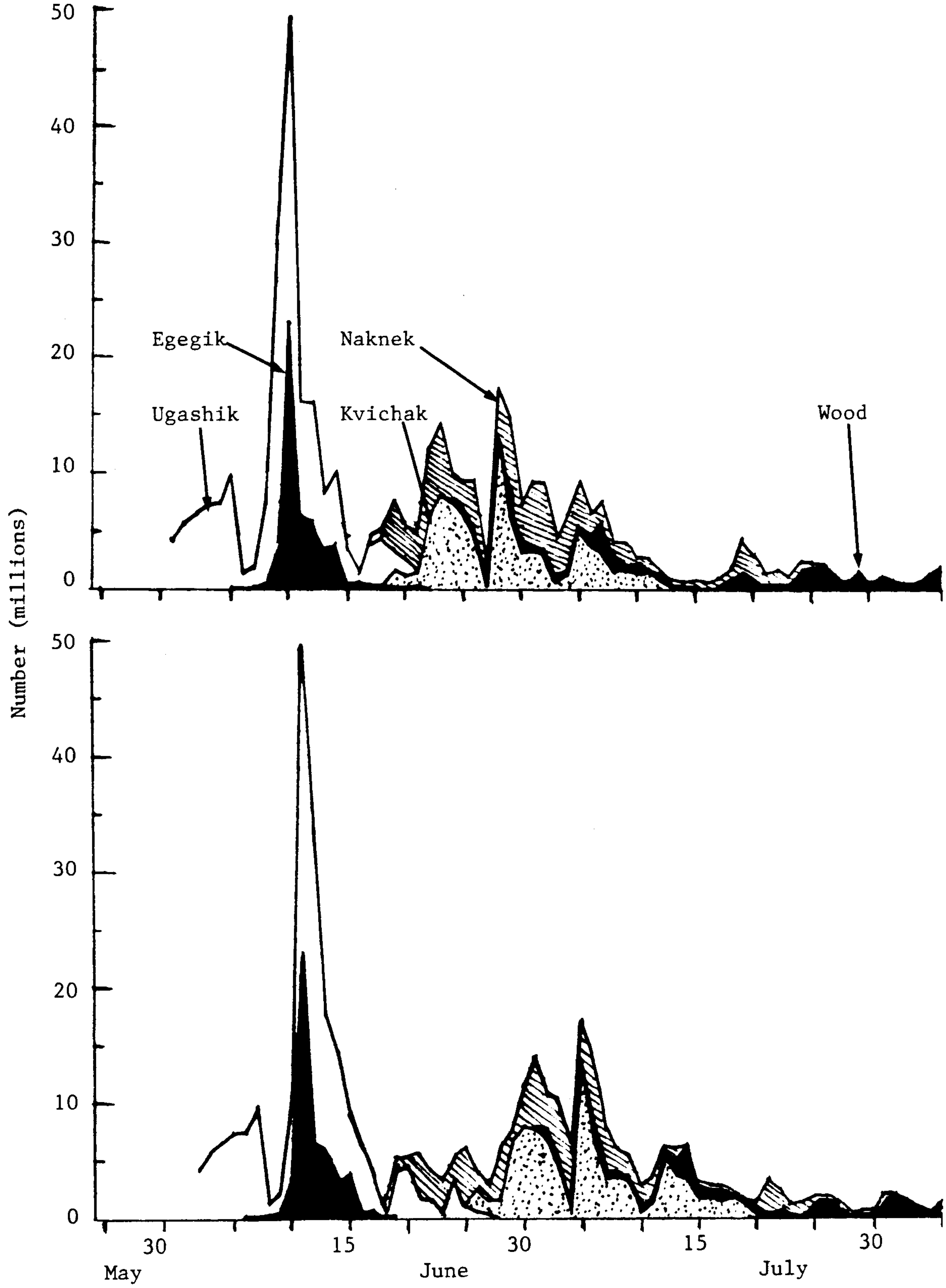
[a] Source: H. Yuen, ADF&G, Anchorage

TABLE 15

BRISTOL BAY SOCKEYE SALMON SMOLT PRODUCTION BY BROOD YEAR, 1979-82[a]

Lake system	Brood year	Escape. (millions)	Number of smolts (millions)			Smolts/escape.
			Age I	Age II	Total	
Kvichak	1979	11.2	163.0	81.1	244.1	22
	80	22.5	122.9	76.2	199.1	9
	81	1.8	6.5	37.6	44.1	24
	82	1.1	51.9	--	--	--
	83	3.6	--	--	--	--
Naknek	1979	0.9	--	12.9	--	--
	80	2.6	115.6	16.5	132.1	51
	81	1.8	36.8	48.8	85.6	48
	82	1.2	32.1	--	--	--
	83	0.9	--	--	--	--
Egegik	1979	1.0	--	14.3	--	--
	80	1.1	49.5	16.5	66.0	60
	81	0.7	2.2	32.2	34.4	49
	82	1.0	17.2	--	--	--
	83	0.8	--	--	--	--
Ugashik	1979	1.7	--	--	--	--
	80	3.3	--	12.7	--	--
	81	1.3	31.3	82.7	114.0	88
	82	1.2	75.5	--	--	--
	83	1.0	--	--	--	--
Wood	1979	1.7	64.3	4.7	69.0	41
	80	3.0	32.4	4.1	36.5	12
	81	1.2	19.6	1.4	21.0	18
	82	1.0	22.3	--	--	(23)
	83	1.4	--	--	--	--

[a] Source: ADF&G unpublished statistics.



Predicted Timing of the Sockeye Juvenile Migration at Port Heiden in 1984 Based on Migration Rates of 10 km per day (top) and One Body Length Per Second (bottom)

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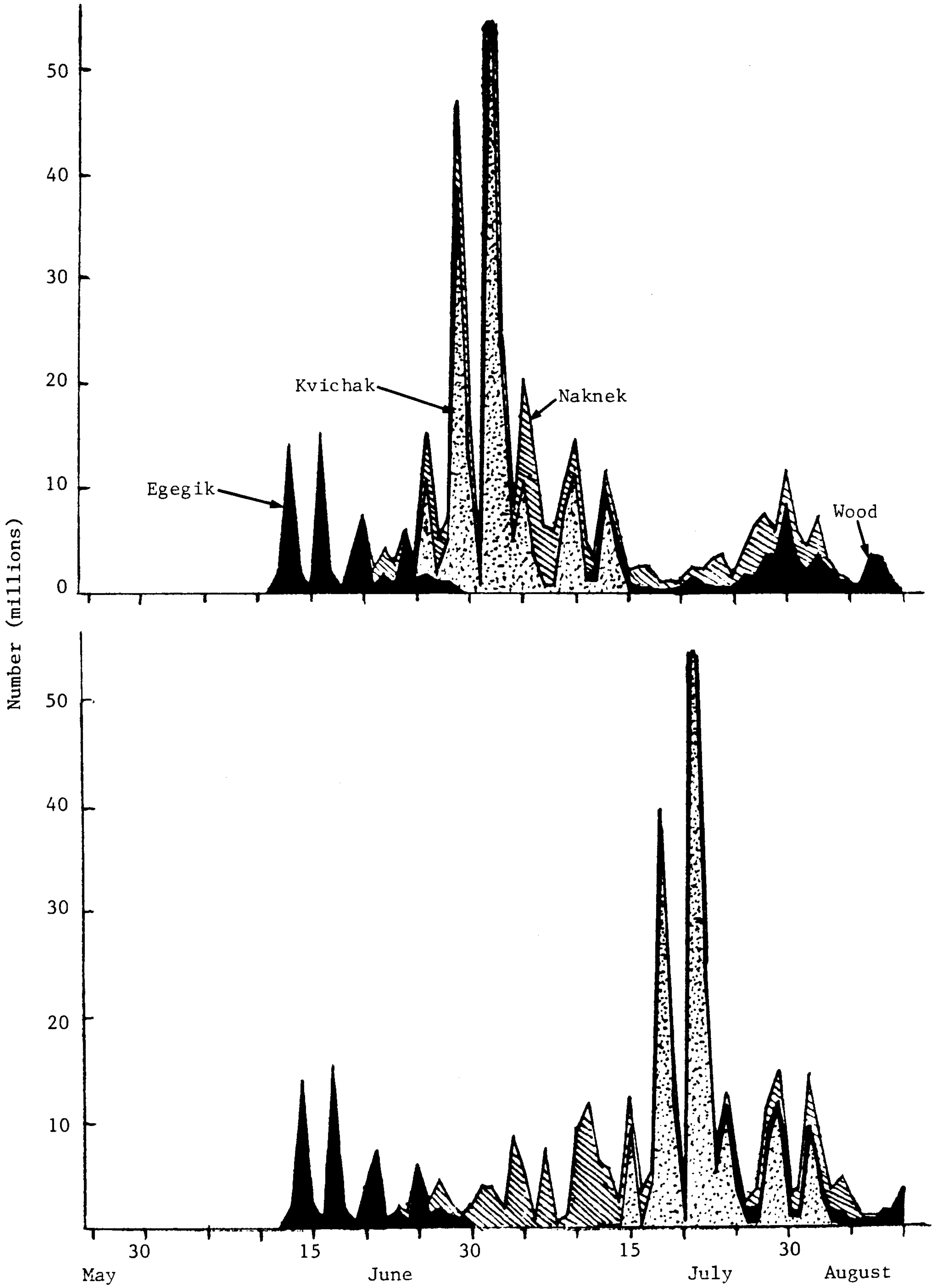
Figure 21



Predicted Timing of the Sockeye Juvenile Migration at Port Heiden in 1982 Based on Migration Rates of 10 km per day (top) and One Body Length Per Second (bottom)

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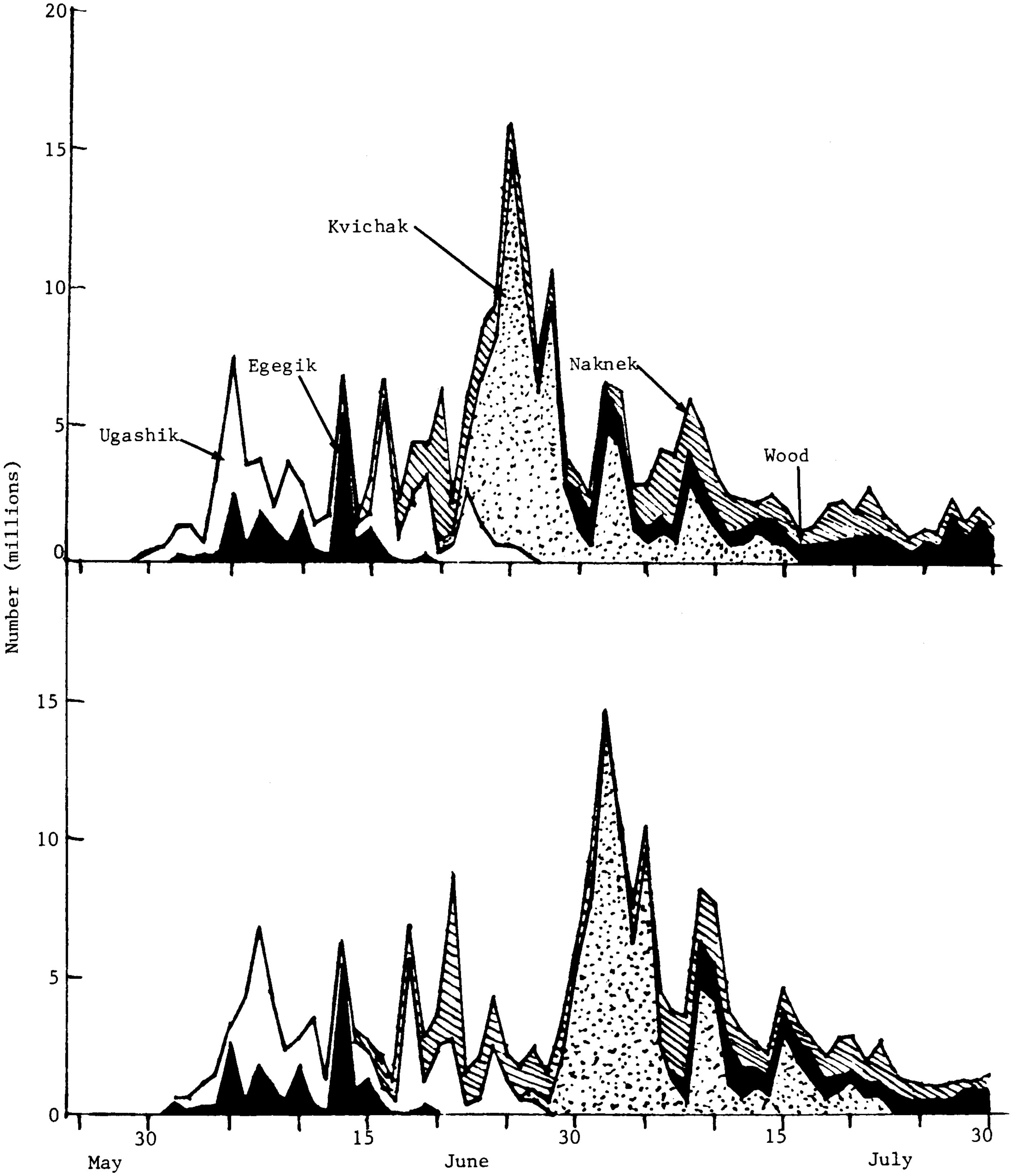
Figure 22



Predicted Timing of the Sockeye Juvenile Migration at Port Heiden in 1983 Based on Migration Rates of 10 km per day (top) and One Body Length Per Second (bottom)

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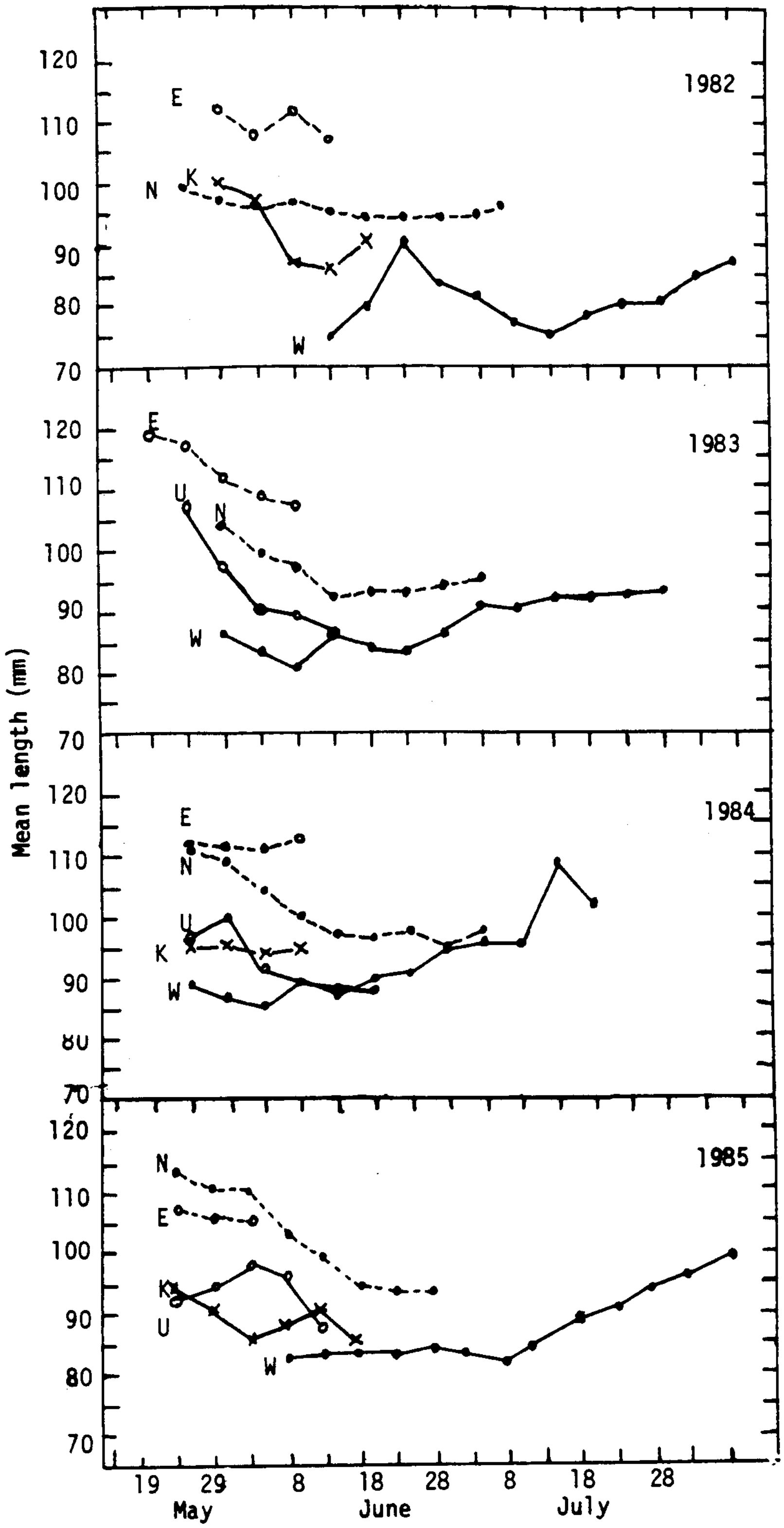
The 1984 Wood River smolts were the largest (average length 92.3 mm) observed for that system since 1951; they typically average only 80 to 85 mm and are usually the smallest smolts migrating from Bristol Bay. Smolts from Egegik (Lake Becharof) are usually the largest in Bristol Bay, and this was the case in 1984 (Figure 24).

Most of the juvenile sockeye salmon in 1984 were probably beyond our sampling area after the first cruise (e.g., by late July) and most of those that were present (e.g., Cruise 2) were probably from the Nushagak District. Juvenile chum salmon, which are smaller (3-4 cm) than sockeye salmon at migration and come predominantly from the Nushagak River, were likely the most abundant salmonid in the outer Bay after the first of August (Table 16). Juvenile chum salmon were co-dominant with the sockeye in the second cruise (Figure 8). The lack of catches beyond Port Moller in early September may indicate that most of the Nushagak chum salmon had not yet arrived there by that time or that fish had moved off shore by this time.

A second hypothesis (not at all mutually exclusive with the first, as discussed above) considered to explain our relatively low catches of juvenile salmonids in nearshore sampling, compared with catches by Hartt and Dell (1978) and Straty (1974) offshore, was that these fish simply do not use the nearshore zone to the degree that they use offshore waters. Various accounts of early marine life history of juvenile salmon have indicated movements generally following shorelines (e.g., Bax et al. 1980, Dames & Moore 1983). As fish increase in size, there is a known tendency to move to deeper waters, and species migrating as larger juveniles (e.g., chinook and coho) tend to favor deeper or more open water habitats (e.g., Simenstad et al. 1982). Simenstad et al. (p. 352) observe that, in Puget Sound, sockeye juveniles "move directly in neritic habitats and show no affinity for nearshore habitats." In our study area the dynamic nature of the coastline, with its wave action and wave-generated turbidity, may reduce the desirability of nearshore habitats to the point where even smaller juvenile salmonids move farther



Mean Lengths of Sockeye Salmon Smolts by 5-day Periods in Migrations from Egegik (E), Kvichak (K), Naknek (N), Ugashik (U), and Wood River(W) Lake Systems, 1982-1985

Dames & Moore

Figure 24

TABLE 16

MEAN PURSE SEINE CATCHES OF JUVENILE SALMON BY LOCATION AND DATE OF SAMPLING AND THE ESTIMATED ABUNDANCE OF SOCKEYE SALMON ASSUMING TWO RATES OF TRAVEL

Cruise	Sampling location		Date	No. of hauls	Mean standard catch			Sockeye abundance[b]	
					Sockeye	Chum	Total[a]	A	B
I	Transect	1		0	--	--	--	--	--
	(Heiden)	2	7/3	4	0.9	0	31.7	4	10
		3	7/1	4	2.2	0	2.2	14	6
	(Moller)	4	6/29	6	3.6	0	3.8	10	18
			7/1	1	2.9	0	2.9	2	9
		5	7/15	4	0.2	0.4	0.6	5	6
	(Izembek)	6		0	--	--	--	--	--
II	Transect	1	7/27	6	10.8	0	10.8	1	2
	(Heiden)	2		0	--	--	--	--	--
		3	8/2-3	6	13.3	16.1	32.1	2	1
	(Moller)	4	8/12	6	0.5	0	2.7	1	2
		5	8/5	5	0.8	0	0.8	2	7
	(Izembek)	6	8/10	6	0.1	0	1.3	3	6
III	Transect	1	9/12	4	1.5	27.1	27.1	≤ 2	≤ 2
	(Heiden)	2	9/11	6	0.6	1.7	2.4	≤ 2	≤ 2
		3	9/8	4	0	0.8	1.2	≤ 2	≤ 2
	(Moller)	4	9/4	4	0	1.2	1.7	≤ 2	≤ 2
		5	9/2	2	0	0	0	≤ 2	≤ 2
	(Izembek)	6	9/2	3	0	0	0	≤ 2	≤ 2

[a] Total includes coho, pinks and chinook (mostly coho)

[b] Number in millions assuming travel rates of 10 km/day (A) and 1 body length/sec (B)

offshore soon after leaving their home estuary. It may also be that the unusually rough weather during the 1984 sampling period could have increased the tendency to use more offshore habitats. This distributional pattern was suggested in our Cruise 2 (late July to mid-August, 1984) purse seine results (Tables 6 through 8), but did not hold for all species in the 1985 results (Section 4.3). Our trend of diminishing purse seine catches with distance down the peninsula (which did hold in 1985) could also be symptomatic of an increasing tendency, with time in the marine environment, tor juvenile salmon to move offshore.

Examination of 1966 and 1968 catches of sockeye and chum juveniles, broken down from raw data of Hartt and Dell (1978) in Appendix F, reveals a shift in peak catches from their stations closest to shore to mid-bay station in September (contrast Appendix F, Figures F-7 and F-8; F-15 and F-16). Thus, the tendency to abandon the nearshore areas may become more pronounced later in the summer as fish size increases.

4.3 SALMONIDS - 1985

Initiation of sampling in 1985 was timed to coincide with the beginning of smolt outmigrations from Bristol Bay river systems, which was relatively late due to cold spring temperatures. Sampling began off Port Moller on June 16 and continued up-bay to intercept the peak in abundance of early-migrating smolts from Egegik and Ugashik rivers. We reversed direction at Ugashik and worked back and forth over the study area as many times as weather and time allowed, averaging 1 transect each 2.5 days. The survey was concluded on July 28 at Ugashik.

4.3.1 General Catch Patterns

Catches in the study area in 1985 confirmed that large numbers of salmonids seasonally inhabit the nearshore waters of the North Aleutian Shelf (e.g., inshore of 10 nautical miles). Juveniles of all five species of Pacific salmon, as well as adult sockeye, chum, pink, and Dolly Varden were taken by the various gear employed. Of the 15,619 juvenile salmonids captured (Table 17), sockeye was the most abundant species (59.2 percent), followed by chum (32.9 percent), pink (6.1 percent),

TABLE 17

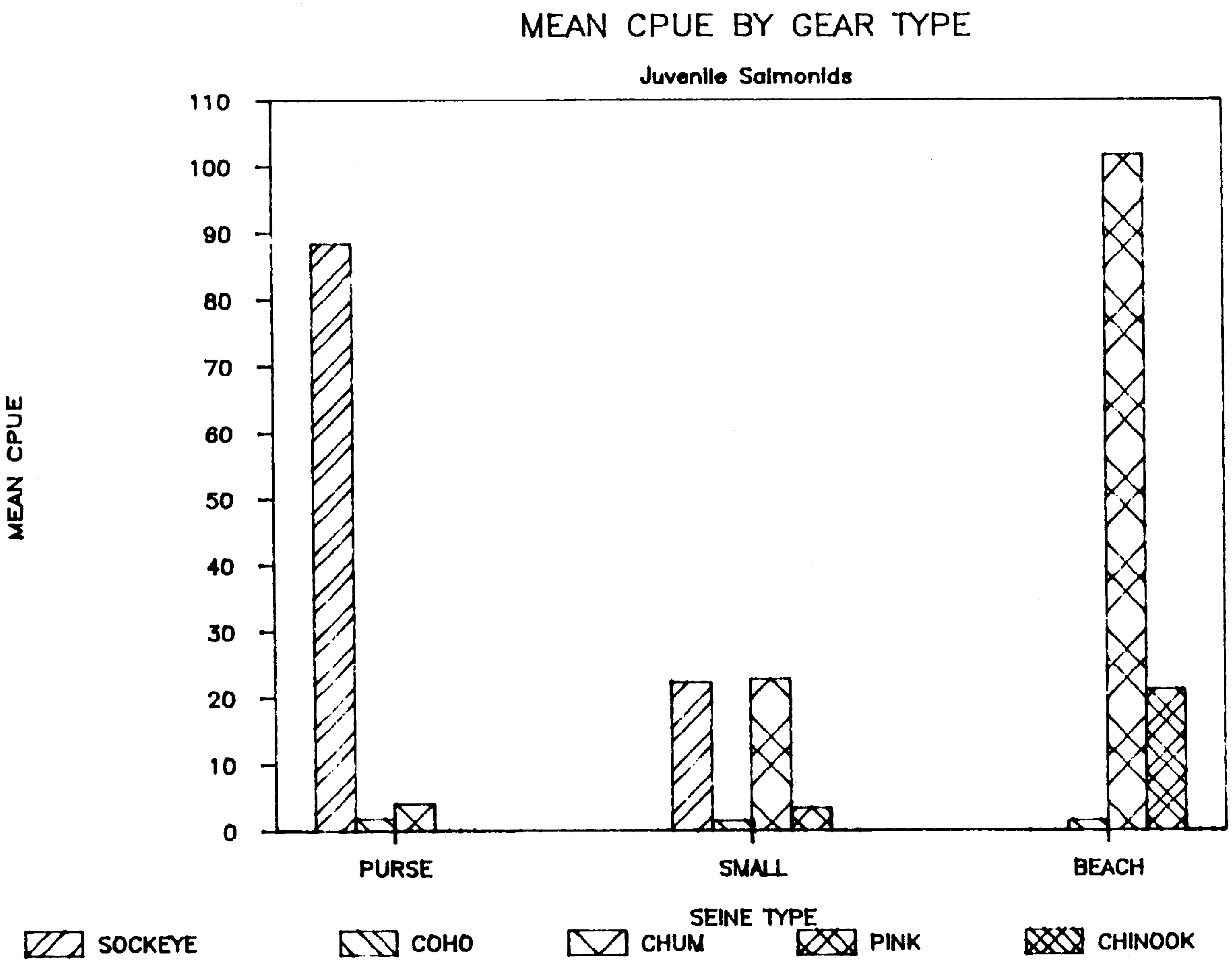
CATCHES OF JUVENILE SALMON BY GEAR TYPE IN 1985

GEAR	SETS	NUMBERS CAUGHT					TOTAL
		SOCKEYE	COHO	CHUM	PINK	CHINOOK	
PURSE SEINE	97	8,498	178	403	5	2	9,084
SMALL SEINE	34	738	52	758	115	2	1,665
BEACH SEINE	41	5	61	3,970	832	2	4,870

coho (1.9 percent), and chinook (0.04 percent). Mean CPUE for all gear types combined was highest for sockeye (54.1), followed by chum (30.5), pink (5.7), coho (1.7), and chinook (0.04). However, mean CPUE for each species was strongly gear dependent (Figure 25).

To the extent that it reflects actual species distributions, the pattern of catch by gear type suggests marked habitat affinities for most species (Figure 26). While juvenile sockeye were most ubiquitous in the study area and were taken in nearly all transect/gear combinations, catches described a generally offshore distribution, with comparatively little use of estuarine or littoral habitats. Coho juveniles were taken commonly, but not consistently, in nearshore and estuarine habitats throughout the survey period. They were present in equal abundance inside estuaries and offshore within 5.0 nm of shore. Pink and chum salmon juveniles were restricted largely to intertidal habitats, although movement offshore was detected late in the survey period. Their distributions showed the high degree of spatial overlap typical of these two species. Since only six juvenile chinook were captured by all gears during the survey, we hesitate to make inferences about habitat use by this species. Habitat used by all species is most probably a function of fish size and, therefore, time of sampling.

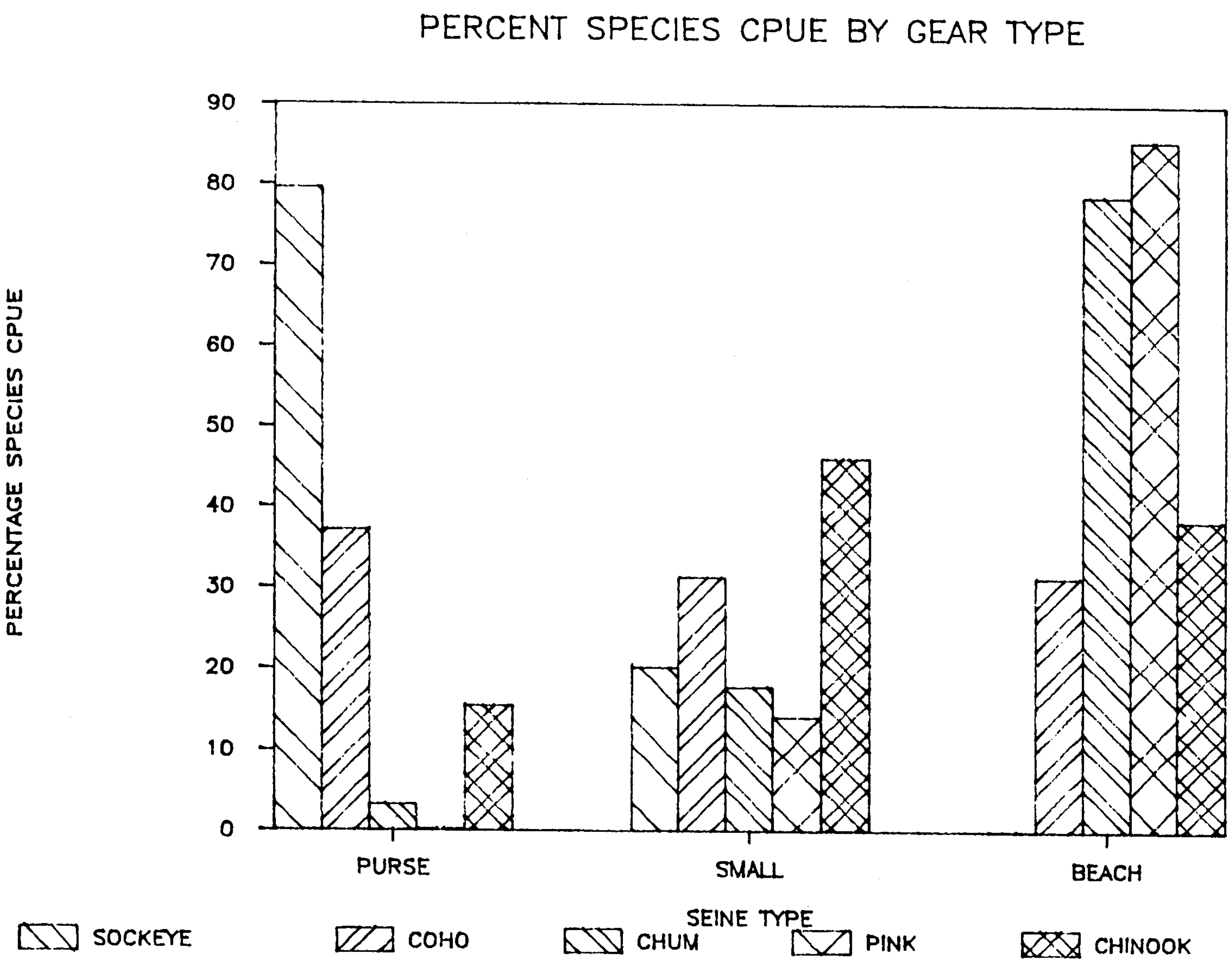
Adult sockeye, chum, pink, and Dolly Varden were taken mainly in offshore purse seine sets, but a few adult chums and Dolly Varden also were caught inside Port Moller. Largest catches of adult sockeye were taken at stations on the Ugashik transect near the terminal fishing grounds, and a relatively large catch of adult chums was taken in the small seine inside Herendeen Bay. Since the distributions and relative abundances of adult salmon in fishing districts within the study area are documented quite well by ADF&G commercial catch records, our catches of adults were considered to be incidental to the survey objectives. However, stomach samples removed from adult sockeye taken at the Ugashik transect on two separate occasions revealed intensive feeding activity much farther into inner Bristol Bay than expected.



1985 Juvenile Salmon Mean Catch By Gear Type

Dames & Moore

Figure 25



1985 Juvenile Salmon Percentage Catch By Gear Type

Dames & Moore

Figure 26

4.3.2 Adult Salmonids

Catches of adult salmonids in any gear were so infrequent that no attempt has been made to discern trends. This is not to say that adults were not abundant in the study area. A breakdown of 1985 commercial catches and escapements of all species in the study area by ADF&G statistical sub-area is provided in Table 18. Nearly 4.6 million adult salmon of all species returned to natal streams or were caught within the NAS study area in 1985. The distribution of abundance of locally produced adult salmon was centered around Port Moller and Bear River (the Ilnik/Three Hills fishery is suspected to intercept sockeye of Bristol Bay origin). Substantial escapements of all species again point to the importance of the Port Moller vicinity as a center of production of salmonids on the north side of the Alaska Peninsula. A chum salmon stock of moderate size apparently utilizes Izembek Lagoon, judging from catches up to 300,000 and escapements of nearly 450,000 in the years since 1977 (see Appendix J for a summary of North Peninsula fishery statistics).

One of the more significant results of adult salmon catches in the large seine is the fact that sockeye salmon were found to be feeding within inner Bristol Bay. Stomachs of five sockeye sampled from catches on June 14 and July 20 at the Ugashik transect were filled to capacity with freshly consumed euphausiids. Many fishery biologists have in the past tacitly assumed that feeding ceases in maturing Bristol Bay sockeye as they enter the outer approaches to the Bay (cf., Straty and Jaenicke 1980). Our data show that sockeye continue to feed aggressively in the inner Bay to at least Ugashik. The ultimate destination of adults feeding at this location is not known.

4.3.3 Juvenile Salmon

4.3.3.1 Sockeye Salmon

The large purse seine was by far the most effective gear for catching juvenile sockeye salmon. Mean CPUE for the entire 1985 survey

TABLE 18

PRELIMINARY ADF&G ESTIMATES OF ESCAPEMENTS (TOP NUMBER) AND COMMERCIAL CATCHES OF ADULT SALMON WITHIN THE NAS STUDY AREA IN 1985 (SOURCE: A. SHAUL, AREA MANAGEMENT BIOLOGIST)

LOCATION	SOCKEYE	CHUM	COHO	CHINOOK	PINK	TOTAL
CINDER	12600	3200	13300	700	0	29500
RIVER	400	0	13500	0	0	13900
PORT	45500	26500	40000	4700	0	116700
HEIDEN	5100	0	13400	4400	0	22900
ILNIK/	22700	200	35000	0	0	57900
3 HILLS	978700	87300	3100	1700	0	1070800
BEAR	451500	5200	0	1200	0	457900
RIVER	823100	68000	16200	4800	800	913723
NELSON	314800	13000	18000	3200	0	349000
LAGOON	700000	6700	90200	10900	700	808500
HERENDEEN	700	71700	0	0	0	72400
PT. MOLLER	4900	262000	4900	1800	100	273700
BLACK	3700	4100	0	3200	0	11000
HILLS	0	0	0	0	0	0
IZEMBEK	17200	194700	0	0	0	211900
LAGOON	6200	126600	0	0	0	132800
BECHEVIN	200	21900	0	0	1400	23500
BAY	0	0	26700	0	1900	28600
TOTAL	3387300	891100	274000	36600	4900	4593900

(adjusted to 10.0 min sets) was 79.7 sockeye/set of the large seine, compared to 22.4 for the small purse seine and 0.1 for the beach seine. Aside from a few rather large catches in the small seine which indicated the presence of juvenile sockeye inside Herendeen Bay, the small seine and beach seine catch data described infrequent utilization of estuarine and littoral habitats. The following discussion therefore is limited to results of the offshore component of the survey.

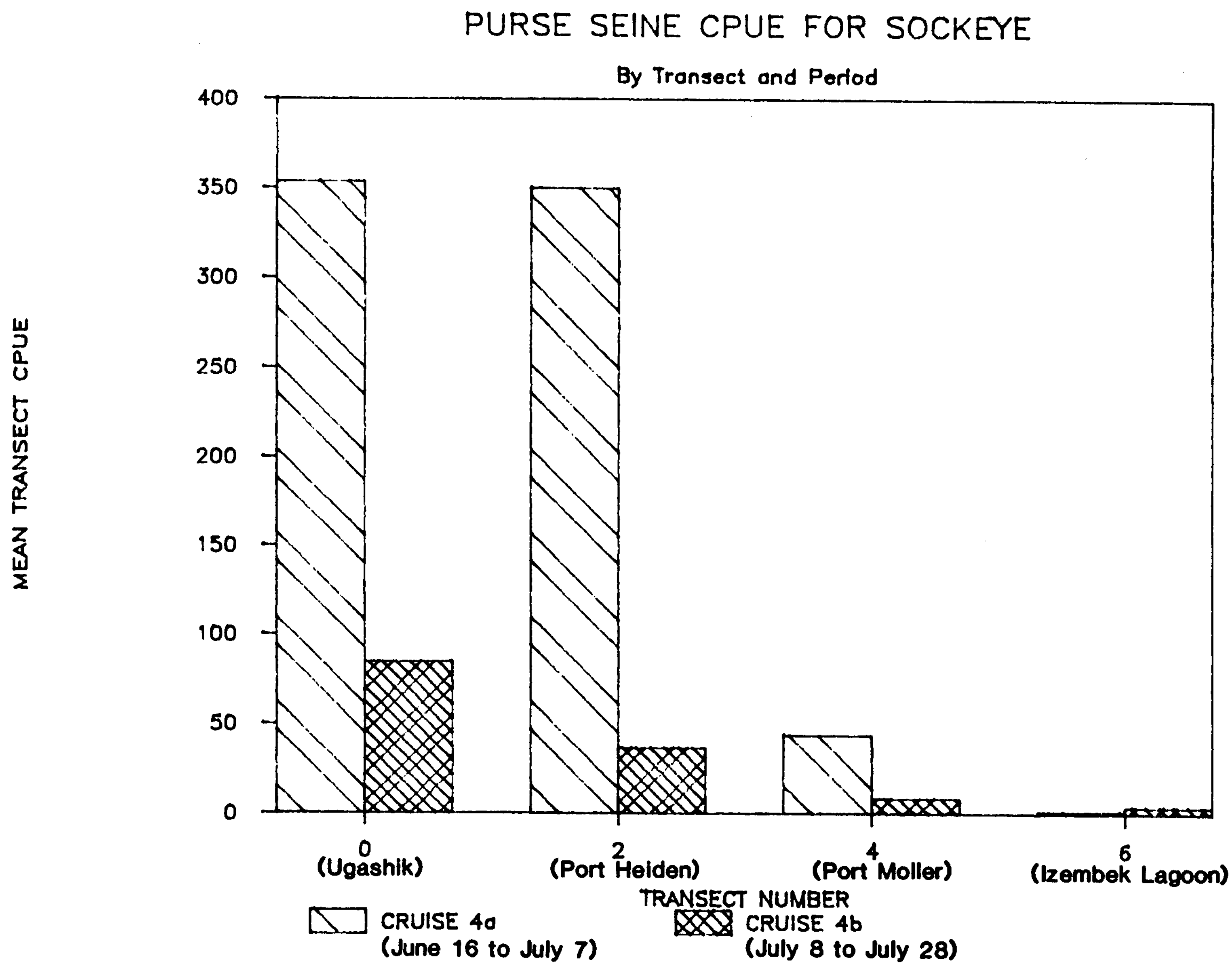
Strong trends in sockeye abundance were apparent in the purse seine catch data (Table 19). Mean CPUE of all sets declined with increasing time and distance from inner Bristol Bay (Figure 27). Highest mean CPUE was recorded in Cruise 4a (June 16 to July 7) at Ugashik, with slightly lower CPUE for sets at Port Heiden 2 days later, and much lower CPUE at Port Moller 3 days hence. Peak CPUE for Port Moller sets was recorded 6 days later on July 2, which may reflect the arrival of early juveniles from inner bay transects. The pattern of CPUE shown in Figure 27 suggests that peak densities of juvenile sockeye had not reached Port Moller by the beginning of sampling on June 16, but were enroute somewhere between there and Port Heiden.

The reconstructed time series of CPUE (Figure 28) was highly correlated with the time series of estimated total sockeye abundance at the Ugashik transect. Mean transect CPUE at each transect was expanded and lagged back in time to the approximate date that fish in the catches would have passed Ugashik. Expansions were based on tag recovery data (Figure 19; also Jaenicke, unpublished data) that showed an exponential decline in tag density with distance from release (Figure 29). Travel times were estimated to be 10 days from Ugashik to Port Heiden, 27 days from Ugashik to Port Moller, and 44 days from Ugashik to Izembek Lagoon, based on an average body length of 9 cm and an assumed average daily swimming speed of 1 b.l./sec (see Section 4.2.7). The resulting pattern of CPUE shown in Figure 28 closely resembles the pattern of daily juvenile abundance at Ugashik calculated by assuming smolts enumerated at the five major river systems migrate at an average swimming speed of 1 b.l./sec (Figure 30).

TABLE 19

SUMMARY OF CRUISE 4 PURSE SEINE CATCHES OF JUVENILE SOCKEYE SALMON

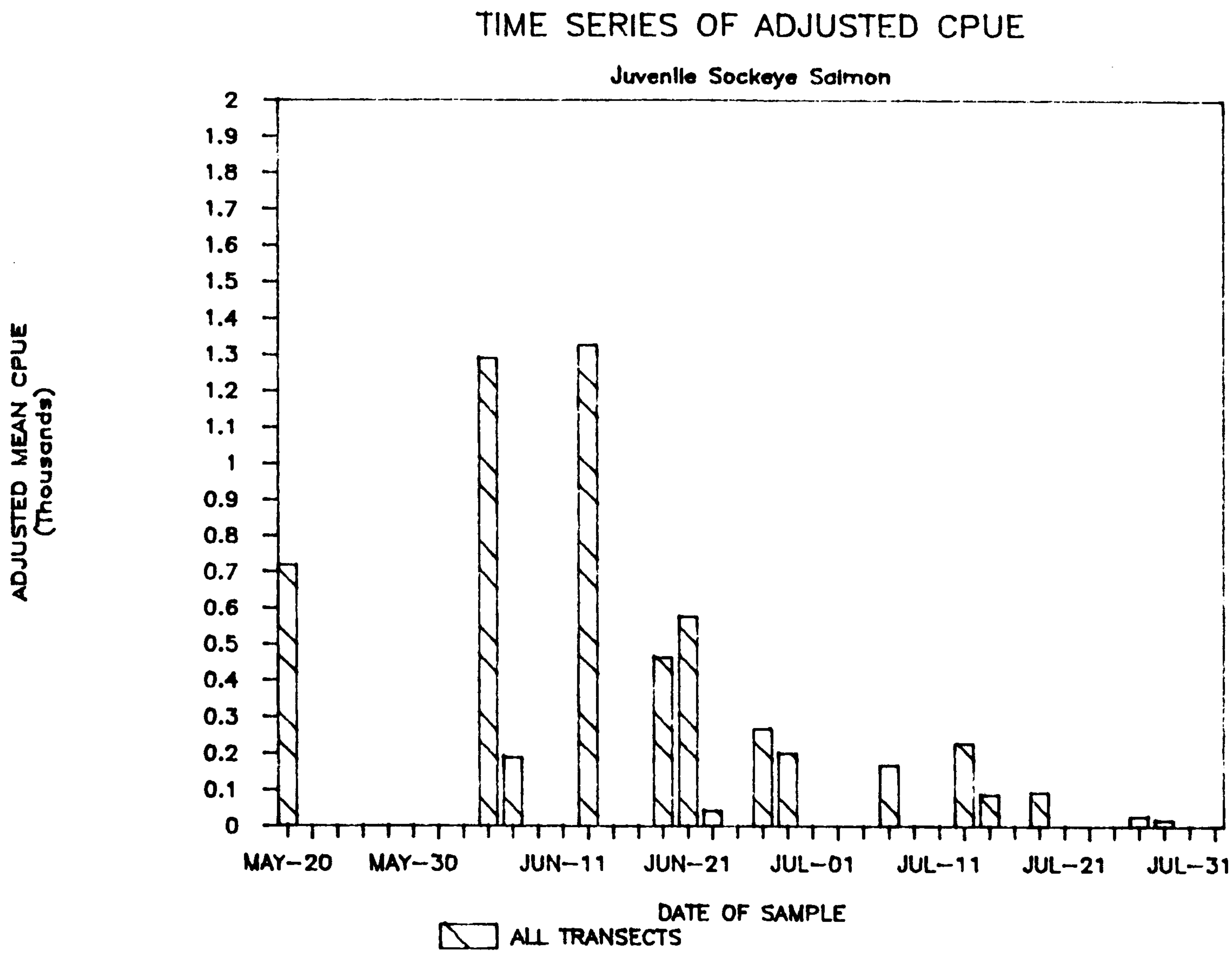
CRUISE	TRANSECT	STATION	NUMBER OF SETS	MEAN CATCH
4a	UGASHIK	2	3	139.7
		1	3	907.7
		0	3	13.3
	PORT HEIDEN	3	2	296.5
		2	2	734.0
		1	1	40.0
		0	1	0.0
	PORT MOLLER	3	5	21.2
		2	4	52.3
		1	4	45.0
		0	3	52.3
	IZEMBEK LAGOON	3	2	1.5
		2	2	3.5
		1	2	0.0
		0	2	0.0
4b	UGASHIK	2	10	97.3
		1	5	49.0
		0	5	96.0
	PORT HEIDEN	3	5	74.8
		2	5	51.6
		1	5	21.6
		0	5	0.0
	PORT MOLLER	3	4	3.8
		2	3	1.4
		1	2	36.1
		0	1	0.0
	IZEMBEK LAGOON	3	2	0.0
		2	2	13.5
		1	2	0.0
		0	2	0.5



1985 Juvenile Sockeye Catch By Transect and Period

Dames & Moore

Figure 27

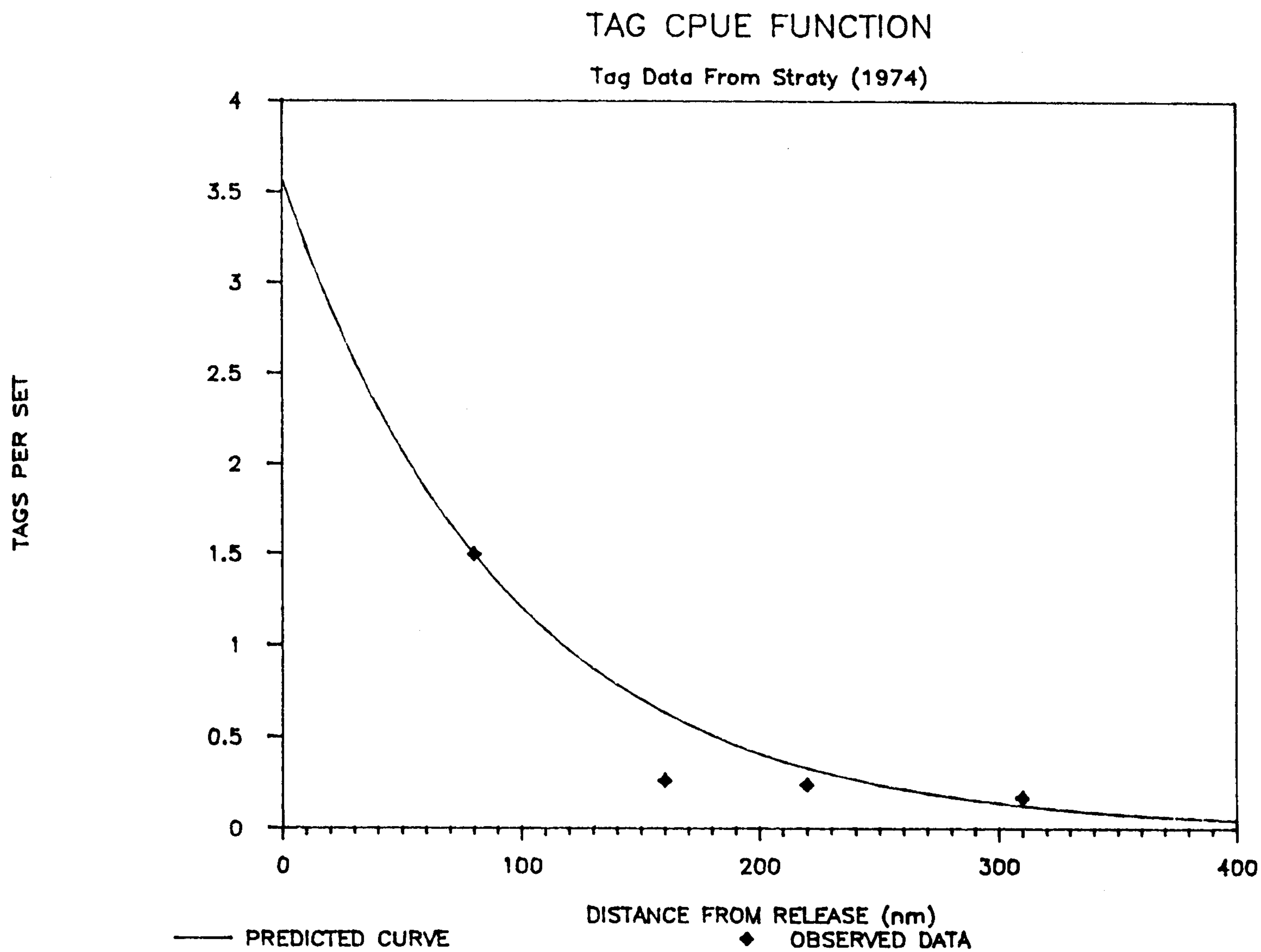


Adjusted Transect Catches of Juvenile Sockeye in 1985

Time-Lagged to Date of Passage, Ugashik

Dames & Moore

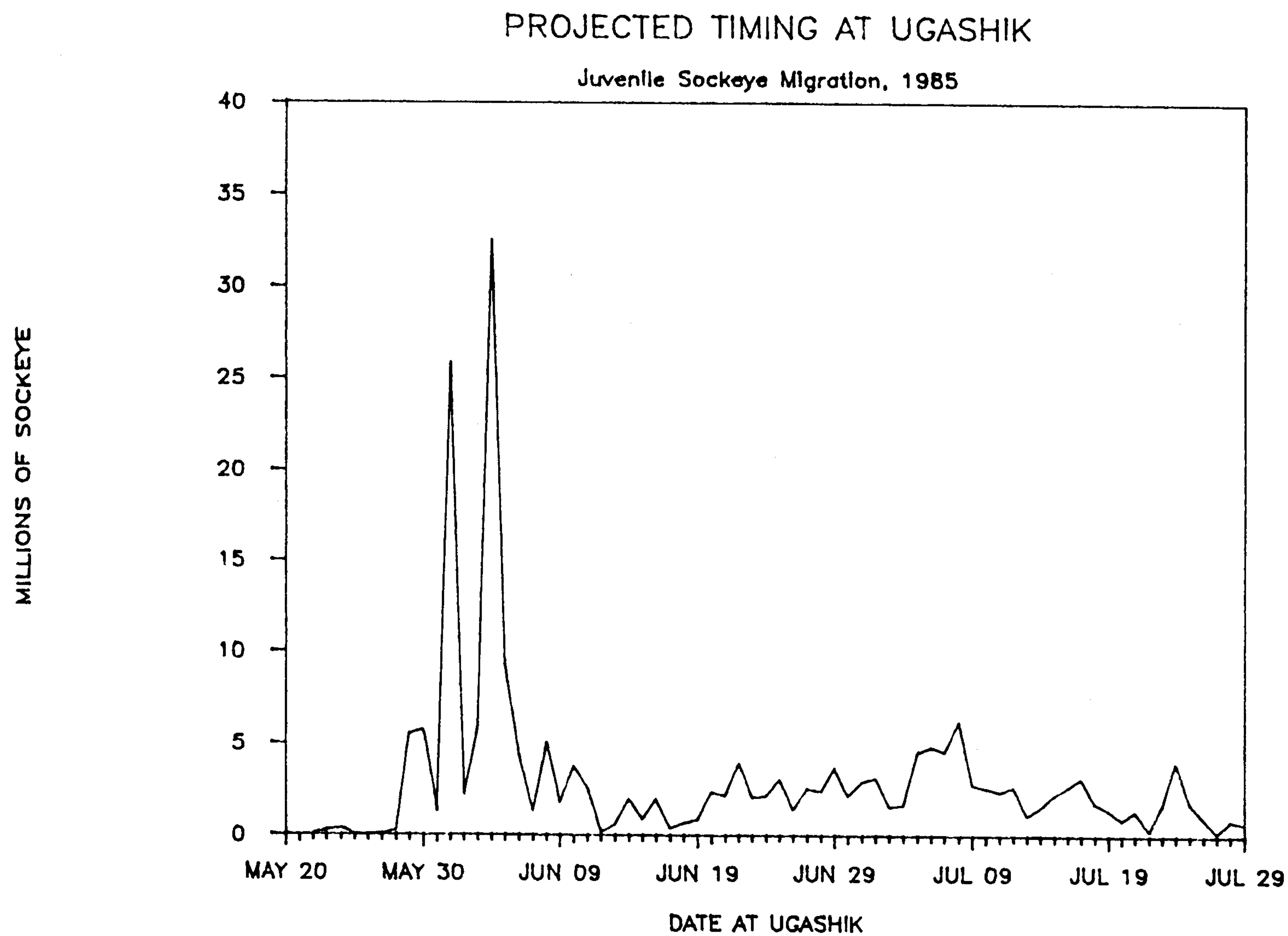
Figure 28



Juvenile Sockeye Tag Recovery With Distance From Point of Release

Dames & Moore

Figure 29



Predicted Timing of Juvenile Sockeye Migration at Ugashik in 1985
Based on One Body Length Per Second Swimming Speed

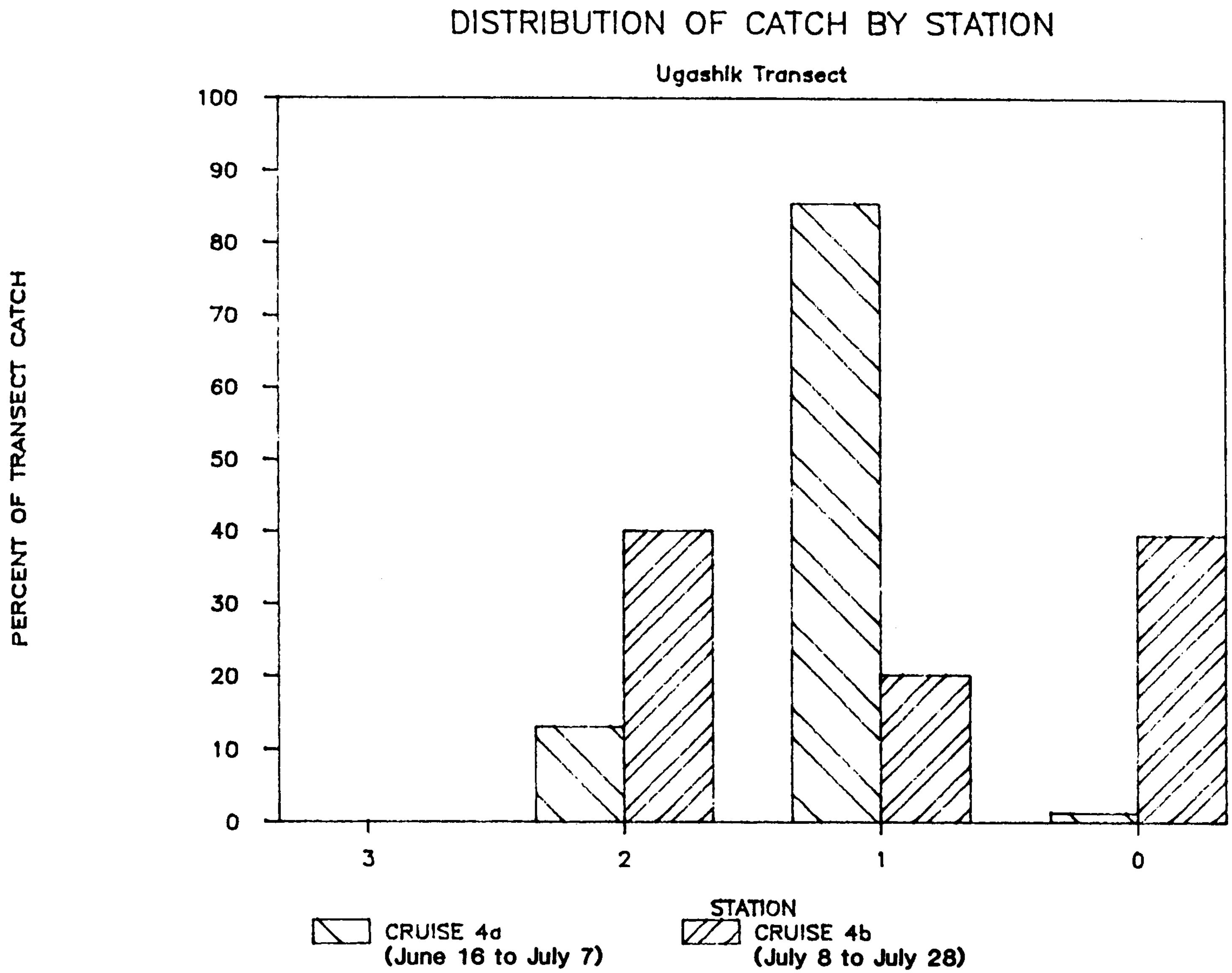
Dames & Moore

Figure 30

The projection of migration timing above, if reasonably accurate, indicates that peak numbers of juveniles passed Ugashik before our first visit on June 19. Large catches at Port Heiden on June 22 support this conclusion, since distance between the two transects represents about 10 days' travel time for an average-sized juvenile. However, high abundance at Ugashik on May 20, as indicated by the Port Moller catch on June 16, almost certainly is an artifact, since few smolts were enumerated leaving their river systems on that date. The June 16 catch most likely represents a local abundance of Hoodoo Lake or Bear Lake sockeye stocks. The very low CPUE at Izembek Lagoon on June 29 is explained by the fact that the main Bristol Bay juvenile sockeye migration could not have been in the area by that date.

Trends in sockeye catches going offshore were transect-specific. Distributions of CPUE by station are shown for each transect in Figures 31 through 34. The distribution of catches at the Ugashik transect (Figure 31) was influenced heavily in Cruise 4a (June 16 to July 7) by large catches at Station 1 (10 nm offshore) on both June 19 and 20 (1,168 and 1,503, respectively). Cruise 4b (July 8 to 28) catches were relatively evenly distributed offshore. (Recall that Station 3 does not exist at the Ugashik transect.) Trends in abundance offshore were revealed somewhat more clearly at the Port Heiden transect (Figure 32). A definite shoreward bias was described by catches in both cruises; however, the Cruise 4a data were also influenced heavily by a single large catch of some 1,467 juveniles at Station 2 (5 nm offshore). We failed to catch any juvenile sockeye in five sets at Station 0 on three separate visits to the Port Heiden transect.

Trends in catches at the outer transects (Port Moller and Izembek) were less clearly described than at inner transects (Figures 33 and 34). Cruise 4a catches at Port Moller implied a roughly uniform distribution of sockeye to the offshore limit of the transect, whereas Cruise 4b catches, although greatly reduced in size, were clustered about Station 1 (Figure 33). This general offshore distribution of juveniles at Port Moller contrasted with the strong onshore bias shown at Port Heiden during the same period. Consistently small catches at Izembek Lagoon



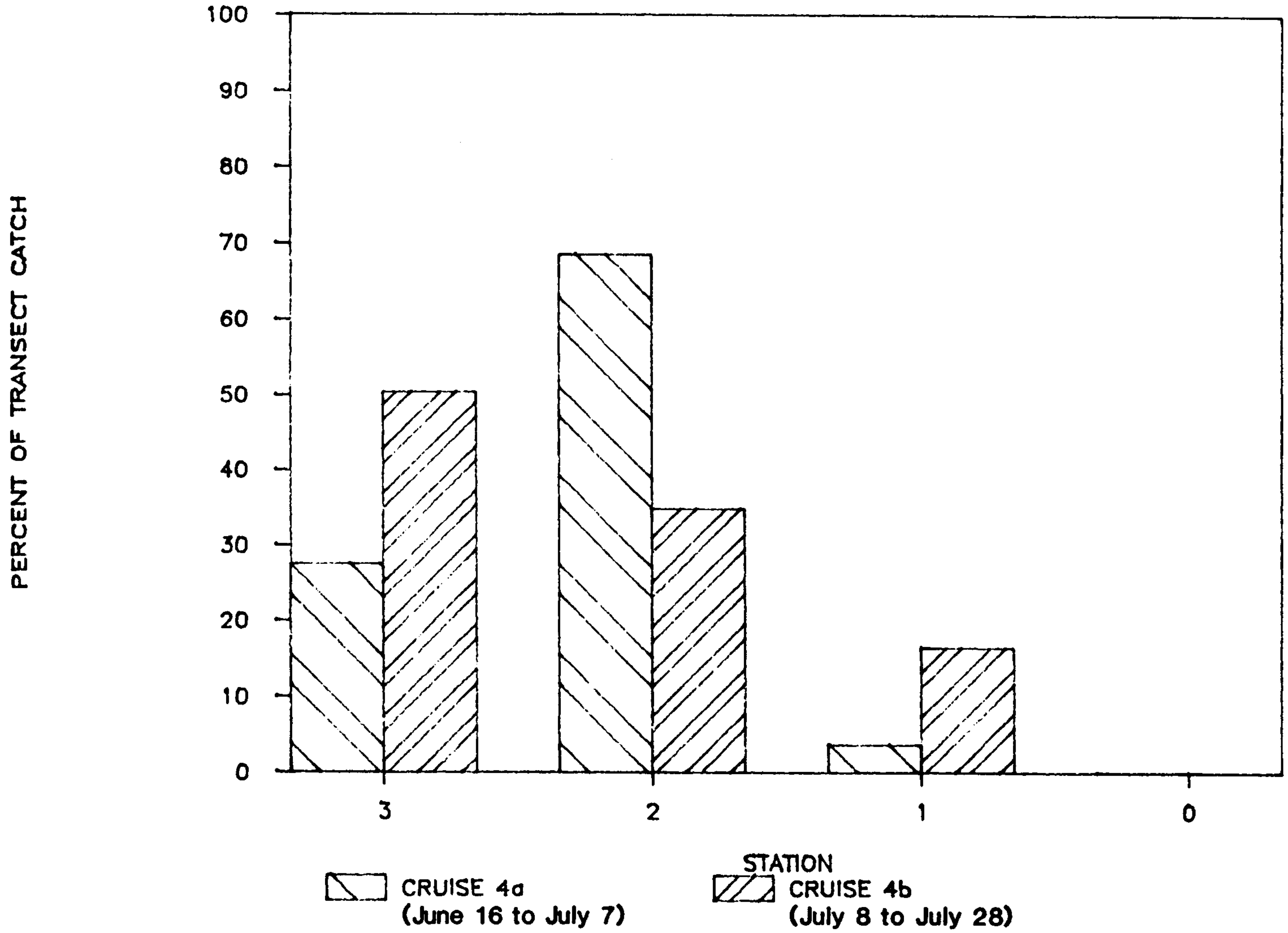
1985 Juvenile Sockeye Purse Seine Catch By Station and Period, Ugashik

Figure 31

Dames & Moore

DISTRIBUTION OF CATCH BY STATION

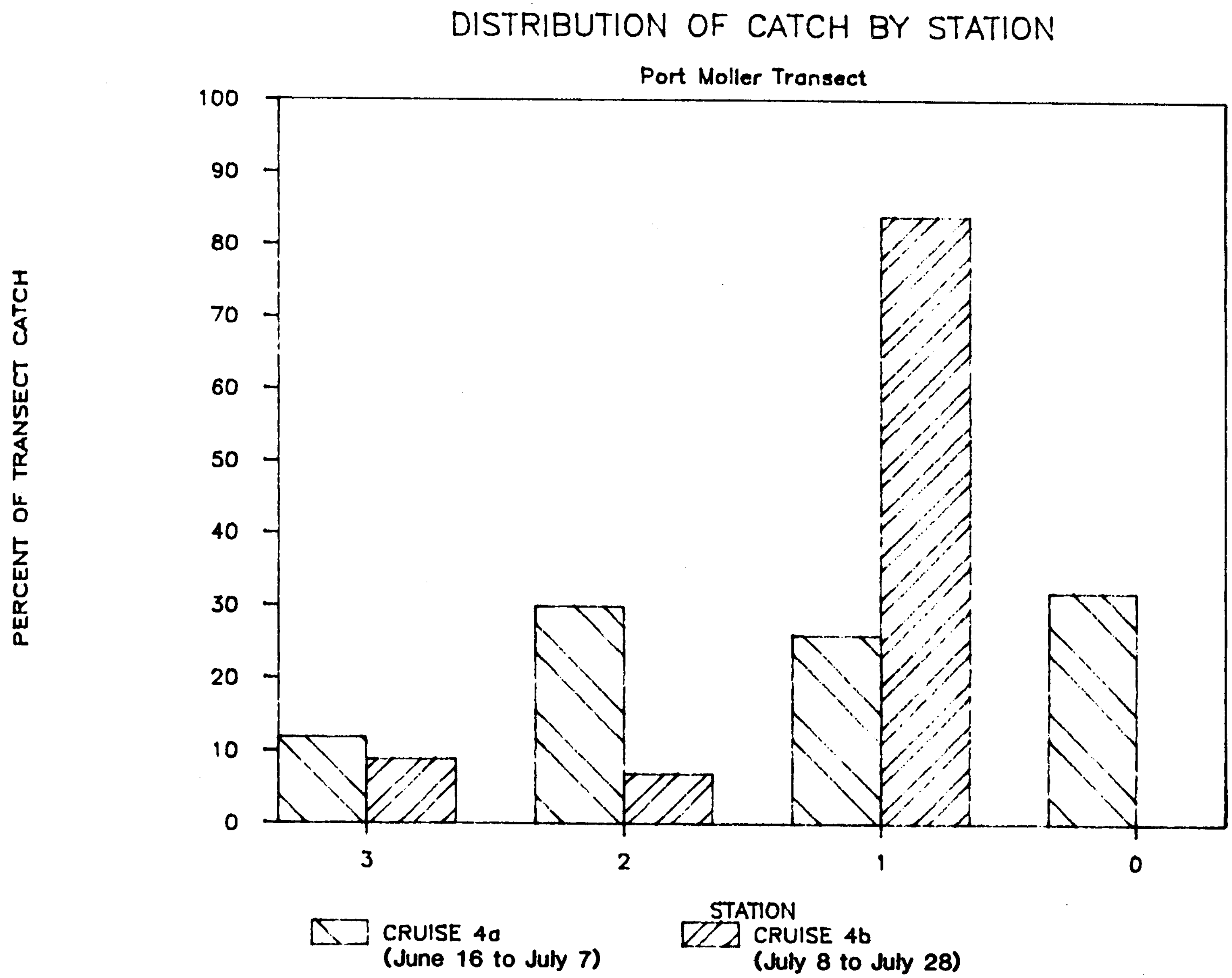
Port Heiden Transect



1985 Juvenile Sockeye Purse Seine Catch By Station and Period, Port Heiden

Dames & Moore

Figure 32



1985 Juvenile Sockeye Purse Seine Catch

By Station and Period, Port Moller

Dames & Moore

Figure 33

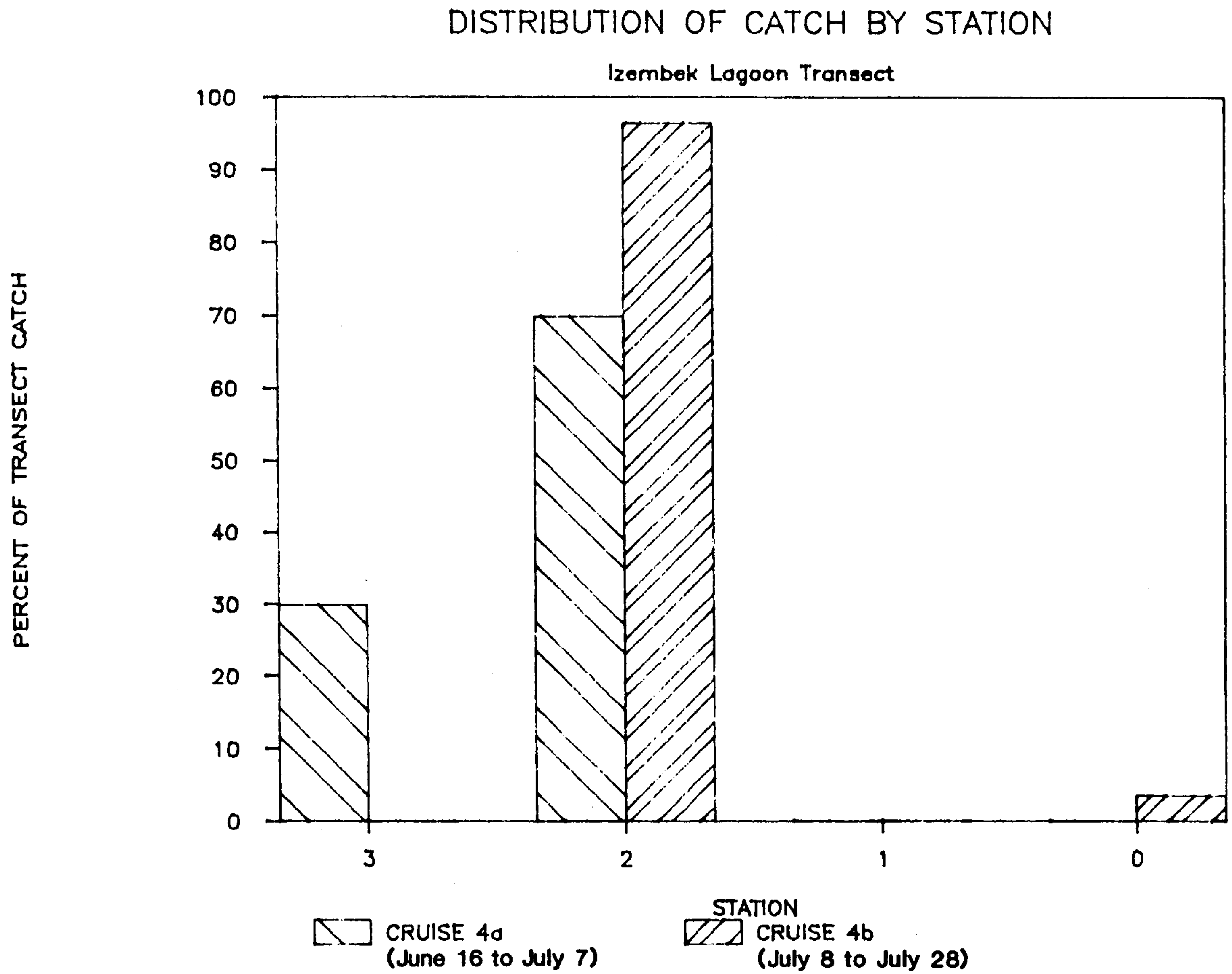


Figure 34

1985 Juvenile Sockeye Purse Seine Catch By Station and Period, Izembek

Dames & Moore

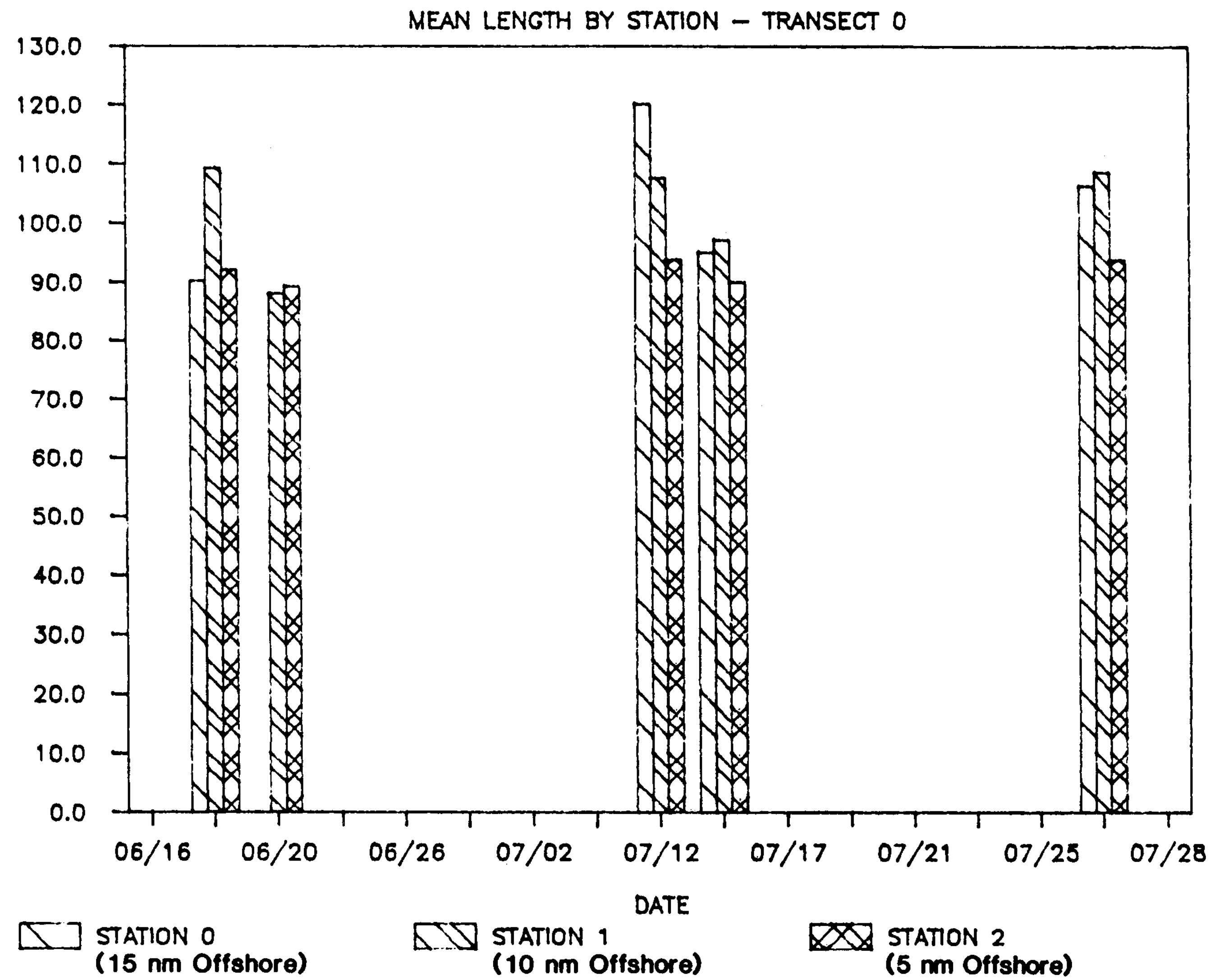
suggested a low-density, patchy distribution of sockeye centered some distance offshore, perhaps outside the transect boundary. We interpret these data to confirm a general offshore movement of sockeye juveniles in the outer bay as proposed by Straty (1974).

Sample mean lengths of juvenile sockeye in purse seine catches displayed no remarkable trends over time or space other than a trend toward increasing mean length with distance down-bay (Figures 35 through 38). Mean lengths in samples taken at Ugashik and Port Heiden generally fell between 90 and 110 mm, while mean lengths of samples taken at Port Moller and Izembek Lagoon fell between about 100 and 130 mm. The hypothesis that juvenile sockeye progressively move offshore with increasing size is not strongly supported by these data (Figures 35 through 38).

4.3.3.2 Chum Salmon

Juvenile chum salmon showed pronounced seasonal and spatial distributions patterns in 1985 (Figure 39). Chum salmon were taken nowhere outside, and only intertidally inside, the Port Moller estuary in Cruise 4a (June 16 to July 7), but they were present in all gear at all locations in Cruise 4b (July 8 to 29). Chum abundance declined from inner Bay to outer Bay transects (Table 20). The density of juvenile chums evidenced by catches at Port Moller emphasizes the importance of this estuary as a nursery for local stocks.

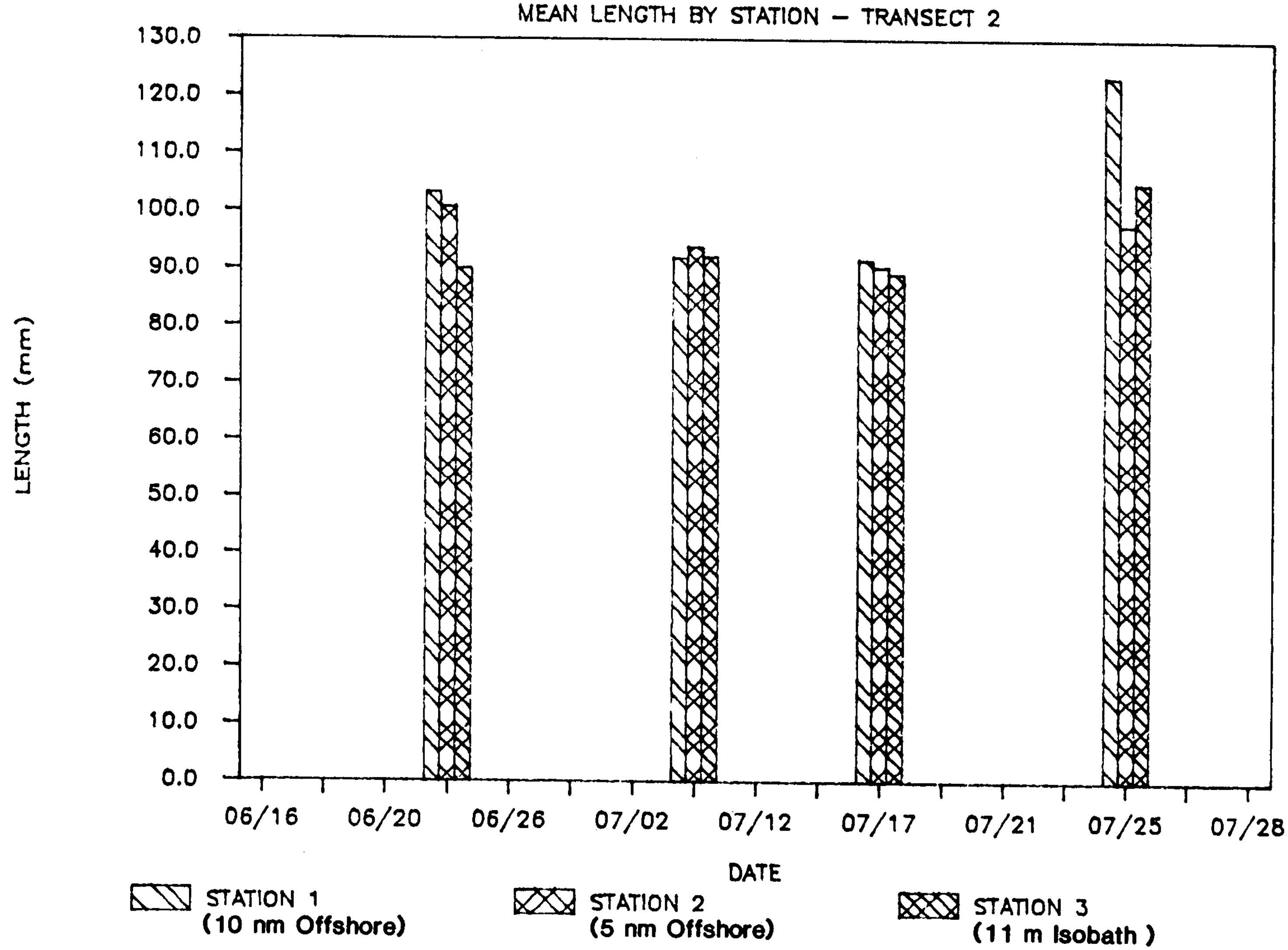
A temporal shift in habitat use which has been documented elsewhere for juvenile chum (Bax, et al. 1980; Simenstad, et al. 1982) is clearly displayed in Figure 39. The relationship between beach seine CPUE and small seine CPUE in the first and second survey periods at Port Moller suggested a size-dependent movement of chum fry out of intertidal habitats. However, variability in our size data for juvenile chum masked significant differences in mean size of fish in beach seine and small seine samples.



Mean Lengths of Juvenile Sockeye in 1985
Purse Seine Catch by Station, Ugashik.

Dames & Moore

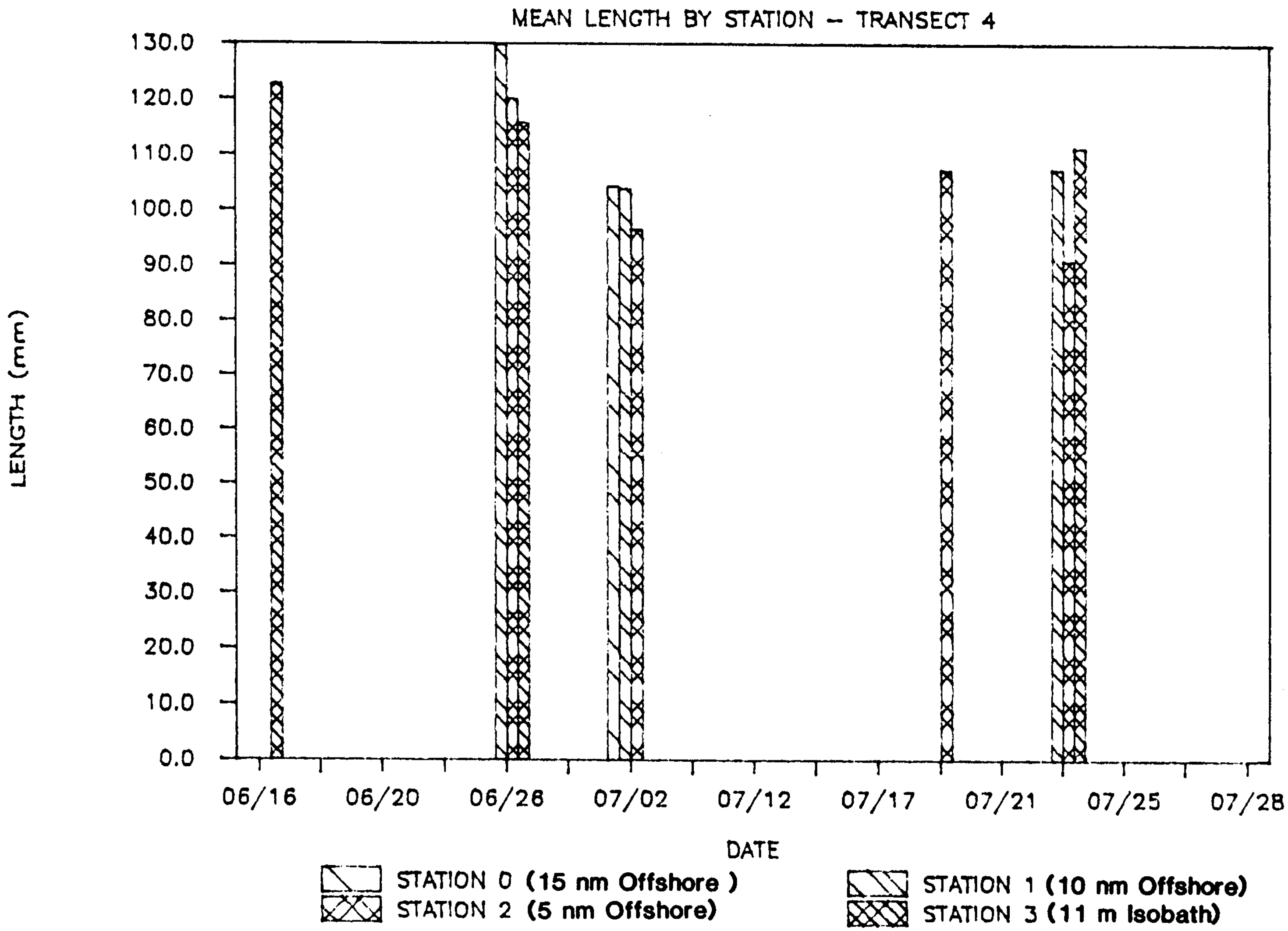
Figure 35



Mean Lengths of Juvenile Sockeye in 1985
Purse Seine Catch by Station, Port Heiden

Dames & Moore

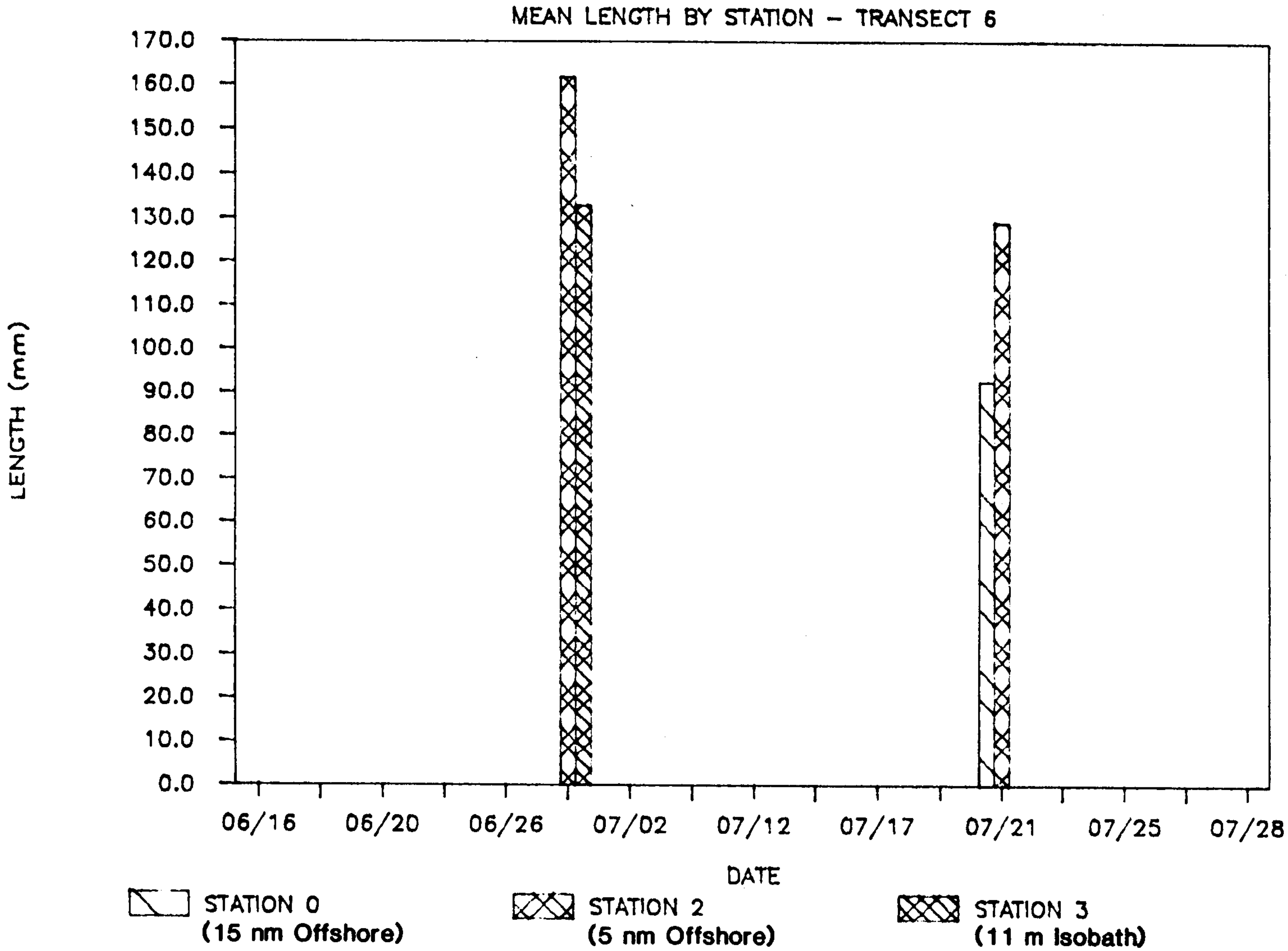
Figure 36



Mean Lengths of Juvenile Sockeye in 1985
Purse Seine Catch by Station, Port Moller.

Dames & Moore

Figure 37



Mean Lengths of Juvenile Sockeye in 1985 Purse
Purse Seine Catch by Station, Izembek.

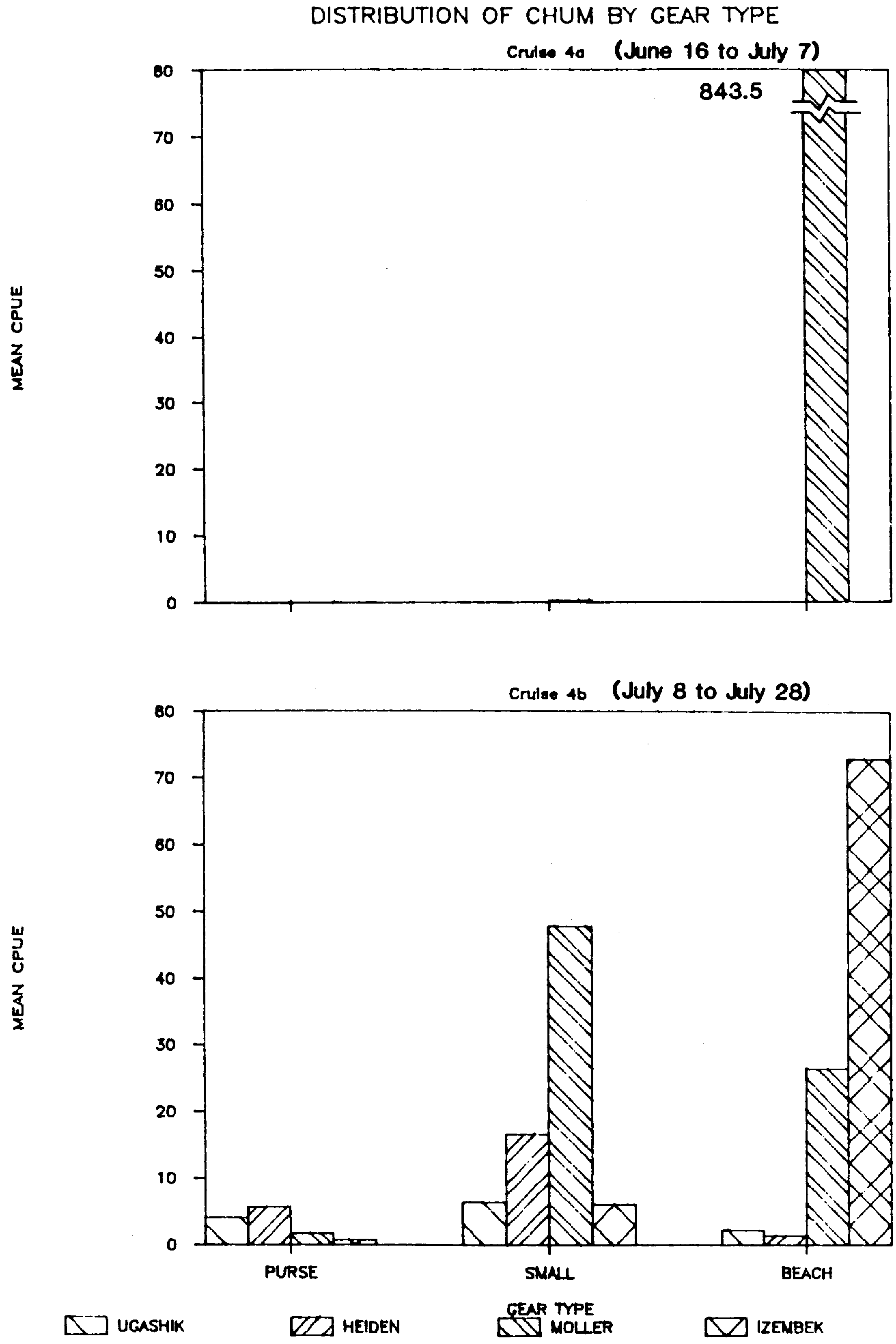
Dames & Moore

Figure 38

TABLE 20

SUMMARY OF JUVENILE NON-SOCKEYE SALMON CPUE BY GEAR TYPE AND PERIOD AT EACH TRANSECT

		CRUISE 4a (June 16 - July 7)			CRUISE 4b (July 8 - 28)			
SPECIES	TRANSECT	PURSE SEINE	SMALL SEINE	BEACH SEINE	PURSE SEINE	SMALL SEINE	BEACH SEINE	GEAR POOLED
COHO	UGASHIK	.7	0.0	0.0	2.9	0.0	0.0	0.6
	PT. HEIDEN	0.3	0.0	0.0	6.0	0.0	0.8	1.2
	PT. MOLLER	3.4	2.7	4.6	2.2	2.0	0.7	2.6
	IZEMBEK	0.0	0.0	0.0	0.7	2.3	3.5	1.1
CHUM	UGASHIK	0.0	-	-	4.2	6.5	2.3	3.3
	PT. HEIDEN	0.0	0.0	-	5.8	16.7	0.8	2.9
	PT. MOLLER	0.0	0.3	843.5	0.0	47.9	26.5	153.0
	IZEMBEK	0.0	-	-	0.8	6.2	73.0	20.0
PINK	UGASHIK	0.0	-	-	0.6	0.0	0.0	0.2
	PT. HEIDEN	0.0	0.0	-	0.0	0.0	0.0	0.0
	PT. MOLLER	0.0	0.0	179.1	0.3	12.9	3.8	32.7
	IZEMBEK	0.0	-	-	0.0	0.0	0.0	0.0



1985 Juvenile Chum Catch By Gear Type

Dames & Moore

Figure 39

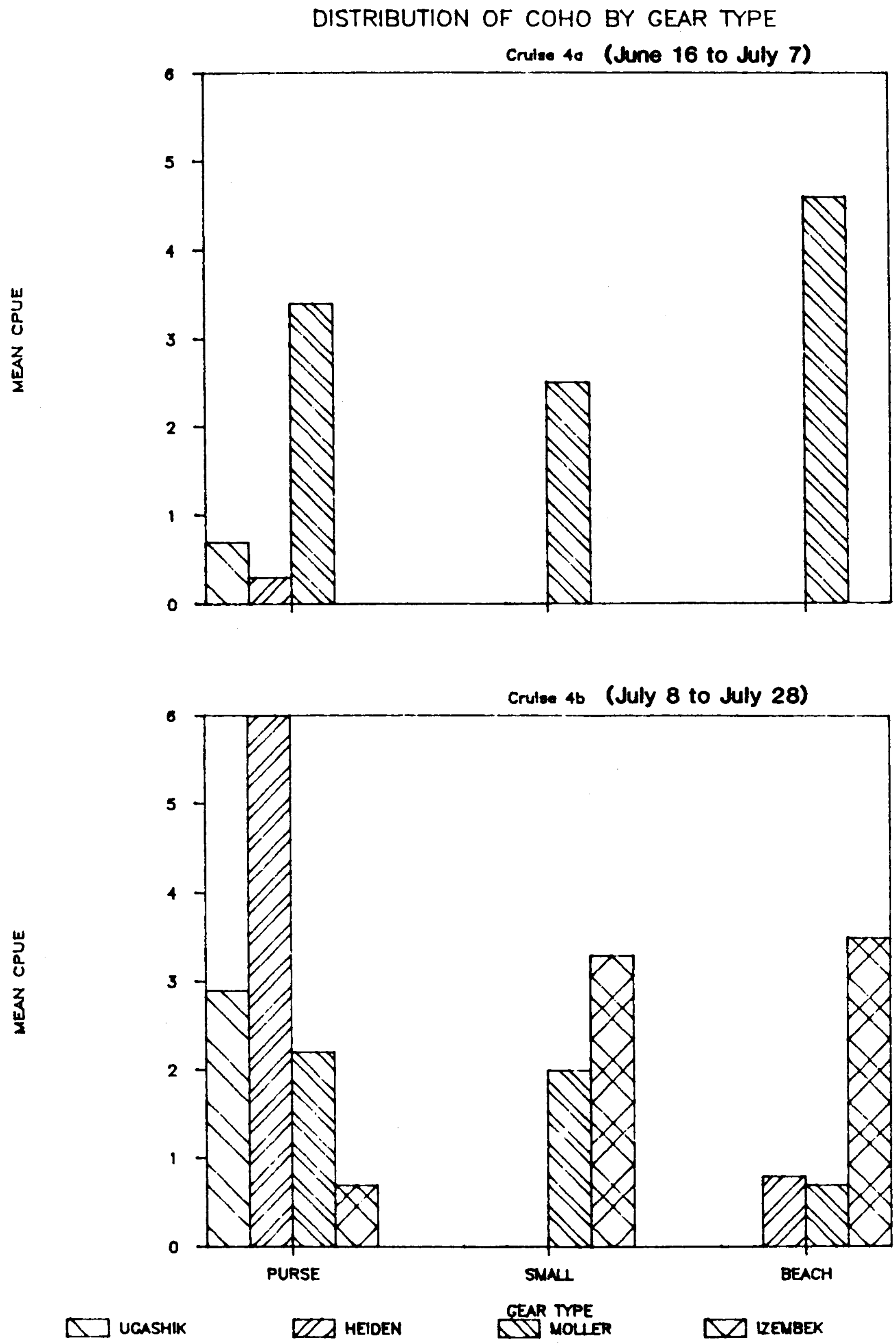
The appearance of juvenile chum in large and small seine catches at all locations late in the survey (Cruise 4b) marked a directed migration of juveniles to estuarine habitats and the nearshore neritic zone. Chum were distributed essentially within 5 nm of shore, as only 0.6 percent of all chum taken in the large purse seine were captured farther offshore. Juvenile chum had by this time become comparable in body size to the 2- and 3-year old juvenile sockeye taken coincidentally with them. Because the purse seine CPUE of chum was increasing at the end of sampling activities, we conclude that the offshore movement of juveniles was incompletely documented during the survey period.

4.3.3.3 Coho Salmon

The pattern of catches of juvenile coho salmon by all gear suggests that they were not present in estuarine habitats of Ugashik Bay or Port Heiden, but did use such habitats inside Port Moller and Izembek Lagoon. Further, their distribution offshore was strongly biased shoreward and was temporally variable.

Juvenile coho were uniformly distributed in relatively low abundance between estuarine and very nearshore intertidal and subtidal habitats over the 1985 survey period. Over 70 percent of all coho were taken within 3.5 nm of shore, and none was caught offshore of 5.0 nm. Mean CPUE for juvenile coho was 1.9, 1.6, and 1.6 fish/set for the large seine, small seine, and beach seine, respectively. Of the total catch of coho by all gear , about 11 percent was taken at Ugashik, 22 percent at Port Heiden, 47 percent at Port Moller, and 20 percent at Izembek Lagoon (Table 20).

With the exception of the Port Moller transect, catches generally increased with time at all transects with all gear (Figure 40). Juvenile coho were virtually absent inside Ugashik Bay and Port Heiden at all times. The increase in purse seine CPUE over time at these transects probably reflected the arrival of juveniles from inner Bristol Bay rivers. The stability of catches over time in and near Port Moller implies that juvenile coho remain in this estuary for extended periods.



1985 Juvenile Coho Catch By Gear Type

Dames & Moore

Figure 40

Catches of coho at the Port Moller transect suggest a trend of movement out of intertidal habitats with time. Highest mean CPUE was obtained in the beach seine in Cruise 4a, but this trend reversed in Cruise 4b with larger catches in the small and large purse seine. Movement offshore probably is a size-dependent rather than a time-dependent process. The mean weight of coho taken in beach seine sets was significantly lower than that for coho taken in the small seine or purse seine (17.4 grams vs 49.8 and 55.5, respectively; $P < .001$), indicating that coho obtained additional growth inside Port Moller before moving to the open coastline. We interpret these data to confirm the suggestion that Port Moller serves an important function as a secondary rearing area for juvenile coho.

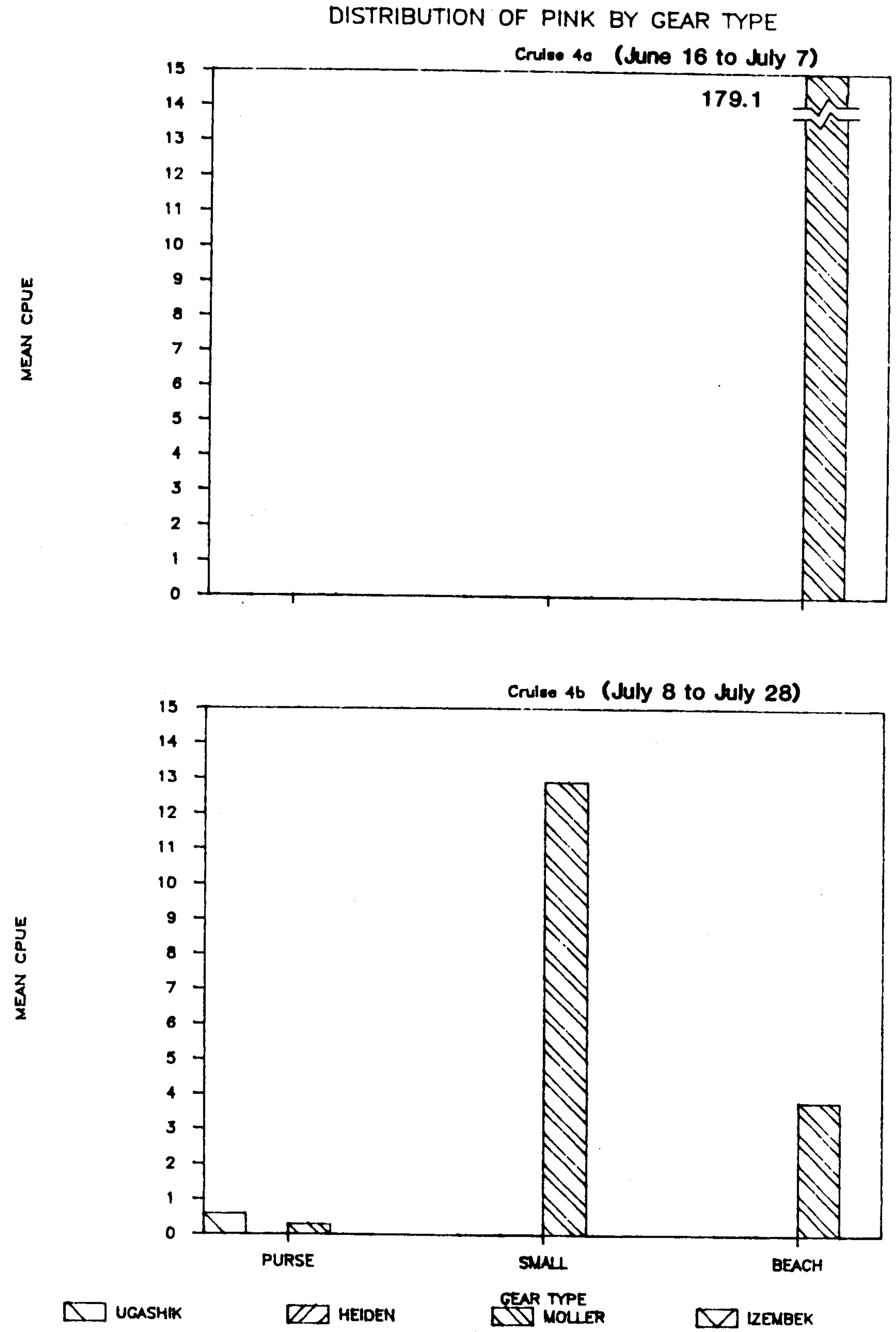
4.3.3.4 Chinook Salmon

The six juvenile chinook salmon caught in 1985 were equally distributed between each of the three gear types. Four of the six individuals were taken from mid- to late July inside or near the mouth of Ugashik Bay, to which a sizeable run of adult chinook returns annually. The other fish were taken by purse seine off Port Moller on June 16 and by beach seine inside Port Heiden on July 25.

Straty (NMFS, Juneau, personal communication 1986) suggests that poor catches of juvenile chinook in the study area may not accurately depict the relative numbers of this species in the study area. Studies in southeast Alaska have found that juvenile chinook tend to migrate earlier and travel in deeper water than do juveniles of other species. Therefore, juvenile chinook may have been out of the study area before sampling began or in deeper water inaccessible to the purse seines.

4.3.3.5 Pink Salmon

Juvenile pink salmon were not widely distributed in the study area during the 1985 survey period (Table 20). No pink juveniles were taken at any transect other than Port Moller, except for several taken in the large purse seine on the last 2 days of sampling at Ugashik (Figure 41).



1985 Juvenile Pink Catch By Gear Type

Dames & Moore

Figure 41

Within the Port Moller estuary, the pattern of habitat use by pink salmon was very similar to that of chum salmon. Figure 41 traces a shift away from intertidal habitats in Cruise 4a to open-water estuarine and offshore habitats in Cruise 4b. A complete image of the ultimate movement of pinks to the open water probably was truncated by cessation of the survey.

The abundance of pink fry should have been relatively high in 1985 after the even-year adult return to Bristol Bay rivers in 1984. Our failure to find evidence of them in bays and estuaries or near shore throughout the survey indicates that local production of pink salmon in the study area is negligible outside of Port Moller. The abundance of pinks offshore is not accurately depicted by 1985 purse seine catches because sampling was terminated before the bulk of juveniles migrating from Bristol Bay spawning grounds could have reached the study area.

4.3.3.6 Sockeye Salmon Scale Pattern Analysis

Analysis of scales collected in 1985 from juvenile sockeye captured at Ugashik and Port Heiden produced poor estimates of the stock composition. Growth patterns in scales of Ugashik, Naknek, and Wood River sockeye were virtually indistinguishable, whereas those in scales of Egegik and Kvichak sockeye were distinct from the other stocks. Several techniques employed to enhance the low intrinsic separability of Ugashik, Naknek, and Wood River scales are described in detail below.

A total of 1,415 scales from juvenile sockeye salmon was examined for the scale pattern analysis. Training samples (hereafter called "standards") from each of the five river systems in the analysis totalled 989 scales, and the remaining 426 scales were of unknown origin (hereafter called "unknowns") sampled at the Ugashik and Port Heiden transects between June 19 and July 28. Eighteen of the unknowns were determined to be unreadable and were excluded. Age analysis of the remaining scales revealed that over 78 percent of captured sockeye were age I and less than 22 percent were age II migrants. Sample size considerations consequently limited the scale pattern analysis to age I scales.

Location and date of capture of unknown samples are summarized in Table 21. Sample sizes generally were small owing to the post hoc nature of the scale study. Samples of unknowns were pooled to transect level to obtain adequate sample sizes for each location. Some samples taken on adjacent dates, such as on June 19 to 20 and on July 27 to 28, were pooled for the same reason.

Standard samples were assembled from scales collected by ADF&G during smolt enumeration projects on each of the major Bristol Bay river systems in 1985. Approximately 200 scales were subsampled from all time segments of the smolt outmigration at each river system in proportion to smolt abundance during the time period in which scales had been collected.

A total of 11 scale features was defined from summary scale measurement data and 3 more were added by transformation (Table 22). However, scale characters beyond the first freshwater annulus were not permitted to enter the analysis, because the inability to distinguish lacustrine "plus growth" from early ocean growth on the scales would bias the classification of unknowns. Summarized scale measurement data for each standard and the unknown samples were submitted to a stepwise linear discriminant function (LOF) analysis (BMDP7M) for initial screening and estimation of classification accuracies.

Initial runs of the discriminant analysis included all standards and unknowns, no assignment of prior probabilities, and unconstrained stepping through the scale character set. Results of these runs provided a first assessment of the set of significant scale characters and estimates of classification accuracy of the discriminant function with inclusion of each variable.

The classification matrix for a five-class discriminant function under conditions as stated above showed weak recognition of Ugashik, Naknek, and Wood River stocks, and strong recognition of Egegik and Kvichak stocks (Table 23). Frequency distributions of the two most significant allowable scale characters illustrated the reasons for poor classification accuracy in the five-class analysis (Figure 42).

TABLE 21

LOCATION AND DATE OF CAPTURE
OF SCALES IN UNKNOWN SAMPLES

Sample Date	Location	Number
6/19-20	Ugashik	9
6/22	Port Heiden	42
7/8	Port Heiden	38
7/12	Ugashik	39
7/14	Ugashik	45
7/17	Port Heiden	72
7/25	Port Heiden	47
7/27-28	Ugashik	17

TABLE 22

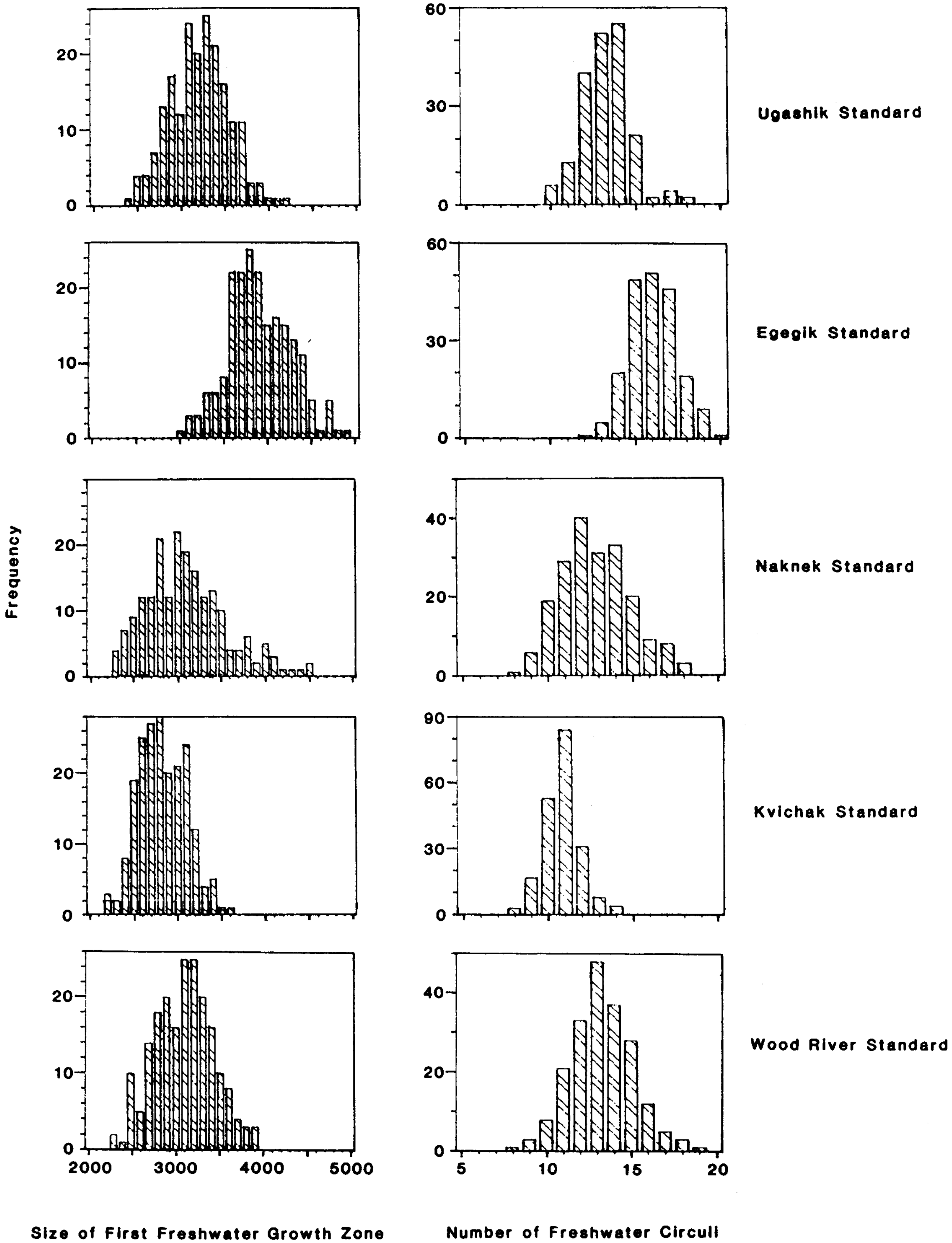
LIST OF SCALE CHARACTERS SUBMITTED TO
STEPWISE DISCRIMINANT FUNCTION ANALYSIS

VARIABLE	CODE	VARIABLE DESCRIPTION
NCIRC	3	TOTAL NUMBER OF CIRCULI
INRAD	4	SIZE OF SCALE FOCUS
AFWCRC	5	NUMBER OF CIRCULI IN FRESHWATER ZONE 1
AFWSZ	6	SIZE OF FRESHWATER ZONE 1
TRIPA	7	DISTANCE FROM 1ST TO 4TH CIRCULUS
TRIPB	8	DISTANCE FROM 4TH TO 7TH CIRCULUS
TRIPC	9	DISTANCE FROM 7TH TO 10TH CIRCULUS
TRIPD	10	DISTANCE FROM 10TH TO 13TH CIRCULUS
TRIPE	11	DISTANCE FROM 13TH TO 16TH CIRCULUS
PLCRC	12	NUMBER OF PLUS GROWTH CIRCULI
PLSZ	13	SIZE OF PLUS GROWTH ZONE
ADDED BY TRANSFORMATION:		
TOTSZ	14	TOTAL SIZE OF SCALE
PRESD	15	PRESENCE OR ABSENCE OF TRIPD
PRESE	16	PRESENCE OR ABSENCE OF TRIPE

TABLE 23

CLASSIFICATION MATRIX FOR A 5-CLASS DISCRIMINANT FUNCTION WITH NO PRIOR PROBABILITIES AND STEPPING LIMITED BY MINIMUM F-TO-ENTER CRITERIA

GROUP	PERCENT CORRECT DECISIONS	NUMBER OF DECISIONS				
		UGASHIK	EGEGIK	NAKNEK	KVICHAK	WOOD RIVER
UGASHIK	55.5	111	10	26	26	27
EGEGIK	73.6	35	148	7	0	11
NAKNEK	55.3	22	16	110	17	34
KVICHAK	83.1	12	1	9	157	10
WOOD RIVER	55.2	30	10	25	25	111
MEAN	64.3					



Distribution of Two Characters in 1985 Scale Standards

Dames & Moore

Figure 42

Comparisons of circulus number and total size of the freshwater scale growth zone clearly showed broad overlap in the distributions of Ugashik, Naknek, and Wood River standards, while those of Egegik and Kvichak standards were somewhat displaced from the others. Note that these scale characters displayed the highest degree of stock-specificity of all characters in the data set.

Alternative classification schemes were devised to enhance the minimal differences between scale patterns. For example, a set of prior probabilities of stock assignment was imposed on the classification of unknowns based on the relative abundances of age I smolts contributed by each stock to the bay-wide smolt migration in 1985. However, since this procedure failed to significantly improve overall classification accuracy and carried the implicit, probably unrealistic, assumption that juveniles of all stocks were equally vulnerable to capture at all times, assignment of prior probabilities was dropped from subsequent analyses.

Another approach taken to mitigate the effect of poor separability of Ugashik, Naknek, and Wood River stocks was simply to exclude one or more of these standards from the classification of unknowns. We assumed, based on smolt outmigration timing and distance to the study area, that Wood River sockeye were not in the vicinity of Ugashik or Port Heiden on the first sampling dates at those transects and, further, that Ugashik fish likely had migrated out of the area by the second and subsequent visits. Accordingly, the Wood River standard was excluded from the classification of unknowns sampled on June 19 to 20 at Ugashik and on June 22 at Port Heiden, and the Ugashik standard was excluded from the classification of unknowns sampled thereafter (Table 24).

Separate linear discriminant functions were developed for the classification schemes described above. The results of stepwise variable selection indicated that a single scale character (number of lacustrine circuli) provided maximum accuracy in classification of unknowns sampled on June 19 to 20 and June 22 (Wood River excluded), whereas a set of 5 characters was warranted in the classification of remaining unknown samples (Ugashik excluded). Overall classification

TABLE 24

CORRECTED ESTIMATES (+/- 80% CONFIDENCE LIMIT) OF PERCENTAGES OF EACH STOCK PRESENT IN SAMPLES COLLECTED AT UGASHIK AND PORT HEIDEN

DATE	TRANSECT		STOCK: UGASHIK	EGEGIK	NAKNEK	KVICHAK	WOOD RIVER
6/19-20	UGASHIK	%	0.0	0.0	100.0	0.0	N/A
	n = 9	+/-	419.0	82.9	759.0	258.0	---
6/22	PT. HEIDEN	%	13.8	0.0	0.0	86.2	N/A
	n = 42	+/-	91.6	18.3	162.2	55.6	---
7/8	PT. HEIDEN	%	N/A	0.0	0.0	42.3	57.6
	n = 38	+/-	---	7.4	72.3	33.2	53.9
7/12	UGASHIK	%	N/A	0.0	100.0	0.0	0.0
	n = 39	+/-	---	16.7	95.6	37.4	60.7
7/14	UGASHIK	%	N/A	1.3	78.1	7.4	13.2
	n = 45	+/-	---	16.5	83.8	32.2	55.8
7/17	PT. HEIDEN	%	N/A	0.0	95.2	4.8	0.0
	n = 74	+/-	---	10.6	78.3	31.0	49.8
7/25	PT. HEIDEN	%	N/A	0.0	65.1	27.4	7.5
	n = 47	+/-	---	13.8	83.5	35.1	52.3
7/27-28	UGASHIK	%	N/A	9.5	20.1	54.1	16.3
	n = 17	+/-	---	23.9	103.0	49.5	65.9

accuracy for the Wood River-excluded LDF was 60.3 percent, and that for the Ugashik-excluded LDF was 64.3 percent.

The matrix correction procedure given in Cook (1982) was used to adjust estimates of proportions of each stock present in unknown samples to account for misclassification error. Resulting corrected estimates (± 80 percent confidence limit) of stock mixing proportions are summarized for the classification of unknown samples in Table 24 and are expanded in Table 25 to estimates of relative numbers of each stock present in total transect catches. These results indicate that Naknek stock predominated in virtually all juvenile sockeye catches at Ugashik and Port Heiden in both Cruise 4a and 4b. Given the broad confidence intervals about the proportional estimates, there is little point in carrying the discussion further. It is noteworthy, however, that the absence of Ugashik and Egegik sockeye from most samples is consistent with results obtained when a migration rate of 1 b.l./sec. was applied to the time and distance of migration from rivers of origin.

To summarize, the similarity of scale growth patterns for three of the five major Bristol Bay stocks precluded successful stock identification in samples of sockeye salmon juveniles captured at the Ugashik and Port Heiden transects using scale patterns and a linear discriminant function analysis. Plots of the frequency distributions of significant scale measurements revealed substantial overlap in those for Ugashik, Naknek, and Wood River stocks, while those for Egegik and Kvichak stocks were somewhat displaced. Results suggest that Naknek sockeye juveniles predominated in catches throughout the survey period, but the precision of estimates of stock mixing proportions permits no reliable conclusions. It should be noted that the 1985 smolts from Wood River were unusually large (second largest since 1954) for that system. In most years, the typically small Wood River smolts probably could be separated from the other systems by scale measurements.

TABLE 25

ESTIMATED NUMBERS OF SOCKEYE OF EACH BRISTOL BAY STOCK IN CATCHES AT UGASHIK AND PORT HEIDEN DURING CRUISE 4

			STOCK				
DATE	TRANSECT	CATCH	UGASHIK	EGEGIK	NAKNEK	KVICHAK	WOOD RIVER
6/19-20	UGASHIK	3182	0	0	3182	0	0
6/22	PT. HEIDEN	2101	290	0	0	1811	0
7/8	PT. HEIDEN	260	0	0	0	110	150
7/12	UGASHIK	1145	0	0	1145	0	0
7/14	UGASHIK	268	0	4	209	20	35
7/17	PT. HEIDEN	317	0	0	302	15	0
7/25	PT. HEIDEN	163	0	0	106	45	12
7/27-28	UGASHIK	283	0	27	57	153	46
	TOTAL	7719	290	31	5001	2154	243

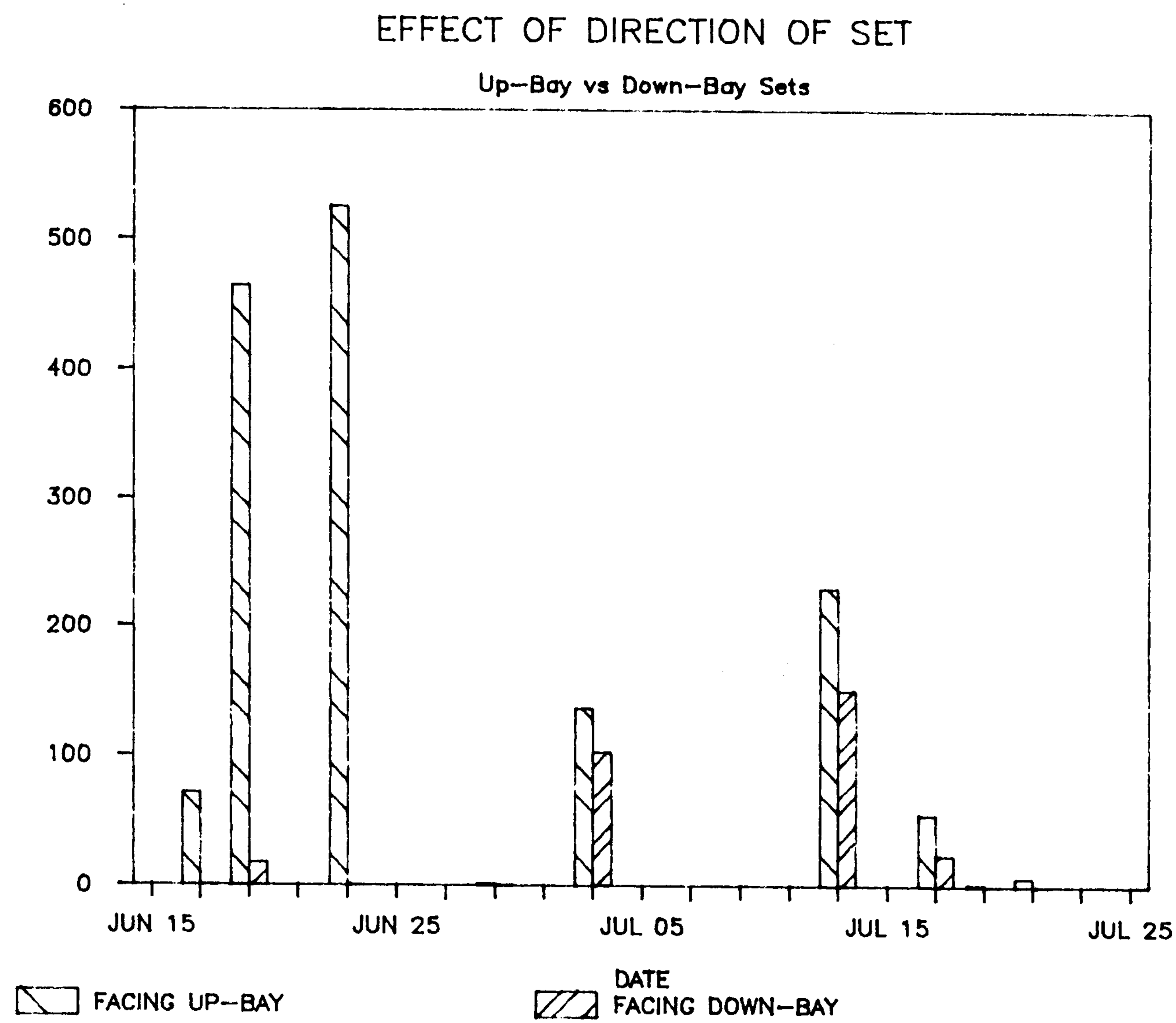
4.3.4 Discussion of 1985 Juvenile Salmonid Catches

The obvious problem in assigning some significance to the juvenile salmon catch data is in determining how much of an observed trend is real and how much is the product of sampling error. We assumed that the major source of variability in catches would be the spatial and temporal differences in the density of juvenile salmon encountering the purse seine – in other words, real trends. However, we assumed as well that other factors related to the distributional characteristics of out-migrants could also influence the probability of their encountering the net. We tested specifically for variability in catch due to direction of set, tide stage, and schooling of juvenile sockeye.

The strong directional component of the sockeye migration was clearly displayed in comparisons of catches from back-to-back purse seine sets at several stations. Catches in sets facing toward inner Bristol Bay consistently were higher than companion sets facing outward, irrespective of tide stage (Figure 43). It is clear, therefore, that the direction of set must be taken into consideration when catches are compared between locations, dates, or years.

We also found evidence that tide stage may secondarily affect the number of fish caught. Sockeye catches from paired experimental sets facing down-bay at Port Moller on June 26 were significantly smaller during the flood than during the ebb (Table 26). Paired experimental sets facing up-bay at Port Moller on July 23 also revealed the presence of substantial numbers of juvenile sockeye offshore on the ebb and an absence of fish offshore during the flood. Paired catches at the less affected inshore Station 3 (11-m isobath) were nearly identical. Similar but less persuasive evidence was obtained from paired sets facing up-bay at Port Heiden 2 days later.

This result implies that the direction of sockeye migration is not altered by strong adverse currents, insofar as large numbers of juveniles were not swept into sets facing into the flood tide. If sockeye adjusted either the depth or distance offshore of their migration path



1985 Juvenile Sockeye Purse Seine Catch by Direction of Set

Dames & Moore

Figure 43

TABLE 26

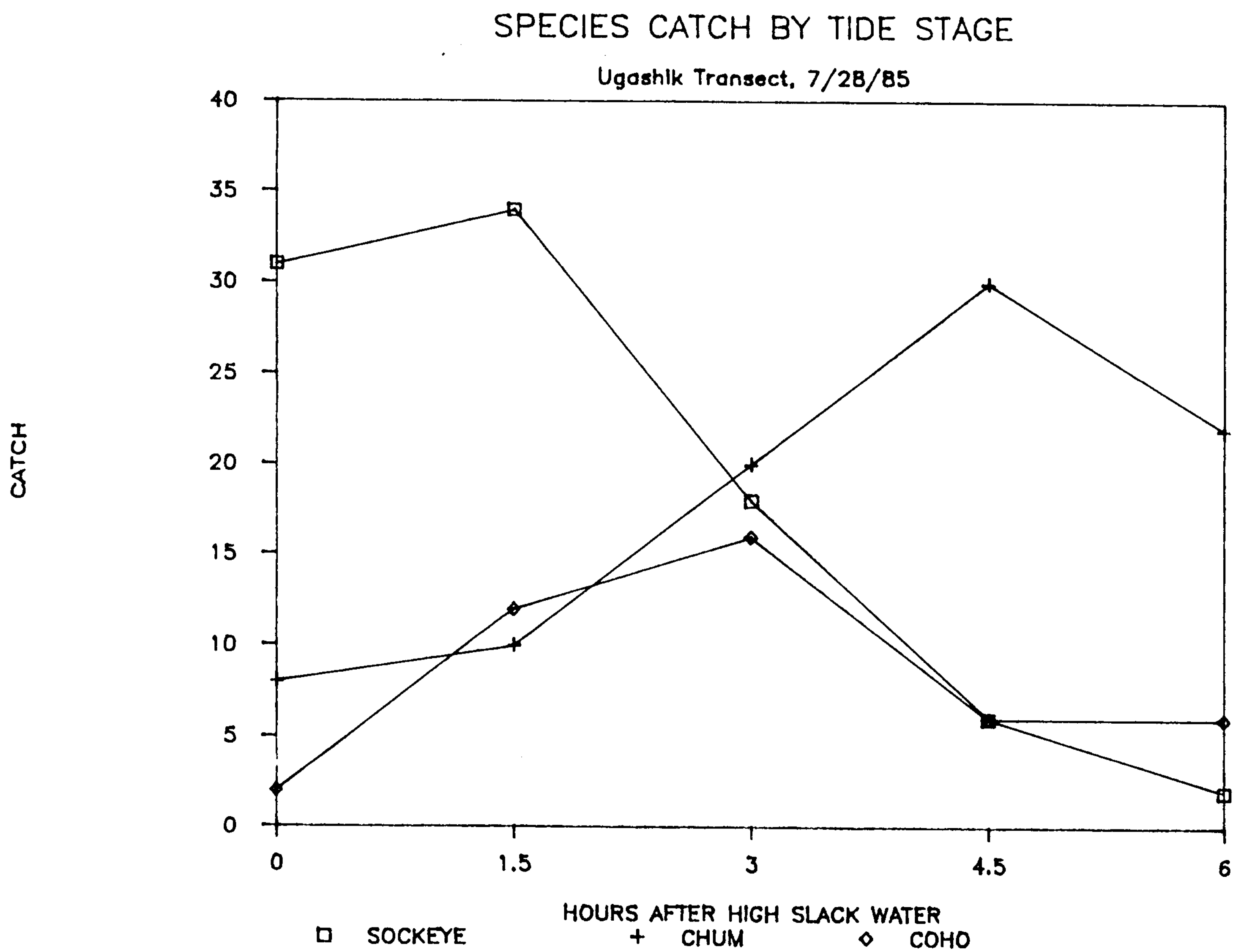
SUMMARY OF CATCHES OF JUVENILE SOCKEYE SALMON IN CRUISE 4 EXPERIMENTAL PURSE SEINE SETS

DATE	TRANSECT	STATION	DIRECTION OF SETS	SET 1 CATCH	TIDE STAGE	SET 2 CATCH	TIDE STAGE
6/26	PORT	3	DOWN	29	EBB	5	HI SLACK
	MOLLER	2	DOWN	1	EBB	1	FLOOD
		1	DOWN	59	EBB	5	FLOOD
		0	DOWN	0	FLOOD	NO SET	
7/23	PORT	3	UP	7	FLOOD	8	EBB
	MOLLER	2	UP	0	FLOOD	1	EBB
		1	UP	0	FLOOD	72	EBB
		0	UP	0	FLOOD	NO SET	
7/25	PORT	3	UP	1	EBB	73	FLOOD
	HEIDEN	2	UP	43	EBB	12	FLOOD
		1	UP	20	EBB	14	FLOOD
		0	UP	0	FLOOD	NO SET	
7/27	UGASHIK	2	UP	62	EBB	84	HI SLACK
		1	UP	24	EBB	17	EBB
		0	UP	2	EBB	3	EBB
7/28	UGASHIK	2	UP	31	EBB		
		2	UP	34	EBB		
		2	UP	18	EBB		
		2	UP	6	EBB		
		2	UP	2	EBB		

to avoid the mainstream of adverse currents, then their differential availability to the purse seine would be shown as differences in CPUE on alternate tide stages. Note for comparison that paired sets facing up-bay through a single ebb tide at Ugashik on July 27 showed nearly identical catch rates even though the sets were separated in time by several hours.

A final series of purse seine sets was conducted at Ugashik on July 28 to establish the repeatability of catches with location and tide stage fixed. Station 2 was sampled five times at 1.5-hour intervals beginning at high slack tide. We have no satisfactory explanation for the observed regular pattern of replacement of sockeye in the catch by juvenile chum salmon over the course of the experiment (Figure 44). The fact that sockeye were replaced by juvenile chum, which are typically associated with intertidal habitats in the study area, suggests that juveniles of both species were advected or actively moved offshore with an extremely strong ebb current characteristic of Ugashik Bay (e.g., Straty 1975; S. Parker, University of Washington, personal observation).

In view of these confounding effects in the catch data, the consistency of observed trends is remarkable. For example, catches in up-bay facing sets at the Ugashik transect were virtually identical on June 19 and June 20 in terms of numbers caught and their distribution offshore. The same pattern and nearly identical numbers were observed 2 days later at Port Heiden. The correlation between Ugashik and Port Heiden catches persisted through the survey period. Such low variability in catch rates in such a dynamic sampling environment suggests a relatively cohesive migration through the inner Bay. We submit that time/space distributions of sockeye in inner Bristol Bay are accurately described by catches at Ugashik and Port Heiden. However, the catch data for Port Moller and Izembek Lagoon transects are extrapolated only to the extent that they reflect a low fish density in the nearshore area of outer Bristol Bay.



1985 Juvenile Salmon Purse Seine Catch With Time After High Slack Water, Ugashik

Figure 44

Dames & Moore

Comparisons between the present results and those reported by Straty (1974) and Straty and Jaenicke (1980) are hampered by differences in sampling methods and survey design. As discussed in Section 4.2.7, the most obvious of these are the much larger vessel and net employed in the earlier survey, their longer duration of sets, differences in transect location and direction offshore, distribution of fishing effort in the study area, and relative abundances of sockeye smolts in years of the surveys. In addition, differences in seasonal timing between years also limit comparisons between the two survey programs to a few generalities.

In the discussion below we do not compare CPUE directly between Straty and Jaenicke's data and the present study, but instead compare trends in the distribution of CPUE in the two studies at comparable locations and dates. We have concentrated on the data for 1969 and 1970 because they are the most comprehensive and systematic for the surveys performed between 1966 and 1971. To facilitate comparisons between station locations, those given in the raw data of Straty and Jaenicke have been stratified according to our survey design so that stations falling within the distance strata defined by our study have been numbered according to our system (Table 27).

The distribution of CPUE reveals some features of the 1969 sockeye migration that contrast with or contradict the results of the present study, while others agree in principle. Trends in mean CPUE did not show declines with distance toward the outer bay, nor were declines over time similar to those in the present study (Figures 45 through 47). Mean transect CPUE at inner bay transects was relatively lower in June than in July, whereas peak mean CPUE occurred at Port Moller in June. Catches decreased substantially at all transects in August. The fact that largest catches typically were recorded off Port Moller rather than at inner Bay transects is in stark contrast to our results and is likely a function of differences in timing between the two sampling programs.

TABLE 27

STATION DESIGNATIONS USED IN GROUPING SAMPLING SITES OCCUPIED BY STRATY AND JAENICKE

DISTANCE OFFSHORE (nautical miles)	STATION DESIGNATION
0 - 3.5	3
3.6 - 7.5	2
7.6 - 12.5	1
12.6 - 17.5	0
17.6 - 22.5	00
22.6 - 40.0	000

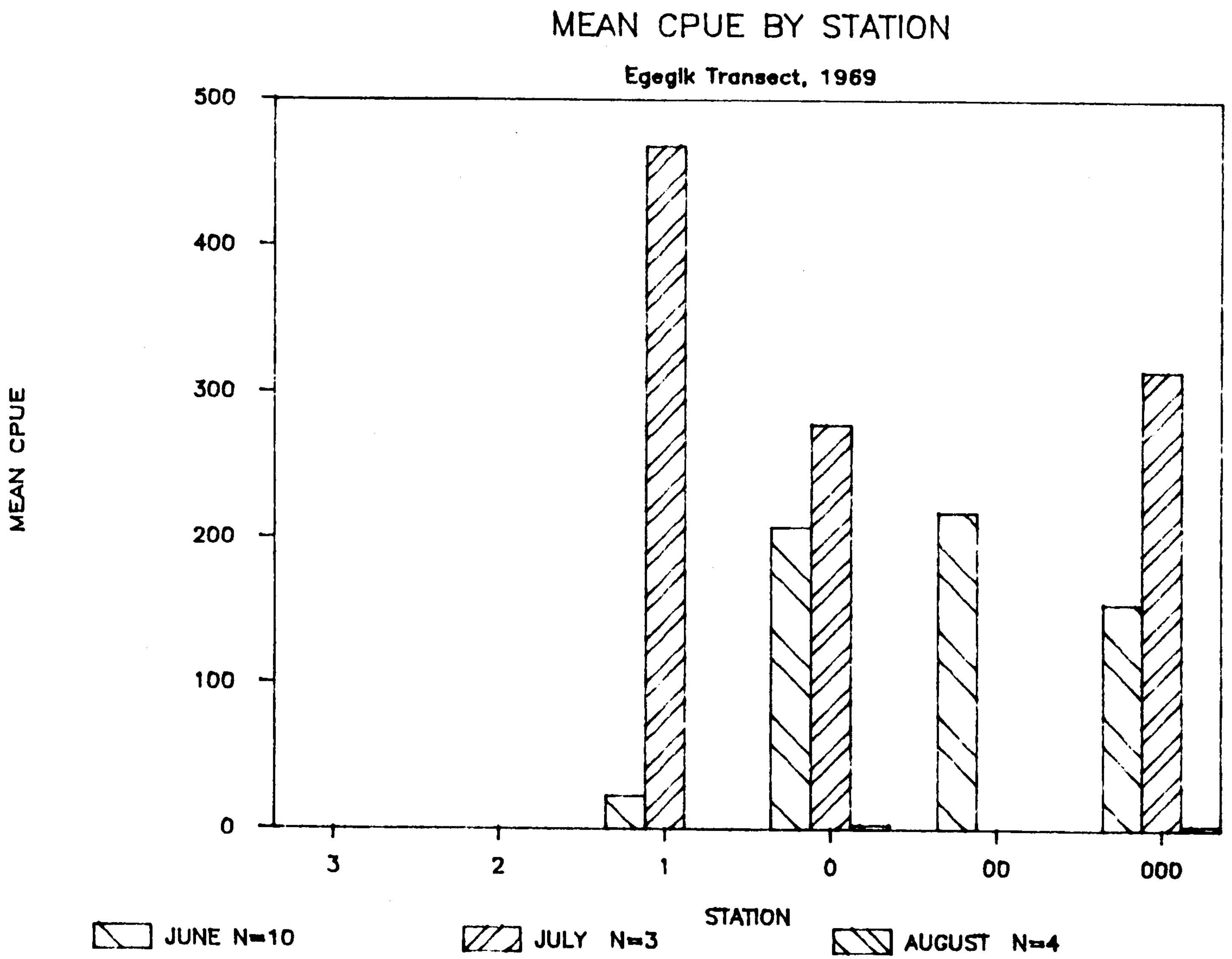
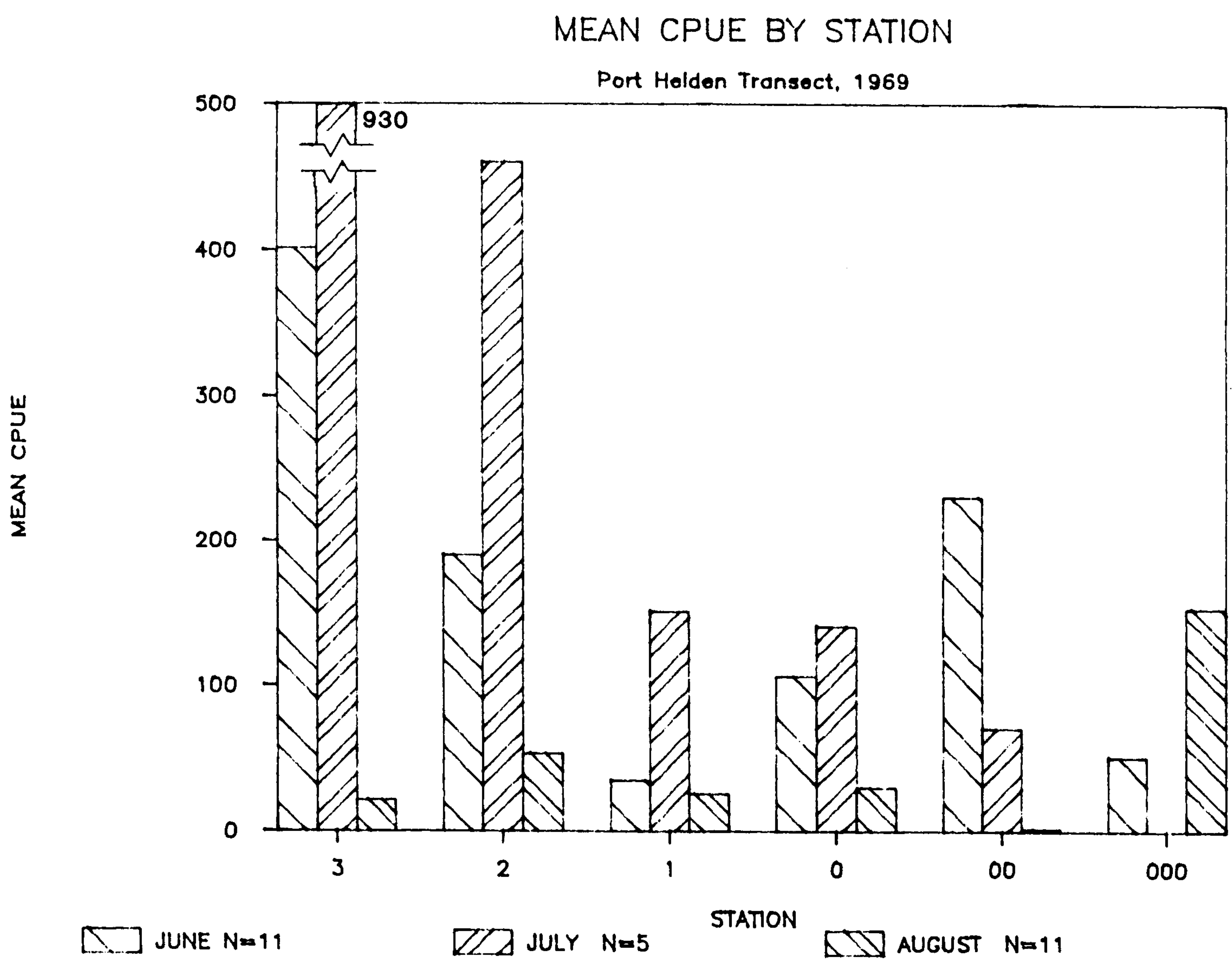


Figure 45

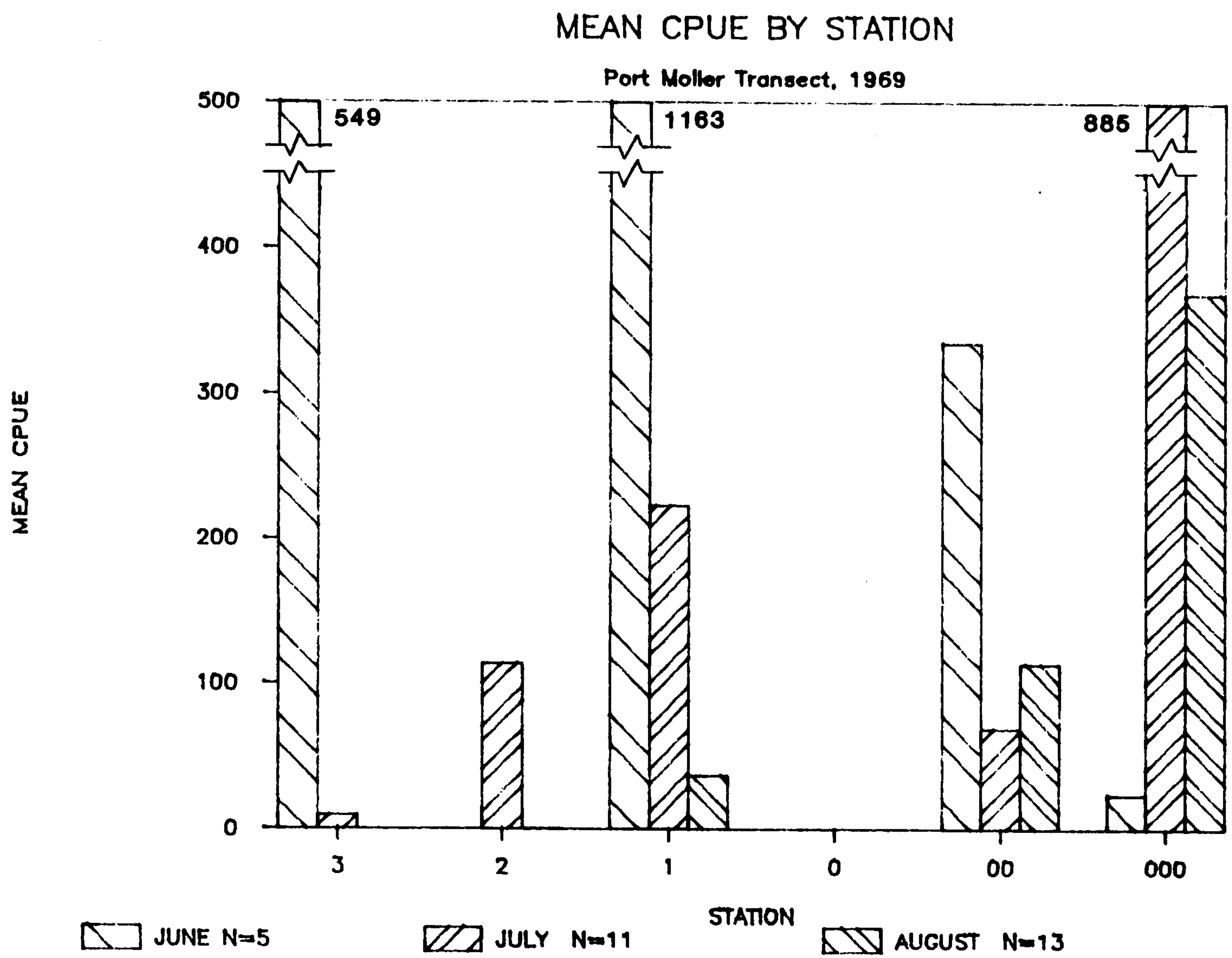
1969 Juvenile Sockeye Purse Seine Catch At Egegik
(Drawn From Data Reported by Straty 1974)



1969 Juvenile Sockeye Purse Seine Catch At Port Heiden
(Drawn From Data Reported By Straty 1974)

Dames & Moore

Figure 46



1969 Juvenile Sockeye Purse Seine Catch at Port Moller
(Drawn From Data Reported by Straty 1974)

Dames & Moore

Figure 47

Trends in the distribution offshore were consistent with those in the present study. Results at Egegik are not included in this discussion because of the lack of comparable data. However, the trend in CPUE at stations on the Port Heiden transect showed a strong inshore bias in June and July (Figure 46), consistent with present results. Similarly, catches at Port Moller reflected high sockeye abundances within 15 nm of shore in June and became more pronounced offshore in July and August (Figure 47), consistent with our conclusions.

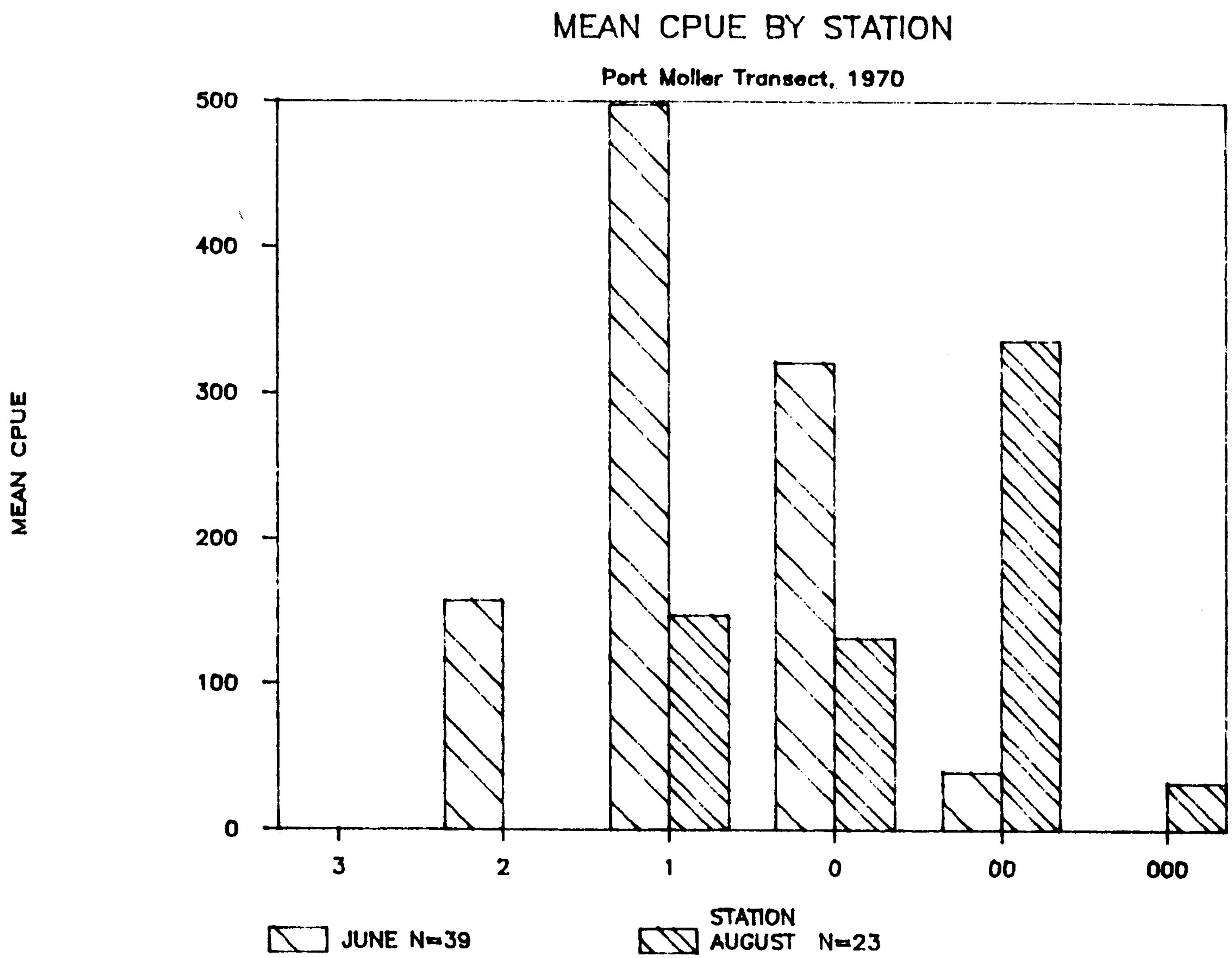
Results of sampling at the Port Moller transect in 1970 are inconclusive but tend to confirm the trends described above (Figure 48). Sockeye abundance was higher in June than in August, and the center of distribution across the transect appeared to shift somewhat from nearshore in June to more offshore in August.

4.4 GENERAL DISCUSSION OF JUVENILE SALMONID DISTRIBUTIONS AND MOVEMENTS

4.4.1 1984 - 1985 Comparisons

It is misleading to compare the results of the 1984 and 1985 surveys across years in terms of calendar dates. Given the vastly different climatic circumstances involved, it is more appropriate to view Cruises 1 through 3 in 1984 as a summer-fall extension of the spring 1985 survey. Virtually all of Cruise 4 was conducted in water temperatures colder than those observed at the beginning of Cruise 1 (late June) in 1984 (Figure 49). Since the biological processes governing the initiation of spring fish migrations are at least partially temperature-dependent, it is necessary to consider climatic state when comparing distribution trends.

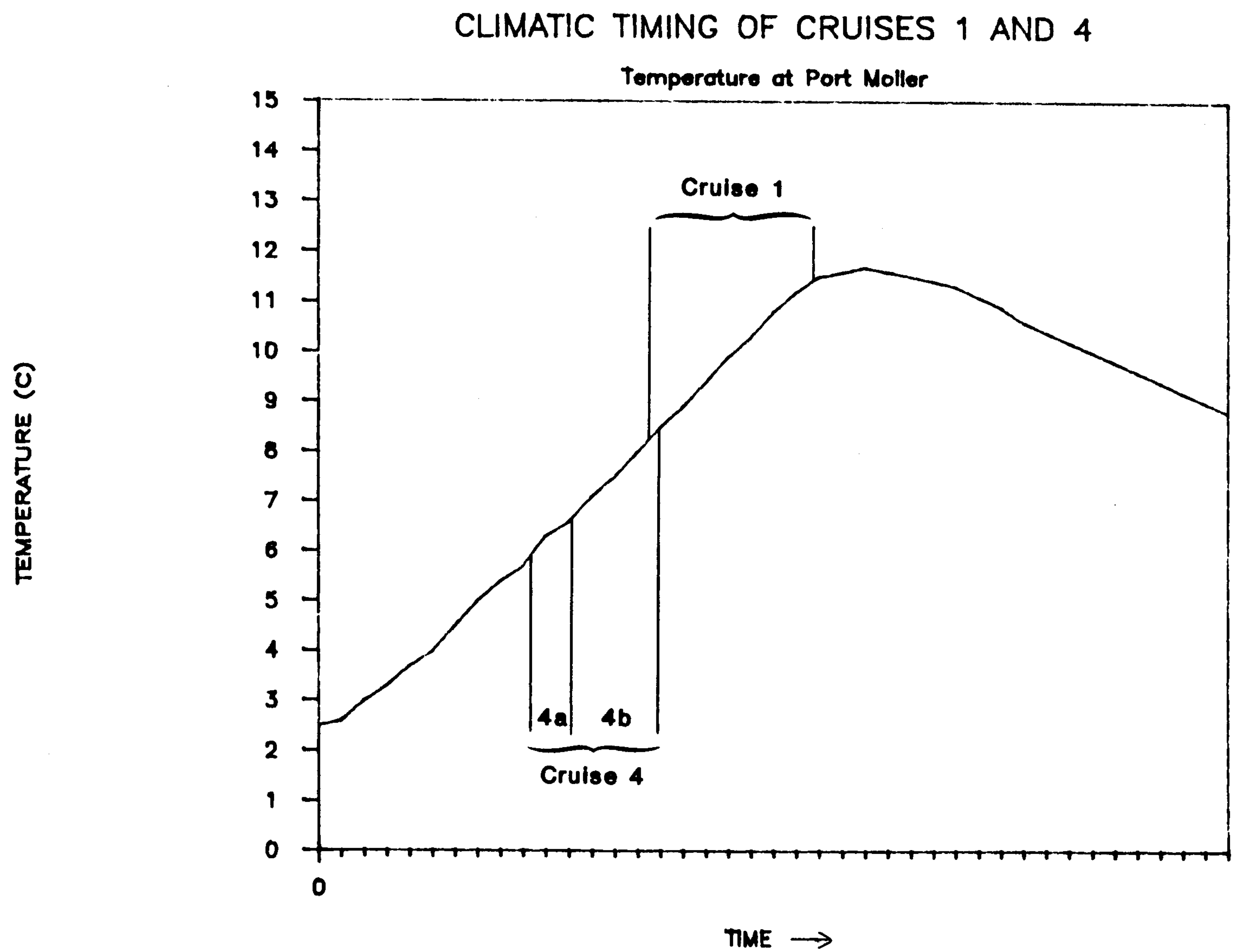
The 1985 survey provided data to answer the main question raised by consistently low CPUE in the 1984 survey. A hypothesis put forth in Section 4.2.7 to explain our low catch rates in 1984 suggested that low CPUE through the summer and fall months could indicate that juvenile salmonids did not extensively use nearshore habitats in the study area.



1970 Juvenile Sockeye Purse Seine Catch at Port Moller
(Drawn From Data Reported by Straty 1974)

Dames & Moore

Figure 48



Timing of Cruise 1 (1984) and Cruise 4 (1985) Relative to Port Moller Sea Surface Temperatures

Dames & Moore

Figure 49

Results from the 1985 survey conclusively show that juvenile salmonids of all species reside in estuarine and nearshore neritic habitats, and that some species appear to be obligate nearshore residents during early marine life history.

Our original explanation (Section 4.2.7) for unexpectedly low CPUE in 1984 purse seine sets was confirmed by catches in 1985. Based on calculated juvenile migration rates, it was concluded that purse seine sampling in 1984 had missed the peak of sockeye abundance in the study zone. Bay-wide migrations of juvenile sockeye in both 1984 and 1985 were dominated by smolts from the Ugashik and Egegik systems, which skewed the temporal patterns of peak abundance toward early migrations. Sampling began much earlier, in terms of spring climate, in 1985 relative to 1984, and peak sockeye migratory activity was shown to occur at water temperatures much lower than those at the beginning of sampling in 1984 (Figure 49).

4.4.2. Conceptual Model of Juvenile Sockeye Migration

Juvenile sockeye salmon are present in the NAS study area in variable numbers for a period of roughly 15 to 20 weeks, from late May to at least mid-September and perhaps October (Straty 1974). The spatial distribution of sockeye within this time frame is, of course, dynamic since juveniles apparently are moving in a unidirectional migration from inner Bristol Bay toward the outer bay. Consequently, discussions of particular features of the sockeye migration are complicated by the need to define abundance distributions with respect to both time and space. Such complex situations are simplified by collapsing the spatial domain to a fixed geographic reference point, which for convenience we have set to Port Heiden.

The distribution of sockeye abundance in the study area reflects the mixing of several major stocks in space and time. We assume that three variables essentially control mixing proportions and the resulting temporal distribution of sockeye abundance at the Port Heiden transect:

1. Timing of smolt outmigrations (i.e., relative earliness or lateness within river systems, and the chronological order of smolt outmigration between river systems).

2. Relative abundance of smolts produced by each of the major river systems.

3. Travel time from river system to the study area, which is a function of distance traveled and migration rate (in turn, a function of size) of juveniles.

These factors are examined in detail to determine their relative importance and the effects of annual variability in moderating the distribution of juveniles at Port Heiden.

Timing of annual smolt migrations from Bristol Bay river systems defines the initial day, or day 0, of the migration into the NAS study area. Annual variation in smolt outmigration timing is documented by ADF&G smolt enumeration reports to be correlated with spring climate to the extent that cold springs delay migration. Migration timing of the individual stocks is segregated to varying degrees, but it is not clear whether climatic variability affects the chronological order and temporal segregation of smolt migrations. The degree of variation in timing of smolt migrations between years was quantified by calculating the migratory time densities (Mundy 1979) for each major river system using data for 1982-85. This set of years includes two "cold" (1982, 1985) and two "warm" (1983, 1984) springs (Figure 16). Data for Ugashik and the Nuyakuk portion of the Nushagak migrations were not collected in 1982.

Analysis of migratory timing revealed that the central date of migration within stocks varies with climatic conditions over a period of 1 to 3 weeks, but the chronological sequence and temporal segregation of stock migrations are resistant to climatic variability. Migrations are earlier in warm years than in cold years for all stocks (Table 28). Egegik smolts generally migrate first, followed by Kvichak in most years, then Ugashik, Naknek, Nuyakuk, and Wood River smolts in order.

TABLE 28

CENTRAL DATES OF SOCKEYE SMOLT MIGRATIONS FROM BRISTOL BAY RIVER SYSTEMS

YEAR	KVICHAK	WOOD	NAKNEK	EGEGIK	UGASHIK	NUYAKUK
1982	6/2	7/9	6/14	6/5	---	---
1983	5/28	6/27	6/8	5/26	6/3	6/11
1984	5/28	6/22	6/7	5/27	5/31	6/4
1985	6/11	7/1	6/10	5/29	6/5	6/11
MEAN	6/2	6/30	6/10	5/30	6/3	6/9
SD (days)	6.6	7.2	3.1	4.5	2.5	4.0

Variability in earliest to latest central dates of migration generally is less for systems along the east side of Bristol Bay. The central date of Kvichak smolt migration spanned 14 days from May 28 in the warm years to June 11 in the cold spring of 1985 (Figure 17). This is a representative range of peak migration timing for Kvichak smolts. The midpoint of Wood River smolt migrations is the most variable, ranging over a 19-day period from June 22 in 1984 to July 9 in 1982 (Figure 18). This is probably typical of multi-lake systems in which the central date of migration may be influenced as much by differential timing and productivity of nursery lake substocks as by climatic factors.

Despite interannual variability in central dates of migration, variability in temporal spacing between smolt migrations is remarkably low for all stock combinations except those involving the Kvichak stock (Table 29). For example, temporal separation in central dates of the Egegik and Naknek smolt migrations for 1982-1985 was on average 11.8 days and varied by only $\pm$ 2.4 days (95 percent confidence limit) for cold and warm years combined. The Egegik migration preceded the Kvichak migration by an average of 3.3 days, but the segregation in timing of these smolt runs was not clear. In general, however, the sequence of smolt emigrations from the major river systems of Bristol Bay exhibits a rather precise linkage in order and relative timing regardless of climatic conditions.

Aside from the earliness or lateness of smolt migrations in a given year, the time of greatest sockeye abundance off Port Heiden is determined by the time and distance from the study area at which the largest concentrations of smolts enter saltwater. At the present time, smolt production from each of the major Bristol Bay river systems is routinely estimated by ADF&G from acoustic counters deployed during outmigration at the outlets of the nursery lakes. Although the Kvichak stock has the largest capacity for smolt production and typically provides the bulk of all smolts entering Bristol Bay, production is variable over two orders of magnitude from about 250,000 (1966) to nearly 250 million (1978).

TABLE 29

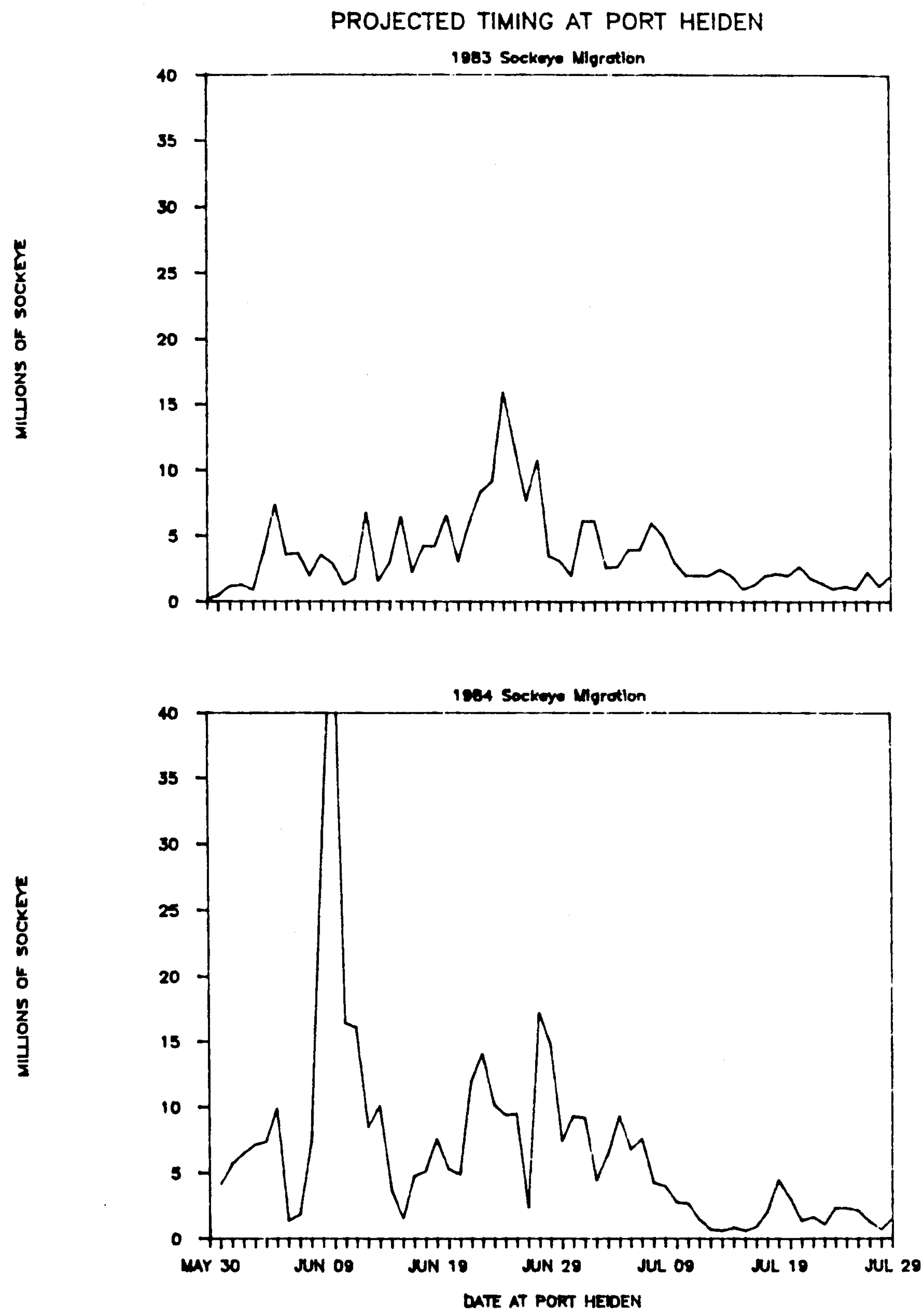
MEAN SEPARATION IN DAYS BETWEEN CENTRAL DATES OF MIGRATION FOR BRISTOL BAY SOCKEYE SMOLTS, 1982-1985 (STANDARD DEVIATIONS INDICATED IN PARENTHESES)

	KVICHAK	WOOD	NAKNEK	EGEGIK	UGASHIK	NUYAKUK
KVICHAK	0.0	25.8 (4.3)	7.0 (5.5)	-3.3 (6.8)	1.0 (5.1)	7.0 (5.7)
WOOD		0.0	-18.8 (2.6)	-30.5 (3.1)	-24.8 (2.2)	-18.8 (2.2)
NAKNEK			0.0	-11.8 (1.0)	-6.0 (1.2)	0.5 (2.5)
EGEGIK				0.0	5.5 (2.4)	11.8 (3.5)
UGASHIK					0.0	6.0 (1.6)
NUYAKUK						0.0

In both 1984 and 1985 the contributions of smolts from the Egegik and Ugashik systems predominated in the bay-wide smolt migration. The Kvichak system produced the majority of smolts in 1983. It is apparent from Table 29 that the Kvichak, Egegik, and Ugashik migrations are separated in time by only a few days, but they are separated in space by over 200 km. The effect of this distance in modifying the temporal pattern of abundance off Port Heiden is demonstrated in Figure 50, wherein Bristol Bay smolt migrations in 1983 and 1984 have been projected to their time of arrival at Port Heiden based on a fixed migration rate of 10 km/day. The early peak in 1984 represents the passage of Egegik and Ugashik sockeye, while the late peak in 1983 marks the passage of Kvichak fish. Dates of pèak juvenile sockeye abundance off Port Heiden in these projections varied by about 2 weeks.

Under fixed conditions of time and location of departure, the arrival of Bristol Bay stocks of sockeye off Port Heiden is influenced also by the migration rate of juveniles. Figure 51 illustrates the difference in temporal distributions of juvenile sockeye off Port Heiden in 1982 predicted by varying migration rate from 10 km/day for all stocks to 1 b.l./sec. for individual stocks. Peak abundance of the Kvichak stock is displaced about 3 weeks later if 1 b.l./sec.is used to calculate migration rate. Timing of the Egegik and Naknek stocks at Port Heiden would not change much in the simulations because 10 km/day is roughly equivalent to a migration rate of 1 b.l./sec.for a 115 mm juvenile, which is near the mean length of smolts leaving these rivers in 1982.

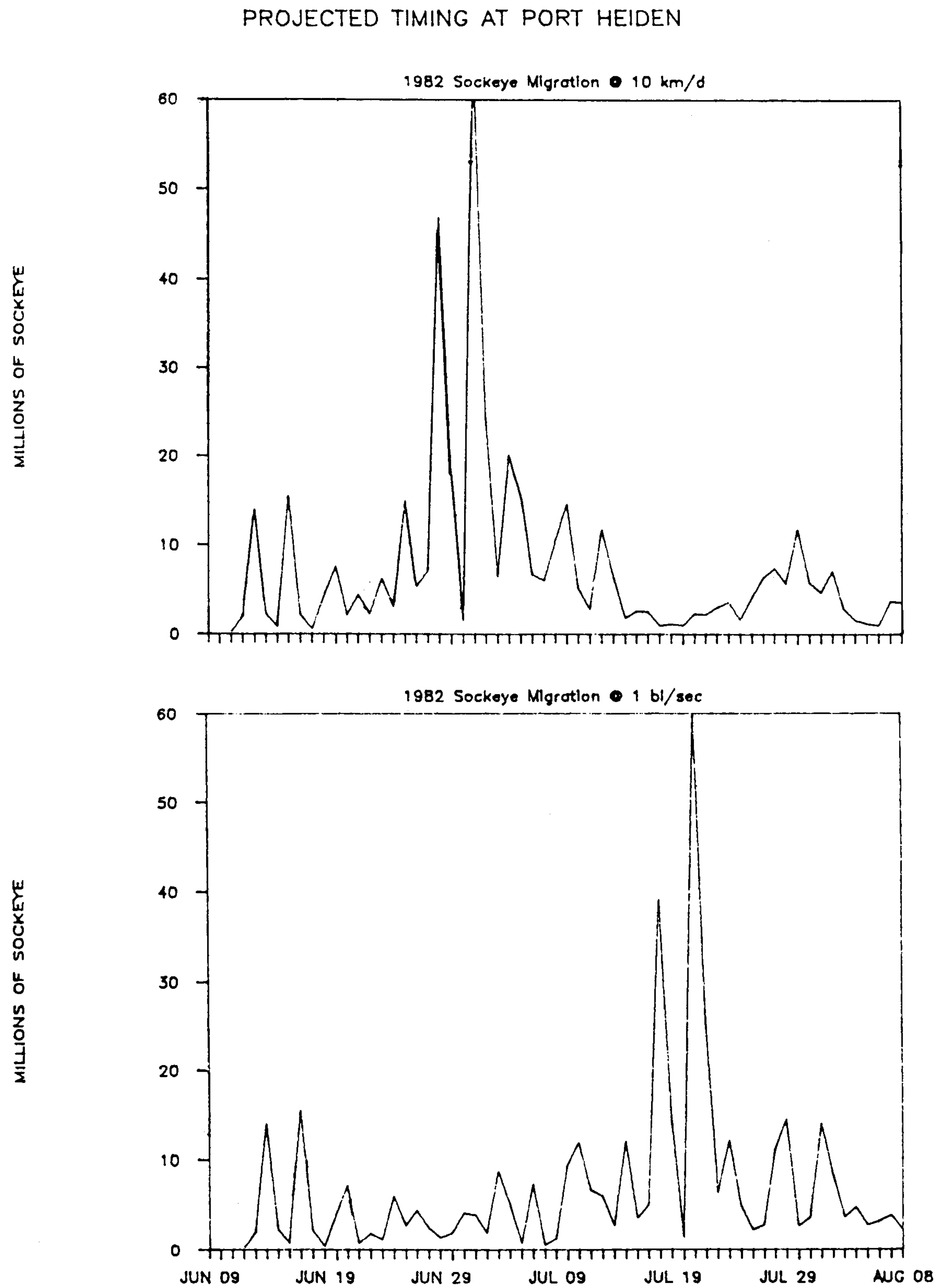
Average smolt lengths tend to be strongly stock-specific and may differ by up to 30 mm between stocks, but variation in mean smolt length within a stock probably seldom exceeds 10 mm (Figure 24). Size differences of a few millimeters would have relatively little effect on travel time to Port Heiden if swimming speed is a constant function of body length (Table 30). However, minor differences in swimming speeds could cause significant changes in migration rate and travel times. Note that a 90-mm smolt swimming at 1.5 b.l./sec. is the equivalent of a 135-mm smolt swimming at 1 b.l./sec. Since sockeye smolts can travel at



Predicted Timing of Juvenile Sockeye Migration at Port Heiden in 1983 (Top) and 1984 (Bottom) Based on Migration Rate of 10 km Per Day

Dames & Moore

Figure 50



Predicted Timing of 1982 Juvenile Sockeye Migration at Port Heiden Based on Migration Rates of 10 km Per Day (Top) and One Body Length Per Second (Bottom)

Dames & Moore

Figure 51

TABLE 30

CALCULATED TRAVEL TIMES OF JUVENILE SOCKEYE
TO PORT HEIDEN FROM RIVERS OF ORIGIN
BASED ON A SWIMMING SPEED OF ONE BODY LENGTH PER SECOND

LENGTH (CM)	MIGRATION RATE (KM/D)	TRAVEL TIME TO PORT HEIDEN (DAYS)				
		KVICHAK	WOOD	NAKNEK	EGEGIK	UGASHIK
6.5	5.6	58	52	45	27	16
7.0	6.0	54	48	42	25	15
7.5	6.5	50	45	38	23	14
8.0	6.9	47	42	36	22	13
8.5	7.3	45	40	34	21	12
9.0	7.8	42	37	32	19	12
9.5	8.2	40	35	30	18	11
10.0	8.6	38	34	29	17	10
10.5	9.1	36	32	27	16	10
11.0	9.5	34	31	26	16	9
11.5	9.9	33	29	25	15	9
12.0	10.4	31	28	24	14	9
12.5	10.8	30	27	23	14	8
13.0	11.2	29	26	22	13	8
13.5	11.7	28	25	21	13	8
14.0	12.1	27	24	21	12	7
14.5	12.5	26	23	20	12	7
15.0	13.0	25	22	19	11	7
15.5	13.4	24	22	19	11	7
16.0	13.8	24	21	18	10	7
16.5	14.3	23	20	17	10	6
17.0	14.7	22	20	17	10	6
17.5	15.1	22	19	17	10	6
18.0	15.6	21	19	16	9	6
18.5	16.0	21	18	16	9	6
19.0	16.4	20	18	15	9	6
19.5	16.9	20	17	15	9	5
20.0	17.3	19	17	14	9	5
50.0	43.0	8	7	6	3	2

sustained rates of 1 to 2 b.l./sec. (Hoar and Randall 1978), it is easily conceivable that variability in swimming speeds could differentially influence migration rates of Bristol Bay stocks.

Migration swimming speeds have not been measured directly for Bristol Bay juvenile sockeye, but available evidence suggests that 1 b.l./sec. is a likely value. Smolt marking experiments reported by Straty (1974) have been summarized in Figure 19 and Table 31. Means of migration rate estimates calculated for pooled stocks by year and for pooled years by stock converge to a grand mean of 9.6 km/day, which is very close to 1 b.l./sec. for a juvenile of average Bristol Bay size. Since swimming speed can be influenced by water temperature (Brett, et al. 1958), migration rates may be lower in cold years than in warm years.

Other sources also support an average migration rate of 1 b.l./sec. for juvenile sockeye. Bax (1985) showed by regression analysis of migration rate on fish length that Straty's (1974) mark/recapture data are best fit by a line representing a mean swimming speed of 0.9 b.l./sec. The precision of the relationship was such that there is no statistical distinction between 0.9 and 1 b.l./sec. Estimates calculated from data given in Hartt (1980) for tagged juvenile Fraser River and Skeena sockeye indicate a range in observed swimming speeds of 0.7 to 1.7 b.l./sec. and 0.7 to 1.9 b.l./sec., respectively. It is noteworthy that these estimates obtain even though Fraser and Skeena sockeye migrate north with a favorable current (Hartt 1980) whereas Bristol Bay sockeye migrate southwest against an adverse net current.

To summarize thus far, analysis of factors presumed to affect the timing of juvenile sockeye movements in the eastern Bering Sea suggests that initiation of smolt migration is variable within a stock over a 1- to 3-week period, depending on spring temperatures. Alaska Peninsula stocks tend to migrate earliest and show least variation in central date of migration, while Wood River sockeye migrate latest and show greatest variation in timing. The order and temporal segregation of stock migrations are largely independent of climatic variability. While first presence of juveniles at Port Heiden is largely a function of the timing of

TABLE 31

SUMMARY OF MEAN MIGRATION RATE ESTIMATES (KM/DAY) FOR
SOCKEYE SALMON SMOLTS MARKED BY STRATY AND JAENICKE IN STUDIES, 1967-70

YEAR		WOOD	KVICHAK	NAKNEK	UGASHIK	ALL STOCKS
1967	MEAN		9.8		3.8	5.3
	ST. DEV.		0.0		1.1	3.1
	RECOVERIES	N/A	1.0	N/A	3.0	4.0
1969	MEAN	6.5		4.6		6.4
	ST. DEV.	1.8		1.1		2.7
	RECOVERIES	28.0	N/A	9.0	N/A	37.0
1970	MEAN	3.9			6.2	5.0
	ST. DEV.	0.4			5.1	3.7
	RECOVERIES	6.0	N/A	N/A	6.0	12.0
					ALL STOCKS	6.0
YEARS	MEAN	6.1	9.8	4.6	5.4	5.8
POOLED	ST. DEV.	2.0	0.0	1.1	4.3	
	RECOVERIES	34.0	1.0	9.0	9.0	

Egegik and Ugashik smolt migrations because they are the earliest and closest systems, the center of the temporal distribution of sockeye abundance is determined by the timing of the system providing the largest number of smolts to the bay-wide migration in any year. Peak abundance at Port Heiden will occur within 1 to 2 weeks of the Egegik or Ugashik migrations if these systems produce the majority of smolts, whereas peak abundance could be as late as mid-August if Wood River produces the majority. Migration rates probably vary little within stocks but considerably between stocks if swimming speed is assumed to be approximately constant and proportional to body length. However, relatively small differences in swimming speed could profoundly alter the timing of stocks off Port Heiden. Available evidence uniformly suggests that 1 b.l./sec. is a most likely swimming speed for Bristol Bay juvenile sockeye in the nearshore areas of the eastern Bering Sea.

4.4.3 Offshore Distribution

One of the more intriguing unanswered questions about the distribution of juvenile sockeye concerns the pattern of offshore dispersion at various times and locations in the study area. While the results of this study, combined with those reported variously by Straty (1974, 1975, 1981), form a reasonably coherent description of the juvenile sockeye migration, information supporting a predictive model of migration patterns within the nearshore zone is almost totally lacking. The following section reviews empirical data on, and proposed explanations for, sockeye distributions in the study area.

The first problem in assessing distributional trends is to identify whether changes in CPUE relate to changes in absolute abundance or in distribution. The time series of sockeye purse seine CPUE at Ugashik in 1985 (Figure 28) shows diminishing sockeye densities over time that could have resulted either from declining absolute abundance in a fixed migration band, or from fixed abundance dispersing offshore with time. The pattern of estimated total daily juvenile sockeye abundance at Ugashik (Figure 30) indicates that reduced abundance probably accounts for decreasing CPUE in this case.

However, the pattern of diminishing CPUE with distance down-bay must have resulted from a changed offshore distribution, rather than lower abundance. Reduced catches at the Port Moller and Izembek Lagoon transects could indicate either that sockeye indexed at inner bay transects had dispersed uniformly in lower density across and outside the sampling area, or that the center of density of the migration had moved beyond the offshore extent of sampling in 1985. The latter argument is supported by the results of Straty (1974).

The generalized migration corridor depicted by Straty (1974) and more or less confirmed in the present study suggests that the migration of juvenile sockeye is essentially coastal within inner Bristol Bay and becomes more offshore with distance down-bay. Evidence from both studies describes a migration path compressed to within 10 nm of shore as far west as Port Heiden. Data from Straty's (1974) study indicates that the center of the migration thereafter is found 20 to 40 nm offshore.

None of the studies on juvenile salmonid migrations in the eastern Bering Sea has adequately considered an explanation for observed patterns of offshore distribution. Discussion of factors controlling the inshore/offshore distribution of sockeye necessarily is more qualitative than that relating to timing because mechanisms of dispersal have yet to be positively identified and measured. Although an innate navigational sense undoubtedly provides the major directional component to salmonid migrations, second-order interactions with the biological and physical environment likely alter migration patterns in time and space. Defining the roles and consequences of biotic and abiotic variables in modifying salmon migrations probably is the most critical remaining information need in this study.

Some studies of juvenile salmon migrations suggest that biological interactions with prey or predators drive dispersal behavior. Simenstad and Wissmar (University of Washington, personal communication) have hypothesized that the migration of juvenile chum salmon through Hood Canal, Washington reflects the movement of chum through a succession of foraging habitats. Their model suggests that growing chum move seaward in pursuit of larger prey species and higher prey densities found in neritic and offshore marine habitats. A similar mechanism has been proposed for juvenile pink salmon movements off Kamchatka (Andrievskaya 1970).

Straty (1974) and Straty and Jaenicke (1980) suggested that prey distributions may have been responsible for luring juvenile sockeye offshore near Port Moller. Straty (1974) indicated that sockeye did not feed within the inner Bay where the migration band tended to compress into coastal waters. Aggressive feeding on zooplankton was found to commence in the outer bay, where measurably higher densities of prey in offshore waters (Straty and Jaenicke 1980) could account for the offshore movement of sockeye.

Other studies suggest that the physical environment may affect migration rates and routes. Bax (1982) demonstrated a correlation between the migration rate of juvenile chum through Hood Canal and changes in residual surface outflow caused by changes in prevailing wind patterns. He concluded that juvenile chum migrations were less related to biological (prey) dynamics than to physical (circulation) dynamics.

Groot (in preparation) showed that the migration routes of juvenile salmonids from the Fraser River are strongly affected by tidal stage at entry into the Strait of Georgia. The general migration pattern is northward toward Johnstone Strait, but juveniles entering seawater on flood tides migrate in a narrow band along the eastern (mainland B.C.) shore, whereas those entering on ebbing tides are displaced as far west as Vancouver Island before beginning a northward traverse of Georgia Strait back to the mainland side.

Straty and Jaenicke (1980) cited evidence from their studies indicating that the distribution of juvenile sockeye in the eastern Bering Sea may have been correlated with water temperature to the extent that extremely cold water compressed the migration into a relatively narrow band along shore. Results from the present study shed little additional light, except to note that the proximity of very cold water near shore in 1985 coincided with a restricted offshore distribution of sockeye early in the survey. Whether or not warming of coastal waters permits a wider offshore dispersal of later sockeye migrants was not demonstrated because of the incomplete temporal coverage in each year of this study.

It is clear that numerous potential explanations for salmonid migration patterns may be applicable to Bristol Bay and the eastern Bering Sea. At the present time, however, an information base of sufficient scope and resolution to permit hypothesis testing does not exist for the region. Simple biological explanations are confounded by the tremendously complex and dynamic physical environment. Hypotheses about the influence of physical factors on migration patterns simply cannot be evaluated because relevant physical processes have not been studied at necessary levels of resolution. It is our conclusion that a complete understanding of migration dynamics awaits a fuller description of the nearshore marine ecosystem and the place of juvenile salmonids in it.

4.5 NONSALMONIDS - 1984

4.5.1 General Distribution

Of the 47 identified nonsalmonid fish species captured in 1984, 13 are generally considered pelagic and 30 are considered demersal. The remaining four species (Pacific cod, Pacific sandfish, walleye pollock and whitespotted greenling) all are often labeled as demersal. However, these species were also caught well off the bottom in the purse seine (Table la) either in juvenile stages (which are truly pelagic) or, in the case of Pacific sandfish, as larger individuals. Other species such as Pacific sand lance are found in both pelagic and demersal habitats at various times in their life history. The bulk of purse seining and tow netting was done in relatively shallow water (10 to 11 m and less for the tow net). In some cases, the seine and the tow net actually contacted the bottom. Therefore, truly demersal species may appear in these gear types that target on pelagic species.

It is noteworthy that two species reported in abundance in the nearshore areas of Bristol Bay (longhead dab, and capelin; Section 2.2.2) were not prominent in our catches, while Pacific cod, sand lance, and walleye pollock were more dominant in our catches than would be suggested by previous work, perhaps due to our smaller mesh sizes.

4.5.2 Pelagic Fish Species - 1984

"Pelagic" fish species dominated the 1984 catches. Of the five most abundant fish species in our catches (Table 1a) only Pacific sand lance and rainbow smelt are primarily thought of as pelagic. However, over 62 percent of the total numbers of fish caught were Pacific sand lance. In addition, juveniles of two demersal fish (Pacific cod and whitespotted greenling) were among these top five species, and were more abundant in the pelagic habitat than were larger members of these species in the demersal habitat.

Other, primarily pelagic species captured in significant numbers included Pacific herring (third in tow net catches) and surf smelt (third in beach seine catches) as well as juvenile and adult salmonids. Walleye pollock and Pacific sandfish, both primarily demersal species, ranked fourth and fifth overall in purse seine catches.

The general distribution and observed size patterns of dominant pelagic species are described below.

Pacific sand lance

The Pacific sand lance, *Ammodytes hexapterus*, was by far the most numerically dominant species in this study, comprising 62.5 percent of all fish captured in 1984. Sand lance was the most abundant species in both the beach seine and tow net catches. It also ranked second to Pacific cod in purse seines and fourth in otter trawl. This catch distribution illustrates the wide variety of habitats both pelagic and benthic, inshore and offshore used by this species at various times. These results seem to confirm this species' role as one of, if not *the*, most important forage fish in this part of the Bering Sea.

Sand lance were widely but irregularly distributed throughout the study area. As with other species, major concentrations in a few catches largely drove the apparent distribution pattern (Figures 9, 12 and 13). Beach seine catches of sand lance were greater on protected beaches, with mean catches as high as 2,360 fish in 13 sets (all cruises combined) inside Port Moller. This high catch rate was largely the result of a single haul total of over 28,000 individuals at Station 8 (Shingle Point, Herendeen Bay) in Port Moller on Cruise 1. Catches in excess of 1,000 in a haul were also recorded at Station 6 inside Harbor Point in Port Moller and on the exposed beach of Transect 3, all during Cruise 1. During Cruise 1 (late June to mid-July), in all 6 of the 10 beach seine hauls that captured sand lance, the smallest catch was 521. All sand lance were taken on Transects 3 and 4 in this cruise. Overall average catch per set was 5,107 fish in protected beach stations and 493 fish per set on exposed beaches.

In subsequent sampling periods there was a sharp, progressive decline in catches. The average on protected beaches dropped from 5,107 to 20.5 and 4.1 per set in Cruises 2 (late July to mid-August) and 3 (late August to mid-September), respectively, while the average on exposed beaches dropped from 492 to 25.3 to 0 in the three cruises (Figure 12).

Sand lance strongly dominated tow net catches during the first cruise at outside stations (about 900 per haul, n=8; Figure 13), but, surprisingly, were not taken in tow nets inside protected waters (only Port Moller sampled; n = 4). In Cruise 2, tow net catches of sand lance in protected waters (over 1,000 per haul; n = 10) exceeded those in outside waters (about 800 per haul), indicating a shift away from the beaches and into midbay area by mid-summer. By late summer (Cruise 3) average tow net catches at both inside and outside stations fell to less than 5 per set, suggesting, along with beach seine results, a strong offshore movement. This movement may have been confirmed by purse seine catch (outside stations only) which jumped from less than about 4 per set in Cruises 1 and 2 to over 30 per set in Cruise 3 (Figure 9). Otter trawl catches at outer stations also tended to increase slightly from Cruise 1 through Cruise 3. However, significant catches of sand lance in the otter trawls (greater than 10 in a trawl) occurred only on Transect 6, Cruise 3 (replicate hauls at Station 8 inside the north entrance to Izembek Lagoon captured 672 and 232 sand lance). Thus, not all sand lance had left Izembek by Cruise 3. This transect was, however, the first sampled on Cruise 3 and the offshore movement suspected at other transects may not have occurred yet in the southern part of the study area.

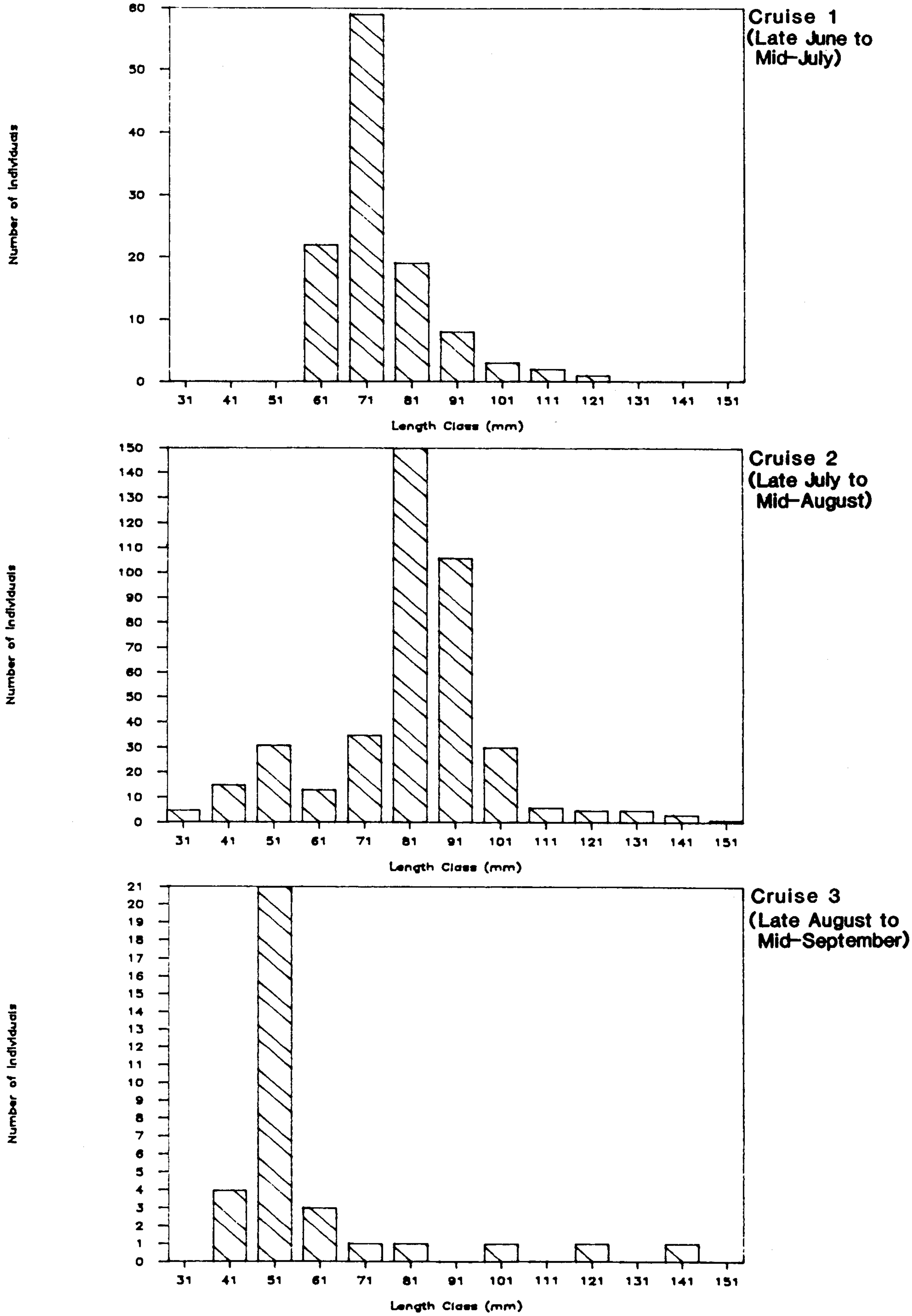
Three distinct size classes of sand lance were evident in our catches. In Cruise 1, the mode in beach seines was 71 to 80 mm (Figure 52) while a large size class (121 to 130 mm) dominated purse seine catches offshore. These two size groups were evident in the respective gears in Cruise 2, but a new group (41 to 60 mm) appeared in the beach seines. This group (now 51 to 70 mm) dominated in beach seines and otter trawls during Cruise 3. It was also strongly represented in purse seine catches which, unlike the other gear types, included all three size groups in Cruise 3. Overall, the beach seine was more effective on smaller fish than the purse seine, through which we observed small fish passing.

Rainbow smelt

The second most abundant pelagic species in our 1984 catches was the rainbow smelt (Osmerus mordax) which comprised 9.4 percent of the total catch (ranked second in both the beach seines and tow nets). Beach seine catches were greater on exposed than on protected beaches (Figure 13) during the first (late June to mid-July) and third (late August to mid-September) cruises. This relationship would likely have held in the second cruise (late July to mid-August) as well except for good catches in Ugashik Bay (Transect 0) which was not sampled on other cruises. There was a steady increase in catch of rainbow smelt over the sample period (all transects combined) at exposed stations (from 5.5 to 30.5 to 83.6 per set for Cruises 1, 2, and 3, respectively). The maximum catch in any set (284 fish) occurred in Cruise 3 on the exposed side (Station 5) of Harbor Point in Port Moller.

There was a clear trend for decreasing rainbow smelt catches in beach seines from inner to outer Bristol Bay at exposed stations (Figure 13). This trend would hold for sampling in embayments as well except for significant catches inside Izembek Lagoon on Cruise 2.

Tow net catches of rainbow smelt were generally insignificant except for two replicate hauls inside Ugashik Bay on Cruise 2 which



Length-Frequency of Pacific Sand Lance in Beach Seines,1984
(all transects and stations combined)

Dames & Moore

Figure 52

netted an estimated 2,800 and 4,200 fish. Rainbow smelt were generally poorly represented in the purse seine catches as well, with most of the catch during the third cruise on Transect 2 and 4 (Figure 9). All purse seine caught rainbow smelt were taken at the shallowest station seined (Station 3; 11 m) perhaps indicating a nearshore orientation of this species.

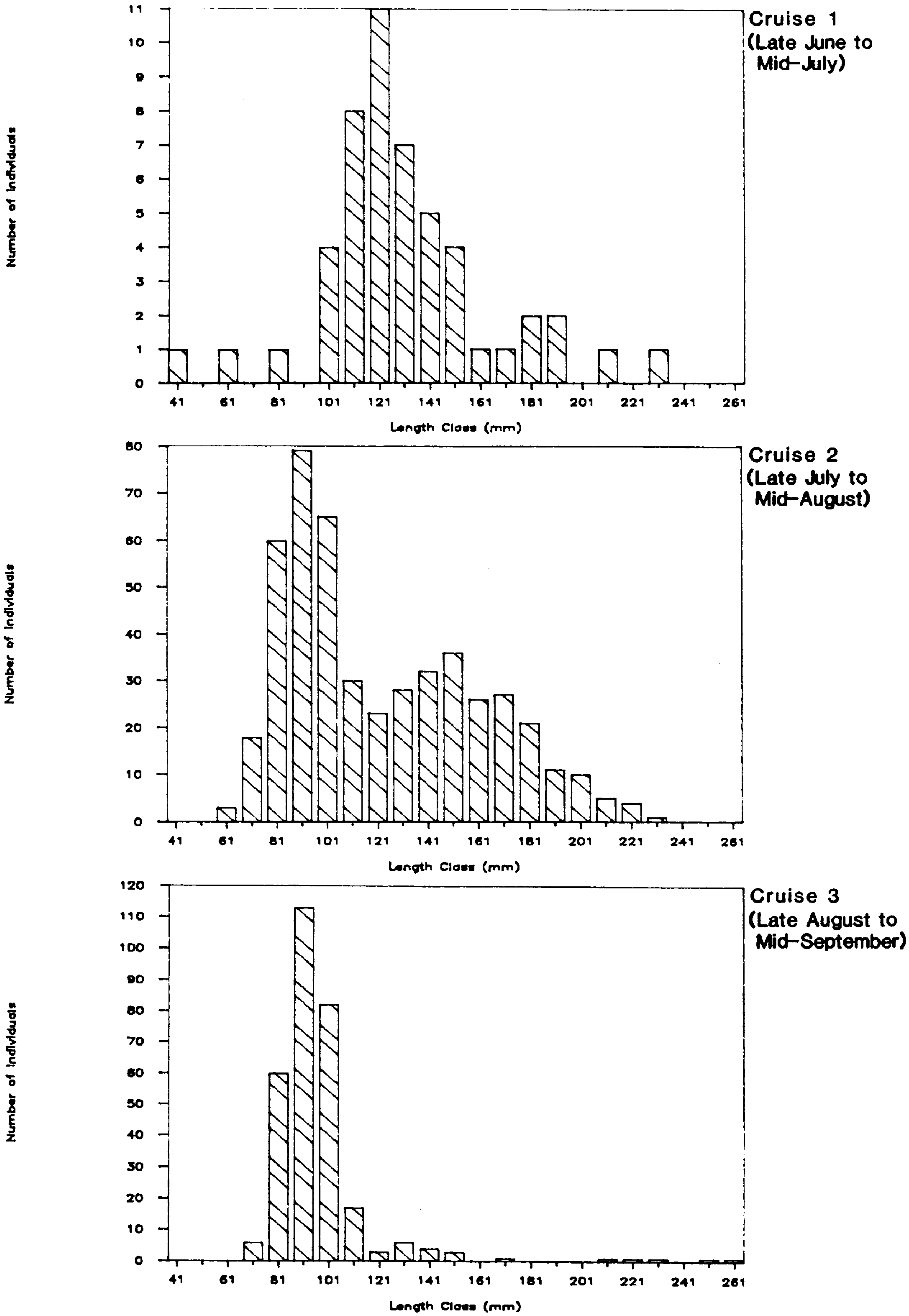
Rainbow smelt were widely distributed in otter trawls, occurring in 32 percent of all trawls. Catches never exceeded 35 per trawl, with maximum catches in Cruise 3 at the nearshore stations (6-m depth; station 4) on Transect 1 and 3. These catches emphasized a pattern of increasing rainbow smelt catch at outside (primarily shallow) stations with time and decreasing catch rates from inner to outer Bristol Bay.

During Cruise 1 beach seine (Figure 53) and otter trawls, the dominant size class of rainbow smelt was in the 111 to 130 mm range. Cruise 2 beach seines displayed a bimodal distribution of fish with peaks at 91 to 100 and 151 to 160 mm. This latter mode may represent growth of the dominant mode from Cruise 1. In Cruise 3, older fish had moved offshore leaving only a strong mode in the 80 to 109 size range in the beach seines. Offshore, purse seines took only fish greater than 130 mm during Cruise 3.

Pacific herring

Pacific herring (Clupea harengus pallasi) were taken only occasionally in tow nets and purse seines during 1984, yet they were the third most abundant species overall in tow net catches. This low catch rate is somewhat surprising considering the known spawning of herring in Port Moller in May and June and their presumed summer and fall migration route through the study area from major spawning areas on the north side of Bristol Bay (Thorsteinson and Thorsteinson 1984).

In our 71 purse seine sets only four herring were caught: two in Cruise 2 and one each in Cruise 1 and 3. In the tow nets, herring were only captured in Cruise 1 (one fish at Station 11, inner Port Moller) and Cruise 3 (736 fish at stations 4 and 7 in the entrance to, and



Length-Frequency of Rainbow Smelt in Beach Seines, 1984
(all transects and stations combined)

Dames & Moore

Figure 53

inside of Port Moller). Of these fish, more (72 percent) were taken at the inner bay stations. These fish were all young-of-the-year (37 to 55 mm) probably from the earlier spawning in Port Moller. Possibly these fish spawned in the Port in the spring and remained inside, recruiting to our gear by early fall (September). The June 26 start date was too late to capture adult herring.

Surf smelt

Surf smelt (*Hypomesus pretiosus*) was the third most abundant species taken in 1984 beach seines. Surf smelt were captured in beach seines only in Cruises 2 and 3 with the vast majority (98 percent) in Cruise 3 (late August to mid-September). Also they were captured only on Transects 4 (Port Moller) and 6 (Izembek) with the majority (about 90 percent) on Transect 6. The greatest single catch (121 fish) was on the exposed side of a sand bar in the north entrance to Izembek Lagoon. This catch included two distinct size classes, with peaks at 40 to 60 mm and 160 to 200 mm.

4.5.3 Demersal Fish Species - 1984

On the basis of numbers, fewer fish were taken in demersal than in pelagic habitats (assuming the sand lance catch in beach seines to be pelagic). However, in total weight caught, species like yellow-fin sole and rock sole included large individuals that in many cases equaled the remainder of otter trawl catches (in weight). Otter trawl catches generally exceeded the weight of most tow net and purse seine hauls. Considering the small size of the otter trawl used, one could speculate that even larger individuals or greater numbers of large individuals of these species were present and avoided the small net opening.

Therefore, to initially examine overall demersal fish distribution from otter trawls, we chose to look at mean weights of catches with all species combined. Catch distribution was examined by cruise (time) and by area (inner, middle and outer bay; inside [protected] bay versus outside [exposed] stations). Mean-weight-per-trawl data are summarized in

Table 32, Figures 54 through 57, and Appendix E. Where data are missing for a cruise, that station was not sampled at that time by otter trawl.

The outside stations (1-4) displayed no consistent catch patterns over the sampling period (Figure 54). Greater weights per tow of demersal fish were taken at Transects 2, 3, and 4 in Cruise 1 (late June to mid-July). Cruise 3 (late August to mid-September) catches were a little higher in weight per tow on Transect 6 but this transect was not fished during Cruise 1 (Figure 54).

The average weight of fish caught in outside station otter trawls in all cruises by station and transect are presented in Figure 55. Transects 1, 3, and 6 all yielded high overall catches (> 6.2 kg per haul); Transect 5, the lowest catches (1.4 kg per haul, Table 32). The stations closer to shore (3 and 4) yielded heavier otter trawl catches on Transects 1, 3, and 6 (Figure 55). Catch at the outside station (2) was relatively greater than one (or both) of the inner stations at Transects 2, 4, and 5. Bottom type (soft versus harder bottoms) may be a greater factor than depth in shifting species dominance from generally larger flatfish on softer bottoms to generally smaller sculpins on harder bottoms. On Transect 5, rocky bottom conditions at some stations may have affected otter trawl efficiency. More fish may have been missed or lost than were captured because of problems encountered in trawling on harder bottom. Sampling inside embayments was not consistent, with only Transect 4 trawled during all cruises (Figure 56). Catches were greatest during Cruise 2.

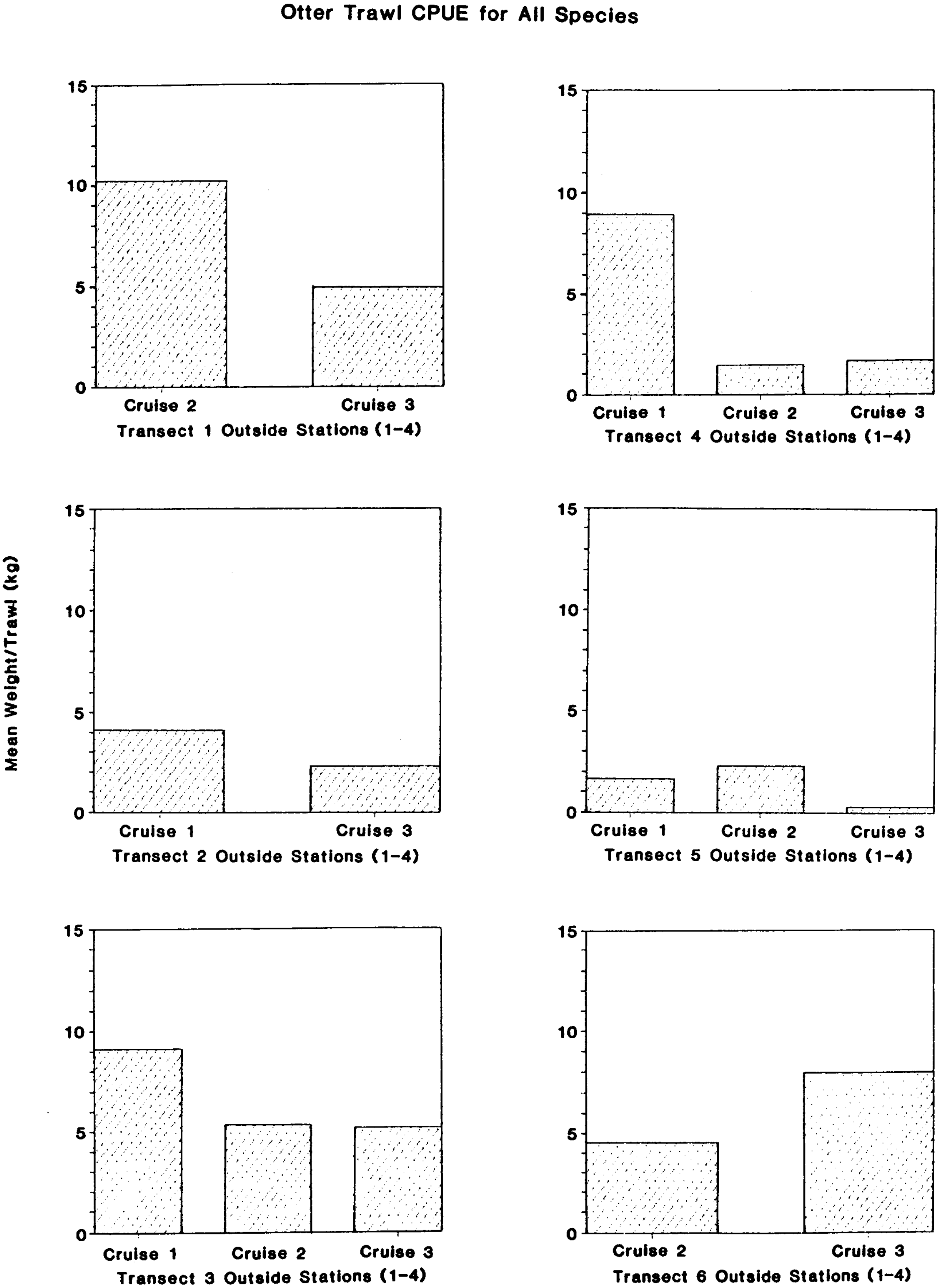
Mean otter trawl catches are displayed by station for each transect (all cruises combined) on Figure 57. Station 3 yielded markedly higher catches than other stations on Transects 1, 2, and 6. Transect 4 had generally increasing catches of demersal fish as sampling moved closer in-shore (Stations 2 to 4) and continued to increase in inside waters (Stations 7 through 11). However, a similar pattern of increase in average weight per trawl did not hold for Transect 6. No inside stations were otter trawled at Transect 2 (Port Heiden).

TABLE 32

TOTAL FISH CATCH IN OTTER TRAWLS
(mean weight per set, grams)

Station	Cruise 1	Cruise 2	Cruise 3	Mean	Standard Deviation
Transect 1					
1.0					
2.0		1707.5	449.5	1078.5	629.0
3.0		19009.5	11549.0	15279.3	3730.3
4.0		9984.5	2816.5	6400.5	3584.0
5.0					
mean		10233.8	4938.3	7586.1	
std dev		7065.7	4773.3		
Transect 3					
1.0					
2.0	5864.0	1696.5	1787.5	3116.0	1943.5
3.0	3875.5	11737.5	5499.0	7037.3	3389.0
4.0	17584.0	2537.0	8297.0	9472.7	6198.9
5.0					
mean	9107.8	5323.7	5194.5	6542.0	
std dev	6048.3	4548.2	2666.2		
Transect 5					
1.0					
2.0	35.0	4213.0		2124.0	2089.0
3.0	745.5	1056.0	25.0	608.8	431.9
4.0	4280.5	1659.0	560.0	2166.5	1560.7
5.0					
mean	1687.0	2309.3	292.5	1429.6	
std dev	1856.7	1368.4	267.5		

Station	Cruise 1	Cruise 2	Cruise 3	Mean	Standard Deviation
Transect 2					
1.0			1758.5	1758.5	0.0
2.0	2461.0		1194.0	1827.5	633.5
3.0	7730.0		5739.5	6734.8	995.3
4.0	2156.5		452.5	1304.5	852.0
5.0					
mean	4115.8		2286.1	3201.0	
std dev	2558.6		2046.9		
Transect 4					
1.0					
2.0	9230.0	1250.0	736.0	3738.7	3888.6
3.0	8614.0	459.5		4536.8	4077.3
4.0	8953.0	2532.5	2618.5	4701.3	3006.6
7.0	8055.0	4710.0	2337.5	5034.2	2345.4
10.0	5527.0	23962.5	1235.0	10241.5	9859.2
11.0	14520.0	15723.5		15121.8	601.8
mean	9149.8	8106.3	1731.8	6329.3	
std dev	2692.4	8732.4	773.2		
outside	8932.3	1414.0	1677.3	4007.9	
stations	251.9	854.2	941.3		
inside	9367.3	14798.7	1786.3	8650.8	
stations	3786.8	7887.0	551.3		
Transect 6					
1.0					
2.0		2636.5	3130.0	2883.3	246.8
3.0		3974.0	18260.0	11117.0	7143.0
4.0		7021.0	2578.0	4799.5	2221.5
7.0		4904.0	383.5	2643.8	2260.3
8.0		1245.5	1076.5	1161.0	84.5
9.0		3527.5	1698.5	2613.0	914.5
mean		3884.8	4521.1	4202.9	
std dev		1804.4	6210.5		
outside sta		4543.8	7989.3	6266.6	
		1834.8	7266.0		
inside sta		3225.7	1052.8	2139.3	
		1508.7	537.1		

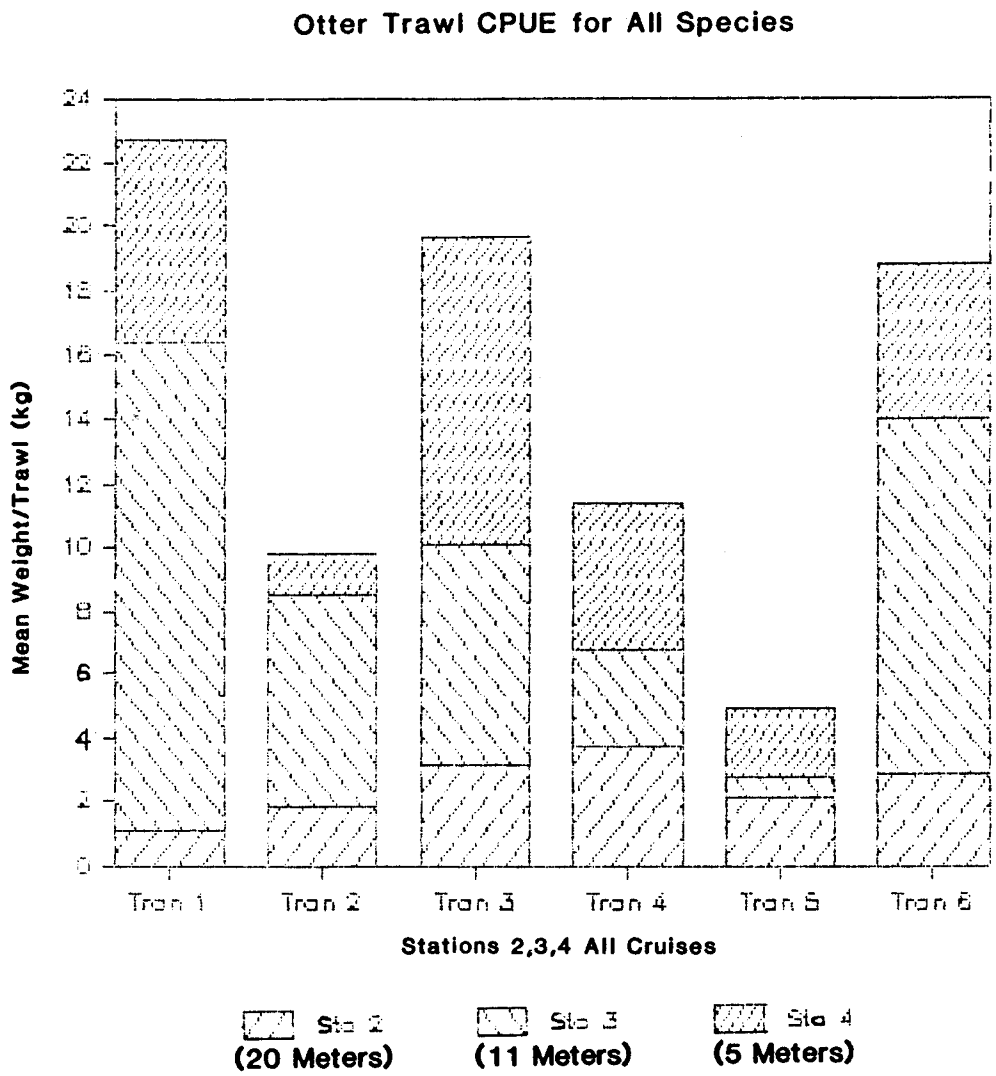


Mean Weight (kg) of Fish Taken in 1984 Otter Trawls

by Cruise at Outside Stations (1-4)

Dames & Moore

Figure 54

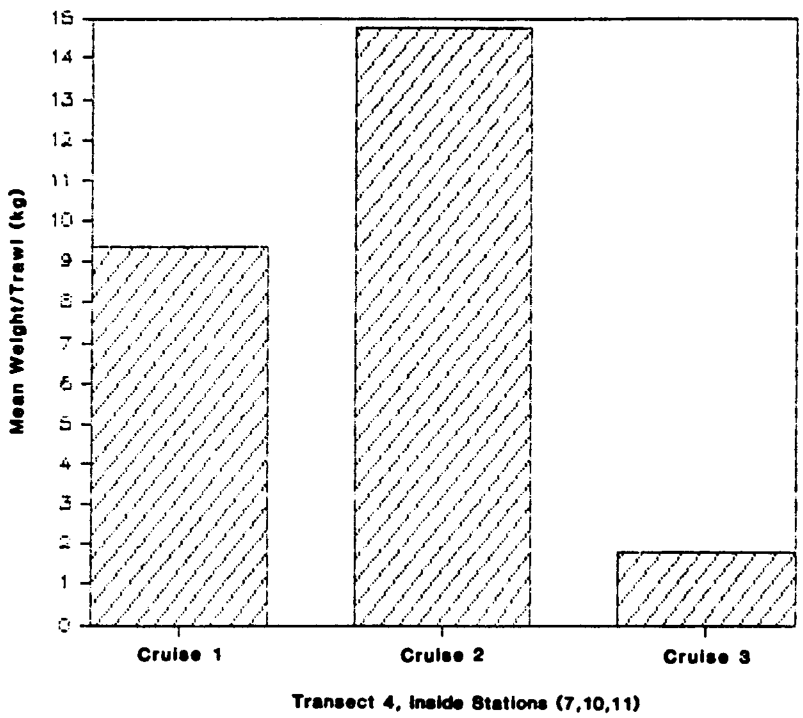


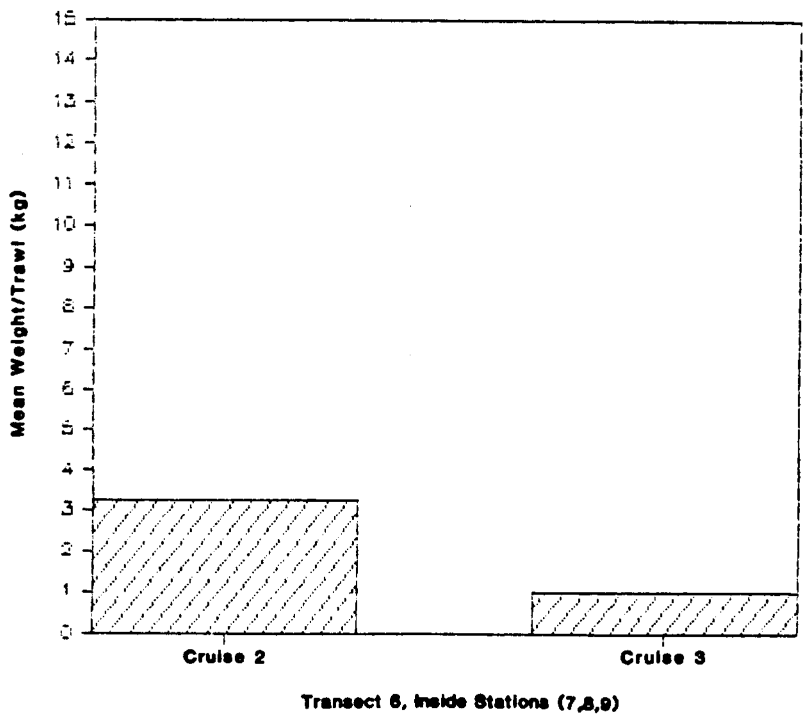
Mean Weight (kg) of Fish Taken in 1984 Otter Trawls by Transect for Stations 2, 3, and 4
(all cruises combined)

Dames & Moore

Figure 55

Otter Trawl CPUE for All Species

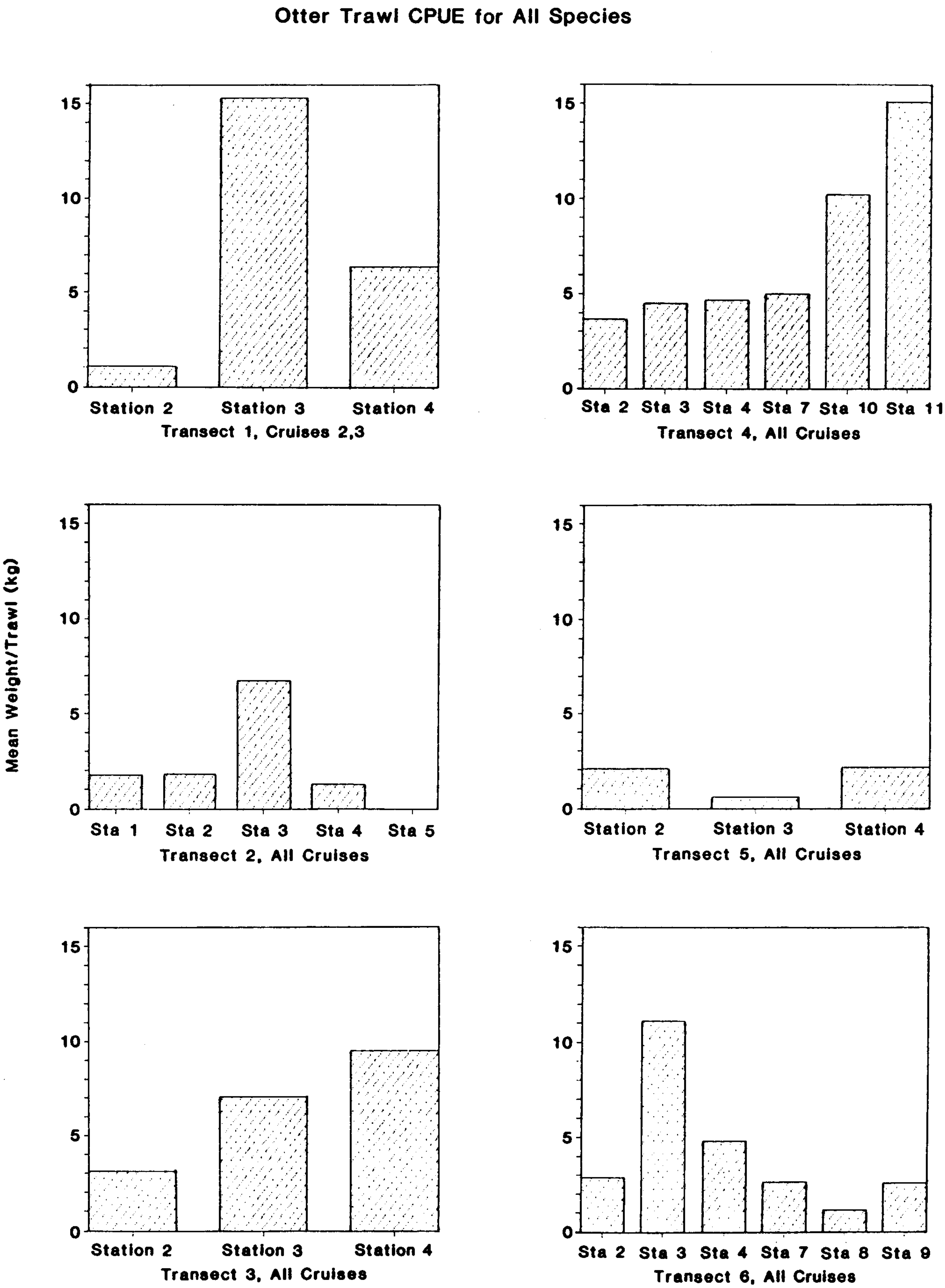




Mean Weight (kg) of Fish Taken in 1984 Otter Trawls by Cruise at Inside Stations

Dames & Moore

Figure 56



Mean Weight (kg) of Fish Taken in 1984 Otter Trawls by Transect and by Station

Dames & Moore

Figure 57

All evaluations that follow are based on numbers, not weight of species caught.

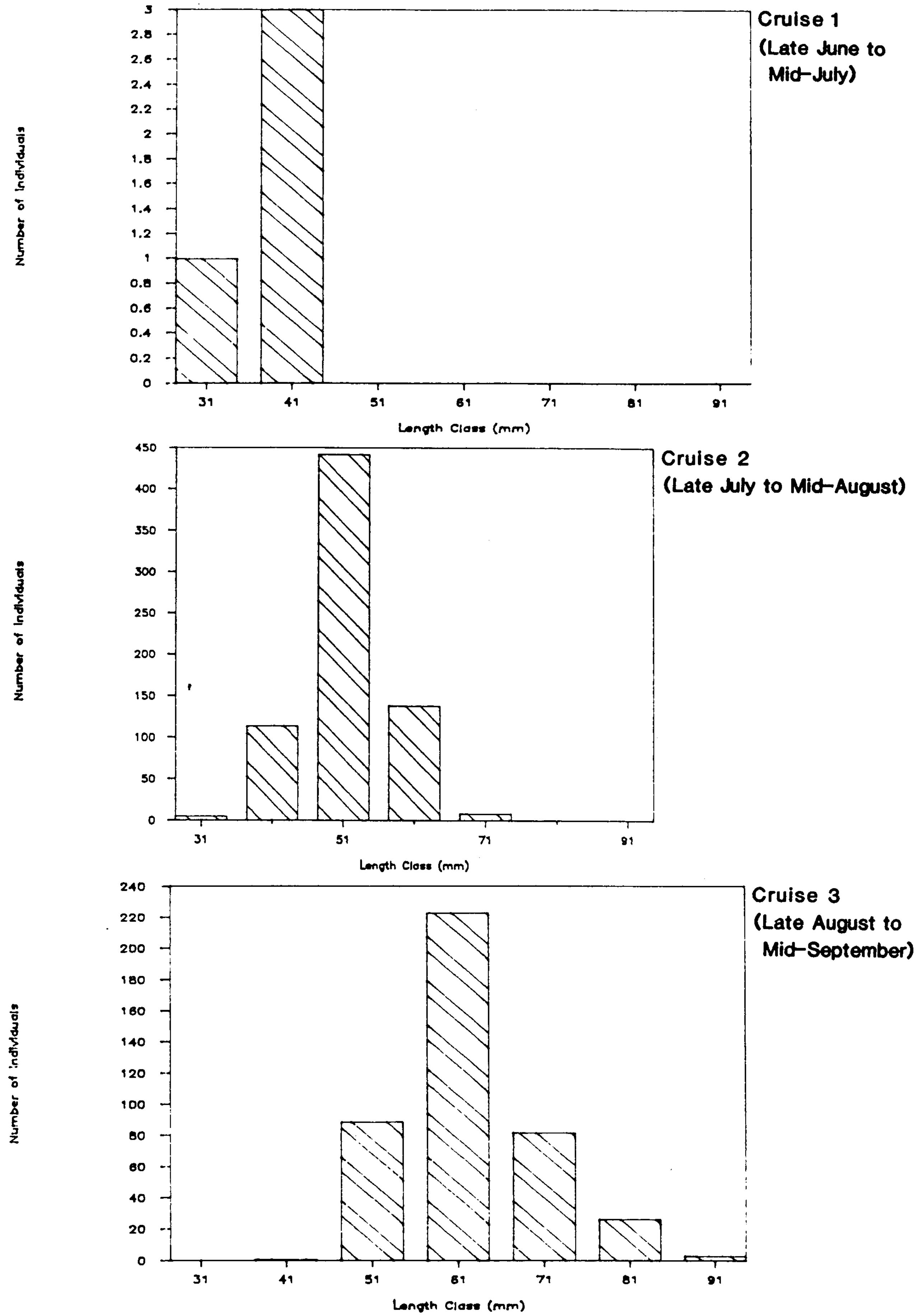
Pacific cod

The Pacific cod (Gadus macrocephalus) ranked fourth numerically, accounting for about 8 percent of our total 1984 catch in all gear. Cod were taken in the pelagic environment as well as on the bottom in about equal numbers overall, ranking first in purse seine and second in otter trawl catches (Table 1a). Many of the unidentified cod from Cruise 1 were probably this species, as well. Moreover, the numbers retained in the purse seine are but a small portion of those cod encircled in some sets. The small size of these fish (and the walleye pollock juveniles sometimes mixed with the cod), 30 to 50 mm (mean of 45.8 mm) in Cruise 1, often allowed more to pass through the seine web than were captured. The fewer numbers of Pacific cod taken in the otter trawl outweighed the purse seine catches of cod because individuals were generally larger.

Cod numbers in otter trawls increased with time in both inside and outside areas, although this may merely reflect increased retention of smaller fish in the gear (Figure 12). Outside stations had slightly higher average numbers of cod caught when compared with inside stations. As juveniles in the pelagic habitat, cod also were much more abundant in purse seine sets in Cruises 2 and 3 compared to Cruise 1 (Figure 9). By Cruise 3, the young-of-the-year cod were in the 50 to 80+ mm size range (mean of 66.9 mm in purse seines, Figure 58). No large Pacific cod (> 279 mm) were taken with the otter trawl in any cruise, indicating larger cod were either outside of our sampling area or missed by our small trawl.

Cod numbers were higher at outside (exposed) stations in inner bay (Transects 1 and 2) otter trawls, with middle and outer bay transects about equal with all cruises combined (Figure 13). At inside (protected) stations, Izembek Lagoon had slightly higher catches of cod than did stations inside Port Moller.

In the pelagic environment, cod juveniles in purse seine catches were least abundant in the middle area (Transects 3 and 4).



Length-Frequency of Pacific Cod in Purse Seines, 1984
(all transects and stations combined)

Dames & Moore

Figure 58

Yellowfin sole

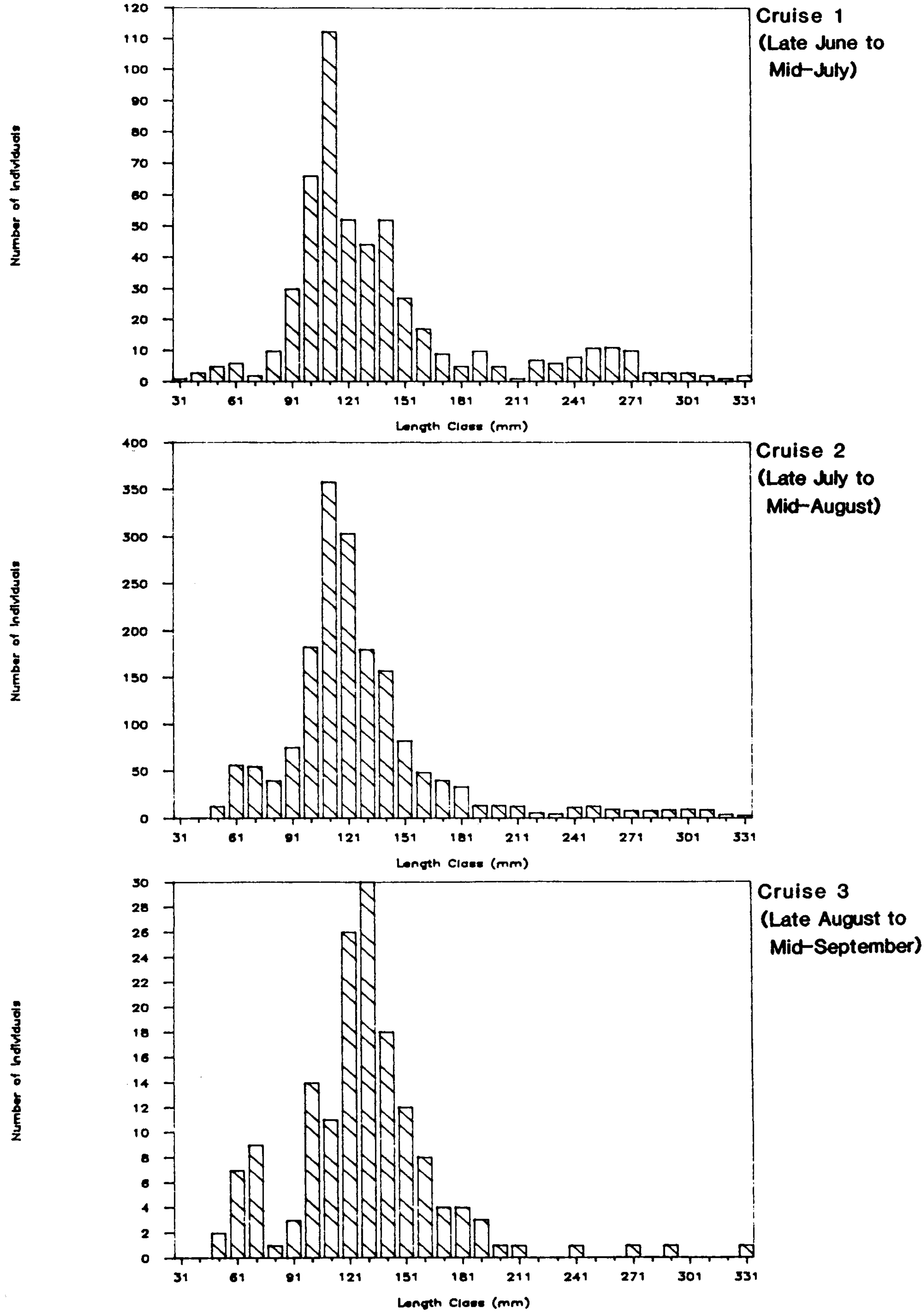
The yellowfin sole (Limanda aspera) was the most numerous fish in otter trawls and was the second (to Pacific sand lance) most numerous fish overall in 1984 (10 percent of all fish caught). In terms of weight, this species dominated every trawl set except for a few instances where several larger rock sole or a few large starry flounder dominated the weight of fish captured.

Yellowfin sole catches showed a slight (likely insignificant) downward trend by cruise, or with time, at both inside and outside stations. Catches in outside waters were quite similar in inner, middle, and outer bay areas (Figure 13). Of inside stations, yellowfin sole catches were higher in Port Moller than in Izembek Lagoon (no otter trawls were made in Port Heiden).

A broad range of sizes (< 50 to > 300 mm) of yellowfin sole was present in otter trawls from all cruises, both in inside and outside waters (Figures 59 and 60). Mean size of all yellowfin sole was similar in inside and outside otter trawls in Cruises 1 and 2,although the mode for the dominant year-class was smaller at the outside stations. Average size was distinctly greater at outside stations during Cruise 3,with the virtual absence of larger fish (> 200-m) from inside stations and a greater proportion of smaller size classes at outside stations. Three or four year classes were likely present at both inside and outside stations in Cruises 1 and 2, with only two likely present at inside stations in Cruise 3. Yellowfin sole in our otter trawls had mean lengths similar to those reported by Baxter (1976), but our catches included both larger and smaller fish than the range taken in his Bristol Bay sampling.

Rock sole

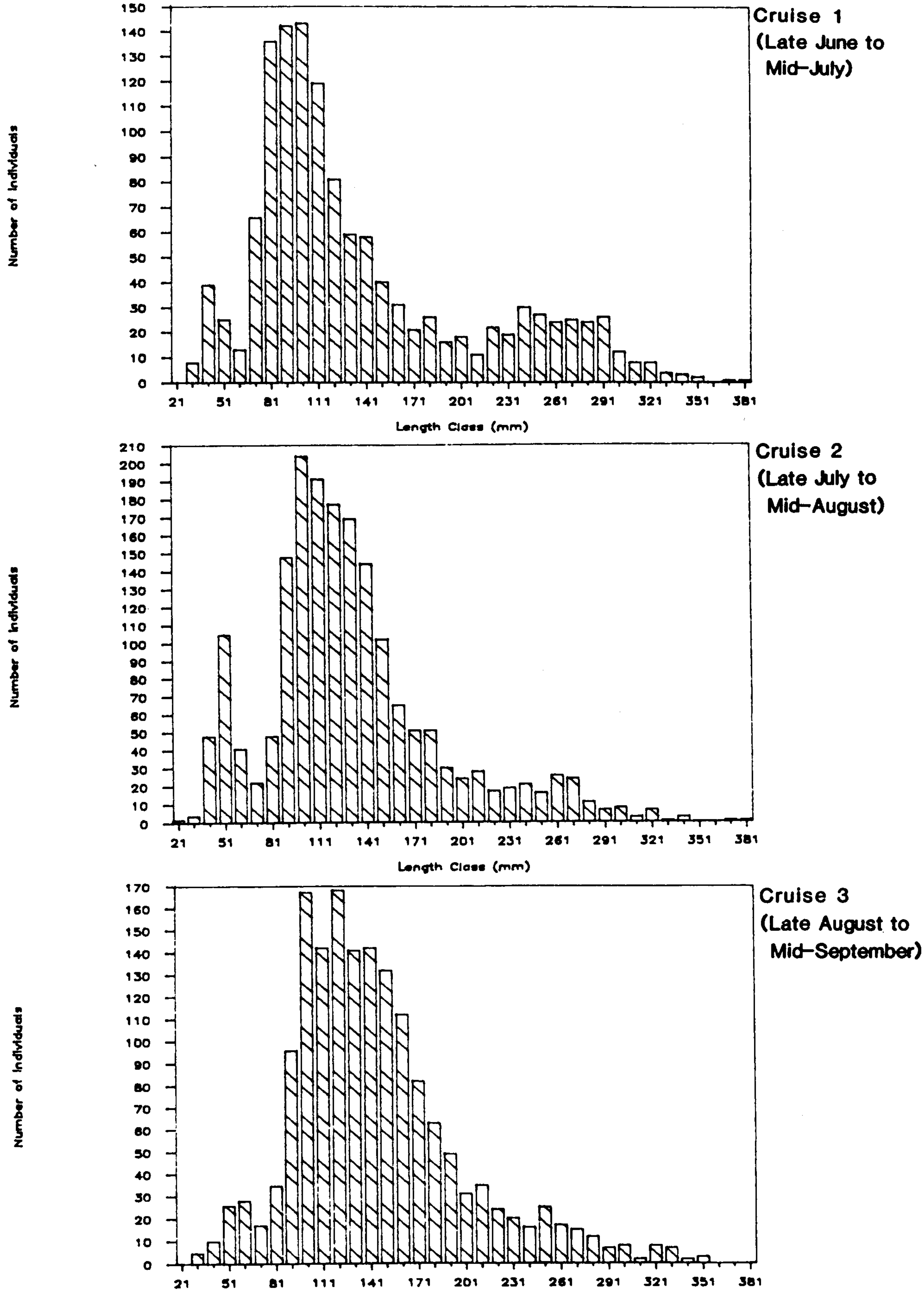
Rock sole (Lepidopsetta bilineata) ranked sixth numerically in our total 1984 catch for all gear types and third behind yellowfin sole and



Length-Frequency of Yellowfin Sole in Otter Trawls at Stations Inside Embayments, 1984
(all transects combined)

Dames & Moore

Figure 59



Length-Frequency of Yellowfin Sole in Otter Trawls at Coastal (Outside) Stations, 1984
(all transects combined)

Dames & Moore

Figure 60

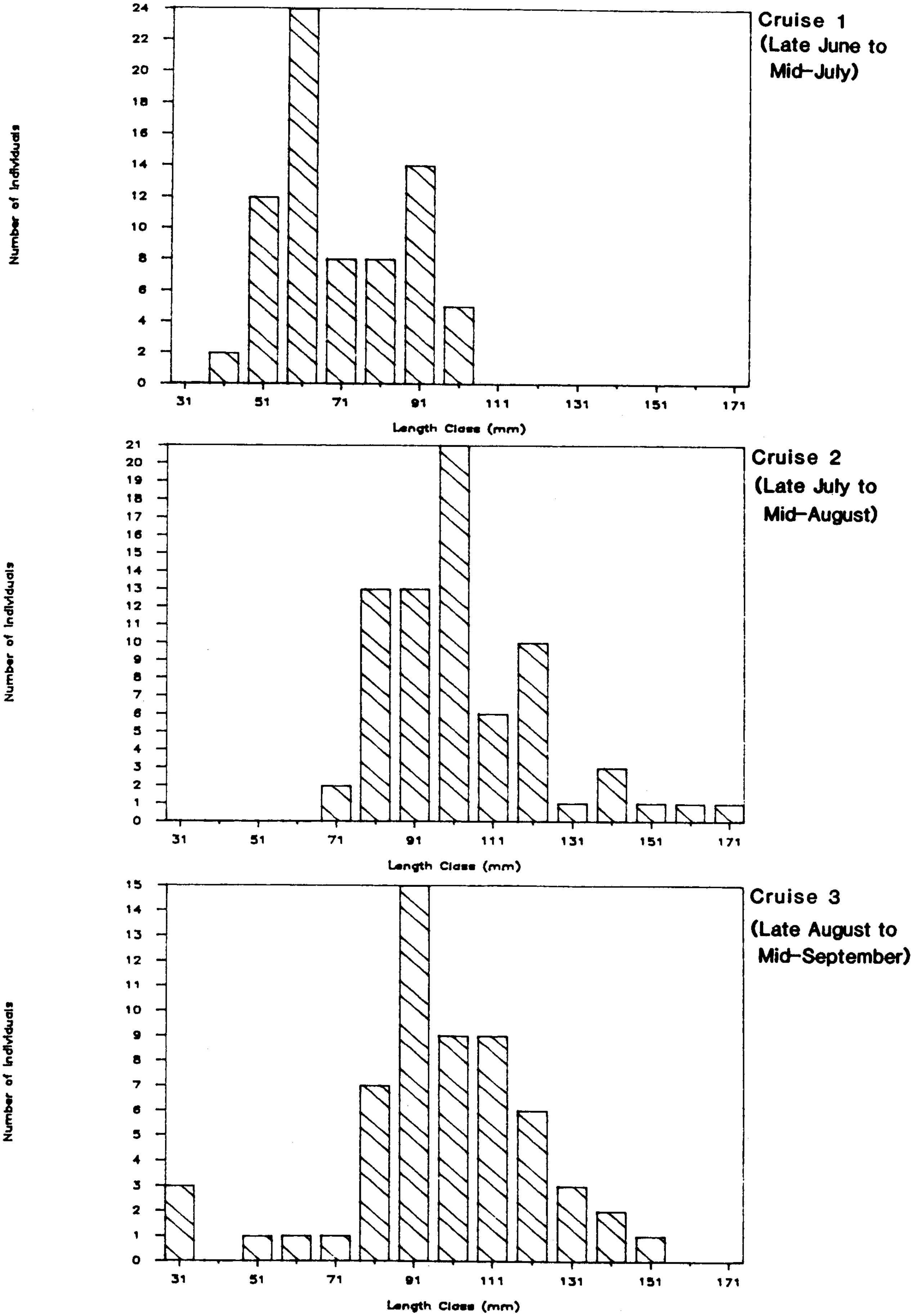
Pacific cod in otter trawl catches (Table la). As mentioned above, a few larger rock sole would often dominate specific trawls much like yellowfin sole and starry flounder. Like yellowfin sole, this demersal species was taken incidentally in purse seine sets, and a small number was taken in beach seines (Table la).

Rock sole numbers in otter trawl catches declined with time especially at outside stations (Figure 12). Rock sole were somewhat more numerous in Cruise 1 and 2 inside stations as compared to outside stations. There was little difference in rock sole numbers caught between inner, middle and outer bay areas at outside stations.

No large rock sole (< 172 mm) were taken in any otter trawls at inside stations (Figure 61). During Cruise 1 this resulted in a much greater mean length at outside (93.3 mm) vs. inside (75.3 mm) stations. In Cruise 2 this difference in mean size was negated by recruitment of a new group of fish in the 25 to 40 mm size range at outside stations (Figure 62) where the size of all rock sole taken ranged from 25 to 331 mm (compared to a range of only 80 to 172 mm at inside stations). In Cruise 3, this smallest size class had recruited at inside stations as well (Figure 61). At outside stations it had merged with the broader dominant size mode (Figure 62), which likely contained three year-classes.

Whitespotted greenling

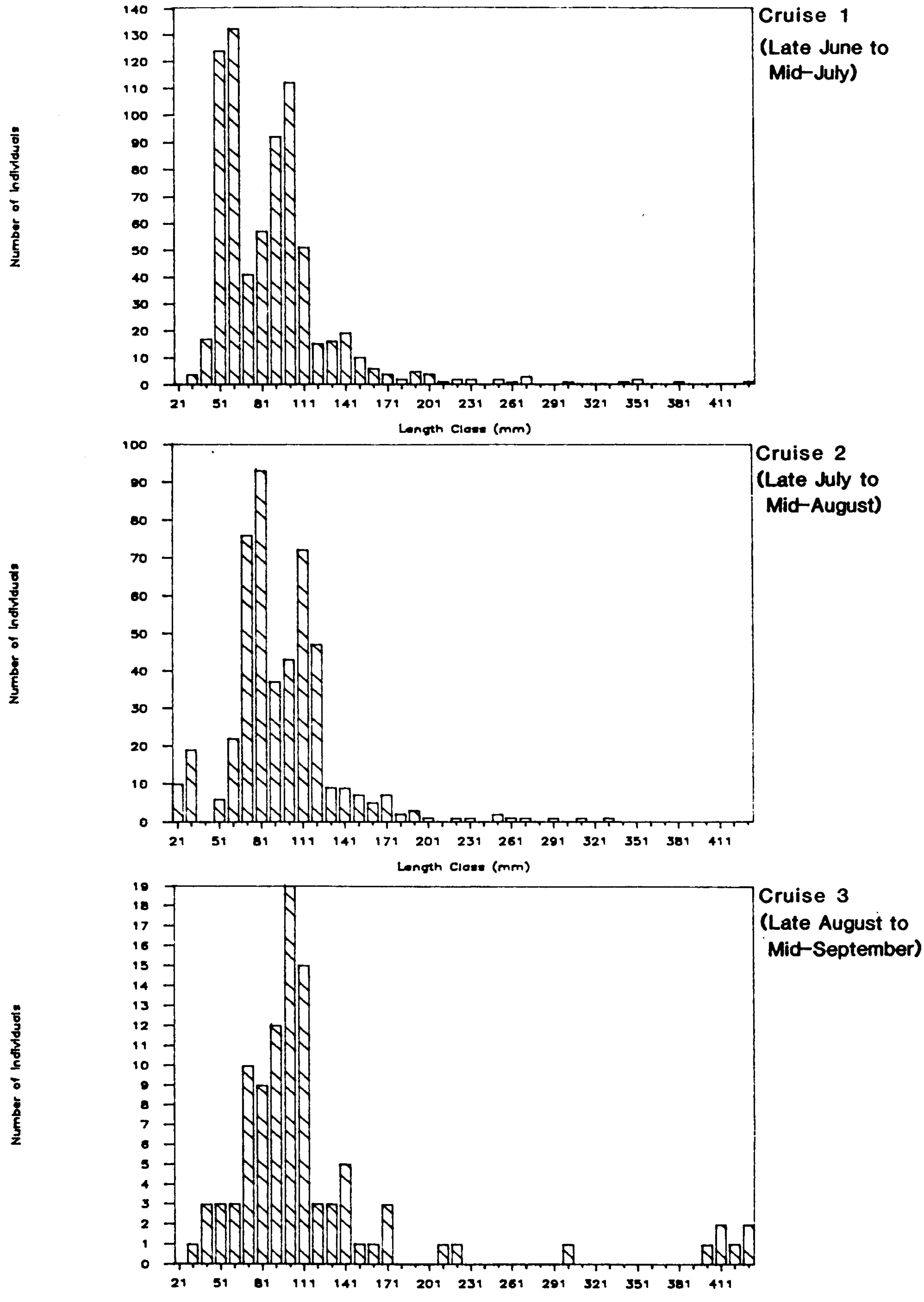
Whitespotted greenling (Hexagrammos stelleri) was among the top 10 species numerically in all four gear types in 1984 (third in purse seine catches, fifth in otter trawls, ninth in beach seines and tenth in tow nets). In purse seine catches, pelagic juvenile greenling were relatively abundant in the first two cruises (15 and 18 fish per set, overall average) but much less so (0.5 per set) in Cruise 3 (Figure 9). Purse seine catches generally increased from inner Bristol Bay to the outer transects. Beach seine catches increased steadily over the three cruises but were generally low (Figure 12). The largest beach seine catch (12 fish) was inside Ugashik Bay. Whitespotted greenling in both purse seine and beach seines were generally small (less than 85 mm) and showed no noticeable growth through the sample period.



Length-Frequency of Rock Sole in Otter Trawls at Stations Inside Embayments, 1984
(all transects combined)

Dames & Moore

Figure 61



Length-Frequency of Rock Sole in Otter Trawls at Coastal (Outside) Stations, 1984
(all transects combined)

Dames & Moore

Figure 62

The demersal form of this species was widely distributed in otter trawls but was most abundant inside embayments in Cruises 2 and 3 and outside embayments on Cruise 3. Largest concentrations encountered were at less protected stations inside Port Moller and Izembek Lagoon on Cruise 2 and inside the mouth of Port Moller (Station 4) on Cruise 3.

Trawl-caught whitespotted greenling included at least two size classes. Early in the season (Cruise 1) only the larger size class (120 to 160 mm) was taken (Figure 63). The smaller size class (70 to 119 mm) was abundant at inside stations in Cruise 2. In Cruise 3, the smaller size class (80 to 130 mm) predominated at both inside and outside stations.

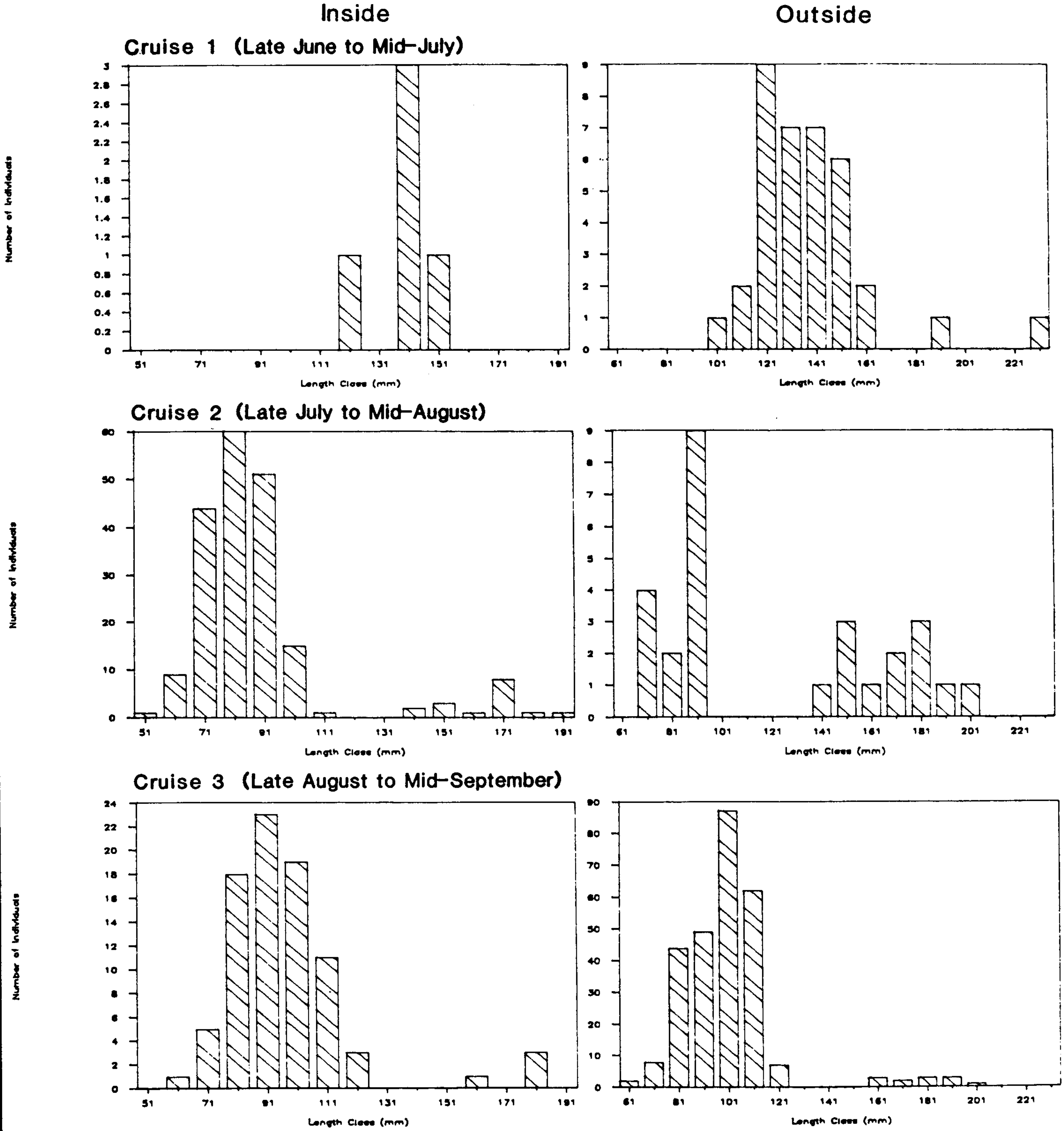
Walleye pollock

Like Pacific cod, walleye pollock were taken in both pelagic and demersal gear. Although it is generally considered a demersal species, walleye pollock ranked fourth in 1984 purse seine catches. Interestingly, this species was captured in the pelagic habitat only in Cruises 1 and 2 and only on Transects 3 and 5, transects removed from association with embayments. Pollock were also only caught at offshore stations. Greatest catches (303 and 169 fish) were in a set at the deepest station (27 m) and the shallowest station (11 m), respectively, seined on Transect 3 in Cruise 2. These fish were all in the 35 to 67 mm size range (mean 47.1 mm; n = 205).

Walleye pollock were scattered in otter trawl catches with a few fish in each survey. In Cruise 1 fish were taken on Transects 3, 4, and 5, while on Cruises 2 and 3 no pollock were taken south of Transect 3. Trawl-caught pollock tended to be substantially larger than purse-seine-caught fish. However, by Cruise 3, pollock in the 80 to 100 mm range began to dominate in otter trawls, perhaps recently undergoing the transition from pelagic to demersal life style.

Pacific sandfish

Life history of the Pacific sandfish (Trichodon trichodon) does not appear to be well described (e.g., Hart 1973). In our 1984 catches,



Length-Frequency of Whitespotted Greenling in Otter Trawls at Inside and Outside Stations, 1984
(all transects combined)

Dames & Moore

Figure 63

sandfish were fairly widely distributed in purse seine and tow net catches (ranking fifth numerically in each) and were also taken in otter trawls. In purse seines, sandfish were taken in all cruises with greatest catch on Transect 3 (11-m station) in Cruise 1 and on Transect 6 in Cruises 2 and 3. Sandfish were of moderate size (100 to 200 mm) in Cruise 1, increasing somewhat by Cruise 2 (120 to 220 mm). By Cruise 3, larger sandfish were absent from purse seine catches and were replaced by a smaller size class (60 to 100 mm).

In tow nets, sandfish (112 to 212 mm) were only taken in Cruise 1 in replicate hauls on Transect 3, Station 4. Of all otter trawl catches, sandfish were most abundant (same size class) at this same station and time, demonstrating the overlap in these gear types at the shallower stations.

Starry flounder

Starry flounder (<u>Platichthys</u> <u>stellatus</u>) ranked fifth in 1984 beach seine catches but did not rank in the top 10 in otter trawls. This demersal fish species was generally close to shore as indicated by beach seine versus otter trawl catches. Occasionally, one or two large individual starry flounders would dominate beach seine or otter trawl sets on the basis of total weight captured. Despite not ranking in the top 10 numerically in total catch, starry flounder were included in Figures 12 and 13 since they appeared in all gear types and were of large size (to 522 mm) in some cases.

Starry flounder numbers in beach seines were comparable to the other flatfish graphed (Figure 12). They were fairly stable in numbers through the summer at outside stations but were noticeably more abundant at inside stations in Cruise 2. Both beach seine and otter trawl catches at inside stations peaked in Cruise 2.

Beach seines at protected stations had greater numbers of starry flounder in the inner bay (Port Heiden) as compared to the other two subareas. More starry flounder were caught at inside than at outside stations and none was taken in beach seines at exposed beaches on

Transect 5 or 6. Starry flounder numbers in otter trawls were small (generally less than two per haul), especially in the midbay subarea (Transects 3 and 4) at both inside and outer stations.

Beach seine-caught starry flounder included much smaller sized fish (to 40 mm) than did otter trawls. A strong mode in the 65 to 90 mm size was present in Cruise 1 beach seine catches, while Cruise 1 otter trawls took none smaller than 337 mm. No strong modes were present in otter trawl catches, although many fish were in the 330 to 360 range.

Alaska plaice

Alaska plaice (Pleuronectes quadrituberculatus) ranked sixth in otter trawl catches and ninth in total catch in 1984 (Table 1a). This demersal flatfish, like starry flounder, was taken in both otter trawl and beach seines, indicating some preference for nearshore shallow waters.

Alaska plaice were not taken in beach seines at inside stations during Cruise 1, and catches increased slightly from Cruise 2 to 3 (Figure 12). Numbers of Alaska plaice taken in beach seines at outside stations declined slightly from Cruise 2 to 3 with none taken in Cruise 1. In otter trawl catches, Alaska plaice were more abundant and numbers generally declined with time at both inside and outside stations.

No plaice were captured in beach seines at inside (protected) stations in the inner bay subarea (Figure 14). At outside (exposed) stations, beach seine catches of Alaska plaice were reversed with no catches in the outer bay and increasing numbers from middle to inner bay subareas. Otter trawl catches of Alaska plaice showed a strong pattern of reduced numbers taken from inner to outer bay subareas (Figure 13).

In Cruise 1 otter trawls, there were at least two distinct size classes of Alaska plaice, with modes in the 50 to 75 mm and 135 to 170 mm range. In Cruise 2, these two modes were less abundant with increased numbers of fish < 200 mm. By Cruise 3, the initial two modes had increased in size by about 15 to 20 mm and a new size class in the 35 to 50 mm range had appeared, especially inside Izembek Lagoon.

Bering poacher

Bering poacher (Occella dodecaedron) ranked seventh in 1984 otter trawl catches with a few caught in other gear types (Table 1a). This species did not rank in the top 10 in total numbers of fish caught by all gear types.

In otter trawl catches, Bering poacher appeared in greater numbers nearer to shore (Stations 2, 3 and 4) with small numbers near the beach (as indicated by beach seine catches). However, very few were taken inside embayments. There was little trend in otter trawl catch rate over time. They were substantially more numerous in the inner and middle bay compared to the outer bay subarea.

Otter trawl-caught Bering poachers tended to be larger at deeper water stations.

Snake prickleback

Snake prickleback (Lumpenus sagitta) ranked eighth in otter trawl catches based on numbers caught, but did not rank in the top 10 fish species taken in 1984 with all gear types (Table 1a). This species was also taken incidentally in all other gear types. Based on tabulated otter trawl catches this demersal species appears more numerous nearshore (Stations 4 and 3) and inside bays (Port Moller). Numbers increased steadily through the sampling period with the greatest catch (132 and 64 fish) in trawls from Station 4, Transect 1, on Cruise 3.

Snake pricklebacks were more numerous in inner and middle bay subareas as compared to the outer bay subarea.

Sizes of snake pricklebacks varied a great deal through the sampling period.

4.5.4 Discussion

By far the dominant forage fish in our 1984 catches was Pacific sand lance, which has not been reported as unusually abundant in earlier studies in the area (e.g., Baxter 1976, Barton et al. 1977, McMurray et al. 1984). Our results indicate heavy early July usage of protected coastlines in the study area by yearling sand lance, with lesser use of exposed coastlines. Larger sand lance (2-year fish?) were abundant in the pelagic habitat offshore. There was obvious growth of these two year-classes by midsummer (Cruise 2; Figure 52) along with an apparent shift away from the shorelines (reduced beach seine catches; increased tow net catches) within the embayments. By late summer, these size classes had largely abandoned beach areas and embayments and were increasingly abundant offshore in purse seine catches. However, a new size class (young-of-the-year?) which first appeared in beach seines in Cruise 2 was dominant in both shoreline (beach seine) and pelagic (purse seine) habitats in September.

Catches of rainbow smelt, the second most abundant pelagic species in 1984, exhibited some similarities with sand lance patterns and sizes. Rainbow smelt, however, tended to be more abundant on exposed than on protected beaches. Beach seine catches of smaller size classes of rainbow smelt generally increased through our entire sampling period while catches in purse seines declined; thus, there seems to be a more prolonged size segregation (smaller size classes remaining nearshore) in rainbow smelt than in sand lance.

Yellowfin sole domination of demersal fish communities in shallow waters north of the Alaska Peninsula, previously reported by many investigators (e.g., Baxter 1976, Cable 1981, Walters 1983, Grabacki 1984, McMurray et al. 1984), was certainly confirmed in our sampling. Our data indicate that by early July large numbers of yellowfin sole are present, with numbers gradually declining as summer progresses.

Our data also suggest a recruitment of young-of-the-year yellowfin and rock sole to coastal waters from offshore (cf., from local transformations from the planktonic to the demersal lifestyle). This is indicated by the relative dominance of the smallest size class taken in the otter trawls at our stations outside of embayments (Figures 60 and 62) versus inside stations (Figures 59 and 61). For example, with yellowfin sole, this smallest size class was more apparent at outside stations during Cruises 1 and 2, shifting to inside stations in Cruise

3. Many size classes of yellowfin sole were present inside and outside of the embayments sampled while larger rock sole were absent from otter trawls within embayments.

Thus, the inshore waters and embayments along the north shore of the Alaska Peninsula serve, at least seasonally, as nursery areas for several important pelagic and demersal species. There is an influx or a recruitment in size of juveniles during the spring and summer and a continued residence of subadult year-classes through the summer and early fall period. Presumably there is a major offshore movement of most of these species later in the fall. However, fish use of the study area from October through May has not been well studied.

4.6 NONSALMONIDS - 1985

4.6.1 General

Of the 25 identified non-salmon species (Dolly Varden are included here) taken in 1985, only 6 species are considered pelagic and 19 are considered demersal. As in 1984, the Pacific cod, Pacific sandfish, walleye pollock, and whitespotted greenling are considered demersal but were captured in the pelagic environment with the large purse seine. All representatives of these species except the sandfish were juveniles that are truly pelagic at this life stage. As noted above, adult Pacific sandfish make distant migrations from the demersal habitat with which they are usually associated. The small seine in 1985, and to a lesser extent the large seine in both years, sampled some shallow stations where true demersal species were taken in or near their actual habitats.

4.6.2 Pelagic Fish Species - 1985

"Pelagic" fish species dominated the 1985 catches in numbers caught with only 6 species of non-salmon taken. In terms of total number of fish caught, Pacific sand lance ranked first for all gear (Table 1b) and made up 32 percent of the total 1985 catches. Rainbow smelt ranked fourth and made up 9 percent of the total catch in 1985. Whitespotted greenling, primarily juveniles in large purse seine catches, ranked eighth and made up 0.4 percent of the 1985 catches. Capelin ranked ninth and pond smelt ranked tenth with even smaller percentages of the total catch in 1985. Of the six non-salmon species considered pelagic only the Dolly Varden did not rank in the top 10 catches in terms of numbers caught in 1985. Pelagic nonsalmon dominated all gear types including the beach seine. Only the demersal starry flounder ranked in the top 5 in beach seine catches, and that species was in fifth place. The starry flounder ranked sixth in numbers of all fish taken in 1985 (Table 1b).

The general distribution and observed size patterns of dominant 1985 pelagic species are described below.

Pacific Sand Lance

The Pacific sand lance was the most abundant fish taken in 1985 as it was in 1984. The catch of sand lance by gear type again indicated this species is highly adaptable to a wide variety of nearshore and offshore habitats and appears to be an extremely important forage fish in the study area.

Beach seines captured 86 percent of all sand lance taken in 1985 (Table 1b). In Cruise 4a beach seine sets (Appendix I), the largest catches of sand lance were in the protected beaches of Port Moller (Transect 4), at Harbor Point (Station 6), and at Shingle Point (Station 8) in Herendeen Bay; average abundances were 671 and 253 sand lance per set, respectively. Both of these beaches have gradual slopes and are exposed to relatively little wave action. The substrate ranges from sands to small cobbles with some attached algae. No other transects were sampled by beach seine in Cruise 4a.

In Cruise 4b, sand lance were absent from all beach seine sets in Ugashik (Transect 0) and all 6 sets in Port Heiden (Transect 2) possibly due to the greater fresh water influences on the beaches sampled (cf. Port Moller). Substrate was also fine grained (sand and muds), often with a lot of organic debris. On Transect 4 in the Port Moller area, sand lance were taken in Cruise 4b at all beach seine stations, with the greatest overall numbers at the more exposed and more steeply sloped Station 9 on the outside face of Shingle Point. Even the more exposed side of Harbor Point in Port Moller (Station 5) had small numbers of sand lance. Stations 5, 6, 8, and 9 had mean abundances of 92, 233, 227, and 352 sand lance per set, respectively.

In Moffet Lagoon (Transect 6), both beaches sampled are fairly protected from surf. However, Station 6 inside Operl Island is fairly dynamic with respect to tidal current velocities and had no sand lance. Station 7 located on a sand to mud bar on the north side of the Moffet Lagoon entrance had large numbers of sand lance (average abundance of 2102 fish per set) in four beach seine sets in Cruise 4b. The difference may have been in the shallower slope and the generally slower tidal currents very close to shore at Station 7, compared to Station 6.

The small purse seine (Appendix H) accounted for only 3.5 percent of the sand lance taken by all gear types in 1985 (Table 1b). Five small seine sets in Port Heiden (Tràansect 2) captured no sand lance in Cruise 4a. Small numbers of sand lance were taken in Port Moller (Transect 4; 9 sets) at Stations 3 and 7, while no sand lance were taken at Station 4 off Harbor Point or at Station 13 in the entrance to Herendeen Bay.

In Cruise 4b, no sand lance were taken with the small seine at Transects 0 (3 sets) and 2 (1 set). At Port Moller (Transect 4; 13 sets), the stations on the outside and inside of Harbor Point had no sand lance in small seine catches, while one set (Station 12) had 322 fish, 96 percent of all the sand lance taken in 1985 with this gear. This single set in the inner part of Herendeen Bay was made on July 23. A small number of sand lance was taken in 1 of 3 sets in outer Herendeen Bay (Station 13). In Moffet Lagoon (Transect 6), no sand lance were taken in three small seine sets. These sets were made under high tidal current periods which may have influenced sand lance distribution or the efficiency of this gear type.

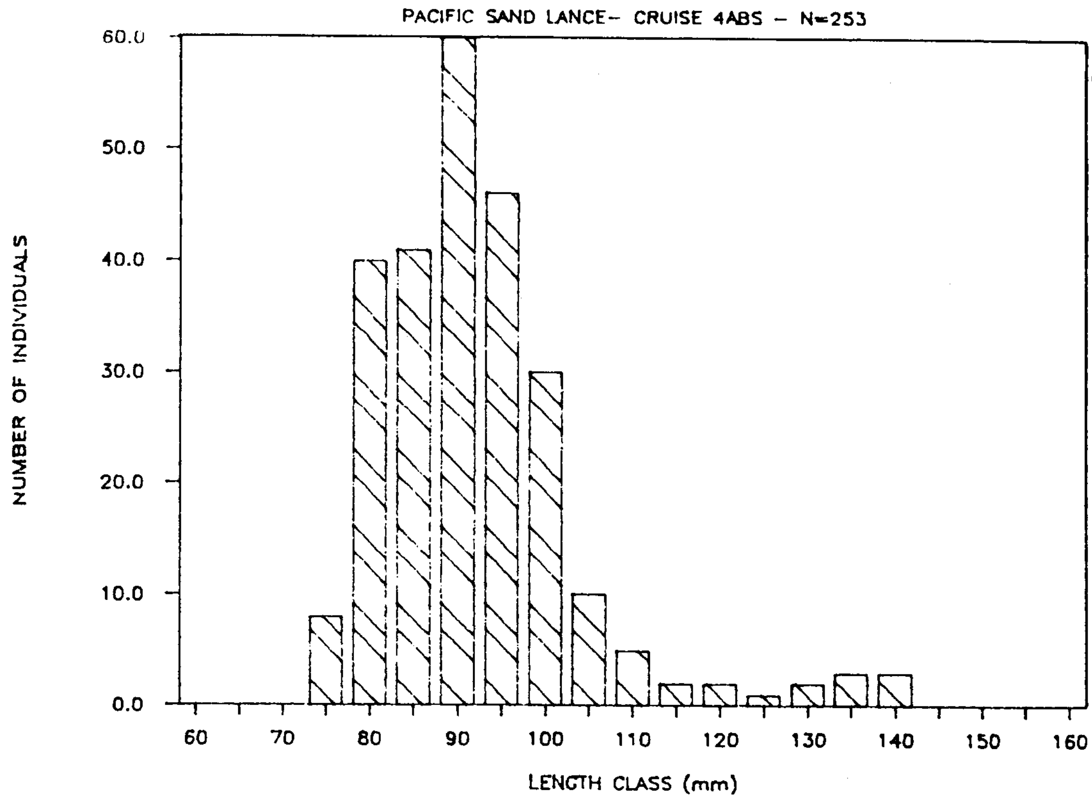
Approximately 10 percent of all sand lance taken in 1985 were captured in the large purse seine in the offshore stations (Table 1b). In

Cruise 4a, a few sand lance were taken in 1 of 3 sets each made at Stations 0, 1, and 2 on Transect 0 (Appendix G). Off Port Heiden (Transect 2), only one of two sets at Station 3 took a small number of sand lance (6 sets total). In Cruise 4a on Transect 4 (Port Moller), sand lance numbers increased as sampling moved closer to shore with mean catches of 2, 1.5, 61.4, and 106.8 fish per set at Stations 0, 1, 2, and 3, respectively (16 sets, total). Cruise 4a large purse seine catches of sand lance on Transect 6 (Izembek Lagoon) exhibited this same pattern with reduced numbers of fish taken with distance offshore. The Station 0, 1, 2, and 3 mean catches were 0, 0, 8.8, and 12.4 fish per set, respectively.

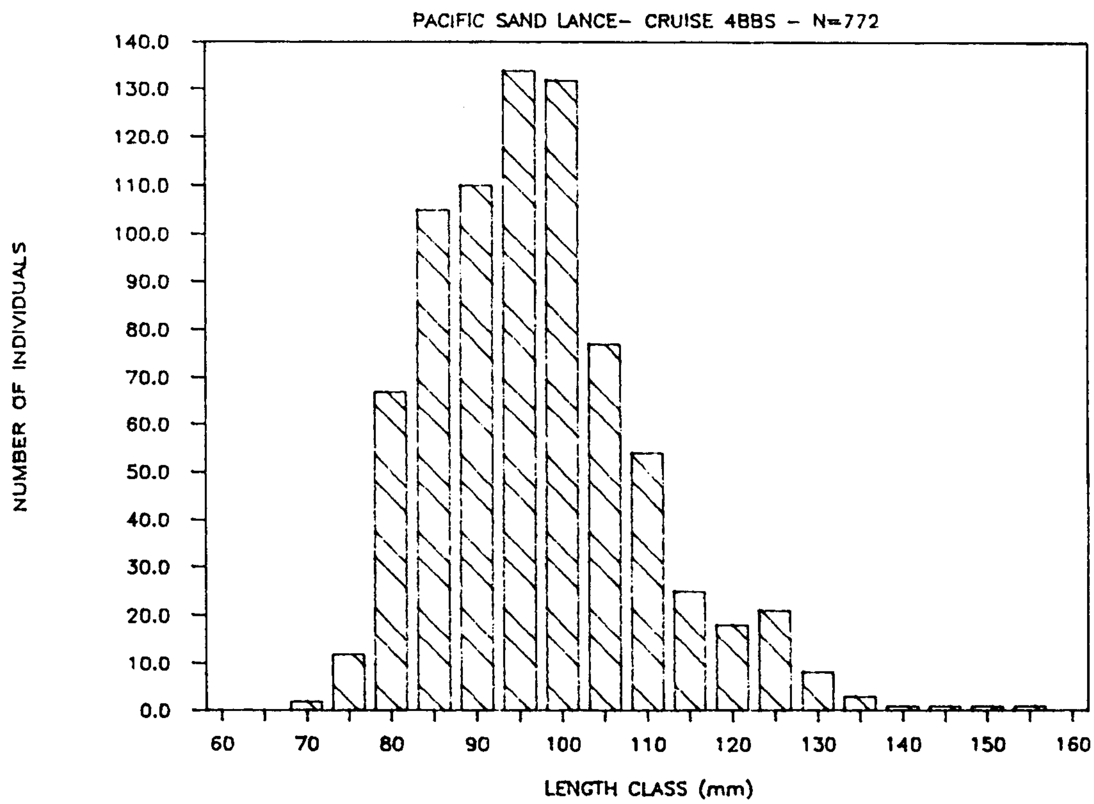
Large purse seine sets in Cruise 4b took somewhat smaller numbers of sand lance at Transects 2, 4, and 6 while numbers increased slightly at Transect 0. However, the Ugashik catches remained small with no fish taken at Station 0 and about equal numbers taken at Stations 1 and 2. Off Port Heiden (Transect 2), the only sand lance taken in 20 sets were at the most nearshore Station 3. As in Cruise 4a, the largest mean transect catch of sand lance in Cruise 4b was attained off Port Moller. The mean abundance in 10 sets at Stations 0, 1, 2, and 3 on this transect was 0, 15, 117, and 1 sand lance, respectively. On Transect 6 (Izembek Lagoon) in Cruise 4b, only Station 2 of the four offshore stations for the large purse seine had a small catch of sand lance.

In summary, Pacific sand lance were fairly patchy in distribution in the 1985 catches; they were not consistent at any station on any transect with any gear type.

Length-frequency patterns for sand lance taken by beach seine in Cruises 4a (253 fish) and 4b (772 fish) are presented in Figure 64. The beach seine pattern shows some growth between Cruises 4a and 4b with a suggestion of two or three year-classes present near the beaches in the study area. (No ageing of any non-salmon was completed in the study.) Length-frequencies of sand lance taken by small seines nearshore in Cruises 4a (13 fish) and 4b (56 fish) (Figure 65) also suggest some



Cruise 4a
(June 16 - July 7)



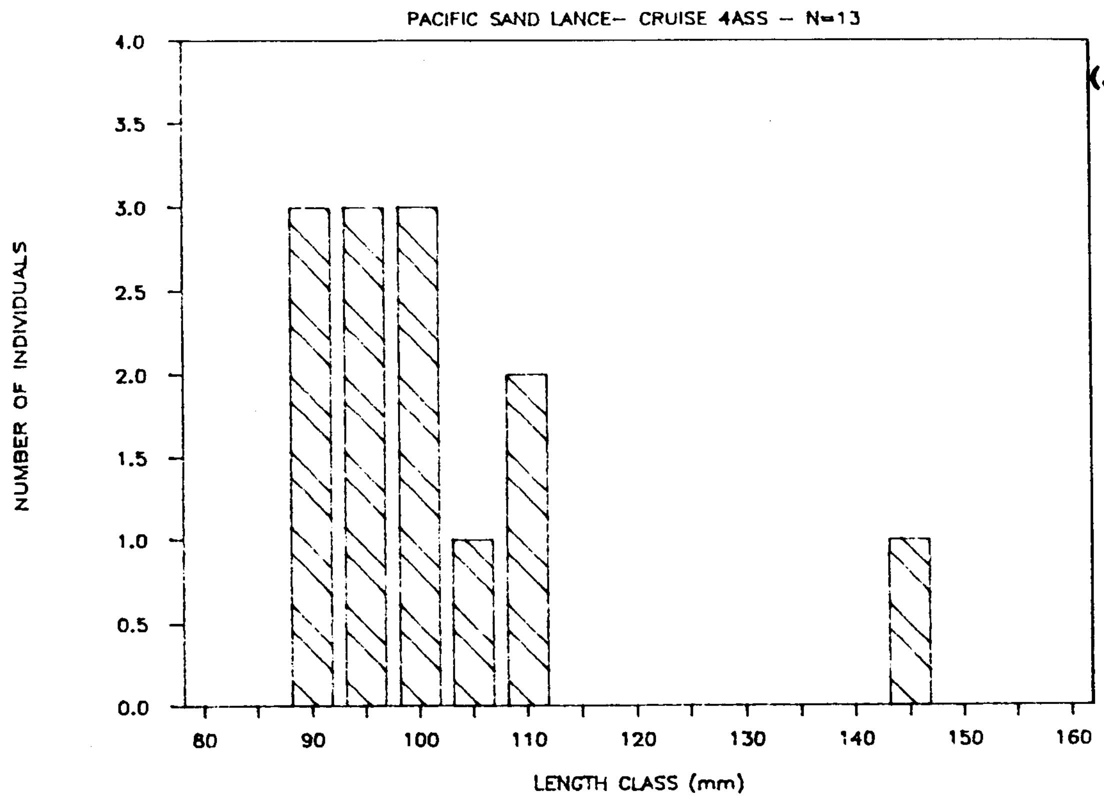
Cruise 4b
(July 8 - 28)

Length-Frequency of Pacific Sand Lance in Beach Seines, 1985

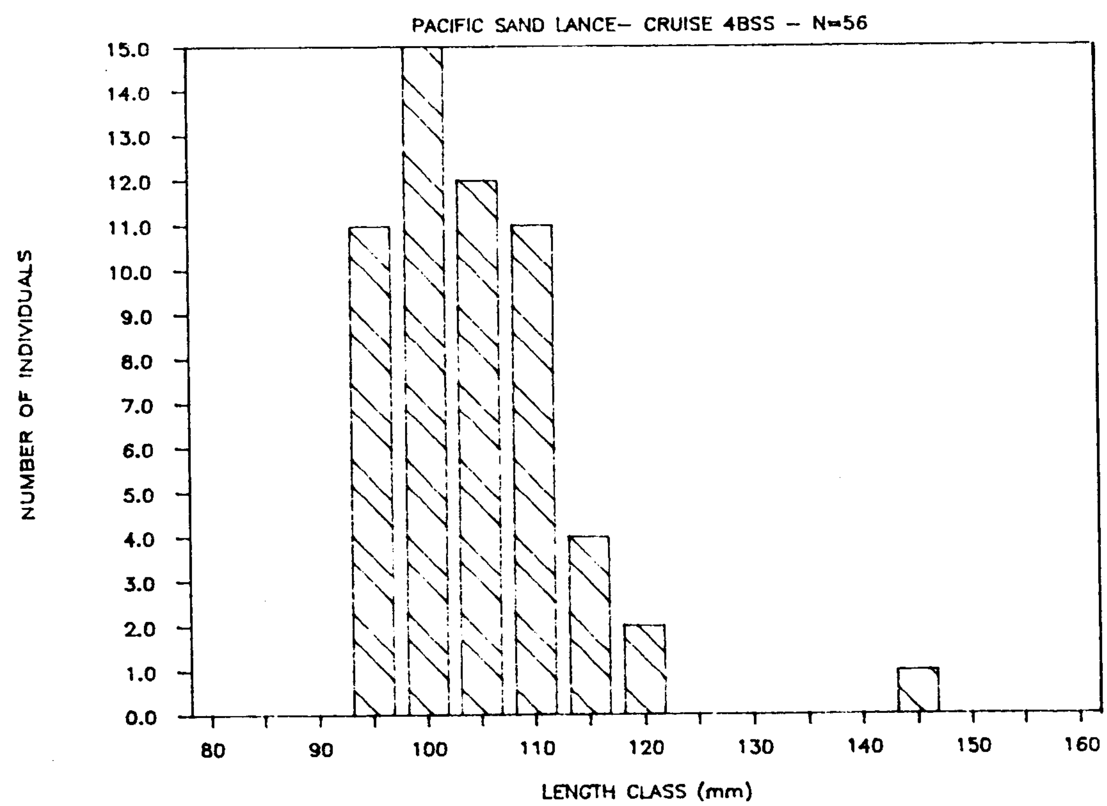
(all transects and stations combined)

Dames & Moore

Figure 64



Cruise 4a
(June 16 – July 7)



Cruise 4b
(July 8 – 28)

Length–Frequency of Pacific Sand Lance in Small Seines, 1985

(all transects and stations combined)

Dames & Moore

Figure 65

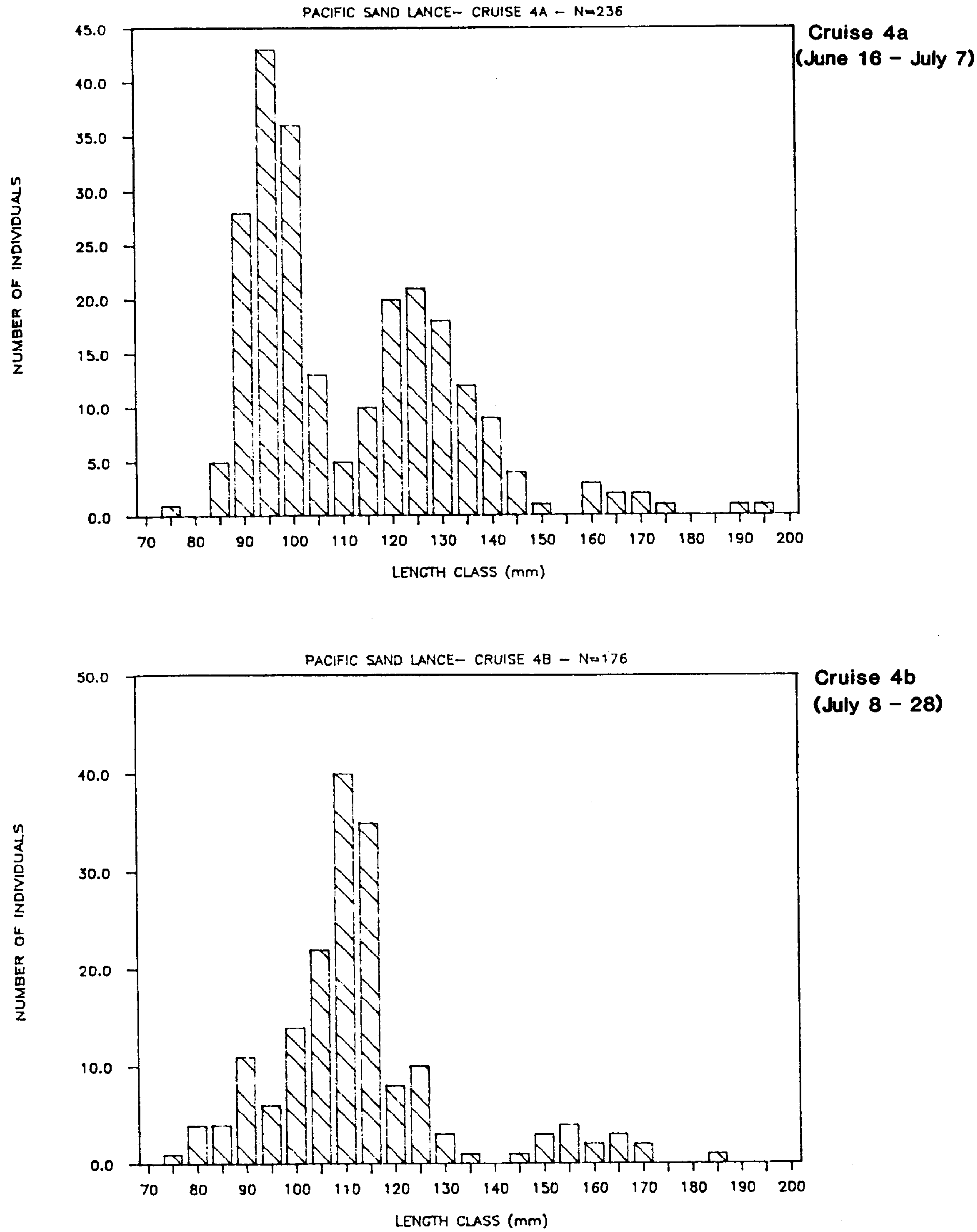
growth between periods. Length-frequencies of sand lance taken by large purse seine offshore in Cruises 4a (236 fish) and 4b (176 fish) (Figure 66) strongly indicated growth between cruises. There is also an apparent reduction in Cruise 4b of the frequency of the second and possibly the third largest modes from Cruise 4a. These 130± and 165± mm fish in Cruise 4a are either moving out of the study area or being selectively consumed by other animals. There are likely 3 or 4 year-classes in the large seine data.

If all three gear types are compared for the size of Pacific sand lance taken in 1985, some interesting patterns are present. In Cruise 4a, the 90- to 100-mm size class is apparent in all three study locations (offshore, nearshore and beach). However, the 130± and 165± mm size classes seen offshore in the large purse seine are not apparent nearshore and are diminished near the beach. When all gear in Cruise 4b are compared, a similar pattern of larger fish with distance offshore is evident. Since different gear are compared here, some caution is needed in that we may be seeing the result of gear selectivity since larger sand lance may be able to escape the small purse seine and the beach seine. However, the beach seine did appear capable of capturing a few fish in the 140- to 155-mm range.

Rainbow Smelt

The rainbow smelt was the second most abundant nonsalmonid in 1985 and ranked fourth in overall fish catches in 1985 (Table 1b). The rainbow smelt catch was 9 percent (by number) of all fish taken. The beach seine and small seine accounted for 74 and 25 percent of all rainbow smelt taken, reconfirming this species' affinity for beach and shallow nearshore environments.

In Cruise 4a, the beach seine catches (Appendix I) varied a great deal at Transect 4 (Port Moller), the only area beach seined in this cruise. The mean abundance of this smelt at Stations 5, 6, 8, and 9 was 35.7, 1, 0, and 8 per set, respectively (10 sets, total). Stations 5



Length–Frequency of Pacific Sand Lance in Purse Seines, 1985

(all transects and stations combined)

Dames & Moore

Figure 66

and 9 are located on the the steeper, generally coarse (sand-to-cobble) substrate beaches that usually have the higher wave action at Harbor Point (Port Moller) and Shingle Point (Herendeen Bay). This pattern for rainbow smelt is the opposite of that discussed above for Pacific sand lance,which were more numerous at Stations 6 and 8 in this same cruise period.

In Cruise 4b, Transect 0 (Ugashik) beach seine sets at Stations 4, 5, and 7 had mean abundances of rainbow smelt of 95.5, 9.7, and 131.5 per set, respectively. Station 4 is on the outer coast outside Smoky Point, while Station 5 is on Smoky Point,and Station 7 is inside Dago Creek's small estuary. This pattern is confusing since Station 4 is very exposed and Station 7 is fairly protected. The key variable may be the more steeply sloped sand beach at Station 5. All three areas are sand beaches with the lowest sloped, most protected area at Station 7.

In Cruise 4b, Transect 2 (Port Heiden) beach seine sets at Stations 5 and 6 had mean abundances of 204.7 and 267.7 rainbow smelt per set. The somewhat higher catches were in the more protected area (Station 6) which is the so called "marina" for local gill net vessels. This area was gently sloped with a fine sand-to-mud bottom,while the more exposed Station 5 beach was a somewhat steeper sand beach. Numerical comparisons for this and other fish species may be complicated by the light mud at Station 6 and the large amount of organic debris in Station 5 which influenced the effectiveness of the beach seine. The problem was less in catching fish than in finding them in the mud or debris in the net once a set was completed. Smaller smelt and other fish species may have been missed in removing the catch from the nets. With the exception of eelgrass problems at Transect 6, no other beach seine sites approached the debris problems at Port Heiden.

In Cruise 4b, the largest beach seine effort (14 sets) was at Port Moller where Stations 5, 6, 8, and 9 had mean abundances of 4, 4.5, 0, and 0 rainbow smelt per set, respectively. One can only conclude that rainbow smelt numbers declined overall on the Port Moller beaches by Cruise 4b in 1985.

In Cruise 4b at Moffet Lagoon (Transect 6), no rainbow smelt were taken at Stations 6 and 7 in 4 beach seine sets.

On beaches sampled in 1985, rainbow smelt were most abundant at Port Heiden and were very consistent in beach seine catches there and at Ugashik. Rainbow smelt were much less abundant on Port Moller beaches than farther upbay at Transects 0 and 2 in Cruise 4b.

The small seine took 25 percent of the total rainbow smelt catch in 1985 (Appendix H). In Cruise 4a, 5 sets on Transect 0 (Ugashik) captured no smelt. In this same cruise, 9 sets on Transect 4 (Port Moller) captured rainbow smelt only at Station 7 (mean abundance, 9.3 fish per set in 3 sets) located well inside the bay behind Anchor Point. Transects 0 and 6 were not sampled with the small seine in Cruise 4a.

In Cruise 4b, the small seine was fished at all transects and was much more successful on rainbow smelt. Single sets at Transect 0 (Ugashik), Stations 8, 9, and 10 took 105.6, 276, and 236.2 smelt, respectively. All of these stations are inside Ugashik Bay with Stations 8, 9, and 10 located in the outer, middle and inner parts of the bay. Based on these limited data, rainbow smelt were least abundant in the most seaward station in the bay.

At Transect 2 in Cruise 4b, the single small seine set at Station 4 yielded no rainbow smelt. At Transect 4 in this same cruise, Stations 4, 7, 12, and 13 had mean abundances of 0.9, 20.4, 0, and 0 smelt per set, respectively. The more protected bay inside of Harbor Point (Station 7) had by far the largest concentrations of rainbow smelt in pelagic habitats inside Port Moller. These smelt concentrations were still quite small relative to those on the beaches in this area. At Transect 6 in Cruise 4b, 3 small seine sets captured no rainbow smelt.

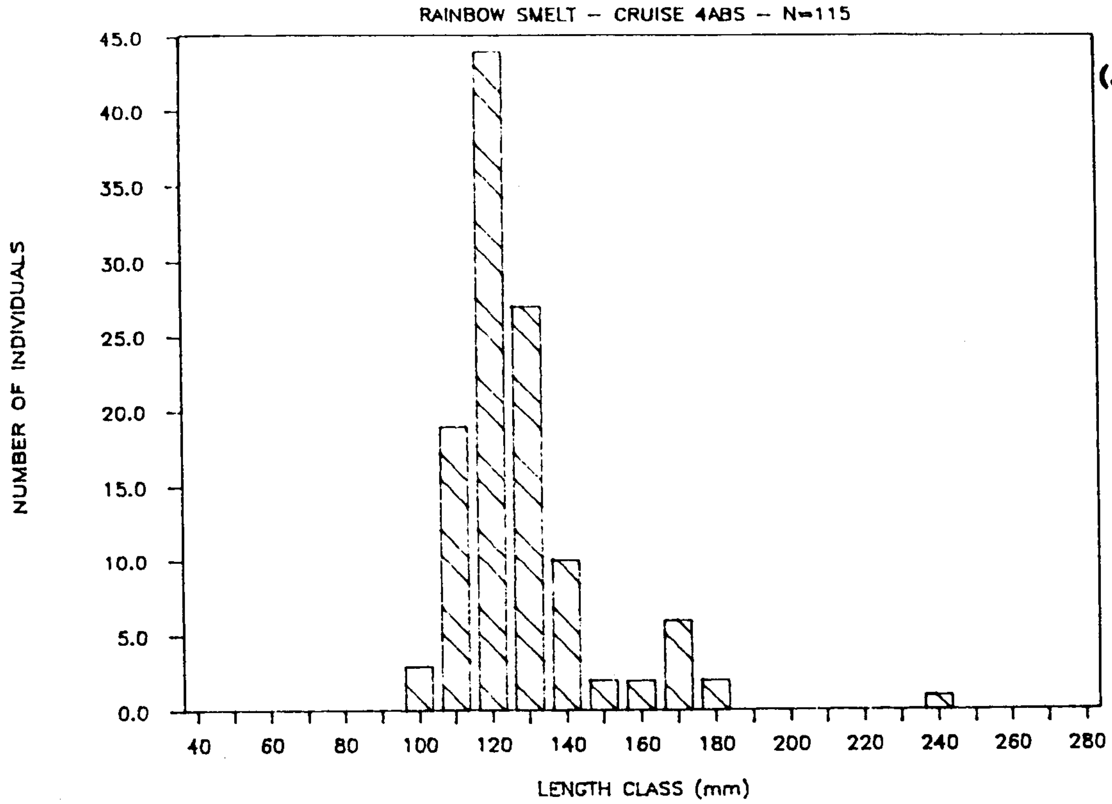
Rainbow smelt were very poorly represented in large purse seine catches (13 fish in 97 sets) indicating very low numbers at offshore stations in the study area. The few rainbow smelt taken with this purse seine were captured in both Cruise 4a and 4b at Station 3 on Transect 2 (Appendix G). This is the nearest offshore station and these small catches are consistent with the large catches of these smelt on Port Heiden beaches and the moderate catches of smelt with the small seine in adjacent nearshore waters.

To provide some insights into the size patterns of rainbow smelt in 1985, Figure 67 presents the length-frequency patterns of fish taken in the beach seine in both Cruise 4a (115 fish) and 4b (921 fish). Some growth is apparent in the shift of the peaks between Cruise 4a and 4b. Although by no means clear, three-year classes may be present in rainbow smelt from Cruise 4b beach seines. Figure 68 presents the rainbow smelt length-frequencies from the small seine in Cruise 4a (10 fish) and Cruise 4b (382 fish). While the sample size is very small for Cruise 4a small seines, there is a hint of some smaller fish recruiting to the nearshore areas sampled in 1985 by Cruise 4b. Two or possibly three year classes of smelt are suggested in Cruise 4b small seine catches.

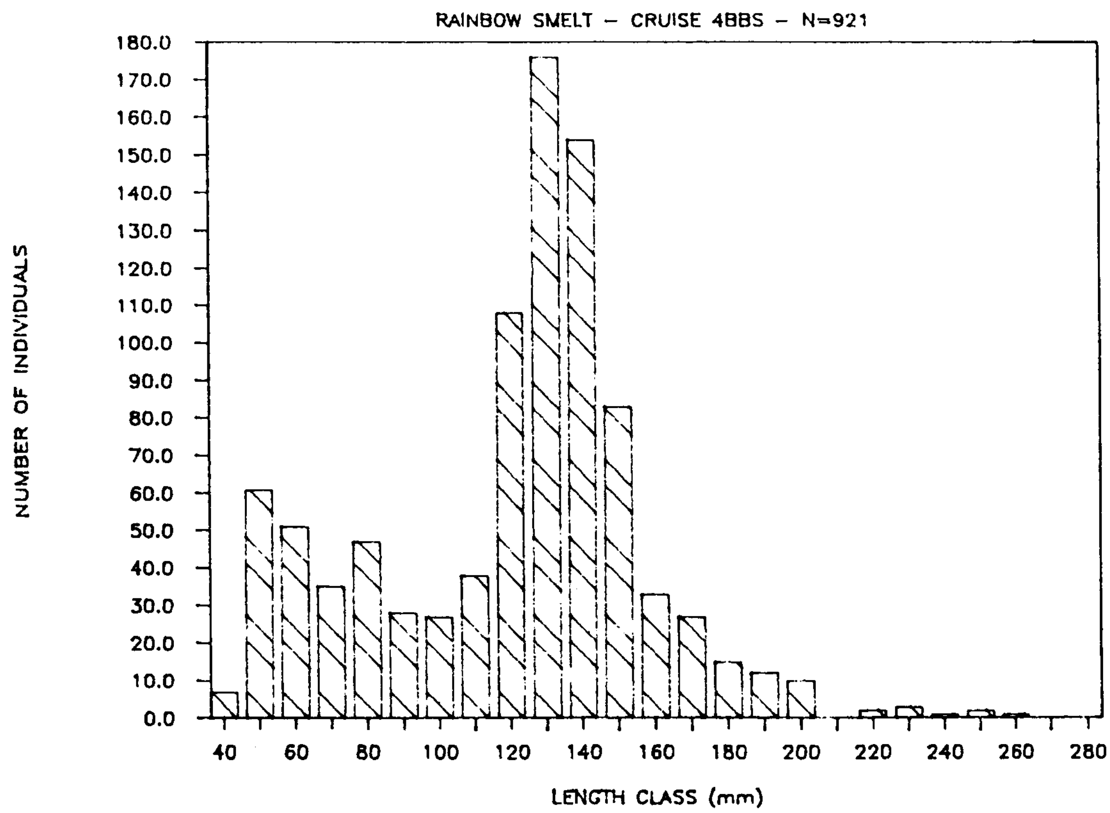
In comparing catches in Cruise 4a, and recognizing the small sample sizes, there is an indication that larger fish are near shore but not adjacent to the beach. This pattern is not maintained in Cruise 4b, where greater numbers of smaller rainbow smelt seem to be nearshore than adjacent to the beach.

Whitespotted Greenling

As adults, whitespotted greenling are demersal fish. However since over 94 percent of the 1985 catch of this species (128 fish) were juveniles taken in the large purse seine, this species is included in this pelagic fish section. This greenling ranked third in the "pelagic" fish group but only ranked eighth in total catch in 1985 (0.4 percent). Too few whitespotted greenling were taken in the small seine and beach seine to make any comments about distribution except to say they were apparently not very numerous nearshore in Cruises 4a or 4b. The few fish taken in the 39 large purse seine sets in Cruise 4a (Appendix G) were taken on Transect 0 Station 0, Transect 2 Station 0, and most were at Transect 6, Stations 0, 1, and 3. No greenling were taken on Transect 4. This pattern in Cruise 4a tends to indicate these juveniles were offshore and in the more southern part of the study area, suggesting a source to the southwest of the study area.



Cruise 4a
(June 16 - July 7)



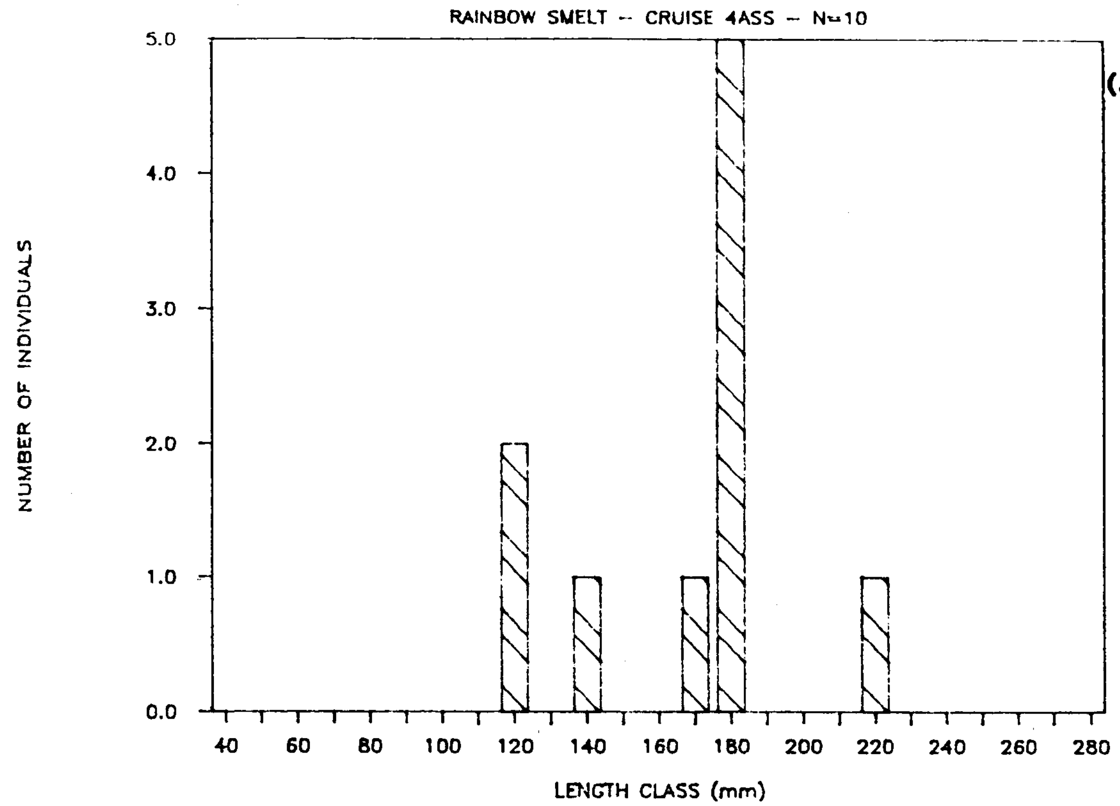
Cruise 4b
(July 8 - 28)

Length-Frequency of Rainbow Smelt in Beach Seines, 1985

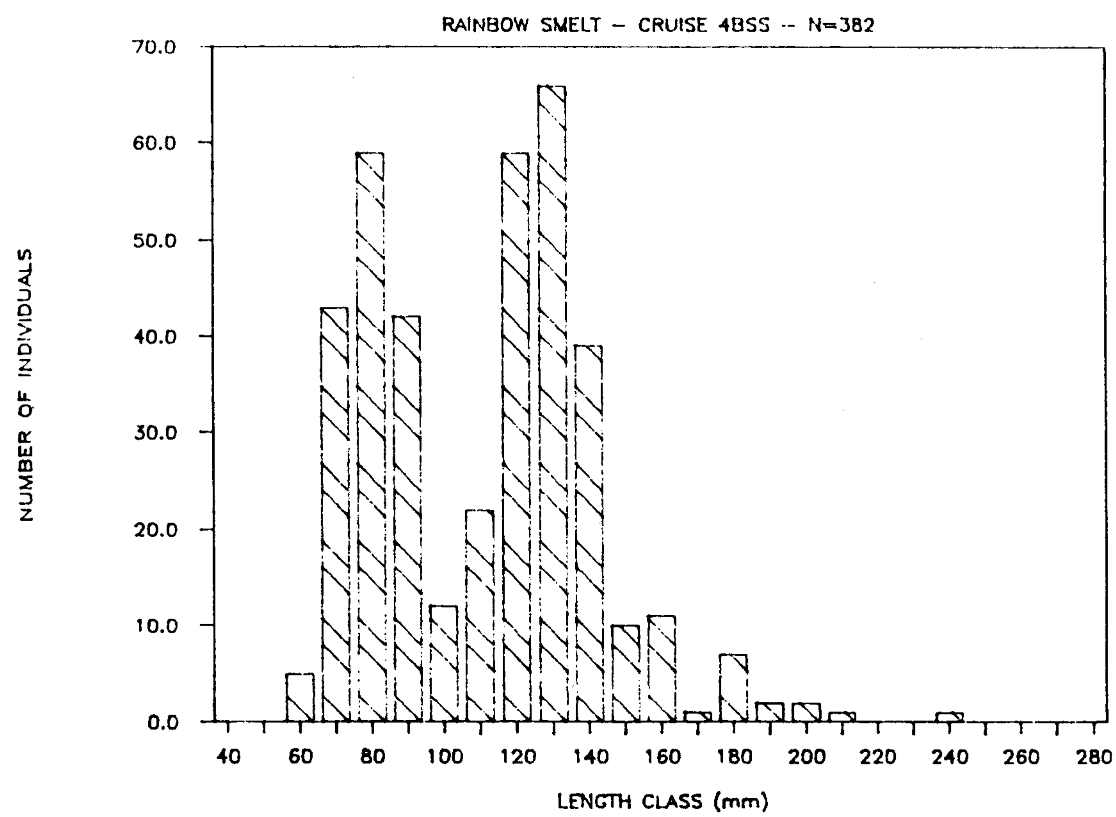
(all transects and stations combined)

Dames & Moore

Figure 67



Cruise 4a
(June 16 - July 7)



Cruise 4b
(July 8 - 28)

Length-Frequency of Rainbow Smelt in Small Seines, 1985

(all transects and stations combined)

Dames & Moore

Figure 68

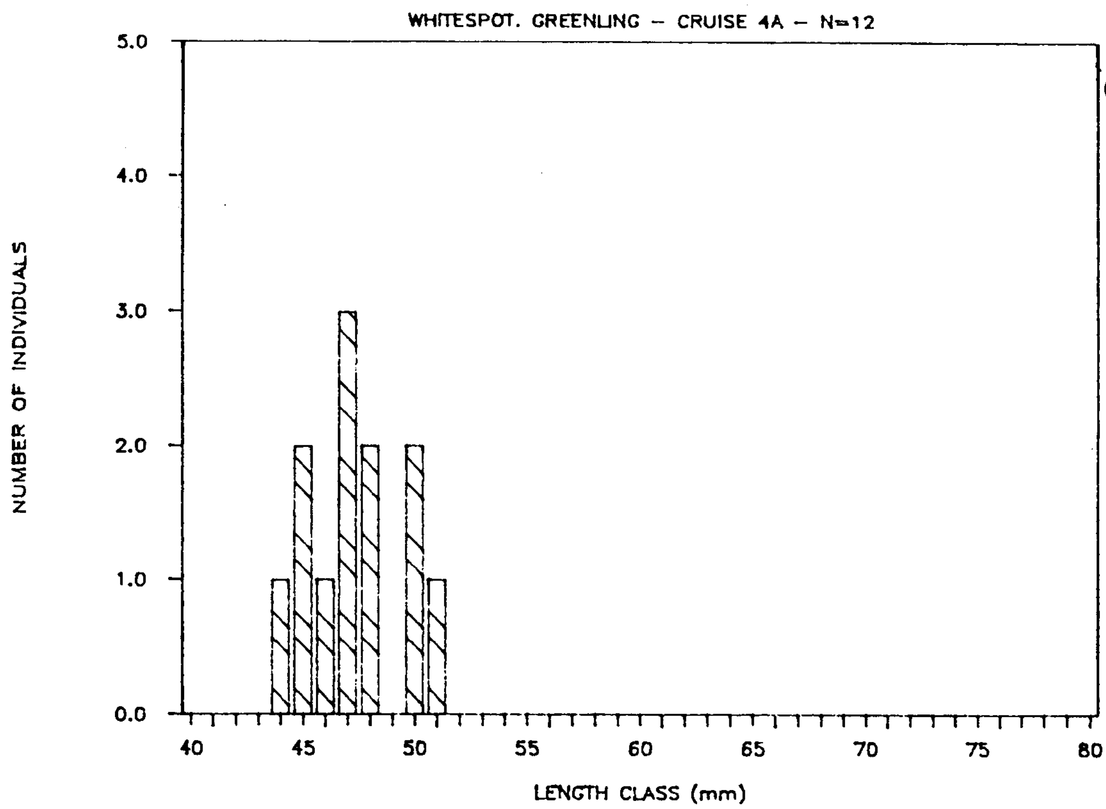
In Cruise 4b, whitespotted greenling were more evenly distributed between transects, although Transect 6 again had a slightly higher average catch with the large seine. At Transect 0 they were caught at Stations 0 and 2, but not at Station 1 (20 sets, total). At Transect 2, Station 0, 1, 2, and 3 large purse seine sets (20 sets, total) had mean abundances of 3.9, 2.1, 0.9, and 9.7 fish, respectively. At Transect 4 in this cruise, the Station 0, 1, 2, and 3 large seine sets (10 sets, total) had mean abundances of 1, 5.3, 6.6, and 1 fish, respectively. At Transect 6 in Cruise 4b, the Station 0, 1, 2, and 3 large seine sets (8 sets, total) had mean abundances of 1, 4, 9, and 7 greenling, respectively.

In 1985, whitespotted greenling were definitely more abundant in Cruise 4b than in 4a. These greenling were also more uniformly distributed offshore of the coast in Cruise 4b with some suggestion, although the numbers are small, of more fish inshore in Cruise 4b than in Cruise 4a large purse seine sets. Care must be taken in assessing these numbers as these are small fish that may, at their youngest age in the pelagic environment, pass though the purse seine web. Also, as small fish, they run a greater risk of being missed in the net clearing process than do larger fish.

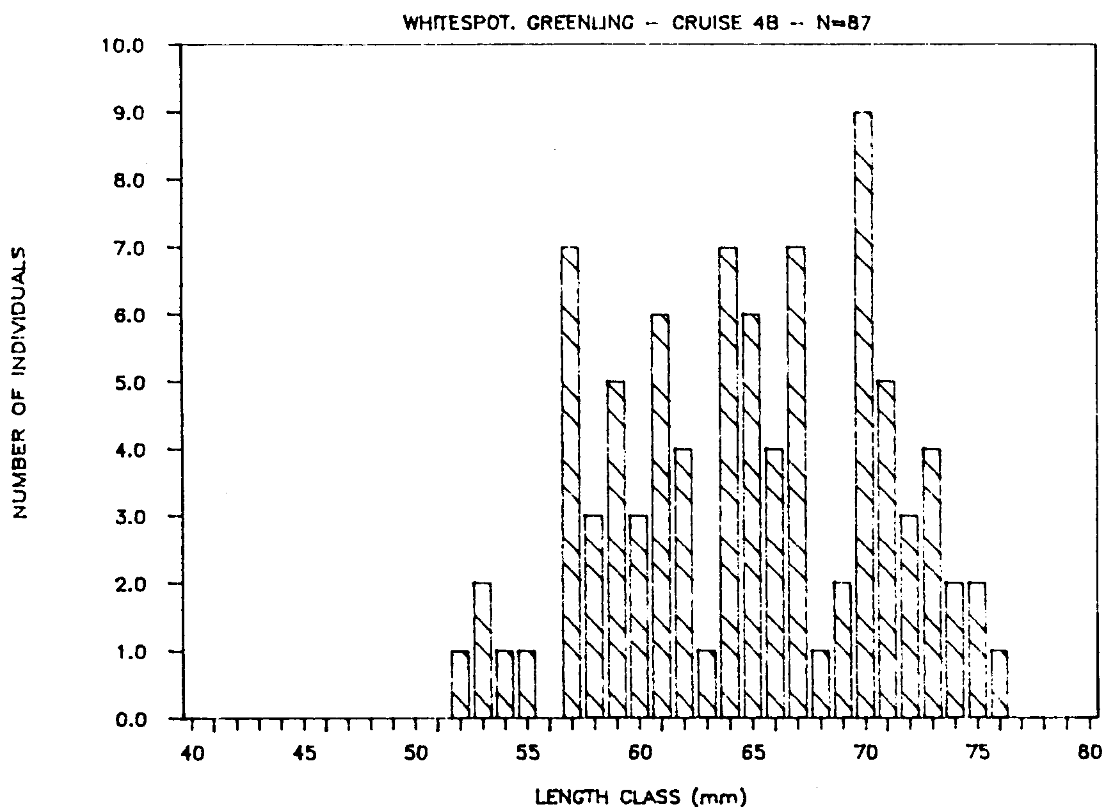
A comparison of whitespotted greenling length-frequencies from large purse seine catches in Cruise 4a (12 fish) and Cruise 4b (87 fish) are provided in Figure 69. The Cruise 4a sample size is obviously quite small but may be representative since a continuous growth pattern is apparent between the two 1985 cruises. All these individuals are assumed to be in a single growing year-class (range 52 to 76 mm).

Capelin

Capelin, Mallotus villosus, were the fourth ranked pelagic fish although they ranked only ninth in overall catches (0.4 percent, Table 1b). With the exception of three fish taken in the small seine, all 109 capelin were taken with the large purse seine. All the Cruise 4a capelin came on Transect 2 (4 sets), Stations 2 and 3, where mean abundances



Cruise 4a
(June 16 – July 7)



Cruise 4b
(July 8 – 28)

Length–Frequency of Whitespotted Greenling in Purse Seines, 1985

(all transects and stations combined)

Dames & Moore

Figure 69

were 1 and 40.8 fish per set (Appendix G). This latter catch in two sets on Station 3 comprised nearly all the capelin taken in 1985, since no capelin were taken in Cruise 4b. Capelin, like rainbow smelt, appear to prosper in the Port Heiden area.

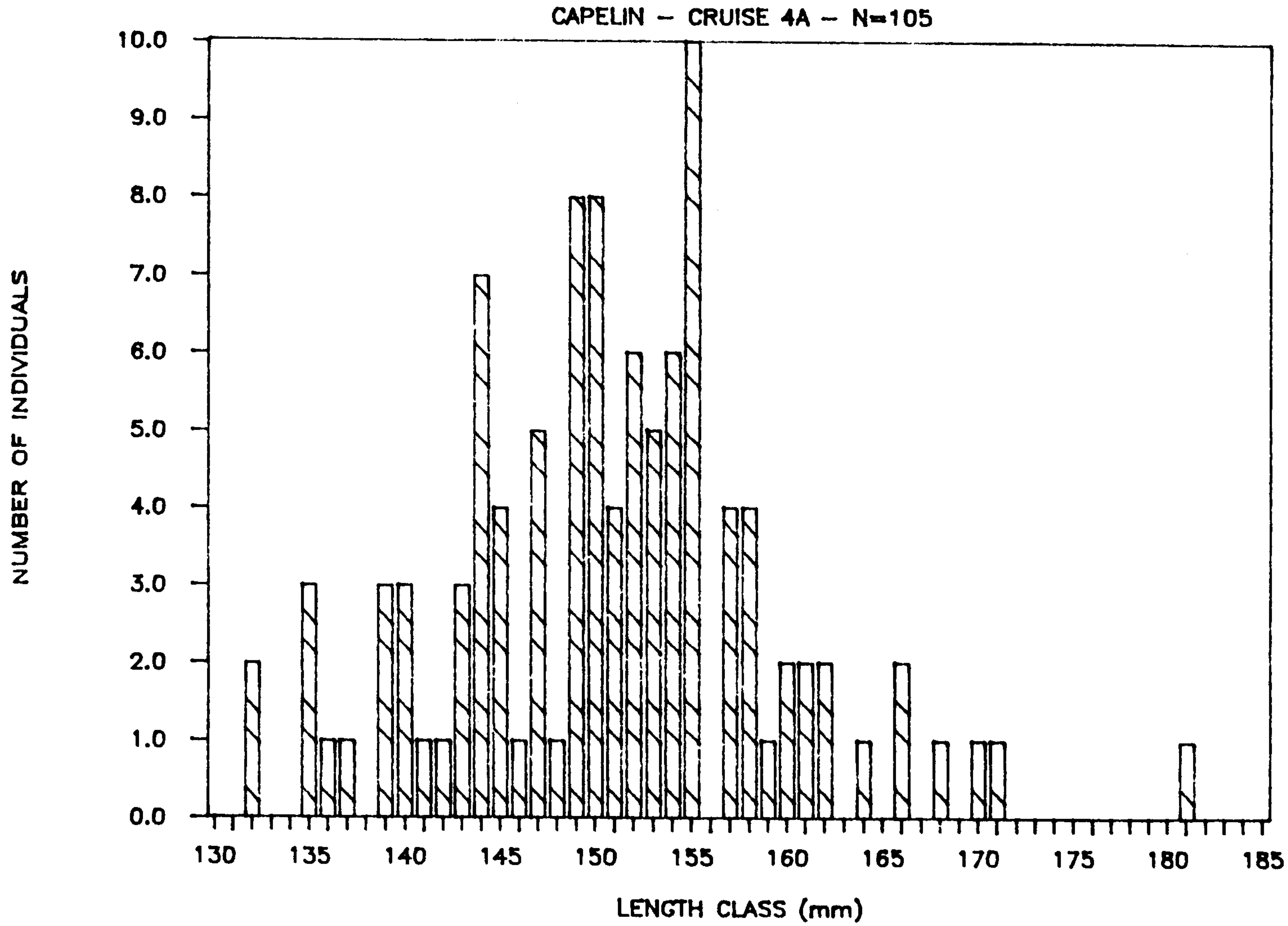
Length-frequency of 105 capelin taken by large purse seine on Transect 2 in Cruise 4a (Figure 70) appears to be a unimodal curve of a single year-class. Capelin are reported to live to be 3 or more years old (Hart 1973).

Pond Smelt

Pond smelt were the fifth ranked pelagic fish, although they ranked only tenth in overall catches (0.3 percent, Table 1b). All the pond smelt were taken in the beach seine indicating strong preference for onshore and estuarine habitats. In Cruise 4a, only a single pond smelt was taken with the beach seine at Transect 4, Station 8 (Shingle Point) in the back part of Herendeen Bay.

All the remaining pond smelt were taken in Cruise 4b (July 8 to July 28) beach seines, and some individuals were taken on every transect except Transect 6 (Appendix I). At Transect 0 (Ugashik), Stations 4, 5, and 7, the mean abundance was 24.5, 14, and 0 pond smelt per set, respectively (7 sets, total). On Transect 2 (Port Heiden), Stations 5 and 6 each had a mean abundance of 1 pond smelt (6 sets, total). Transect 4 (Port Moller) (14 sets, total) had one pond smelt each at Stations 5 and 9; no smelt were taken at Stations 6 and 8.

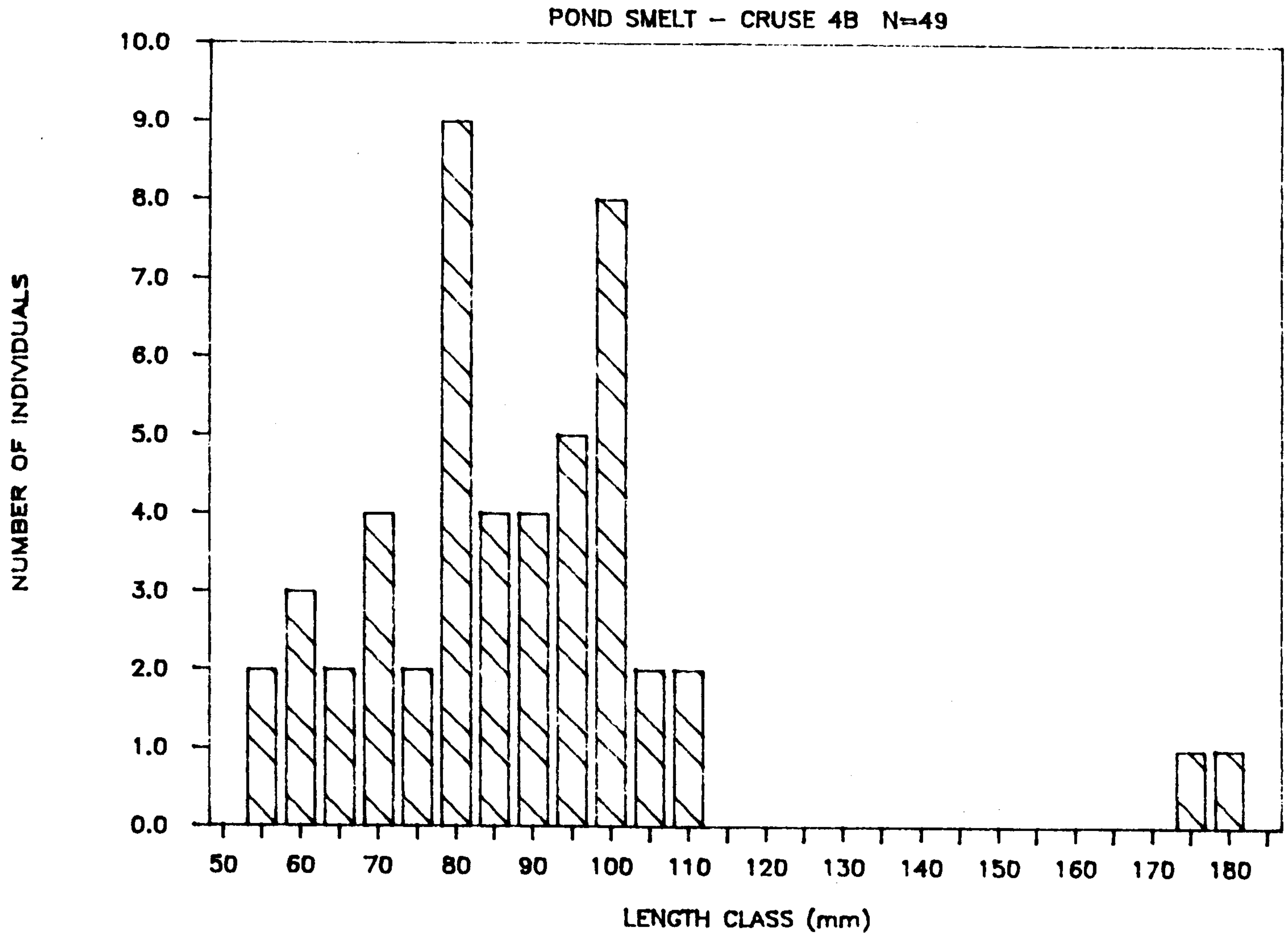
Figure 71 presents the length-frequency of 49 pond smelt from Cruise 4b beach seines. Two year-classes are likely present in these limited data with only two individuals of the larger year-class present.



Length–Frequency of Capelin in Purse Seines, 1985
(transect 2 only)

Dames & Moore

Figure 70



Length-Frequency of Pond Smelt in Beach Seines, 1985
(all transects and stations combined)

Dames & Moore

Figure 71

Pacific Herring

Pacific herring, Clupea harengus pallasi, did not rank in the top ten fish captured in 1985 even though the three gear types should have taken them if they had been present in any numbers.

The few herring taken were fairly evenly distributed in small seine, large purse seine, and beach seine catches (Table 1b). The beach seine took one herring in Cruise 4a at Transect 4 on Station 5 and in Cruise 4b, one herring was taken at Transect 2 at Station 5. The largest catch of herring in Cruise 4b was on Transect 4 (Port Moller) at Station 6, where 11 fish were taken in one of 5 beach seine sets on the protected side of Harbor Point (Appendix I).

In Cruise 4a, no herring were taken with the small seine. However, of the 15 fish taken in Cruise 4b (Appendix H), Transect 0 had a single fish at both Stations 8 and 9, and the largest catch was on Transect 4 (Port Moller) at Station 7 located behind Harbor Point. No herring were taken with the small seine on Transects 2 or 6.

In Cruise 4a, no herring were taken with the large purse seine. However, of the 27 herring taken in Cruise 4b, about half were taken in one of 10 large purse seine sets on Transect 0, Station 2, 5 nm offshore (Appendix G). The remainder of the herring taken in Cruise 4b were on Transect 2, Station 3, located less than 5 nm offshore. No herring were taken on Transects 4 or 6 in Cruise 4b. Cruises 4a and 4b in 1985 must have again, as in 1984, been too late to capture larger numbers of adult herring known to be present in the study area earlier in the spring.

Dolly Varden

Dolly Varden were not ranked in the top ten fish taken in 1985 but are of interest because of how and where they were taken. Of the 49 adults and juveniles (categories based solely on size and not on sexual maturity) taken, only two came out of the beach seine (Table 1b). These two fish came in Cruise 4b from Transect 4, Station 6 and Transect 6, Station 6 (Appendix I). No Dolly Varden were taken in the small seine in 1985.

Nearly all the Dolly Varden were taken offshore in the large purse seine (Appendix G) in Cruise 4a. In Cruise 4a at Transect 0 (Ugashik), Stations 0, 1, and 2 had mean abundances of 1, 13 and 2.6 Dolly Varden (sizes combined) in 9 sets. At Transect 2 (Port Heiden), Stations 0 to 3 were fished (6 sets) and only a single Dolly Varden was taken at Station 2. In 16 sets at Transect 4 (Port Moller) at Stations 0, 1, 2, and 3 the mean abundances were 1, 1, 5, and 4.8 fish (sizes combined). In Cruise 4a at Transect 6 (Izembek Lagoon), 8 large purse seine sets yielded 2 fish at Station 0, and 1 fish at Station 2.

In Cruise 4b, the large seine captured only a single Dolly Varden on Transect 4, Station 2. No Dolly Varden were taken in this cruise at Transects 0, 2, and 6.

Dolly Varden appeared to be scattered in the offshore waters of the study area in Cruise 4a, and moved out of the study area in Cruise 4b. If they had moved closer to shore in Cruise 4b, we should have seen more of them in small seine and beach seine catches.

4.6.3 Demersal Fish Species - 1985

As a result of the change in study direction to focus on pelagic species (specifically, juvenile salmon) in 1985, only incidental catches of demersal species were taken in the beach seine, small seine, and large purse seine. Section 4.6.2 on pelagic species covered the whitespotted greenling whose juvenile stage lives in the pelagic habitats of the study area. Therefore, this species will not be repeated here even though three of these greenling were taken by beach seines in a more demersal habitat.

Starry Flounder

Starry flounder was the most abundant demersal species taken in 1985, but ranked only sixth (2 percent) in total 1985 catches of the total fish caught by number (Table 1b). They appeared above all other demersal species since they frequent beach areas and are vulnerable to a beach seine. The large purse seine captured only 6 of the 616 starry flounder taken; the small seine captured none (Table 1b).

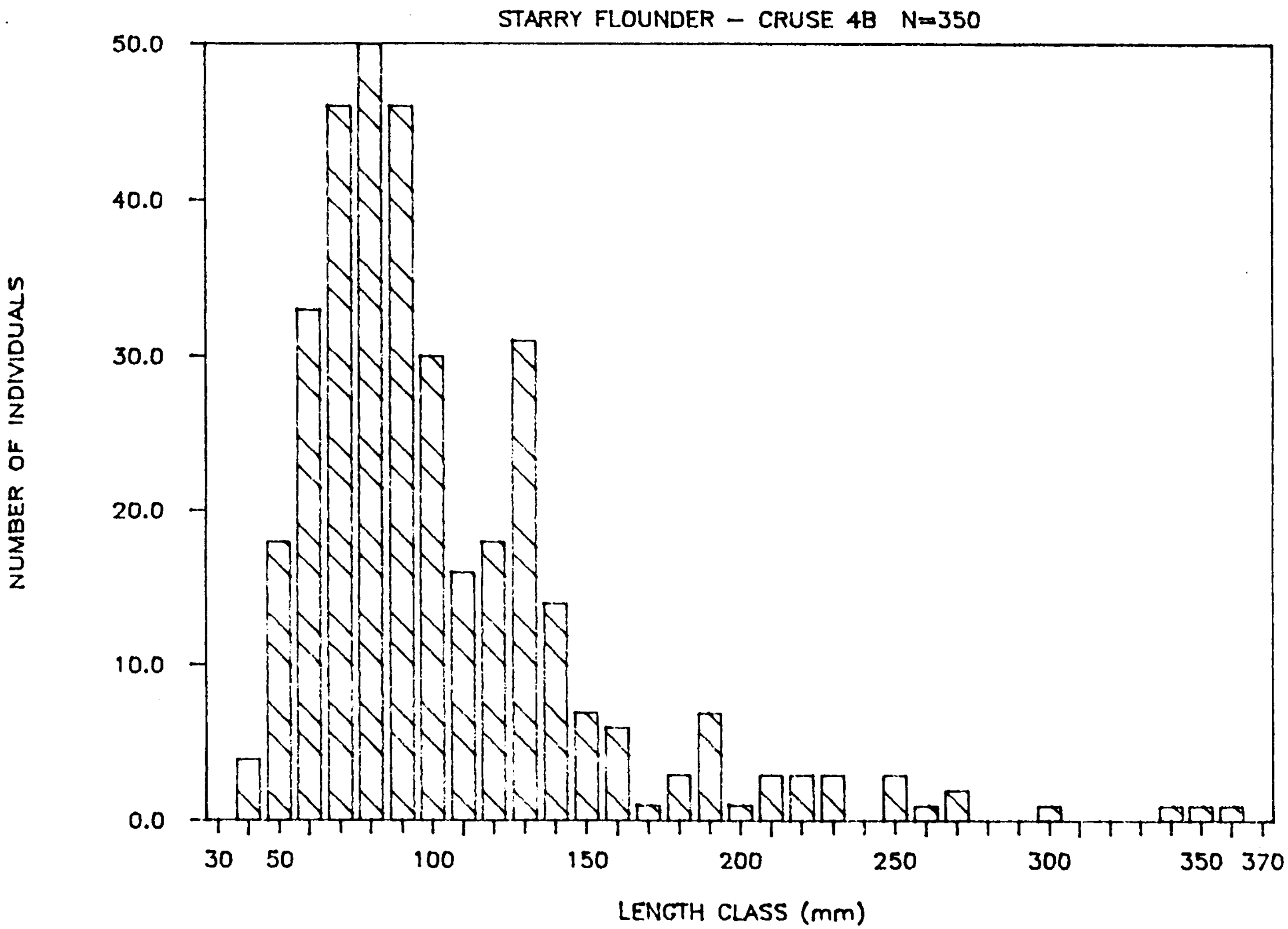
In Cruise 4a (June 16 to July 7) the only beach seining was completed on Transect 4 (10 sets), and only one starry flounder was taken in one of five sets at Station 6 on the protected side of Harbor Point (Appendix I).

In Cruise 4b (July 8 to July 28) starry flounder were unevenly distributed on beaches at all transects. The largest overall numbers of this species were taken at Transect 0 (Ugashik). At Stations 4, 5, and 7, the mean abundances were 25.5, 100.3, and 46 starry flounder (7 sets, total). The Smoky Point beach site seemed by far the preferred location for these fish. On Transect 2 (Port Heiden) Stations 5 and 6 had mean abundances of 26 and 26.3 fish (six sets, total). Transect 4 (Port Moller), Stations 6 and 9, each had a single starry flounder. Transect 6 (Izembek Lagoon), Stations 6 and 7, each had several fish in Cruise 4b. The larger concentrations of starry flounder near beaches in Ugashik and Port Heiden may be due to greater influences of the large rivers entering these estuaries, cf., the more marine beach areas sampled in Port Moller and Moffet Lagoon.

The length-frequencies of 350 starry flounder taken by beach seines in Cruise 4b are shown in Figure 72. The pattern of lengths in Cruise 4b is consistent with the near-beach location of capture. The majority of the fish are small 40- to 90-mm individuals; however, multiple larger year-classes are present.

Arctic Flounder

Arctic flounder ranked eleventh by number of all fish taken in 1985 (Table 1b). All Arctic flounder were taken by beach seines in Cruise 4b in 1985 (Appendix I). In Cruise 4b on Transect 0, a single fish was taken at Station 5 (Smoky Point in Ugashik Bay). The largest Arctic flounder catches were on Transect 2 at Port Heiden. Stations 5 and 6 had mean abundances of 3.5 and 42.5 Arctic flounder (six sets, total). On Transect 4 (Port Moller), a single fish was taken on Station 6 and on Transect 6 (Moffet Lagoon) no arctic flounder were taken. Arctic flounder were more numerous in lower salinity areas (Port Heiden) with shallow-sloped mud and fine-sand bottoms.



Length–Frequency of Starry Flounder in Beach Seines, 1985
(all transects and stations combined)

Figure 72

Dames & Moore

Other Flatfish

The remaining flatfish taken in 1985 ranked by the numbers taken were as follows: Alaska plaice (52 fish all in beach seines), yellowfin sole (27 fish in beach seines and large purse seines), and rock sole (13 fish all in beach seines).

4.7 COMPARISONS OF 1984 AND 1985 NON-SALMONID CATCH DATA

4.7.1 General

Results of our 1984 and 1985 sampling appear to confirm the seasonal importance of inshore waters and embayments along the north side of the Alaska Peninsula to a variety of nonsalmonid fish. In terms of overall ecological (and economic) importance, the role of these waters in production of forage fish is of primary significance. Two species that are already well documented in Bristol Bay, Pacific herring and capelin, were not well represented in our catches in either years, probably because the start of our sampling missed their spring onshore spawning movements. The late summer recruitment of smaller herring to our 1984 tow net catches in Port Moller may indicate a prolonged local rearing of herring spawned in this area. The virtual absence of capelin in our 1984 catches and low numbers in 1985 may indicate a lesser significance of the study area for this species than has been previously suspected (e.g., Barton et al. 1977), or may have resulted from offshore movement following their spring spawning. Both capelin and herring were reportedly abundant in midwater trawls off Izembek Lagoon by LGL Ecological Services in their separately funded ecosystem study (D. Thomson, personal communication 1986).

Several complications exist in making comparisons of 1984 and 1985 for nonsalmonid data. The lack of concurrent sampling dates between the two years is a major inconsistency. Basically, the 1985 season began 10 days earlier (June 16) than Cruise 1 in 1984 and ended July 28, two days after Cruise 2 began in 1984. Taking into account the break between Cruises 1 and 2 in 1984, Cruise 4a in 1985 had 11 days of overlap (June 26 through July 6) and Cruise 4b had only 3 days of overlap (July 25 through July 27). Even this overlap in time is relevant only for the large purse seine. In 1985, both the small purse seine and the beach seine effort in Cruise 4a were initiated after the large purse seine operation was well underway. Therefore the overlap in calendar time is less for these two gear types due to their later start dates in Cruise 4a in 1985.

The water temperature differences between similar periods in the study area in 1984 and 1985 are likely much more important than any differences in calendar date. In effect, the colder and earlier sampling dates in 1985 were really further ahead of 1984, biologically, than the calendar would indicate. With water temperatures influencing fish presence and movements in the area, the fact that water temperatures in Cruises 4a and 4b in 1985 did not approach those at similar stations in similar times in 1984 (Figure 49) is very important. In terms of water temperatures, we actually sampled two different times of the year with little or no overlap. In comparisons of catch and apparent distributions of fish, it is not surprising that 1984 and 1985 look as different as they do.

The 1984 and 1985 biological comparisons are also limited to the species taken in sufficient numbers in both years. Real comparisons can only be made with the catches from the large purse seine and the beach seine which were common to both years. The nearshore pelagic sampling comparisons are complicated by the use of a tow net in 1984 and the switch to a small purse seine in 1985 to improve our efficiency on juvenile salmonids. No good comparisons are possible, especially for the faster swimming pelagic fish which we suspect could generally outswim the tow net in 1984.

Many more fish were taken overall in 1984 than in 1985 (88,436 versus 29,986), although a considerable proportion of the 1984 catch was made up of a single very large Pacific sand lance catch (by beach seine). Even though the 1984 season had more days of field sampling, the effort (total number of sets) in both years was comparable and, in fact, the effort was higher for the large purse seine.

For the large purse seine, 71 sets in 1984 yielded 7,276 fish, while 97 sets in 1985 yielded 10,988 fish. This is quite close in terms of fish per set. The top five fish species caught (by numbers taken) in large purse seines in each year were:

	1984	1985
1.	Pacific cod juveniles	Sockeye salmon juveniles
2.	Pacific sand lance	Pacific sand lance
3.	Whitespotted greenling	Chum salmon juveniles
4.	Walleye pollock juveniles	Sockeye salmon adults
5.	Pacific sandfish	Coho salmon juveniles

It is quite apparent from these lists that large purse seine catches differed markedly from year to year.

The beach seine catches also had large numerical differences between 1984 and 1985. The 47 sets in 1984 yielded 35,122 fish while the 41 sets in 1985 yielded only 16,266 fish. This is not a great difference if one excludes the occasional extremely large catch of sand lance in 1984. Visual observations and small purse seine results indicate that the large schools of sand lance seen and sampled in 1984 were not present in 1985. The top five fish species (by numbers taken) in beach seine catches in each year were:

	1984	1985
1.	Pacific sand lance	Pacific sand lance
2.	Rainbow smelt	Chum salmon juveniles
3.	Surf smelt	Rainbow smelt
4.	Pacific staghorn sculpin	Pink salmon juveniles
5.	Starry flounder	Starry flounder

Sand lance made up 94 percent of all fish taken (by number) by beach seine in 1984 and only 51 percent of all beach seine fish in 1985. Again, it is very apparent that beach seine catches differed substantially between 1984 and 1985.

The obvious differences in catches in these two gear types common to both years strongly support the contention that the earlier start by calendar date and the colder water experienced in 1985 had profound influences on fish numbers and species present relative to 1984.

4.7.2 Pelagic Species Comparisons

Pelagic species dominated 1984 and 1985 fish catches in this study, but in different ways. In both years, Pacific sand lance ranked first in numbers caught. However, in 1984, yellowfin sole and other demersal species (i.e., Pacific cod, rock sole, Alaska plaice, and snake prickleback) ranked in the top 10 fish based upon numbers taken. In 1985, only the demersal starry flounder ranked in the top 10 along with 9 pelagic species (or pelagic life stages of demersal species). Juvenile salmon (discussed in detail in Sections 4.2 and 4.3) numbered 898 fish in 1984 and 15,621 fish in 1985. These pelagic salmon plus the pelagic sand lance and rainbow smelt totaled 93 percent by number of all fish taken in 1985. The 1985 shift toward a pelagic catch was primarily due to dropping the otter trawls in 1985. However, as noted above, there were also real differences in the two common gear types.

In making 1984 versus 1985 comparisons, there is a real possibility that for a given species smaller-sized fish may have been more prevalent in 1985 because of the earlier start and cooler water temperatures; thus more fish may have passed through the common-sized webs in beach and purse seines in 1985. For example, equal numbers or even more sand lance may have been present, but generally smaller in size in 1985, versus 1984. This was a real problem observed in large purse seine operations in 1984 when both small sand lance and small juveniles of Pacific cod and walleye pollock were observed passing through the web. Comparisons between 1984 and 1985 distributions and sizes of selected fish species are described below with the primary focus on Cruise 1 in 1984 and Cruises 4a and 4b in 1985.

Pacific Sand Lance

Based upon beach seine catches, Pacific sand lance were present near the beaches of the study area in greatly reduced numbers in 1985 as compared to 1984. Specifically, Port Moller (Transect 4), Stations 6, 8, and 9 in 1984 averaged several hundred to 20,000 plus (one station) more sand lance per set in Cruise 1 (late June to mid-July 1984) than in 1985. Cruise 2 (late July to mid-August) catches dropped off in 1984 indicating that the peak abundances of sand lance near beaches in the Port Moller area (where nearly all the comparable data is from) were around the time (or prevailing water temperatures) of Cruise 1 in 1984 and were of short duration. We have inadequate information to interpret whether this period of high abundance is typical or atypical of sand lance abundance in this area. Beach seine efforts in both 1984 and 1985 indicate Pacific sand lance are not very numerous in the Ugashik and Port Heiden areas. In fact, Transect 3 (Cape Seniavin vicinity) was the nearest beach seine site up-bay of Port Moller to have sand lance in 1984. On Transect 6 (Moffet Lagoon), sand lance were taken at more stations in Cruise 1 in 1984 than in 1985, but the average abundance at Station 7 (comparable to Station 10 in 1984) was higher in 1985 (average abundance 2102 versus 66.3). In 1984, some 60 percent of all sand lance (by number) came from beach seines while 74 percent of all sand lance came from this gear type in 1985.

In nearshore areas (inside the 10-m isobath), sand lance comparisons are between two gear types. Cruise 1 and 2 sampling in 1984 (late June through mid-August took sand lance nearshore northeast as far as the Cinder River vicinity (Transect 1) with tow nets, suggesting these fish may have been near or on nearby beaches exposed to the open ocean and usually impossible to successfully beach seine. Average tow net catches of sand lance in Cruise 1 in 1984 seem to reflect densities comparable to those of Cruises 4a and 4b (1985) with the small seine in the Port Moller area. However, average catch is somewhat misleading in that one small seine haul in Cruise 4b (July 23) accounted for 322 of the 336 sand lance taken with this gear in 1985. Nearshore (tow net) sand lance did not increase until Cruise 2 (late July) in 1984 with catches many times greater than in both Cruise 1 in the same year and in both cruises in 1985. In all cruises of 1984, about 36 percent of the total sand lance catch came from tow nets, while the small seine operation of 1985 caught only 3.5 percent of the total number of sand lance taken.

In offshore areas (outside the 10-m isobath), sand lance were taken in smaller numbers with the large purse seines in both years compared to beach seines and nearshore gear. Cruise 1 (late June to mid-July) in

1984 and Cruise 4a and 4b in 1985 (June 16 to July 29) produced comparable, scattered catches of sand lance at Port Heiden (Transect 2). At Port Moller (Transect 4), the 1984 catches in Cruises 1 and 2 were smaller than those of Cruise 4a and 4b in 1985. An increasing abundance of sand lance from Station 0 (24 km or 15 nm offshore) to Station 3 (< 8 km or 5 nm offshore) was very apparent in Cruise 4a (June 16 to July 7), and somewhat apparent in Cruise 4b (July 8 to July 29) in 1985 and in Cruises 2 and 3 (late July through mid-September) in 1984. At Izembek Lagoon (Transect 6), Cruise 4b in 1985 and Cruises 2 and 3 in 1984 also had increasing abundances of sand lance from Stations 0 to Station 3.

This limited sampling in 1984 and 1985 indicates two very different sampling seasons relative to Pacific sand lance; numbers in 1984 were considerably greater overall than those in 1985, especially nearshore and on the beaches. Both years' efforts indicate that sand lance numbers drop as one moves up-bay past Cape Seniavin. The data suggest that this species is present in the pelagic environment only in small numbers offshore and increases dramatically closer to shore.

Length-frequency comparisons between 1984 and 1985 do not present an expected pattern. The peaks of the length-frequency distribution of sand lance from beach seines in Cruise 1 and 2 (1984) were at 70 and 80 mm, respectively (Figure 52). In 1985, the Cruise 4a and 4b modes were at 90 and 95 mm (Figure 63). In both years, growth is apparent between cruises. One might expect the beach seine-caught fish in 1985 to be smaller than those in 1984 due to colder water temperatures in 1985; however, the opposite pattern exists. A possible explanation is the cycling of larger and then smaller sand lance as seen in the three 1984 cruises (Figure 52). If varying sized sand lance move sequentially through beaches in the study area, there may be a somewhat random opportunity in sampling them at a given time to get fish of a particular size. The problems of quantitative sampling of this needle-shaped fish species whose smaller life stages can easily pass through the web of any gear type used in 1984 and 1985 must be noted.

Rainbow Smelt

Rainbow smelt were more numerous in beach seine hauls in Port Moller (Transect 4) early in 1985 than in Cruise 1 in 1984 (Transect 4 was the only transect beach seined in Cruise 4a). At Station 5, average abundance was roughly three times as great (11 versus 35.7 fish per set) in 1985. More rainbow smelt also were taken at Stations 5 and 6 in Port Moller in 1984 in Cruise 2 than during Cruise 4b in 1985. The opposite pattern was shown for Moffet Lagoon (Transect 6) where no rainbow smelt were taken in Cruise 4b (1985) and average abundances of up to 20 smelt per set were taken in Cruise 2 (1984). At Ugashik (Transect 0) numbers of rainbow smelt taken in Cruise 4b were comparable with catches in Cruise 2 in 1984. The sample sizes, both in number of sets that can actually be compared between years and the variability within sets in a given year at the same station, suggest that this species is very patchy in its occurrence.

Nearshore area comparisons require the evaluation of catches in two different gear types. Tow nets in Cruise 1 in 1984 captured no rainbow smelt in Port Moller. Small seine sets in Cruise 4a in 1985 captured small numbers of smelt, and larger numbers were taken in Cruise 4b. In contrast, at Ugashik (Transect 0) tow nets in Cruise 2 in 1984 averaged about 3500 smelt per tow against the 100 to 200 fish per small seine set in 1985. These catch rates are not equally representative of the smelt present at Ugashik, even though the 1984 tow net sets were made at about the same location (Station 8) as the small seine was fished in 1985. The tow net was held open to the river flow in 1984 while the small seine sampled the opposite direction due to tides in 1985.

Length-frequencies of rainbow smelt were compared from beach seines in 1984 and 1985. The Cruise 4a and 4b peaks in 1985 were at 90 and 95 mm while the Cruise 1 and Cruise 2 peak modes in 1984 were at 120 and 90 mm, respectively. There appears to be some reduction in size in 1985, possibly due to colder water temperatures, but as with sand lance, multiple size classes of these smelt may be present at various times near beaches in the study area.

Whitespotted Greenling

Whitespotted greenling were taken in greater numbers in the large purse seine in 1984 than 1985. Those greenling taken in 1984 in Cruise 1 generally ranged from about 55 to 85 mm. As can be seen in Figure 69 the 1985 greenling, taken in colder water and generally earlier in the year, were smaller than fish taken in 1984. As might be expected, 1984 otter trawl caught fish (Figure 63) were larger than greenling from the 1985 large purse seine (Figure 69). This is the result of movement from the pelagic to the demersal habitat as size increases.

Greater numbers of greenling may have been present in 1985 than are reflected in the catches, but their smaller size likely allowed many to pass through the large purse seine's web.

Capelin

Capelin were taken primarily in the large purse seine in 1985 (106 fish), whereas no capelin were taken in this gear in 1984. The single capelin taken in 1984 was in a beach seine. Assuming that the large purse seine is an adequate gear for this species, one must conclude that sampling began too late in 1984 to capture capelin. Capelin still were not very numerous in 1985 suggesting that we may have missed the majority of capelin in the study area where they reportedly occur in larger numbers earlier in the spring (Barton et al. 1977).

Pacific Herring

Pacific herring were taken in small numbers in all three gear types fished in 1985 (total catch 55 fish). In 1984, all but 8 of the herring taken were from the tow net (742 fish) which was not fished in 1985. Since the two gear types fished in the nearshore area were different, it is not possible to say herring were less numerous in 1985 than in 1984. There is a possibility that the small purse seine fished in 1985 was not as effective on small herring as the tow net used nearshore in 1984. Where other gear can be compared, the large purse seine took 27 fish in 1985 versus 4 in 1984 and the beach seine took 13 fish in 1985 versus 3 in 1984. With this mixed pattern it is not possible to conclude how the earlier sampling season and colder water temperatures affected herring catches in 1985. It is likely that in neither year were we sampling early enough to assess periods of peak herring abundances in the study area.

Dolly Varden

Dolly Varden were caught offshore in large purse seines in much smaller numbers in 1984 (2 fish) than in 1985 (47 fish). In addition, the smaller Dolly Varden seen and called juveniles in 1985 (Table 1b) were not seen in 1984. Again, the earlier season and colder waters of 1985 may explain these offshore differences with the same gear compared in the 2 years. The smaller fish may also be responding to the same food stimuli that are attracting juvenile salmon to the study area.

Pond Smelt

Pond smelt were taken in greater numbers (96 fish) in 1985 beach seines than in 1984 (27 fish). No other gear types captured pond smelt in either year, supporting the anticipated pattern of a close association with beach habitats.

4.7.3 Demersal Species Comparisons

As previously stated, the demersal species catch in 1985 dropped substantially due to the otter trawl effort being discontinued. Based on numbers caught, demersal fish ranked second (yellowfin sole), fourth (Pacific cod), sixth (rock sole), ninth (Alaska plaice) and tenth (snake prickleback) in total numbers of fish taken in 1984. In addition, whitespotted greenling ranked fifth in 1984, but over 62 percent of those caught were in the large purse in a pelagic life stage. Similarly, walleye pollock ranked eighth in 1984 but almost 95 percent of the fish taken were by large purse seine in the pelagic habitat. Even Pacific cod, fourth-ranked in 1984, had over 44 percent of its numbers taken by the large purse seine in the pelagic habitat. Clearly, this man-made division of fish into pelagic and demersal categories is complicated by life stages of fish moving from one place to another.

In 1985, the starry flounder ranked sixth in total numbers caught (Table 1b) with nearly all of those taken by beach seine. Thus, extensive comparison of 1984 and 1985 demersal fish data is difficult.

Starry Flounder

Based upon total numbers taken by beach seine, starry flounder were generally more numerous in 1985 (610 fish) than in 1984 (106 fish). This suggests that starry flounder may diminish in numbers near the beaches in the study area as the season progresses and water temperatures increase. Smaller-sized starry flounder dominated beach seine catches, thus year-class strength, timing of onshore/offshore movements, or predation rates could contribute to these annual differences. Length-frequency modes in the 65- to 90-mm range seen in 1984 were also seen in the 1985 catches of starry flounder.

Pacific Cod

Demersal Pacific cod can only be compared between beach seines where numbers of this species were small in each year (13 in 1985 versus 83 in 1984). For the pelagic life stage taken in the large purse seine, some dramatic differences existed between the two years. In 1984, the large purse seine captured 3007 pelagic cod while in 1985 only 10 were taken. As with pelagic whitespotted greenling in the large seine, reduced numbers in the large purse seine may have been due to the colder water temperatures and the earlier season sampled in 1985 compared to 1984. Again, there is the possibility that greater numbers of Pacific cod were present in the area but their smaller size caused by colder water temperatures and/or an earlier sampling season may have allowed many more of them to pass through the seine's web in 1985. Variation in year-class strength of Pacific cod recruited into the study area could also contribute to the great difference between 1984 and 1985 pelagic catches.

Walleye Pollock

A difference in pelagic walleye pollock numbers was very apparent between the two years sampled. In 1984, the large purse seine captured 557 fish compared to 15 fish taken in 1985 within this gear type. The above discussion for Pacific cod applies also to these patterns of pelagic walleye pollock abundance.

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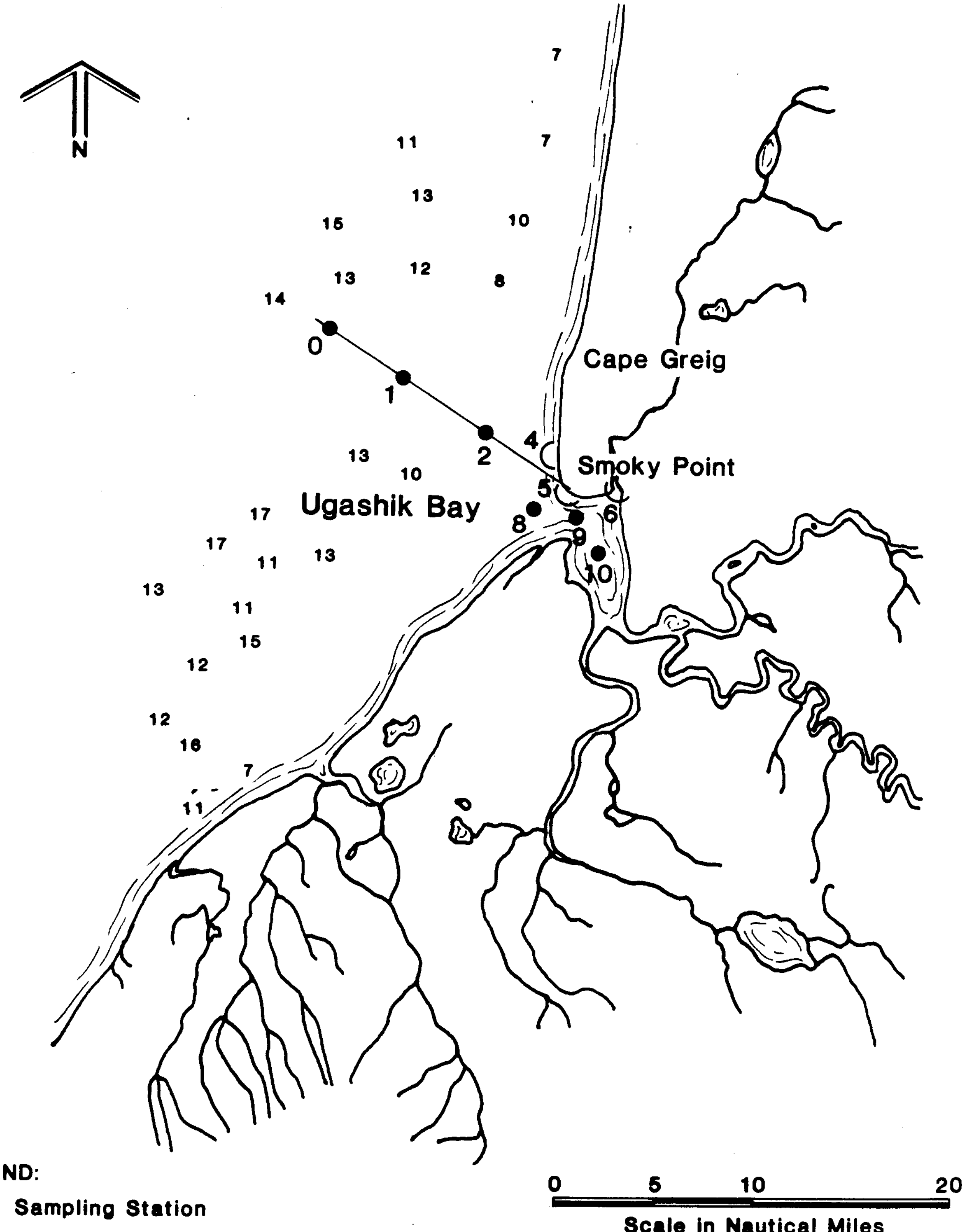
APPENDIX A

STATION LOCATION FIGURES



LEGEND:

1 ● Sampling Station

4 (Beach Seine

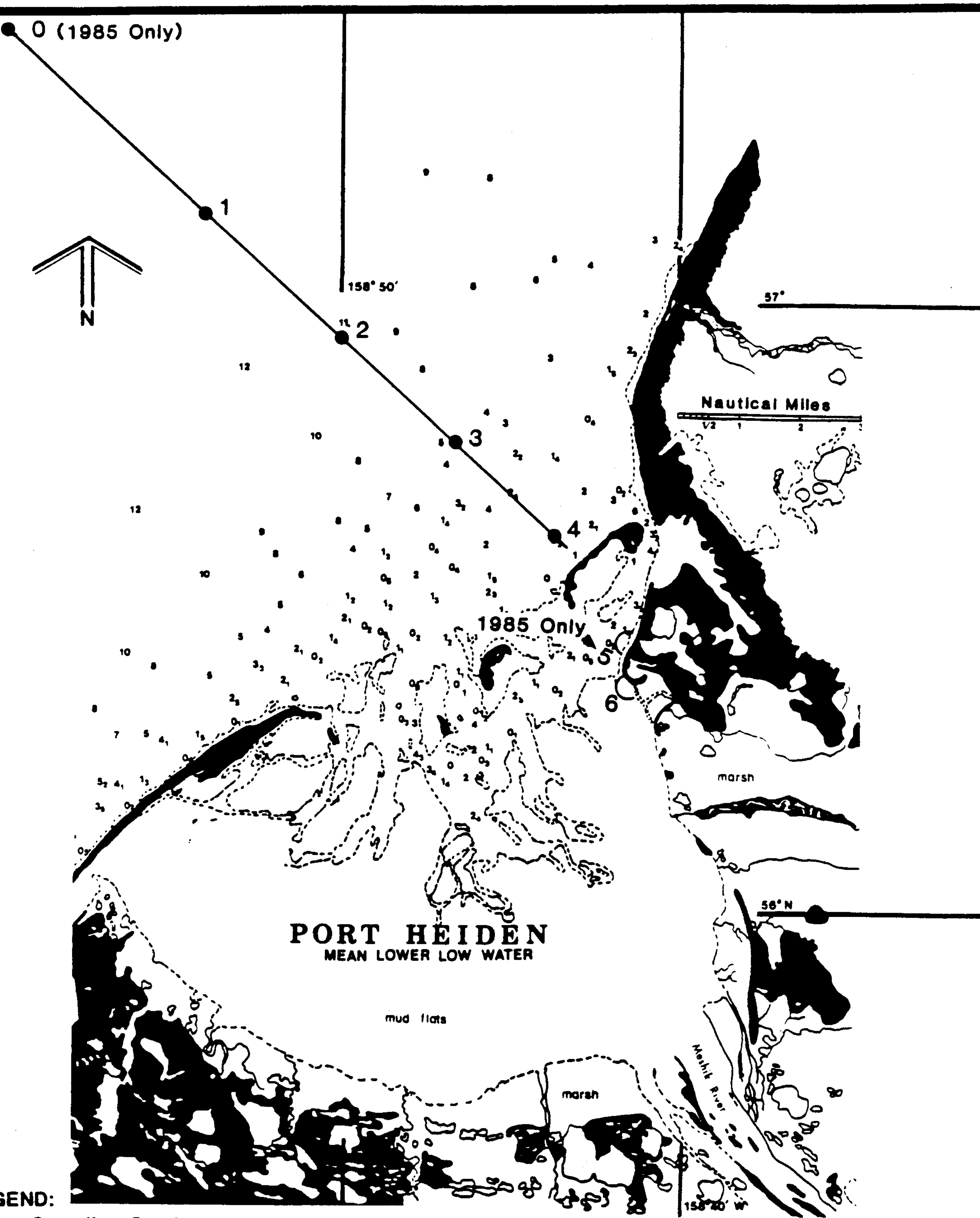
NOTES:

1. Source: NOAA Chart 16011
2. Depths Shown are in Fathoms
3. No Outside Stations in 1984

Approximate Station Locations
Transect 0, 1984 and 1985

Dames & Moore

Figure A-1



LEGEND:

●1 Sampling Station

)5 Beach Seine

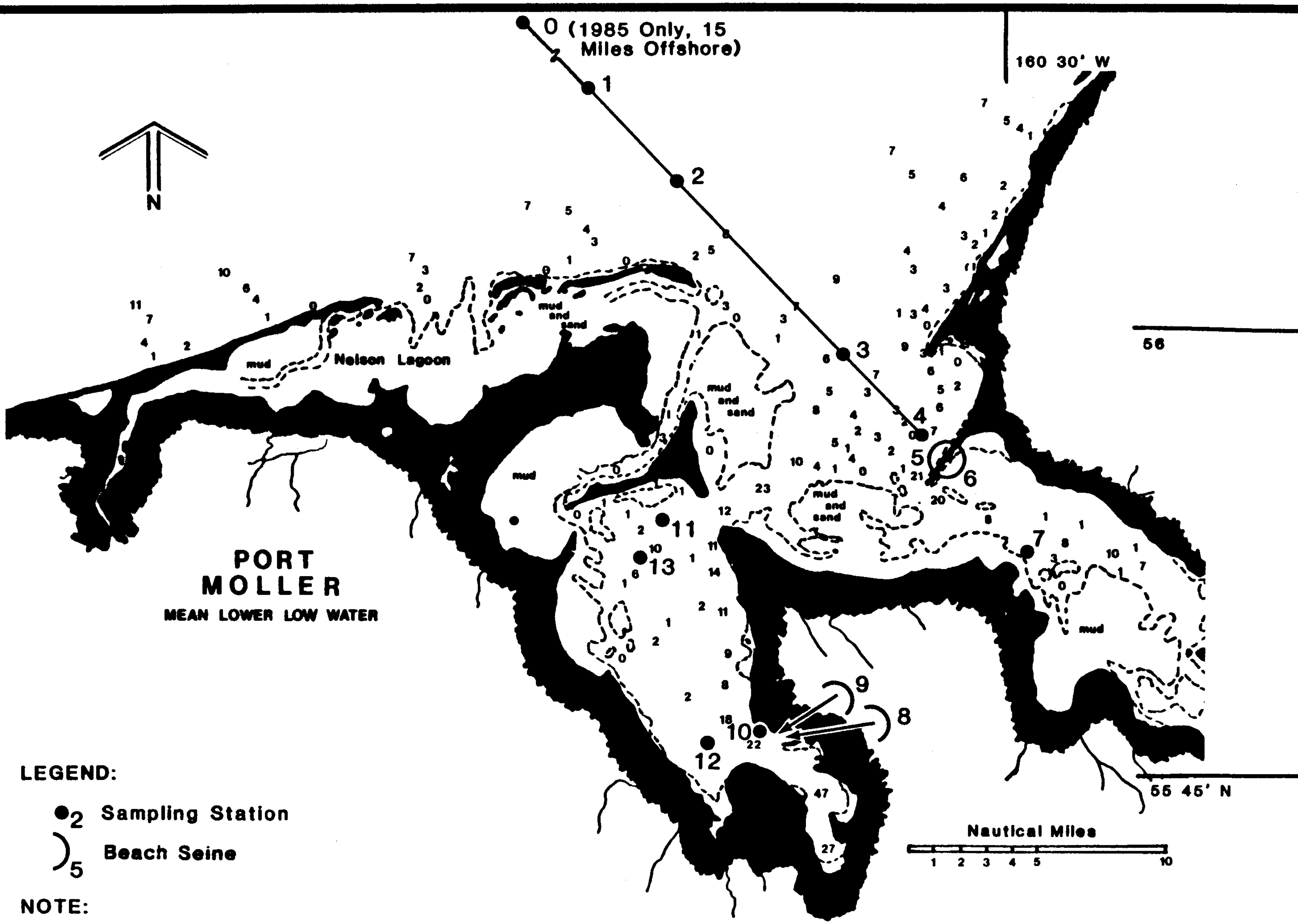
NOTES:

1. Bathymetry and coastline are no longer as shown on NOAA Chart 16343 (Source for this drawing)
2. Depths shown are in fathoms
3. Stations 0 and 5 - 1985 only.

Approximate Station Locations, Transect 2, 1984 and 1985

Dames & Moore

Figure A-2



LEGEND:

●2 Sampling Station

)5 Beach Seine

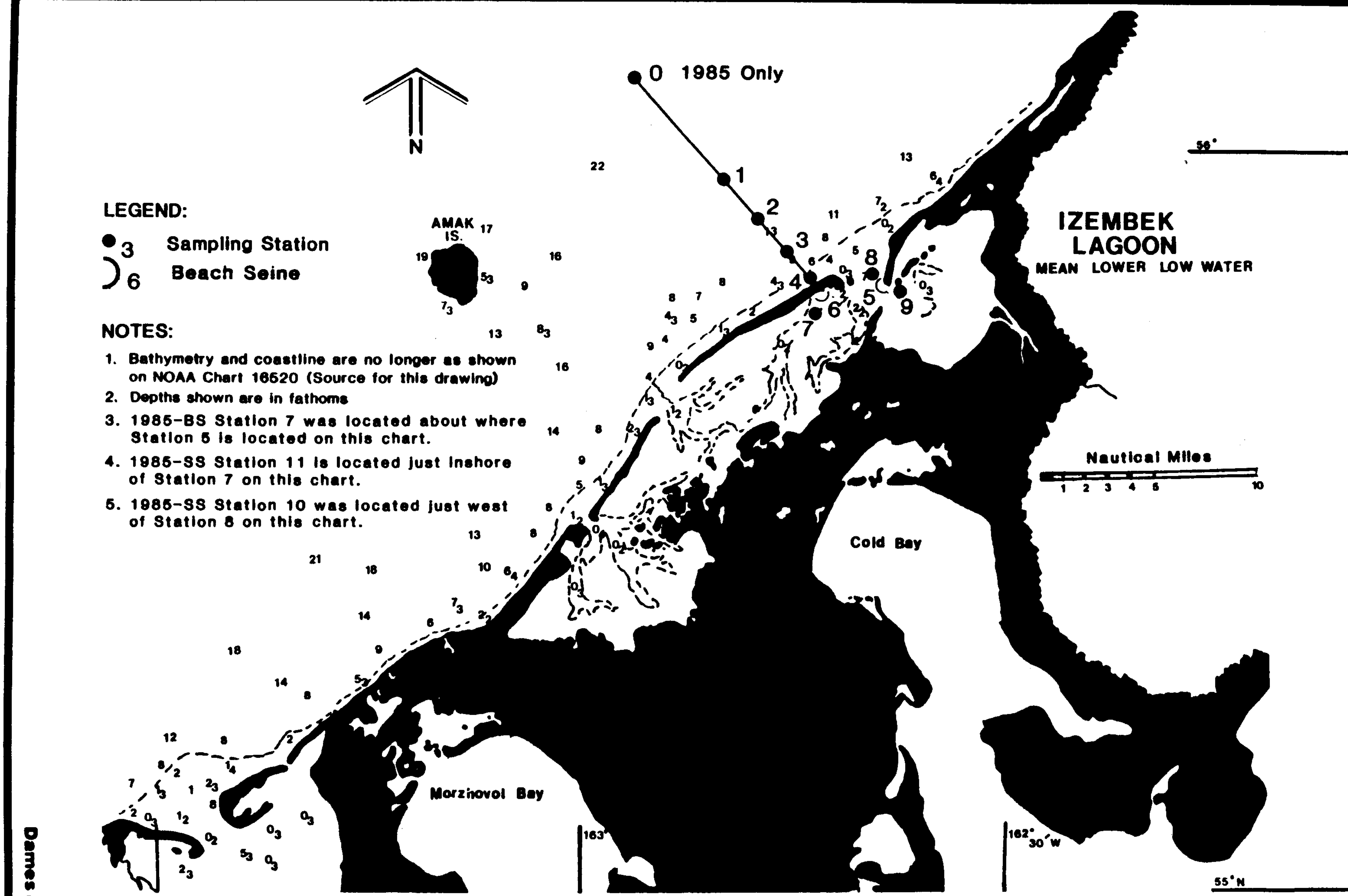
NOTE:

1. Bathymetry and coastline are no longer as shown on NOAA Chart 16363 (Source for this drawing)
2. Depths shown are in fathoms
3. Stations 10 and 11 - 1984 only, Stations 0,12, and 13 -1985 only

Approximate Station Locations, Transect 4, 1984 & 1985

Dames & Moore

Figure A-3



Approximate Station Locations
Transect 6, 1984 & 1985

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Figure A-4

APPENDIX B

PURSE SEINE CATCH DATA 1984

PURSE SEINE CATCH DATA

This appendix provides tables of purse seine catches of each species on each transect broken down by cruise and station. Data presented are means of the replicate taken at that station, transect, and cruise and are standardized to 10-minute opening time by multiplying the inverse of total time opened (10-minute open + 1/2 time to close) by 10. For example, actual catch from a set that was held open into the current for 10 minutes and took 6 minutes to close would be multiplied by 0.77(10+ (10+3)) to obtain standardized catch (both weight and numbers). Approximate water surface area fished is 31,000 m^2 based on the standard 10-minute tow at 0.26 m/s (0.5 knots) with a 145-m net opening. Frequency of occurrence of (number of sets containing) each species is also provided along with a summary for each transect in each cruise.

For identification, a four-digit code is placed at the top of each column. The first digit identifies the cruise, the second the transect number and the last two digits are the station number.

Data from Cruises 1, 2, and 3 are contained in Tables B-1, B-2, and B-3, respectively.

APPENDIX TABLE B-1

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 1

Transect 2

Common Species Name	Station 2 1202 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 1203 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	1.0	0.4	83.3	1.0	0.2	41.7
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	1.0	0.8	2751.5	1.0	0.4	1375.8
COHO SALMON Juv	0.0	0.0	0.0	2.0	62.6	3103.0	1.0	31.3	1551.5
SOCKEYE SALMON Juv	0.0	0.0	0.0	2.0	1.7	25.2	1.0	0.9	12.6
SOCKEYE SALMON Adult	1.0	12.7	28317.5	2.0	12.3	27355.2	2.0	12.5	27836.3
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CODS UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.6	9.9	0.0	0.0	0.0	1.0	0.8	5.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	1.0	1.9	48.1	1.0	1.0	24.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1.0	17.0	64.1	1.0	8.5	32.1
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	2.0			7.0			8.0		
Mean Abundance		14.2			96.5			55.4	
Mean Weight (g)			28327.4			33430.3			30878.8
Number of Replicates			2.0			2.0			4.0

Transect 3

Common Species Name	Station 2 1302 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 1303 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	1.0	4.4	42.9	0.0	0.0	0.0	1.0	2.2	21.4
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CODS UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	1.0	1.5	15.2	1.0	0.8	7.6
WHITESPOTTED GREENLING	1.0	0.4	0.7	0.0	0.0	0.0	1.0	0.2	0.4
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	1.0	0.8	3.8	1.0	0.4	1.9
PACIFIC SANDFISH	0.0	0.0	0.0	2.0	32.6	1185.3	1.0	16.3	592.7
SNAKE PRICKLEBACK	0.0	0.0	0.0	1.0	0.3	4.3	1.0	0.1	2.2
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	2.0	11.6	58.2	1.0	5.8	29.1
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	2.0	5.3	1300.9	1.0	2.6	650.4
STARRY FLOUNDER	0.0	0.0	0.0	1.0	0.3	57.5	1.0	0.1	28.7
Number of Species	2.0			7.0			9.0		
Mean Abundance		4.7			52.2			28.4	
Mean Weight (g)			43.6			2625.0			1334.3
Number of Replicates			2.0			2.0			4.0

Transect 4

Common Species Name	Station 1 1401 Freq	Station 1 Mean Abund	Station 1 Mean Weight	Station 2 1402 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 1403 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	1.0	0.3	11.9	1.0	0.4	15.2	2.0	0.2	7.7
SOCKEYE SALMON Juv	1.0	1.2	19.5	1.0	4.3	67.8	2.0	6.1	93.1	3.0	3.5	54.3
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4	808.0	1.0	0.1	230.8
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.8	90.6	1.0	0.5	25.9
CODS UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	2.0	1.0	2.2	5.4	2.0	1.8	5.4	3.0	1.6	3.9
STURGEON POACHER	0.0	0.0	0.0	1.0	0.4	9.1	0.0	0.0	0.0	1.0	0.1	2.6
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	0.2	25.2	2.0	1.0	136.7	0.0	0.0	0.0	2.0	0.4	49.9
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.7	3.6	1.0	0.2	1.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.8	7.2	1.0	0.5	2.1
PACIFIC SANDLANCE	1.0	2.5	25.2	0.0	0.0	0.0	1.0	0.4	0.7	2.0	1.2	11.0
ROCK SOLE	0.0	0.0	0.0	1.0	0.3	1.0	1.0	0.4	5.1	2.0	0.2	1.7
YELLOWFIN SOLE	1.0	0.2	21.7	0.0	0.0	0.0	1.0	0.4	7.2	2.0	0.2	11.4
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	5.0			6.0			10.0			12.0		
Mean Abundance		5.2			8.5			13.9			8.6	
Mean Weight (g)			93.7			231.7			1035.9			402.3
Number of Replicates			3.0			2.0			2.0			7.0

Transect 5

Common Species Name	Station 2 1502 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 1503 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	1.0	0.3	2.4	1.0	0.4	4.0	2.0	0.3	3.2
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	0.4	17.4	1.0	0.2	8.7
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CODS UNID	1.0	6.9	3.5	2.0	51.8	45.3	2.0	29.4	24.4
PACIFIC COD	1.0	1.1	0.8	0.0	0.0	0.0	1.0	0.6	0.4
WALLEYE POLLOCK	1.0	0.4	0.4	1.0	12.3	10.9	2.0	6.3	5.6
WHITESPOTTED GREENLING	1.0	68.4	173.6	2.0	61.9	351.4	2.0	65.2	262.5
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1.0	2.2	29.0	1.0	1.1	14.5
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	5.0			6.0			7.0		
Mean Abundance		77.1			128.9			103.0	
Mean Weight (g)			180.6			457.8			319.2
Number of Replicates			2.0			2.0			4.0

APPENDIX TABLE B-2

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 2

Transect 1

	Station 1			Station 2			Station 3			Transect Summary		
Common Species Name	2101 Freq	Mean Abund	Mean Weight	2102 Freq	Mean Abund	Mean Weight	2103 Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	1.0	0.4	19.8	1.0	2.8	41.3	2.0	1.0	20.4
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	2.0	31.7	410.3	0.0	0.0	0.0	1.0	0.8	11.1	2.0	10.8	140.5
SOCKEYE SALMON Adult	0.0	0.0	0.0	1.0	0.4	809.5	0.0	0.0	0.0	1.0	0.1	269.8
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC COD	0.0	0.0	0.0	1.0	0.4	0.4	0.0	0.0	0.0	1.0	0.1	0.1
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.4	2.7	2.0	49.5	374.7	2.0	6.5	41.4	3.0	18.8	139.6
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0	2.0	1.2	8.1	0.0	0.0	0.0	1.0	0.4	2.7
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	64.4	1.0	0.3	21.5
WOLF-EEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	2.0	0.8	7.3	0.0	0.0	0.0	1.0	0.3	2.4
PLEURONECTIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4	132.6	1.0	0.1	44.2
Number of Species	2.0			6.0			5.0			9.0		
Mean Abundance		32.0			52.5			11.1			31.8	
Mean Weight (g)			413.0			1219.6			290.7			641.1
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE B-2 (cont.)

Transect 3

Common Species Name	Station 1 2301 Freq	Station 1 Mean Abund	Station 1 Mean Weight	Station 2 2302 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 2303 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	1.0	0.4	36.2	1.0	0.4	16.3	0.0	0.0	0.0	2.0	0.2	17.5
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	1.0	0.4	687.9	1.0	0.4	515.9	2.0	0.2	401.3
CHUM SALMON Juv	2.0	34.3	271.2	2.0	10.5	73.5	1.0	3.6	28.6	3.0	16.1	124.4
CHUM SALMON Adult	0.0	0.0	0.0	1.0	0.4	1203.8	2.0	1.9	5363.8	2.0	0.8	2189.2
COHO SALMON Juv	1.0	0.4	18.8	2.0	1.1	50.3	0.0	0.0	0.0	2.0	0.5	23.0
SOCKEYE SALMON Juv	2.0	19.9	185.2	2.0	14.0	87.7	1.0	6.0	28.2	3.0	13.3	100.3
SOCKEYE SALMON Adult	0.0	0.0	0.0	1.0	1.9	4643.2	1.0	3.8	7566.7	2.0	1.9	4069.9
CHINOOK SALMON Juv	2.0	5.4	42.9	2.0	1.1	49.0	0.0	0.0	0.0	2.0	2.1	30.6
DOLLY VARDEN Adult	0.0	0.0	0.0	1.0	0.4	144.9	0.0	0.0	0.0	1.0	0.1	48.3
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4	15.9	1.0	0.1	5.3
ARCTIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	1.0	22.6	36.5	1.0	0.8	1.5	1.0	4.4	11.9	3.0	9.2	16.6
WALLEYE POLLOCK	1.0	105.2	163.2	2.0	14.3	23.9	2.0	69.7	96.9	3.0	63.1	94.6
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	5.2	2.0	78.9	280.4	2.0	68.4	429.4	3.0	49.4	238.3
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0	1.0	0.4	1.5	0.0	0.0	0.0	1.0	0.1	0.5
PACIFIC SANDFISH	0.0	0.0	0.0	1.0	2.7	151.5	1.0	0.4	11.4	2.0	1.0	54.3
WOLF-EEL	1.0	0.3	27.8	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.1	9.3
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	2.0	8.6	94.9	1.0	2.9	31.6
PLEURONECTIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	2.0	1.1	32.9	0.0	0.0	0.0	1.0	0.4	11.0
YELLOWFIN SOLE	0.0	0.0	0.0	1.0	0.4	113.6	0.0	0.0	0.0	1.0	0.1	37.9
Number of Species	9.0			16.0			11.0			19.0		
Mean Abundance		189.3			128.1			167.3			161.6	
Mean Weight (g)			786.7			7561.6			14163.3			7503.8
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE B-2 (cont.)

Transect 4

Common Species Name	Station 1 2401 Freq	Station 1 Mean Abund	Station 1 Mean Weight	Station 2 2402 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 2403 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	1.0	2.1	25.8	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.7	8.6
PINK SALMON Adult	0.0	0.0,	0.0	1.0	1.7	2149.6	0.0	0.0	0.0	1.0	0.6	716.5
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	1.0	0.4	860.0	0.0	0.0	0.0	1.0	0.1	286.7
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.4	923.4	1.0	1.5	307.8
SOCKEYE SALMON Juv	1.0	0.8	11.7	2.0	0.8	10.8	0.0	0.0	0.0	2.0	0.5	7.5
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	42.1	91.7	1.0	0.8	3.3	0.0	0.0	0.0	2.0	14.3	31.7
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4	0.4	1.0	0.1	0.1
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	1.0	0.8	33.3	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	11.1
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WOLF-EEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1.0	0.4	2.1	2.0	7.9	31.7	2.0	2.8	11.3
PLEURONECTIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	4.0			5.0			3.0			9.0		
Mean Abundance		45.7			4.0			12.6			20.8	
Mean Weight (g)			162.4			3025.7			955.5			1381.2
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE B-2 (cont.)

Transect 5

	Station 1			Station 2			Station 3			Transect Summary		
Common Species Name	2501 Freq	Mean Abund	Mean Weight	2502 Freq	Mean Abund	Mean Weight	2503 Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.1	25.4	1.0	0.8	10.2
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4	860.0	1.0	0.2	344.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4	458.3	1.0	0.2	183.3
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	1.0	182.6	869.5	2.0	495.8	1241.9	2.0	2.0	2.4	3.0	235.6	671.6
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.4	7.2	2.0	22.1	242.8	2.0	7.0	42.7	3.0	11.9	115.6
CRESTED SCULPIN	0.0	0.0	0.0	1.0	0.4	4.0	0.0	0.0	0.0	1.0	0.1	1.6
SILVERSPOT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4	16.3	1.0	0.1	6.5
WOLF-EEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLEURONECTIDAE	1.0	1.4	1.4	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.3
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	3.0			3.0			6.0			8.0		
Mean Abundance		185.4			518.2			12.2			249.2	
Mean Weight (g)			878.1			1488.6			1405.1			1333.1
Number of Replicates			1.0			2.0			2.0			5.0

APPENDIX TABLE B-2 (cont.)

Transect 6

Common Species Name	Station 1 2601 Freq	Station 1 Mean Abund	Station 1 Mean Weight	Station 2 2602 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 2603 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	2.0	8.6	30610.1	1.0	2.9	10203.4
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.6	34.9	1.0	1.2	11.6
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	0.4	2.9	0.0	0.0	0.0	1.0	0.1	1.0
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	40.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	13.3	33.3
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	6.6	37.5	2.0	21.0	88.0	1.0	0.4	2.1	3.0	9.3	42.5
CRESTED SCULPIN	1.0	0.4	4.6	1.0	0.4	8.0	0.0	0.0	0.0	2.0	0.3	4.2
SILVERSPOT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	2.0	27.9	1250.0	1.0	0.4	72.5	2.0	1.6	69.4	3.0	9.9	463.9
WOLF-EEL	0.0	0.0	0.0	1.0	0.4	99.2	0.0	0.0	0.0	1.0	0.1	33.1
PACIFIC SANDLANCE	0.0	0.0	0.0	2.0	13.5	58.1	1.0	19.8	119.0	2.0	11.1	59.0
PLEURONECTIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	4.0			6.0			5.0			9.0		
Mean Abundance		74.9			35.9			33.9			48.2	
Mean Weight (g)			1392.0			328.6			30835.5			10852.0
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE B-3

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 3

Transect 1

Common Species Name	Station 2 3102 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3103 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	2.0	3.4	109.3	2.0	50.8	1374.6	2.0	27.1	741.9
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	1.0	0.4	14.5	2.0	2.5	36.2	2.0	1.5	25.3
CHINOOK SALMON Juv	0.0	0.0	0.0	1.0	0.4	15.4	1.0	0.2	7.7
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	2.0	3.3	112.5	1.0	1.7	56.2
PACIFIC COD	2.0	376.6	880.5	2.0	31.7	116.7	2.0	204.1	498.6
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	2.0	7.9	7.5	1.0	4.0	3.7
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	1.0	1.3	65.8	1.0	1.3	70.8	2.0	1.3	68.3
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WOLF-EEL	2.0	1.3	156.3	0.0	0.0	0.0	1.0	0.6	78.2
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	1.0	63.3	41.7	1.0	0.8	1.3	2.0	32.1	21.5
STARRY FLOUNDER	0.0	0.0	0.0	1.0	0.4	406.3	1.0	0.2	203.1
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	6.0			9.0			10.0		
Mean Abundance		446.2			99.0			272.6	
Mean Weight (g)			1267.9			2141.0			1704.4
Number of Replicates			2.0			2.0			4.0

Transect 2

Common Species Name	Station 1 3201 Freq	Station 1 Mean Abund	Station 1 Mean Weight	Station 2 3202 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3203 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
ARCTIC LAMPREY	0.0	0.0	0.0	1.0	0.4	8.3	0.0	0.0	0.0	1.0	0.1	2.8
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4	2.1	1.0	0.1	0.7
CHUM SALMON Juv	1.0	0.4	2.9	1.0	1.7	51.7	2.0	2.9	95.4	3.0	1.7	50.0
COHO SALMON Juv	0.0	0.0	0.0	1.0	0.4	54.6	0.0	0.0	0.0	1.0	0.1	18.2
SOCKEYE SALMON Juv	2.0	1.7	15.3	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.6	5.1
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.0	125.0	1.0	1.7	41.7
PACIFIC COD	1.0	0.4	0.4	2.0	22.9	58.3	2.0	32.9	75.0	3.0	18.7	44.6
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	3.4	17.3	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.1	5.8
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WOLF-EEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	2.0	15.4	85.4	2.0	16.3	41.7	2.0	10.6	42.3
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.8	91.6	1.0	0.3	30.5
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.4	0.8	1.0	0.1	0.3
Number of Species	4.0			5.0			7.0			11.0		
Mean Abundance		5.9			40.8			58.6			35.1	
Mean Weight (g)			35.9			258.2			431.4			241.8
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE B-3 (cont.)

Transect 3

Common Species Name	Station 2 3302 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3303 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	2.0	0.8	26.7	1.0	0.8	12.1	2.0	0.8	19.4
COHO SALMON Juv	1.0	0.4	9.1	0.0	0.0	0.0	1.0	0.2	4.6
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	1.0	0.4	49.6	1.0	0.2	24.8
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	6.2	10.0	1.0	0.4	0.8	2.0	3.3	5.4
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	1.0	0.4	1.3	1.0	0.2	0.6
WOLF-EEL	0.0	0.0	0.0	1.0	0.4	30.7	1.0	0.2	15.4
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	2.0	3.3	19.6	2.0	116.5	1000.2	2.0	59.9	509.9
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	4.0			6.0			7.0		
Mean Abundance		10.7			118.9			64.8	
Mean Weight (g)			65.3			1094.6			579.9
Number of Replicates			2.0			2.0			4.0

Transect 4

Common Species Name	Station 2 3402 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3403 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	2.0	2.3	38.9	1.0	1.1	19.4
COHO SALMON Juv	1.0	0.5	27.8	0.0	0.0	0.0	1.0	0.2	13.9
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	1.0	0.5	41.7	1.0	0.2	20.8
SMELT UNID	0.0	0.0	0.0	2.0	14.3	23.1	1.0	7.2	11.6
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	2.0	3.7	83.3	1.0	1.8	41.7
PACIFIC COD	1.0	10.7	23.8	2.0	9.6	27.7	2.0	10.2	25.8
THREESPINE STICKLEBACK	1.0	0.5	0.5	1.0	0.5	0.5	2.0	0.5	0.5
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	4.4	23.8	2.0	1.8	6.0	2.0	3.1	14.9
WOLF-EEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	1.0	0.5	18.5	1.0	0.2	9.3
PACIFIC SANDLANCE	2.0	16.4	158.6	2.0	45.3	138.9	2.0	30.8	148.7
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	5.0			9.0			10.0		
Mean Abundance		32.3			78.3			55.3	
Mean Weight (g)			234.4			378.4			306.4
Number of Replicates			2.0			2.0			4.0

APPENDIX TABLE B-3 (cont.)

Transect 5

Common Species Name	Station 3: 3503 Freq	Station 3: Mean Abund	Station 3: Mean Weight	Transect Summary: Freq	Transect Summary: Mean Abund	Transect Summary: Mean Weight
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	1.0	2.3	11.6	1.0	2.3	11.6
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.5	1.4	1.0	0.5	1.4
CRESTED SCULPIN	1.0	0.5	11.6	1.0	0.5	11.6
PACIFIC SANDFISH	1.0	2.3	75.8	1.0	2.3	75.8
WOLF-EEL	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	1.0	5.1	74.1	1.0	5.1	74.1
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	5.0			5.0		
Mean Abundance		10.5			10.5	
Mean Weight (g)			174.3			174.3
Number of Replicates			2.0			2.0

Transect 6

Common Species Name	Station 2: 3602 Freq	Station 2: Mean Abund	Station 2: Mean Weight	Station 3: 3603 Freq	Station 3: Mean Abund	Station 3: Mean Weight	Transect Summary: Freq	Transect Summary: Mean Abund	Transect Summary: Mean Weight
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	1.0	0.8	8.3	0.0	0.0	0.0	1.0	0.3	2.8
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	1.0	40.0	141.6	1.0	6.1	17.5	2.0	17.4	58.9
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	2.5	16.6	1.0	0.4	1.3	2.0	1.1	6.4
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	2.0	38.6	278.5	1.0	25.7	185.7
WOLF-EEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	1.0	0.4	0.4	1.0	0.3	0.3
PACIFIC SANDLANCE	1.0	15.8	83.3	2.0	86.4	267.5	2.0	62.9	206.1
STARRY FLOUNDER	0.0	0.0	0.0	1.0	0.4	63.6	1.0	0.3	42.4
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	4.0			6.0			7.0		
Mean Abundance		59.1			132.3			107.9	
Mean Weight (g)			249.8			628.7			502.4
Number of Replicates			1.0			2.0			3.0

APPENDIX C

TOW NET CATCH DATA 1984

TOW NET CATCH DATA

This appendix provides tables of tow net catches of each species on each transect broken down by cruise and station. Data presented are means of the replicate taken at that station, transect, and cruise and are all based on catch per 10-minute tow. Frequency of occurrence of (number of sets containing) each species is also provided along with a summary for each transect in each cruise.

For identification a four-digit code is placed at the top of each column. The first digit identifies the cruise, the second the transect number and the last two digits are the station number.

Data from Cruises 1, 2, and 3 are contained in Tables C-1, C-2, and C-3, respectively.

APPENDIX TABLE C-1

TOW NET CATCH DATA SUMMARY FOR CRUISE 1

Transect 3

Common Species Name	Station 3 1303 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 1304 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	1.0	0.5	7.0	0.0	0.0	0.0	1.0	0.3	3.5
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.5	4.0	0.0	0.0	0.0	1.0	0.3	2.0
PACIFIC SANDFISH	0.0	0.0	0.0	2.0	14.0	412.5	1.0	7.0	206.3
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	2.0	880.0	2125.0	2.0	1987.0	4808.0	2.0	1433.5	3466.5
FLATHEAD SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	2.0	9.5	1800.0	1.0	4.8	900.0
Number of Species	3.0			3.0			5.0		
Mean Abundance		881.0			2010.5			1445.8	
Mean Weight (g)			2136.0			7020.5			4578.3
Number of Replicates			2.0			2.0			4.0

Transect 4

Common Species Name	Station 2 1402 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 4 1404 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Station 7 1407 Freq	Station 7 Mean Abund	Station 7 Mean Weight	Station 11 1411 Freq	Station 11 Mean Abund	Station 11 Mean Weight
empty haul	1.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0	1.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	10.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	35.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	5.0
PACIFIC SANDLANCE	1.0	1.5	7.5	1.0	2.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
FLATHEAD SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	12.5
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	2.0			2.0			1.0			5.0		
Mean Abundance		1.5			2.0			0.0			2.5	
Mean Weight (g)			7.5			5.0			0.0			62.5
Number of Replicates			2.0			2.0			2.0			2.0

APPENDIX TABLE C-1 (cont.)

Transect 4 (cont.)

Common Species Name	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0
PACIFIC HERRING	1.0	0.1	2.5
SOCKEYE SALMON Juv	0.0	0.0	0.0
RAINBOW SMELT	1.0	0.3	8.8
WHITESPOTTED GREENLING	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0
SNAKE PRICKLEBACK	1.0	0.1	1.3
PACIFIC SANDLANCE	2.0	0.9	3.1
FLATHEAD SOLE	1.0	0.1	3.1
YELLOWFIN SOLE	0.0	0.0	0.0
Number of Species	5.0		
Mean Abundance		1.5	
Mean Weight (g)			18.8
Number of Replicates			8.0

APPENDIX TABLE C-2

TOW NET CATCH DATA SUMMARY FOR CRUISE 2

Transect 0

	Station 8			Transect Summary		
Common Species Name	2008 Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	2.0	2.0	34.0	1.0	2.0	34.0
CHUM SALMON Juv	2.0	15.0	77.0	1.0	15.0	77.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	1.0	0.5	4.0	1.0	0.5	4.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	2.0	3500.0	22680.0	1.0	3500.0	22680.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	1.0	12.0	10.0	1.0	12.0	10.0
WHITESPOTTED GREENLING	2.0	1.0	6.5	1.0	1.0	6.5
PLAIN SCULPIN	1.0	0.5	220.0	1.0	0.5	220.0
SNAKE PRICKLEBACK	1.0	2.0	22.5	1.0	2.0	22.5
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0
PLEURONECTIDAE	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	1.0	0.5	145.0	1.0	0.5	145.0
STARRY FLOUNDER	2.0	5.5	2600.0	1.0	5.5	2600.0
Number of Species	10.0			10.0		
Mean Abundance		3539.0			3539.0	
Mean Weight (g)			25799.0			25799.0
Number of Replicates			2.0			2.0

Tansect 1

	Station 3			Station 4			Transect Summary		
Common Species Name	2103 Freq	Mean Abund	Mean Weight	2104 Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	1.0	4.0	25.0	1.0	2.0	12.5
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	2.0	39.0	60.0	1.0	19.5	30.0
PLEURONECTIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	1.0			2.0			2.0		
Mean Abundance		0.0			43.0			21.5	
Mean Weight (g)			0.0			85.0			42.5
Number of Replicates			2.0			2.0			4.0

APPENDIX TABLE C-2 (cont.)

Transect 3

Common Species Name	Station 3 2303 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 2304 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	1.0	1.0	6.0	0.0	0.0	0.0	1.0	0.5	3.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	1.0	2.0	275.0	1.0	3.0	125.0	2.0	2.5	200.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	2.0	20.0	65.0	2.0	110.5	95.0	2.0	65.3	80.0
PLEURONECTIDAE	1.0	0.5	0.5	0.0	0.0	0.0	1.0	0.3	0.3
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	1.0	0.5	250.0	0.0	0.0	0.0	1.0	0.3	125.0
Number of Species	5.0			2.0			5.0		
Mean Abundance		24.0			113.5			68.8	
Mean Weight (g)			596.5			220.0			408.3
Number of Replicates			2.0			2.0			4.0

Transect 4

Common Species Name	Station 3 2403 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 2404 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Station 7 2407 Freq	Station 7 Mean Abund	Station 7 Mean Weight	Station 10 2410 Freq	Station 10 Mean Abund	Station 10 Mean Weight
empty haul	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	10.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	1.0	7.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	1.0	1638.5	1695.0	2.0	691.0	850.0	2.0	2886.0	3550.0	2.0	781.0	2425.0
PLEURONECTIDAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	1.0	0.5	250.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	3.0			2.0			1.0			2.0		
Mean Abundance		1639.0			698.5			2886.0			782.0	
Mean Weight (g)			1945.0			851.5			3550.0			2435.0
Number of Replicates			2.0			2.0			2.0			2.0

APPEND~~IX~~ TABLE C-2 (cont.)

Transect 4 (cont.)

Common Species Name	Station 11 2411 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	1.0	0.2	2.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	1.0	1.5	0.3
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	2.0	980.5	2352.5	5.0	1395.4	2174.5
PLEURONECTIDAE	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	1.0	0.1	50.0
Number of Species	1.0			4.0		
Mean Abundance		980.5			1397.2	
Mean Weight (g)			2352.5			2226.8
Number of Replicates			2.0			10.0

Transect 6

Common Species Name	Station 8 2608 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	1.0	3.5	22.5	1.0	3.5	22.5
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	1.0	0.5	1.5	1.0	0.5	1.5
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	2.0	6.5	1.0	2.0	6.5
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	1.0	1.0	2.5	1.0	1.0	2.5
PLEURONECTIDAE	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	4.0			4.0		
Mean Abundance		7.0			7.0	
Mean Weight (g)			33.0			33.0
Number of Replicates			2.0			2.0

APPENDIX TABLE C-3

TOW NET CATCH DATA SUMMARY FOR CRUISE 3

Transect 4

Common Species Name	Station 4 3404 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Station 7 3407 Freq	Station 7 Mean Abund	Station 7 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	2.0	102.0	95.0	2.0	268.5	347.5	2.0	185.3	221.3
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	1.0	0.5	30.0	0.0	0.0	0.0	1.0	0.3	15.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIPARIS SP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	2.0	1.5	4.0	1.0	2.0	10.0	2.0	1.8	7.0
STARRY FLOUNDER	0.0	0.0	0.0	2.0	1.0	280.0	1.0	0.5	140.0
Number of Species	3.0			3.0			4.0		
Mean Abundance		104.0			271.5			187.8	
Mean Weight (g)			129.0			637.5			383.3
Number of Replicates			2.0			2.0			4.0

Transect 6

Common Species Name	Station 7 3607 Freq	Station 7 Mean Abund	Station 7 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	1.5	3.0	1.0	1.5	3.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	1.0	0.5	0.5	1.0	0.5	0.5
LIPARIS SP	1.0	0.5	0.5	1.0	0.5	0.5
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	3.0			3.0		
Mean Abundance		2.5			2.5	
Mean Weight (g)			4.0			4.0
Number of Replicates			2.0			2.0

APPENDIX D

BEACH SEINE CATCH DATA 1984

BEACH SEINE CATCH DATA

This appendix provides tables of beach seine catches of each species on each transect broken down by cruise and station. Data presented are means of the replicate taken at that station, transect, and cruise and are based on catch per set. Approximate area sampled by each beach seine was 900 m^2. Frequency of occurrence of (number of sets containing) each species is also provided along with a summary for each transect in each cruise.

For identification a four-digit code is placed at the top of each column. The first digit identifies the cruise, the second the transect number and the last two digits are the station number.

Data from Cruises 1, 2, and 3 are contained in Tables D-1, D-2, and D-3, respectively.

APPENDIX TABLE D-1

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 1

Transect 2

Common Species Name	Station 6 1206 Freq	Station 6 Mean Abund	Station 6 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	2.0	14.0	425.0	1.0	14.0	425.0
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	1.0	0.5	2.5	1.0	0.5	2.5
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	2.0	1.0	45.0	1.0	1.0	45.0
STARRY FLOUNDER	2.0	25.0	850.0	1.0	25.0	850.0
Number of Species	4.0			4.0		
Mean Abundance		40.5			40.5	
Mean Weight (g)			1322.5			1322.5
Number of Replicates			2.0			2.0

Transect 3

Common Species Name	Station 5 1305 Freq	Station 5 Mean Abund	Station 5 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
CHUM SALMON Juv	1.0	1.5	4.5	1.0	1.5	4.5
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	2.0	985.5	2381.0	1.0	985.5	2381.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	2.0			2.0		
Mean Abundance		987.0			987.0	
Mean Weight (g)			2385.5			2385.5
Number of Replicates			2.0			2.0

APPENDIX TABLE D-1 (cont.)

Transect 4

Common Species Name	Station 5 1405 Freq	Station 5 Mean Abund	Station 5 Mean Weight	Station 6 1406 Freq	Station 6 Mean Abund	Station 6 Mean Weight	Station 8 1408 Freq	Station 8 Mean Abund	Station 8 Mean Weight	Station 9 1409 Freq	Station 9 Mean Abund	Station 9 Mean Weight
CHUM SALMON Juv	0.0	0.0	0.0	1.0	1.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	8.5	32800.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.5	91.0	1.0	1.5	42.5
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	4.0	32.0	0.0	0.0	0.0	1.0	0.5	8.5
SOCKEYE SALMON Adult	0.0	0.0	0.0	1.0	0.5	1250.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	2.0	11.0	160.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EULACHON	2.0	5.5	125.0	0.0	0.0	0.0	1.0	0.5	35.0	1.0	2.5	112.5
PACIFIC COD	2.0	1.5	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	1.0	0.5	65.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	1.0	26.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	100.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	1.0	1.0	175.0	1.0	0.5	200.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.5	1000.0	1.0	0.5	500.0
TUBENOSE POACHER	2.0	3.0	19.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	2.0	906.5	1525.0	1.0	14080.0	44000.0	1.0	335.0	1050.0
ROCK SOLE	0.0	0.0	0.0	2.0	1.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	2.0	2.0	80.0	0.0	0.0	0.0	1.0	2.5	500.0	0.0	0.0	0.0
LONGHEAD DAB	0.0	0.0	0.0	1.0	0.5	20.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	1.0	0.5	125.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	8.0			8.0			6.0			6.0		
Mean Abundance		25.5			914.5			14088.5			348.5	
Mean Weight (g)			676.0			3208.0			45726.0			34513.5
Number of Replicates			2.0			2.0			2.0			2.0

Transect 4 (cont.)

Common Species Name	Transect Summary Freq	Mean Abund	Mean Weight
CHUM SALMON Juv	1.0	0.3	1.5
CHUM SALMON Adult	1.0	2.1	8200.0
COHO SALMON Juv	2.0	1.3	33.4
SOCKEYE SALMON Juv	2.0	1.1	10.1
SOCKEYE SALMON Adult	1.0	0.1	312.5
RAINBOW SMELT	1.0	2.8	40.0
EULACHON	3.0	2.1	68.1
PACIFIC COD	1.0	0.4	6.3
KELP GREENLING	1.0	0.1	16.3
WHITESPOTTED GREENLING	1.0	0.3	6.6
SCULPIN UNID	1.0	0.1	25.0
THREADED SCULPIN (A)	0.0	0.0	0.0
STAGHORN SCULPIN	2.0	0.4	93.8
PLAIN SCULPIN	2.0	0.5	375.0
TUBENOSE POACHER	1.0	0.8	4.9
PACIFIC SANDLANCE	3.0	3830.4	11643.8
ROCK SOLE	1.0	0.3	12.5
YELLOWFIN SOLE	2.0	1.1	145.0
LONGHEAD DAB	1.0	0.1	5.0
ARCTIC FLOUNDER	0.0	0.0	0.0
STARRY FLOUNDER	1.0	0.1	31.3
Number of Species	19.0		
Mean Abundance		3844.3	
Mean Weight (g)			21030.9
Number of Replicates			8.0

APPENDIX TABLE D-2

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 2

Transect 0

Common Species Name	Station 6 2006 Freq	Station 6 Mean Abund	Station 6 Mean Weight	Station 7 2007 Freq	Station 7 Mean Abund	Station 7 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
CHUM SALMON Juv	0.0	0.0	0.0	2.0	1.5	29.0	1.0	0.8	14.5
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	1.0	2.0	7.0	1.0	1.0	4.0	2.0	1.5	5.5
CHINOOK SALMON Juv	0.0	0.0	0.0	1.0	1.0	10.5	1.0	0.5	5.3
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
POND SMELT	2.0	2.0	20.0	2.0	11.5	137.5	2.0	6.8	78.8
RAINBOW SMELT	2.0	77.5	850.0	2.0	67.5	712.5	2.0	72.5	781.3
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	1.0	0.5	0.5	2.0	1.0	1.0	2.0	0.8	0.8
WHITESPOTTED GREENLING	2.0	7.0	55.0	0.0	0.0	0.0	1.0	3.5	27.5
SCULPIN UNID	1.0	0.5	10.0	0.0	0.0	0.0	1.0	0.3	5.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	1.0	9.0	100.0	0.0	0.0	0.0	1.0	4.5	50.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	2.0	2.0	55.0	1.0	1.0	27.5
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	2.0	1.5	183.5	1.0	1.0	35.0	2.0	1.3	109.3
STARRY FLOUNDER	2.0	15.5	345.0	2.0	5.5	42.5	2.0	10.5	193.8
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	9.0			9.0			12.0		
Mean Abundance		115.5			92.0			103.8	
Mean Weight (g)			1571.0			1027.0			1299.0
Number of Replicates			2.0			2.0			4.0

APPENDIX TABLE D-2 (cont.)

Transect 1

Common Species Name	Station 5 2105 Freq	Station 5 Mean Abund	Station 5 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0
POND SMELT	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	2.0	60.5	910.0	1.0	60.5	910.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	4.0	85.0	1.0	4.0	85.0
SCULPIN UNID	1.0	0.5	2.5	1.0	0.5	2.5
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	1.0	0.5	2.5	1.0	0.5	2.5
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	2.0	5.0	145.0	1.0	5.0	145.0
LONGHEAD DAB	1.0	0.5	5.0	1.0	0.5	5.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	1.0	1.0	40.0	1.0	1.0	40.0
ALASKA PLAICE	2.0	2.0	16.0	1.0	2.0	16.0
Number of Species	8.0			8.0		
Mean Abundance		74.0			74.0	
Mean Weight (g)			1206.0			1206.0
Number of Replicates			2.0			2.0

APPENDIX TABLE D-2 (cont.)

Transect 4

Common Species Name	Station 5 2405 Freq	Station 5 Mean Abund	Station 5 Mean Weight	Station 6 2406 Freq	Station 6 Mean Abund	Station 6 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
CHUM SALMON Juv	0.0	0.0	0.0	1.0	2.3	5.0	1.0	1.1	2.5
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	0.5	24.8	1.0	0.3	12.4
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	1.0	0.3	86.3	0.0	0.0	0.0	1.0	0.1	43.1
SMELT UNID	0.0	0.0	0.0	1.0	1.3	0.3	1.0	0.6	0.1
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
POND SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	1.0	0.3	6.3	0.0	0.0	0.0	1.0	0.1	3.1
PACIFIC COD	2.0	1.5	6.5	4.0	1.8	4.5	2.0	1.6	5.5
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.3	3.0	0.0	0.0	0.0	1.0	0.1	1.5
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	2.0	0.5	213.3	1.0	0.3	124.0	2.0	0.4	168.6
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	1.0	15.0	31.3	4.0	9.5	22.5	2.0	12.3	26.9
ROCK SOLE	0.0	0.0	0.0	1.0	0.5	17.0	1.0	0.3	8.5
YELLOWFIN SOLE	0.0	0.0	0.0	1.0	0.3	0.5	1.0	0.1	0.3
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	2.0	0.5	85.0	0.0	0.0	0.0	1.0	0.3	42.5
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	7.0			8.0			12.0		
Mean Abundance		18.3			16.3			17.3	
Mean Weight (g)			431.5			198.5			315.0
Number of Replicates			4.0			4.0			8.0

APPENDIX TABLE D-2 (cont.)

Transect 6

Common Species Name	Station 5 2605 Freq	Station 5 Mean Abund	Station 5 Mean Weight	Station 6 2606 Freq	Station 6 Mean Abund	Station 6 Mean Weight	Station 10 2610 Freq	Station 10 Mean Abund	Station 10 Mean Weight	Station 11 2611 Freq	Station 11 Mean Abund	Station 11 Mean Weight
CHUM SALMON Juv	1.0	2.5	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	1.0	1.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	13.5
SOCKEYE SALMON Juv	2.0	7.0	43.5	1.0	0.3	4.7	1.0	0.3	2.3	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	1.0	0.5	65.0	0.0	0.0	0.0	1.0	0.7	80.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.5	2.5
SURF SMELT	1.0	0.5	10.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	15.0
POND SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	1.0	20.0	1166.7	1.0	2.0	146.7	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	8.3	1.0	0.5	3.5
NINE-SPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	5.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	3.0	40.0	2315.0	3.0	7.7	720.0	1.0	0.5	55.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.7	30.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	2.0	71.0	75.0	1.0	0.3	3.3	2.0	66.3	158.0	2.0	45.0	140.0
ROCK SOLE	0.0	0.0	0.0	1.0	0.7	11.7	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	3.0	3.0	83.7	3.0	1.3	71.7	0.0	0.0	0.0
Number of Species	6.0			6.0			9.0			6.0		
Mean Abundance		82.5			64.3			80.3			52.0	
Mean Weight (g)			211.5			3585.0			1222.0			229.5
Number of Replicates			2.0			3.0			3.0			2.0

APPENDIX TABLE D-2 (cont.)

Transect 6 (cont)

Common Species Name	Transect Summary Freq	Mean Abund	Mean Weight
CHUM SALMON Juv	1.0	0.5	1.0
COHO SALMON Juv	2.0	0.3	5.3
SOCKEYE SALMON Juv	3.0	1.6	10.8
CHINOOK SALMON Juv	0.0	0.0	0.0
DOLLY VARDEN Adult	2.0	0.3	37.0
SMELT UNID	1.0	0.9	0.5
SURF SMELT	2.0	0.3	5.0
POND SMELT	0.0	0.0	0.0
RAINBOW SMELT	2.0	6.6	394.0
PACIFIC COD	2.0	0.4	3.2
NINE-SPINE STICKLEBACK	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0
CRESTED SCULPIN	1.0	0.1	1.5
STAGHORN SCULPIN	3.0	14.4	921.5
STURGEON POACHER	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	0.2	9.0
SNAKE PRICKLEBACK	0.0	0.0	0.0
PACIFIC SANDLANCE	4.0	43.2	91.4
ROCK SOLE	1.0	0.2	3.5
YELLOWFIN SOLE	0.0	0.0	0.0
LONGHEAD DAB	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0
ALASKA PLAICE	2.0	1.3	46.6
Number of Species	14.0		
Mean Abundance		70.3	
Mean Weight (g)			1530.3
Number of Replicates			10.0

APPENDIX TABLE D-3

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 3

Transect 3

Common Species Name	Station 5 3305 Freq	Station 5 Mean Abund	Station 5 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Adult	1.0	0.5	2270.0	1.0	0.5	2270.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.5	30.0	1.0	0.5	30.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	1.0	0.5	50.0	1.0	0.5	50.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	1.0	0.5	10.0	1.0	0.5	10.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	0.5	30.0	1.0	0.5	30.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	1.0	2.0	350.0	1.0	2.0	350.0
ALASKA PLAICE	1.0	0.5	2.5	1.0	0.5	2.5
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	7.0			7.0		
Mean Abundance		5.0			5.0	
Mean Weight (g)			2742.5			2742.5
Number of Replicates			2.0			2.0

Transect 4

Common Species Name	Station 5 3405 Freq	Station 5 Mean Abund	Station 5 Mean Weight	Station 6 3406 Freq	Station 6 Mean Abund	Station 6 Mean Weight	Station 9 3409 Freq	Station 9 Mean Abund	Station 9 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	2.0	1.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	4.3
COHO SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	1.0	1.0	31.7	0.0	0.0	0.0	1.0	0.4	13.6
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	2.0	209.0	2525.0	0.0	0.0	0.0	1.0	0.5	2.5	2.0	59.9	722.1
PACIFIC COD	2.0	20.0	97.5	2.0	4.3	14.0	2.0	4.0	4.5	3.0	8.7	35.1
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	4.0	107.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.1	30.7
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.0	37.5	1.0	0.9	10.7
STAGHORN SCULPIN	0.0	0.0	0.0	1.0	0.3	10.0	0.0	0.0	0.0	1.0	0.1	4.3
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	500.0	1.0	0.1	142.9
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	2.0	2.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.6	1.4
PACIFIC SANDFISH	1.0	1.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	7.1
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	1.0	0.3	11.7	2.0	8.0	95.0	2.0	2.4	32.1
YELLOWFIN SOLE	2.0	1.5	75.0	0.0	0.0	0.0	2.0	25.5	4500.0	2.0	7.7	1307.1
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	1.0	0.3	8.3	2.0	10.5	310.0	2.0	3.1	92.1
PACIFIC HALIBUT	0.0	0.0	0.0	1.0	0.3	23.3	0.0	0.0	0.0	1.0	0.1	10.0
Number of Species	7.0			6.0			7.0			14.0		
Mean Abundance		238.5			6.7			52.0			85.9	
Mean Weight (g)			2850.0			99.0			5449.5			2413.7
Number of Replicates			2.0			3.0			2.0			7.0

APPENDIX TABLE D-3 (cont.)

Transect 6

Common Species Name	Station 5 3605 Freq	Station 5 Mean Abund	Station 5 Mean Weight	Station 6 3606 Freq	Station 6 Mean Abund	Station 6 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	1.0	1.5	2.0	0.0	0.0	0.0	1.0	0.6	0.8
COHO SALMON Juv	2.0	5.0	109.5	1.0	0.7	8.3	2.0	2.4	48.8
COHO SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	2.0	69.5	357.5	3.0	23.7	1250.0	2.0	42.0	893.0
CAPELIN	0.0	0.0	0.0	1.0	0.3	1.7	1.0	0.2	1.0
RAINBOW SMELT	0.0	0.0	0.0	1.0	0.3	10.0	1.0	0.2	6.0
PACIFIC COD	0.0	0.0	0.0	1.0	0.7	1.7	1.0	0.4	1.0
THREESPINE STICKLEBACK	2.0	2.0	2.0	0.0	0.0	0.0	1.0	0.8	0.8
WHITESPOTTED GREENLING	0.0	0.0	0.0	1.0	0.3	3.3	1.0	0.2	2.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	1.0	0.5	40.0	2.0	2.0	141.7	2.0	1.4	101.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	2.0	1.3	1.7	1.0	0.8	1.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	3.0	11.0	9.3	1.0	6.6	5.6
ROCK SOLE	1.0	1.0	7.5	2.0	1.3	14.3	2.0	1.2	11.6
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	2.0	1.7	2.7	1.0	1.0	1.6
ALASKA PLAICE	2.0	1.0	13.5	3.0	4.0	70.0	2.0	2.8	47.4
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	7.0			12.0			14.0		
Mean Abundance		80.5			47.3			60.6	
Mean Weight (g)			532.0			1514.7			1121.6
Number of Replicates			2.0			3.0			5.0

APPENDIX E

OTTER TRAWL CATCH DATA 1984

OTTER TRAWL CATCH DATA

This appendix provides tables of otter trawl catches of each species on each transect broken down by cruise and station. Data presented are means of the replicate taken at that station, transect, and cruise and are based on a 10-minute bottom time. The approximate area swept, based on an assumed actual net opening of 5.49 m (18 feet) and an average speed over the bottom of 1 m/s (2 knots), is about 3300 m^2. Frequency of occurrence (number of sets containing) each species is also provided along with a summary for each transect in each cruise.

For identification a four-digit code is placed at the top of each column. The first digit identifies the cruise, the second the transect number and the last two digits are the station number.

Data from Cruises 1, 2, and 3 are contained in Tables E-1, E-2, and E-3, respectively.

APPENDIX TABLE E-1

OTTER TRAWL CATCH DATA SUMMARY FOR CRUISE 1

Transect 2

Common Species Name	Station 2 1202 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 1203 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 1204 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	1.0	0.5	25.0	0.0	0.0	0.0	1.0	0.2	8.3
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	1.5	97.5	1.0	1.5	75.0	2.0	1.0	27.5	3.0	1.3	66.7
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	2.0	71.0	1250.0	2.0	15.0	550.0	0.0	0.0	0.0	2.0	28.7	600.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRIGHTBELLY SCULPIN (B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	1.0	0.5	225.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	75.0
TIDEPOOL SCULPIN (B?)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	2.0	2.0	22.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.7	7.5
STURGEON POACHER	1.0	0.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	0.8
BERING POACHER	0.0	0.0	0.0	2.0	32.0	600.0	2.0	4.5	90.0	2.0	12.2	230.0
TUBENOSE POACHER	2.0	4.0	18.5	2.0	4.5	27.5	1.0	1.5	5.0	3.0	3.3	17.0
PACIFIC SANDFISH	0.0	0.0	0.0	1.0	0.5	15.0	0.0	0.0	0.0	1.0	0.2	5.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	2.0	2.5	117.5	0.0	0.0	0.0	1.0	0.8	39.2
CRESCENT GUNNEL	1.0	0.5	5.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	1.7
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	1.5	1.0	0.2	0.5
FLATHEAD SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	23.0	265.0	2.0	26.0	70.0	2.0	54.0	192.5	3.0	34.3	175.8
YELLOWFIN SOLE	2.0	58.0	575.0	2.0	76.0	3900.0	2.0	77.0	1400.0	3.0	70.3	1958.3
LONGHEAD DAB	0.0	0.0	0.0	2.0	25.5	975.0	1.0	3.0	90.0	2.0	9.5	355.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	2.0	36.0	1375.0	2.0	32.5	350.0	2.0	22.8	575.0
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	9.0			11.0			8.0			16.0		
Mean Abundance		161.0			220.0			174.0			185.0	
Mean Weight (g)			2461.0			7730.0			2156.5			4115.8
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-1 (cont.)

Transect 3

Common Species Name	Station 2 1302 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 1303 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 1304 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	3.0	3.0	265.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	88.3
WALLEYE POLLOCK	2.0	2.5	75.0	1.0	0.5	7.5	0.0	0.0	0.0	2.0	1.0	27.5
WHITESPOTTED GREENLING	1.0	2.5	100.0	1.0	4.0	100.0	0.0	0.0	0.0	2.0	2.2	66.7
SCULPIN UNID	0.0	0.0	0.0	2.0	1.5	35.0	1.0	0.5	10.0	2.0	0.7	15.0
THREADED SCULPIN (A)	1.0	2.5	65.0	2.0	3.0	100.0	0.0	0.0	0.0	2.0	1.8	55.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRIGHTBELLY SCULPIN (B)	0.0	0.0	0.0	2.0	1.5	20.0	0.0	0.0	0.0	1.0	0.5	6.7
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TIDEPOOL SCULPIN (B?)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	1.0	0.5	5.0	0.0	0.0	0.0	1.0	0.2	1.7
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	2.0	4.0	77.5	2.0	19.5	325.0	2.0	7.8	134.2
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	2.0	1.5	75.0	2.0	10.0	296.0	2.0	3.8	123.7
SNAKE PRICKLEBACK	0.0	0.0	0.0	2.0	2.5	75.0	2.0	2.0	65.0	2.0	1.5	46.7
CRESCENT GUNNEL	1.0	1.0	20.0	2.0	2.5	60.0	1.0	1.0	15.5	3.0	1.5	31.8
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	2.5	1.0	0.3	0.8
FLATHEAD SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	18.0	1662.5	2.0	4.5	82.5	2.0	1.5	5.0	3.0	8.0	583.3
YELLOWFIN SOLE	2.0	34.5	2425.0	2.0	41.5	3175.0	2.0	293.0	15775.0	3.0	123.0	7125.0
LONGHEAD DAB	0.0	0.0	0.0	2.0	1.0	20.0	1.0	1.5	25.0	2.0	0.8	15.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.5	1000.0	1.0	0.5	333.3
ALASKA PLAICE	0.0	0.0	0.0	2.0	1.0	3.0	2.0	9.0	65.0	2.0	3.3	22.7
PACIFIC HALIBUT	2.0	1.5	1251.5	1.0	0.5	40.0	0.0	0.0	0.0	2.0	0.7	430.5
Number of Species	8.0			15.0			11.0			18.0		
Mean Abundance		65.5			70.0			340.5			158.7	
Mean Weight (g)			5864.0			3875.5			17584.0			9107.8
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-1 (cont.)

Transect 4

Common Species Name	Station 2: 1402 Freq	Station 2: Mean Abund	Station 2: Mean Weight	Station 3: 1403 Freq	Station 3: Mean Abund	Station 3: Mean Weight	Station 4: 1404 Freq	Station 4: Mean Abund	Station 4: Mean Weight	Station 7: 1407 Freq	Station 7: Mean Abund	Station 7: Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	2.0	1.0	35.0	1.0	0.5	15.0	2.0	5.5	97.5
PACIFIC COD	2.0	3.0	142.5	1.0	1.0	20.0	1.0	0.5	15.0	1.0	0.5	5.0
WALLEYE POLLOCK	1.0	0.5	7.5	1.0	1.0	12.5	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	2.0	1.0	50.0	2.0	6.5	300.0	2.0	2.0	95.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	1.0	0.5	7.5	2.0	6.5	90.0	2.0	19.5	495.0	2.0	13.5	350.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	100.0	1.0	1.0	200.0
BRIGHTBELLY SCULPIN (B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	12.5
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	100.0
TIDEPOOL SCULPIN (B?)	0.0	0.0	0.0	1.0	0.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	1.0	0.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	2.0	3.0	162.5	1.0	4.0	25.0	1.0	1.5	9.0	1.0	1.0	25.0
TUBENOSE POACHER	0.0	0.0	0.0	1.0	0.5	2.5	2.0	1.5	4.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	30.0
PACIFIC SANDLANCE	1.0	1.0	5.0	1.0	1.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0
FLATHEAD SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	1.0	0.5	250.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	110.0	2375.0	2.0	68.0	925.0	2.0	41.5	450.0	2.0	9.0	90.0
YELLOWFIN SOLE	2.0	59.5	5305.0	2.0	110.5	7125.0	2.0	214.0	7250.0	2.0	84.5	6800.0
LONGHEAD DAB	2.0	1.5	135.0	1.0	0.5	10.0	1.0	0.5	22.5	0.0	0.0	0.0
STARRY FLOUNDER	2.0	1.0	750.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	1.0	0.5	87.5	1.0	3.0	300.0	1.0	1.0	100.0	2.0	5.0	250.0
PACIFIC HALIBUT	1.0	0.5	2.5	0.0	0.0	0.0	2.0	4.0	192.5	0.0	0.0	0.0
Number of Species	12.0			14.0			12.0			12.0		
Mean Abundance		181.5			199.0			291.5			124.5	
Mean Weight (g)			9230.0			8614.0			8953.0			8055.0
Number of Replicates			2.0			2.0			2.0			2.0

APPENDIX TABLE E-1 (cont.)

Transect 4

Common Species Name	Station 10 1410 Freq	Station 10 Mean Abund	Station 10 Mean Weight	Station 11 1411 Freq	Station 11 Mean Abund	Station 11 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	1.0	0.5	25.0	4.0	1.3	28.8
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.8	30.4
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.3	3.3
WHITESPOTTED GREENLING	0.0	0.0	0.0	1.0	0.5	22.5	4.0	1.7	77.9
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	1.0	0.5	3.5	1.0	0.5	17.5	6.0	6.8	160.6
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.3	50.0
BRIGHTBELLY SCULPIN (B)	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	2.1
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.1	16.7
TIDEPOOL SCULPIN (B?)	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.1	0.3
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.1	0.4
BERING POACHER	0.0	0.0	0.0	2.0	1.5	25.0	5.0	1.8	41.1
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.3	1.1
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	1.0	4.5	100.0	2.0	8.5	130.0	3.0	2.3	43.3
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.3	3.3
FLATHEAD SOLE	1.0	2.0	60.0	0.0	0.0	0.0	1.0	0.3	10.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.1	41.7
ROCK SOLE	0.0	0.0	0.0	2.0	20.5	112.5	5.0	41.5	658.8
YELLOWFIN SOLE	1.0	41.0	2600.0	2.0	350.0	13225.0	6.0	143.3	7050.8
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.4	27.9
STARRY FLOUNDER	0.0	0.0	0.0	1.0	0.5	262.5	2.0	0.3	168.8
ALASKA PLAICE	0.0	0.0	0.0	2.0	28.5	700.0	5.0	6.3	239.6
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.8	32.5
Number of Species	4.0			9.0			22.0		
Mean Abundance		48.0			411.0			209.3	
Mean Weight (g)			2763.5			14520.0			8689.3
Number of Replicates			2.0			2.0			12.0

APENDIX TABLE E-1 (cont.)

Transect 5

Common Species Name	Station 2: 1502 Freq	Station 2: Mean Abund	Station 2: Mean Weight	Station 3: 1503 Freq	Station 3: Mean Abund	Station 3: Mean Weight	Station 4: 1504 Freq	Station 4: Mean Abund	Station 4: Mean Weight	Transect Summary: Freq	Transect Summary: Mean Abund	Transect Summary: Mean Weight
empty haul	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	1.0	0.5	0.5	1.0	1.0	0.5	2.0	0.5	0.3
WHITESPOTTED GREENLING	1.0	0.5	35.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	11.7
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	1.0	0.5	30.0	0.0	0.0	0.0	1.0	0.2	10.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRIGHTBELLY SCULPIN (B)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TIDEPOOL SCULPIN (B?)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	55.0	1.0	0.2	18.3
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	2.0	7.0	175.0	1.0	2.3	58.3
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	105.0	1.0	0.7	35.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FLATHEAD SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	2.0	12.5	475.0	1.0	5.0	125.0	2.0	5.8	200.0
YELLOWFIN SOLE	0.0	0.0	0.0	2.0	5.0	125.0	2.0	29.0	2900.0	2.0	11.3	1008.3
LONGHEAD DAB	0.0	0.0	0.0	2.0	3.0	115.0	2.0	1.5	70.0	2.0	1.5	61.7
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	850.0	1.0	0.3	283.3
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	2.0			5.0			8.0			10.0		
Mean Abundance		0.5			21.5			47.0			23.0	
Mean Weight (g)			35.0			745.5			4280.5			1687.0
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-2

OTTER TRAWL CATCH DATA SUMMARY FOR CRUISE 2

Transect 1

Common Species Name	Station 2 2102 Freq	Mean Abund	Mean Weight	Station 3 2103 Freq	Mean Abund	Mean Weight	Station 4 2104 Freq	Mean Abund	Mean Weight	Transect Summary Freq	Mean Abund	Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	2.0	8.5	200.0	2.0	12.0	235.0	2.0	6.8	145.0
ARCTIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.5	2.5	0.0	0.0	0.0	1.0	0.5	6.0	2.0	0.3	2.8
PADDED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	1.0	0.5	20.0	2.0	8.0	137.5	2.0	28.0	925.0	3.0	12.2	360.8
TUBENOSE POACHER	0.0	0.0	0.0	1.0	1.0	14.5	1.0	0.5	9.5	2.0	0.5	8.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.5	61.0	1.0	0.5	20.3
SNAKE PRICKLEBACK	0.0	0.0	0.0	2.0	3.0	92.5	2.0	8.0	330.0	2.0	3.7	140.8
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	1.0	4.0	55.0	0.0	0.0	0.0	2.0	1.0	5.0	2.0	1.7	20.0
YELLOWFIN SOLE	2.0	42.5	1300.0	2.0	251.5	17212.5	2.0	52.0	4700.0	3.0	115.3	7737.5
LONGHEAD DAB	0.0	0.0	0.0	1.0	0.5	2.5	1.0	2.0	32.5	2.0	0.8	11.7
STARRY FLOUNDER	1.0	0.5	275.0	0.0	0.0	0.0	2.0	6.5	3662.5	2.0	2.3	1312.5
ALASKA PLAICE	1.0	1.5	55.0	2.0	9.0	1350.0	2.0	2.5	18.0	3.0	4.3	474.3
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	6.0			7.0			11.0			11.0		
Mean Abundance		49.5			281.5			114.5			148.5	
Mean Weight (g)			1707.5			19009.5			9984.5			10233.8
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-2 (cont.)

Transect 3

Common Species Name	Station 2: 2302 Freq	Station 2: Mean Abund	Station 2: Mean Weight	Station 3: 2303 Freq	Station 3: Mean Abund	Station 3: Mean Weight	Station 4: 2304 Freq	Station 4: Mean Abund	Station 4: Mean Weight	Transect Summary: Freq	Transect Summary: Mean Abund	Transect Summary: Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	1.0	0.5	85.0	0.0	0.0	0.0	1.0	0.2	28.3
RAINBOW SMELT	0.0	0.0	0.0	1.0	0.5	12.5	0.0	0.0	0.0	1.0	0.2	4.2
ARCTIC COD	0.0	0.0	0.0	1.0	0.5	15.0	0.0	0.0	0.0	1.0	0.2	5.0
PACIFIC COD	2.0	23.5	55.0	1.0	0.5	0.5	2.0	1.0	1.0	3.0	8.3	18.8
WALLEYE POLLOCK	1.0	0.5	25.0	1.0	1.0	1.5	1.0	1.0	1.0	3.0	0.8	9.2
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	1.0	36.0	2.0	3.0	160.0	2.0	1.0	135.0	3.0	1.7	110.3
PADDED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	2.0	2.0	65.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.7	21.7
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	1.0	0.5	6.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	2.0
STURGEON POACHER	0.0	0.0	0.0	1.0	0.5	2.0	0.0	0.0	0.0	1.0	0.2	0.7
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	2.0	8.0	175.0	1.0	2.7	58.3
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.5	132.5	1.0	0.8	44.2
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	7.5	1.0	0.2	2.5
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	6.5	147.5	1.0	1.0	125.0	0.0	0.0	0.0	2.0	2.5	90.8
YELLOWFIN SOLE	2.0	34.0	1350.0	2.0	203.5	11225.0	2.0	16.5	1850.0	3.0	84.7	4808.3
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	12.5	1.0	0.2	4.2
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	140.0	1.0	0.2	46.7
ALASKA PLAICE	1.0	0.5	10.0	2.0	1.0	111.0	2.0	3.5	82.5	3.0	1.7	67.8
PACIFIC HALIBUT	1.0	0.5	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	0.7
Number of Species	9.0			10.0			10.0			18.0		
Mean Abundance		69.0			212.0			35.0			105.3	
Mean Weight (g)			1696.5			11737.5			2537.0			5323.7
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-2 (cont.)

Transect 4

Common Species Name	Station 2 2402 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 2403 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 2404 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Station 7 2407 Freq	Station 7 Mean Abund	Station 7 Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	1.0	0.5	17.5	1.0	0.5	25.0	1.0	1.5	35.0
ARCTIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	99.5	432.5	2.0	2.5	9.5	0.0	0.0	0.0	1.0	0.5	1.5
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	190.0	2.0	36.0	625.0
PADDED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	2.0	1.0	65.0	2.0	3.5	185.0	2.0	6.5	255.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	625.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	12.5	1.0	0.5	1.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	6.5	127.5	2.0	2.5	80.0	1.0	17.0	200.0	2.0	23.5	287.5
YELLOWFIN SOLE	2.0	12.0	475.0	2.0	7.0	177.5	2.0	66.0	1800.0	2.0	249.5	2625.0
LONGHEAD DAB	1.0	0.5	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	1.0	0.5	200.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	1.0	0.5	110.0	1.0	1.0	85.0	1.0	1.0	60.0
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	35.0	2.0	2.0	195.0
Number of Species	5.0			6.0			8.0			10.0		
Mean Abundance		119.0			14.0			93.0			321.5	
Mean Weight (g)			1250.0			459.5			2532.5			4710.0
Number of Replicates			2.0			2.0			2.0			2.0

APPENDIX TABLE E-2 (cont.)

Transect 4 (cont)

Common Species Name	Station 10 2410 Freq	Station 10 Mean Abund	Station 10 Mean Weight	Station 11 2411 Freq	Station 11 Mean Abund	Station 11 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.4	12.9
ARCTIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	2.0	10.0	2.0	5.5	27.5	5.0	18.3	80.2
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	9.5	97.5	2.0	9.5	255.0	4.0	9.7	194.6
PADDED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	2.0	5.0	285.0	4.0	2.7	131.7
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	2.0	6.0	6525.0	0.0	0.0	0.0	2.0	1.1	1191.7
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	1.0	0.5	2.5	1.0	0.5	1.0	4.0	0.4	2.8
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	2.0	14.5	175.0	0.0	0.0	0.0	1.0	2.4	29.2
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.3	115.8
YELLOWFIN SOLE	2.0	246.5	16910.0	2.0	478.0	14150.0	6.0	176.5	6022.9
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.1	2.5
STARRY FLOUNDER	1.0	0.5	32.5	1.0	0.5	80.0	3.0	0.3	52.1
ALASKA PLAICE	2.0	9.0	210.0	2.0	10.0	925.0	5.0	3.6	231.7
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.5	38.3
Number of Species	8.0			7.0			13.0		
Mean Abundance		288.5			509.0			224.2	
Mean Weight (g)			23962.5			15723.5			8106.3
Number of Replicates			2.0			2.0			12.0

APPENDIX TABLE E-2 (cont.)

Transect 5 (cont.)

Common Species Name	Station 2 2502 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 2503 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 2504 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	15.0	40.5	2.0	12.5	22.5	2.0	26.0	50.0	3.0	17.8	37.7
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	1.0	0.5	3.5	0.0	0.0	0.0	1.0	0.2	1.2
PADDED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	15.0	1.0	0.2	5.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1.0	1.5	3.0	1.0	0.5	1.5	2.0	0.7	1.5
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	45.5	1537.5	2.0	75.5	1000.0	2.0	10.0	262.5	3.0	43.7	933.3
YELLOWFIN SOLE	0.0	0.0	0.0	2.0	2.0	27.0	2.0	25.0	387.5	2.0	9.0	138.2
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	2.0	2.0	2575.0	0.0	0.0	0.0	2.0	1.0	805.0	2.0	1.0	1126.7
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.5	112.5	1.0	0.8	37.5
PACIFIC HALIBUT	2.0	1.5	60.0	0.0	0.0	0.0	1.0	0.5	25.0	2.0	0.7	28.3
Number of Species	4.0			5.0			8.0			9.0		
Mean Abundance		64.0			92.0			66.0			74.0	
Mean Weight (g)			4213.0			1056.0			1659.0			2309.3
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-2 (cont.)

Transect 6

Common Species Name	Station 2 2602 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 2603 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 2604 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Station 7 2607 Freq	Station 7 Mean Abund	Station 7 Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	88.5	125.0	2.0	15.5	37.5	2.0	7.5	22.5	2.0	133.0	625.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	50.0	0.0	0.0	0.0
PADDED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.5	27.5
CRESTED SCULPIN	1.0	0.5	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	1.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	1.0	0.5	200.0	2.0	2.5	550.0	2.0	4.5	1025.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	1.0	0.5	800.0	0.0	0.0	0.0	1.0	0.5	20.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	37.5	2.0	5.0	150.0
BERING POACHER	0.0	0.0	0.0	1.0	0.5	5.0	1.0	1.5	17.5	1.0	1.5	12.5
TUBENOSE POACHER	1.0	0.5	0.5	0.0	0.0	0.0	1.0	0.5	1.0	2.0	2.0	6.5
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	25.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	1.0	0.5	0.5	0.0	0.0	0.0	1.0	1.0	5.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1.0	0.5	3.5	2.0	4.0	10.0	0.0	0.0	0.0
BUTTER SOLE	2.0	3.5	337.5	2.0	3.0	225.0	2.0	2.0	105.0	0.0	0.0	0.0
ROCK SOLE	2.0	56.0	550.0	2.0	12.0	52.5	0.0	0.0	0.0	2.0	8.5	187.5
YELLOWFIN SOLE	2.0	63.0	1387.5	2.0	92.5	2300.0	2.0	91.0	3800.0	2.0	3.0	87.5
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.5	1850.0	2.0	3.5	3675.0
ALASKA PLAICE	1.0	0.5	30.0	0.0	0.0	0.0	2.0	3.5	72.5	0.0	0.0	0.0
PACIFIC HALIBUT	0.0	0.0	0.0	1.0	1.0	0.5	0.0	0.0	0.0	1.0	1.0	112.5
Number of Species	10.0			9.0			13.0			10.0		
Mean Abundance		214.0			128.0			119.5			159.5	
Mean Weight (g)			2636.5			3974.0			7021.0			4904.0
Number of Replicates			2.0			2.0			2.0			2.0

APPENDIX TABLE E-2 (cont.)

Transect 6 (cont.)

Common Species Name	Station 8 2608 Freq	Station 8 Mean Abund	Station 8 Mean Weight	Station 9 2609 Freq	Station 9 Mean Abund	Station 9 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	1.0	1.0	125.0	1.0	0.2	20.8
ARCTIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	1.0	0.5	1.0	2.0	6.5	17.0	6.0	41.9	138.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	2.0	1.0	2.5	1.0	0.2	0.4
WHITESPOTTED GREENLING	1.0	0.5	1.5	2.0	46.0	287.5	3.0	7.9	56.5
PADDED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	4.6
CRESTED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.1	0.8
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.1	0.1
STAGHORN SCULPIN	1.0	0.5	87.5	1.0	1.0	250.0	5.0	1.5	352.1
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.2	136.7
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	1.0	1.0	3.0	2.0	3.5	32.5	4.0	1.8	37.2
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.6	5.8
TUBENOSE POACHER	0.0	0.0	0.0	1.0	1.0	0.5	4.0	0.7	1.4
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.1	4.2
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.3	0.9
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.8	2.3
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.4	111.3
ROCK SOLE	0.0	0.0	0.0	2.0	4.5	87.5	4.0	13.5	146.3
YELLOWFIN SOLE	1.0	1.0	45.0	2.0	15.5	362.5	6.0	44.3	1330.4
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	2.0	1.5	1107.5	2.0	3.5	2287.5	4.0	1.7	1486.7
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.7	17.1
PACIFIC HALIBUT	0.0	0.0	0.0	2.0	8.0	75.0	3.0	1.7	31.3
Number of Species	6.0			11.0			21.0		
Mean Abundance		5.0			91.5			119.6	
Mean Weight (g)			1245.5			3527.5			3884.8
Number of Replicates			2.0			2.0			12.0

APPENDIX TABLE E-3

OTTER TRAWL CATCH DATA SUMMARY FOR CRUISE 3

Transect 1

	Station 2			Station 3			Station 4			Transect Summary		
Common Species Name	3102 Freq	Mean Abund	Mean Weight	3103 Freq	Mean Abund	Mean Weight	3104 Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	2.0	9.0	110.0	2.0	31.0	427.5	2.0	13.3	179.2
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	4.0	7.0	1.0	7.5	20.0	2.0	27.5	100.0	3.0	13.0	42.3
WALLEYE POLLOCK	0.0	0.0	0.0	1.0	0.5	0.5	1.0	0.5	2.5	2.0	0.3	1.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	1.0	0.5	275.0	0.0	0.0	0.0	1.0	0.2	91.7
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SAILFIN SCULPIN	0.0	0.0	0.0	1.0	0.5	30.0	1.0	0.5	27.5	2.0	0.3	19.2
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	2.0	1.5	40.0	1.0	6.0	110.0	2.0	5.0	95.0	3.0	4.2	81.7
TUBENOSE POACHER	0.0	0.0	0.0	2.0	2.0	3.5	2.0	11.5	42.5	2.0	4.5	15.3
LIPARIS SP.	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	4.0	1.0	0.7	1.3
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	1.0	0.5	7.5	2.0	6.0	75.0	2.0	98.0	950.0	3.0	34.8	344.2
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	1.0	2.5	25.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	8.3
YELLOWFIN SOLE	2.0	18.5	290.0	2.0	60.0	9250.0	2.0	4.5	810.0	3.0	27.7	3450.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	45.0	1.0	0.2	15.0
STARRY FLOUNDER	1.0	0.5	80.0	2.0	2.5	1175.0	1.0	0.5	187.5	3.0	1.2	480.8
ALASKA PLAICE	0.0	0.0	0.0	2.0	7.5	500.0	2.0	7.0	125.0	2.0	4.8	208.3
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	6.0			11.0			12.0			14.0		
Mean Abundance		27.5			102.0			188.5			106.0	
Mean Weight (g)			449.5			11549.0			2816.5			4938.3
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-3 (cont.)

Transect 2

Common Species Name	Station 1 3201 Freq	Station 1 Mean Abund	Station 1 Mean Weight	Station 2 3202 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3203 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 3204 Freq	Station 4 Mean Abund	Station 4 Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	1.0	4.5	140.0	2.0	2.0	18.0	2.0	3.0	120.0	2.0	3.0	45.0
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	82.5	270.0	2.0	318.0	875.0	2.0	340.5	825.0	2.0	105.5	200.0
WALLEYE POLLOCK	2.0	6.0	23.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	1.0	0.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	4.5	55.0	1.0	6.0	75.0	0.0	0.0	0.0	1.0	3.5	65.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	2.0	1.0	217.5	2.0	2.5	55.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SAILFIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	1.0	0.5	100.0	1.0	1.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	2.0	6.5	122.5	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.5	6.0	0.0	0.0	0.0
<u>LIPARIS</u> SP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	2.5
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	2.0	21.5	157.5	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1.0	0.5	1.0	2.0	4.5	6.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	7.5	775.0	0.0	0.0	0.0	1.0	2.5	7.5	0.0	0.0	0.0
YELLOWFIN SOLE	2.0	10.5	175.0	2.0	16.0	155.0	2.0	79.0	3007.5	2.0	5.0	110.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.5	75.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	20.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	250.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	1.0	0.5	5.0	2.0	25.5	1162.5	1.0	1.0	10.0
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	9.0			8.0			11.0			7.0		
Mean Abundance		117.5			346.5			488.0			119.5	
Mean Weight (g)			1758.5			1194.0			5739.5			452.5
Number of Replicates			2.0			2.0			2.0			2.0

APPENDIX TABLE E-3 (cont.)

Transect 2 (cont.)

Common Species Name	Transect Summary Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0
RAINBOW SMELT	4.0	3.1	80.8
EULACHON	0.0	0.0	0.0
PACIFIC COD	4.0	211.6	542.5
WALLEYE POLLOCK	1.0	1.5	5.9
KELP GREENLING	1.0	0.1	0.6
WHITESPOTTED GREENLING	3.0	3.5	48.8
SCULPIN UNID	0.0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0
THREADED SCULPIN (A)	2.0	0.9	68.1
STAGHORN SCULPIN	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0
SAILFIN SCULPIN	0.0	0.0	0.0
RIBBED SCULPIN	2.0	0.4	27.5
STURGEON POACHER	0.0	0.0	0.0
BERING POACHER	1.0	1.6	30.6
TUBENOSE POACHER	1.0	0.6	1.5
LIPARIS SP.	1.0	0.1	0.6
PACIFIC SANDFISH	0.0	0.0	0.0
SNAKE PRICKLEBACK	1.0	5.4	39.4
CRESCENT GUNNEL	0.0	0.0	0.0
PACIFIC SANDLANCE	2.0	1.3	1.8
BUTTER SOLE	0.0	0.0	0.0
ROCK SOLE	2.0	2.5	195.6
YELLOWFIN SOLE	4.0	27.6	861.9
LONGHEAD DAB	1.0	0.4	18.8
ARCTIC FLOUNDER	1.0	0.3	5.0
STARRY FLOUNDER	1.0	0.3	62.5
ALASKA PLAICE	3.0	6.8	294.4
PACIFIC HALIBUT	0.0	0.0	0.0
Number of Species	18.0		
Mean Abundance		267.9	
Mean Weight (g)			2286.1
Number of Replicates			8.0

APPENDIX TABLE E-3 (cont.)

Transect 3

Common Species Name	Station 2 3302 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3303 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 3304 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	2.0	10.0	222.5	2.0	34.5	227.5	2.0	14.8	150.0
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	37.0	120.0	2.0	59.0	145.0	2.0	10.0	180.0	3.0	35.3	148.3
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	2.0	7.0	165.0	1.0	0.5	30.0	1.0	0.5	50.0	3.0	2.7	81.7
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	1.0	0.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	0.8
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SAILFIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	1.0	1.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	3.3
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	1.5	1.0	0.2	0.5
BERING POACHER	0.0	0.0	0.0	2.0	11.5	237.5	2.0	18.0	340.0	2.0	9.8	192.5
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIPARIS SP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	80.0	1.0	0.3	26.7
SNAKE PRICKLEBACK	0.0	0.0	0.0	1.0	0.5	5.0	1.0	1.0	65.0	2.0	0.5	23.3
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1.0	0.5	5.0	1.0	0.5	0.5	2.0	0.3	1.8
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	6.0	155.0	2.0	1.0	37.5	1.0	0.5	15.0	3.0	2.5	69.2
YELLOWFIN SOLE	2.0	29.5	1300.0	2.0	84.0	4575.0	2.0	198.5	6250.0	3.0	104.0	4041.7
LONGHEAD DAB	0.0	0.0	0.0	1.0	0.5	15.0	2.0	38.5	1000.0	2.0	13.0	338.3
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	87.5	1.0	0.2	29.2
ALASKA PLAICE	0.0	0.0	0.0	2.0	7.0	226.5	0.0	0.0	0.0	1.0	2.3	75.5
PACIFIC HALIBUT	1.0	0.5	35.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	11.7
Number of Species	7.0			10.0			12.0			16.0		
Mean Abundance		81.5			174.5			304.0			186.7	
Mean Weight (g)			1787.5			5499.0			8297.0			5194.5
Number of Replicates			2.0			2.0			2.0			6.0

APPENDIX TABLE E-3 (cont.)

Transect 4

Common Species Name	Station 2 3402 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3403 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 3404 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Station 7 3407 Freq	Station 7 Mean Abund	Station 7 Mean Weight
empty haul	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	1.0	6.5	50.0	2.0	3.0	5.0
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.5	60.0	0.0	0.0	0.0
PACIFIC COD	2.0	23.5	82.5	0.0	0.0	0.0	2.0	83.0	322.5	1.0	2.0	10.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.5	7.5	0.0	0.0	0.0	2.0	104.5	1750.0	2.0	33.5	650.0
SCULPIN UNID	1.0	0.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.5	80.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	11.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SAILFIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	2.0	1.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIPARIS SP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	1.0	105.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	1.0	0.5	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	10.5	125.0	0.0	0.0	0.0	1.0	3.5	75.0	1.0	13.5	237.5
YELLOWFIN SOLE	2.0	6.5	115.0	0.0	0.0	0.0	2.0	16.5	350.0	2.0	43.0	1300.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	1.0	0.5	283.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	55.0
Number of Species	9.0			1.0			7.0			7.0		
Mean Abundance		44.5			0.0			219.0			99.5	
Mean Weight (g)			736.0			0.0			2618.5			2337.5
Number of Replicates			2.0			2.0			2.0			2.0

APPENDIX TABLE E-3 (cont.)

Transect 4 (cont.)

Common Species Name	Station 10 3410 Freq	Station 10 Mean Abund	Station 10 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	1.0	1.0	4.0	1.0	0.2	0.8
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	1.0	1.5	15.0	3.0	2.2	14.0
EULACHON	0.0	0.0	0.0	1.0	0.9	12.0
PACIFIC COD	2.0	90.5	201.0	4.0	39.8	123.2
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	10.0	4.0	27.9	483.5
SCULPIN UNID	0.0	0.0	0.0	1.0	0.1	0.3
SILVERSPOT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	1.0	0.7	16.0
STAGHORN SCULPIN	0.0	0.0	0.0	1.0	0.1	2.2
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
SAILFIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	1.0	0.2	3.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0
LIPARIS SP.	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	1.0	0.2	21.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	1.0	0.1	0.2
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	3.0	5.5	87.5
YELLOWFIN SOLE	2.0	12.5	1005.0	4.0	15.7	554.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	1.0	0.1	56.7
ALASKA PLAICE	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HALIBUT	0.0	0.0	0.0	1.0	0.2	11.0
Number of Species	5.0			15.0		
Mean Abundance		106.5			93.9	
Mean Weight (g)			1235.0			1385.4
Number of Replicates			2.0			10.0

APPENDIX TABLE E-3 (cont.)

Transect 5 Common Species Name	Station 3 3503 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 3504 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	1.0	1.5	60.0	1.0	0.8	30.0
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	1.0	4.0	15.0	2.0	39.5	120.0	2.0	21.8	67.5
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SAILFIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIPARIS SP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	1.0	0.5	5.0	1.0	0.3	2.5
SNAKE PRICKLEBACK	0.0	0.0	0.0	1.0	0.5	10.0	1.0	0.3	5.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDLANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	1.0	1.0	5.0	0.0	0.0	0.0	1.0	0.5	2.5
YELLOWFIN SOLE	1.0	1.0	5.0	2.0	2.0	145.0	2.0	1.5	75.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	1.0	0.5	130.0	1.0	0.3	65.0
ALASKA PLAICE	0.0	0.0	0.0	2.0	2.0	90.0	1.0	1.0	45.0
PACIFIC HALIBUT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	4.0			7.0			8.0		
Mean Abundance		6.0			46.5			26.3	
Mean Weight (g)			25.0			560.0			292.5
Number of Replicates			2.0			2.0			4.0

APPENDIX TABLE E-3 (cont.)

Transect 6

Common Species Name	Station 2 3602 Freq	Station 2 Mean Abund	Station 2 Mean Weight	Station 3 3603 Freq	Station 3 Mean Abund	Station 3 Mean Weight	Station 4 3604 Freq	Station 4 Mean Abund	Station 4 Mean Weight	Station 7 3607 Freq	Station 7 Mean Abund	Station 7 Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	1.0	0.5	20.0	0.0	0.0	0.0	0.0	0.0	0.0
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	11.0	45.0	2.0	24.5	135.0	2.0	28.0	92.5	2.0	8.5	35.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.5	5.0	2.0	1.5	22.5	2.0	3.0	39.0	2.0	2.0	35.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	11.5
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	2.0	3.0	700.0	1.0	2.5	175.0	1.0	0.5	52.5
PLAIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SAILFIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	25.0	1.0	0.5	1.0
BERING POACHER	2.0	2.0	4.0	0.0	0.0	0.0	1.0	0.5	15.0	0.0	0.0	0.0
TUBENOSE POACHER	2.0	4.5	6.5	2.0	8.0	30.0	2.0	3.5	14.0	2.0	28.5	17.5
LIPARIS SP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRESCENT GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	10.5
PACIFIC SANDLANCE	1.0	0.5	1.5	0.0	0.0	0.0	1.0	5.5	45.0	2.0	1.0	3.0
BUTTER SOLE	1.0	1.0	125.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	2.0	5.0	165.0	2.0	1.0	77.5	2.0	6.0	140.0	2.0	4.5	82.5
YELLOWFIN SOLE	2.0	44.5	1750.0	2.0	221.0	16100.0	2.0	26.0	1350.0	2.0	4.5	80.0
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	2.0	1.0	712.5	2.0	2.5	1175.0	1.0	1.5	600.0	0.0	0.0	0.0
ALASKA PLAICE	1.0	1.0	300.0	0.0	0.0	0.0	2.0	3.5	82.5	2.0	9.0	27.5
PACIFIC HALIBUT	2.0	2.0	15.5	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.5	27.5
Number of Species	11.0			8.0			11.0			12.0		
Mean Abundance		73.0			262.0			80.5			62.0	
Mean Weight (g)			3130.0			18260.0			2578.0			383.5
Number of Replicates			2.0			2.0			2.0			2.0

APPENDIX TABLE E-3 (cont.)

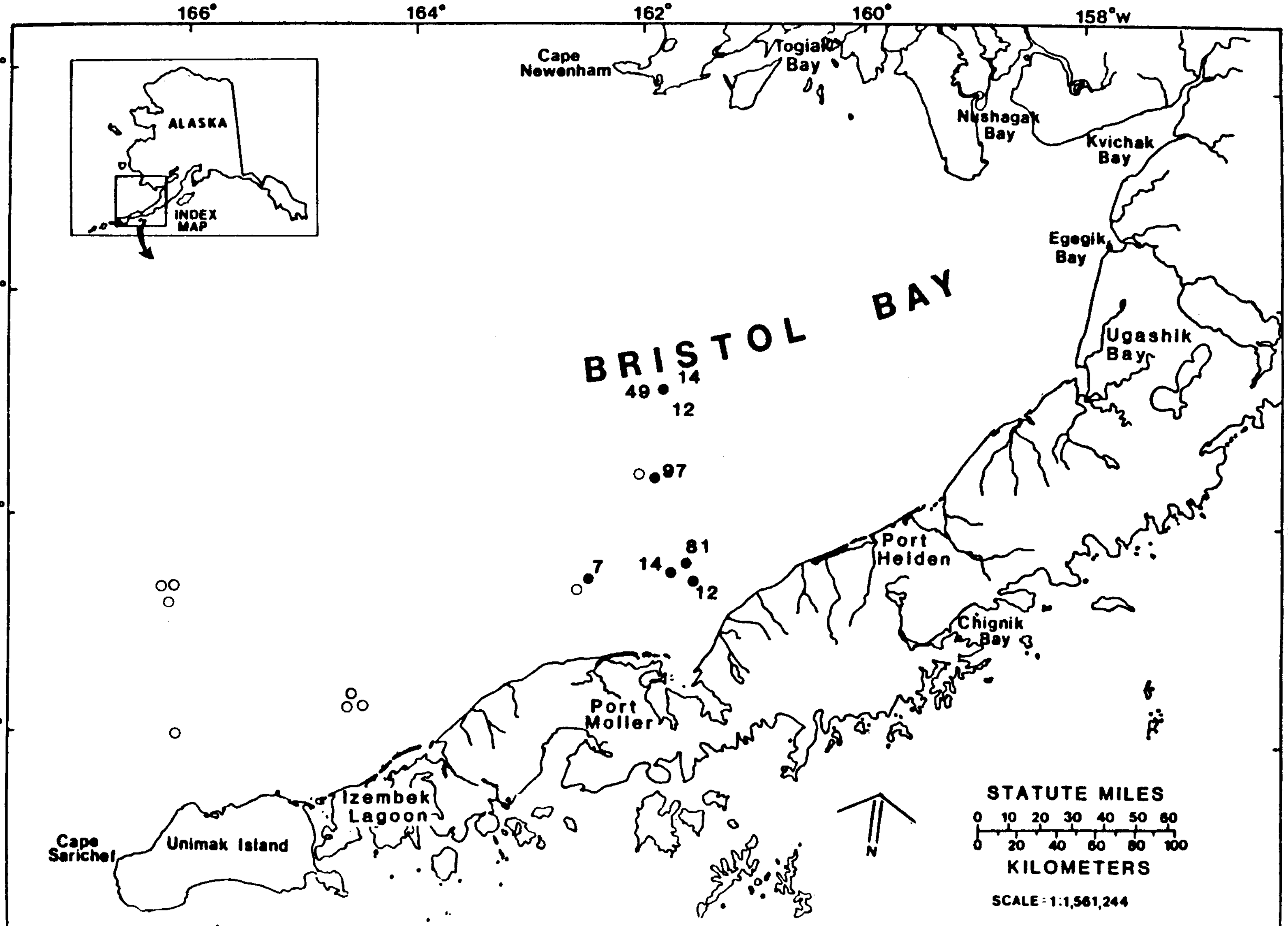
Transect 6 (cont)

Common Species Name	Station 8 3608 Freq	Station 8 Mean Abund	Station 8 Mean Weight	Station 9 3609 Freq	Station 9 Mean Abund	Station 9 Mean Weight	Transect Summary Freq	Transect Summary Mean Abund	Transect Summary Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SURF SMELT	0.0	0.0	0.0	1.0	0.5	0.5	1.0	0.1	0.1
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.1	3.3
EULACHON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	2.0	4.0	17.5	2.0	75.0	195.0	6.0	25.2	86.7
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KELP GREENLING	1.0	0.5	1.5	2.0	1.0	16.0	2.0	0.3	2.9
WHITESPOTTED GREENLING	1.0	0.5	5.0	2.0	5.5	92.5	6.0	2.2	33.2
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SILVERSPOT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	1.9
THREADED SCULPIN (A)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	2.0	2.5	132.5	4.0	1.4	176.7
PLAIN SCULPIN	0.0	0.0	0.0	2.0	1.0	2.5	1.0	0.2	0.4
GREAT SCULPIN	0.0	0.0	0.0	1.0	0.5	0.5	1.0	0.1	0.1
SAILFIN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RIBBED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	2.0	5.5	47.5	3.0	1.1	12.3
BERING POACHER	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.4	3.2
TUBENOSE POACHER	1.0	0.5	0.5	1.0	6.0	6.0	6.0	8.5	12.4
LIPARIS SP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	2.0	1.0	5.0	1.0	0.2	0.8
SNAKE PRICKLEBACK	0.0	0.0	0.0	2.0	1.5	21.0	1.0	0.3	3.5
CRESCENT GUNNEL	0.0	0.0	0.0	1.0	0.5	19.0	2.0	0.2	4.9
PACIFIC SANDLANCE	2.0	452.0	742.5	1.0	1.5	1.5	5.0	76.8	132.3
BUTTER SOLE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	20.8
ROCK SOLE	1.0	1.0	10.0	2.0	10.0	80.0	6.0	4.6	92.5
YELLOWFIN SOLE	2.0	2.0	49.5	2.0	18.0	507.5	6.0	52.7	3306.2
LONGHEAD DAB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	1.0	0.5	225.0	1.0	1.0	412.5	5.0	1.1	520.8
ALASKA PLAICE	0.0	0.0	0.0	2.0	3.5	4.0	4.0	2.8	69.0
PACIFIC HALIBUT	1.0	0.5	25.0	2.0	4.5	155.0	4.0	1.4	37.2
Number of Species	9.0			18.0			22.0		
Mean Abundance		461.5			139.0			179.7	
Mean Weight (g)			1076.5			1698.5			4521.1
Number of Replicates			2.0			2.0			12.0

APPENDIX F

SPECIES BREAKDOWN OF 1962 THROUGH 1968 JUVENILE SALMON PURSE SEINE CATCHES

(Source: Data from Hartt and Dell 1978)

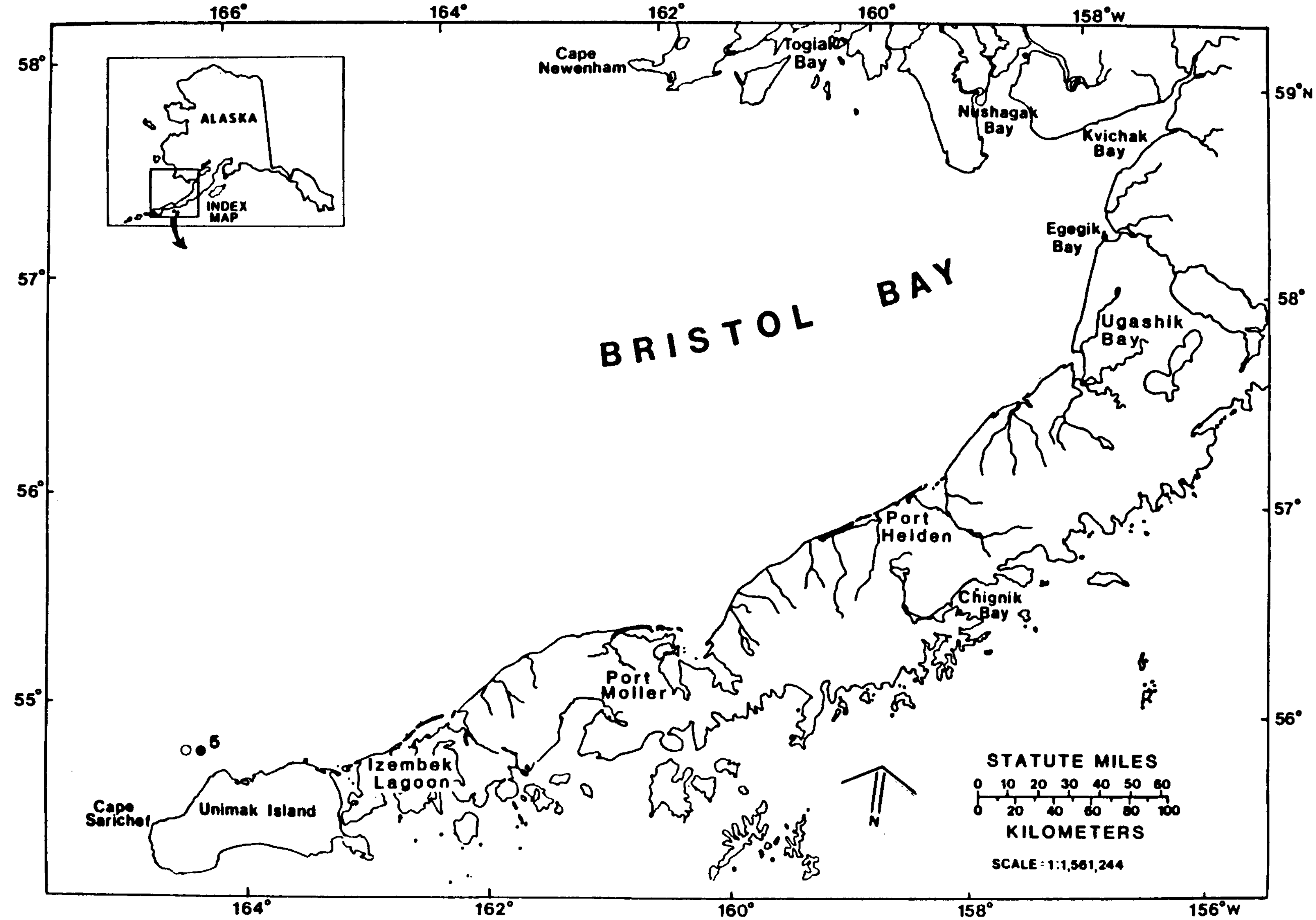


KEY:
○ None of this species taken

Juvenile Sockeye Salmon Purse Seine Catch
July, 1962

Dames & Moore

Figure F-1

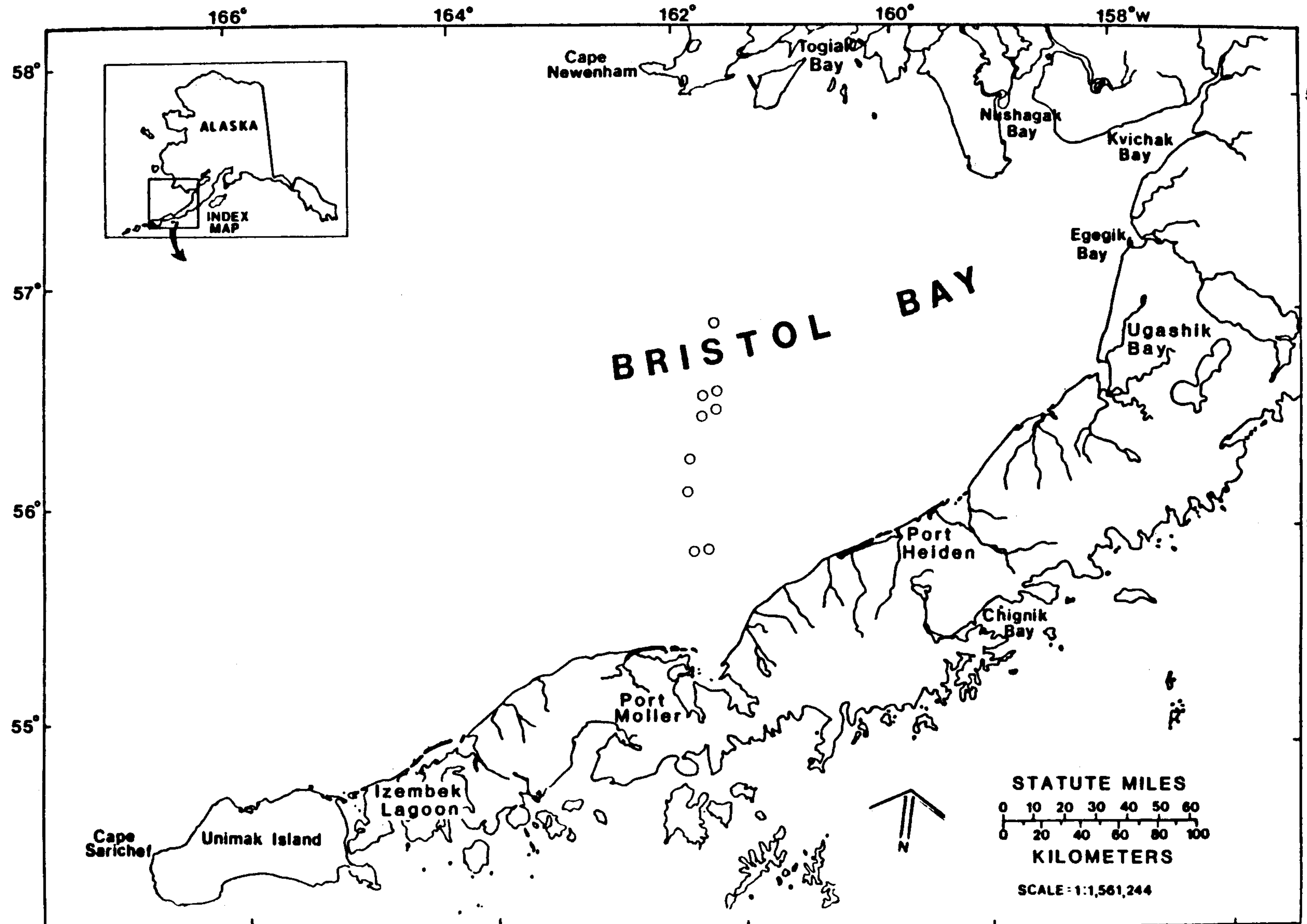


KEY:
○ None of this species taken

Juvenile Sockeye
Salmon Purse Seine Catch
August, 1962

Dames & Moore

Figure F-2

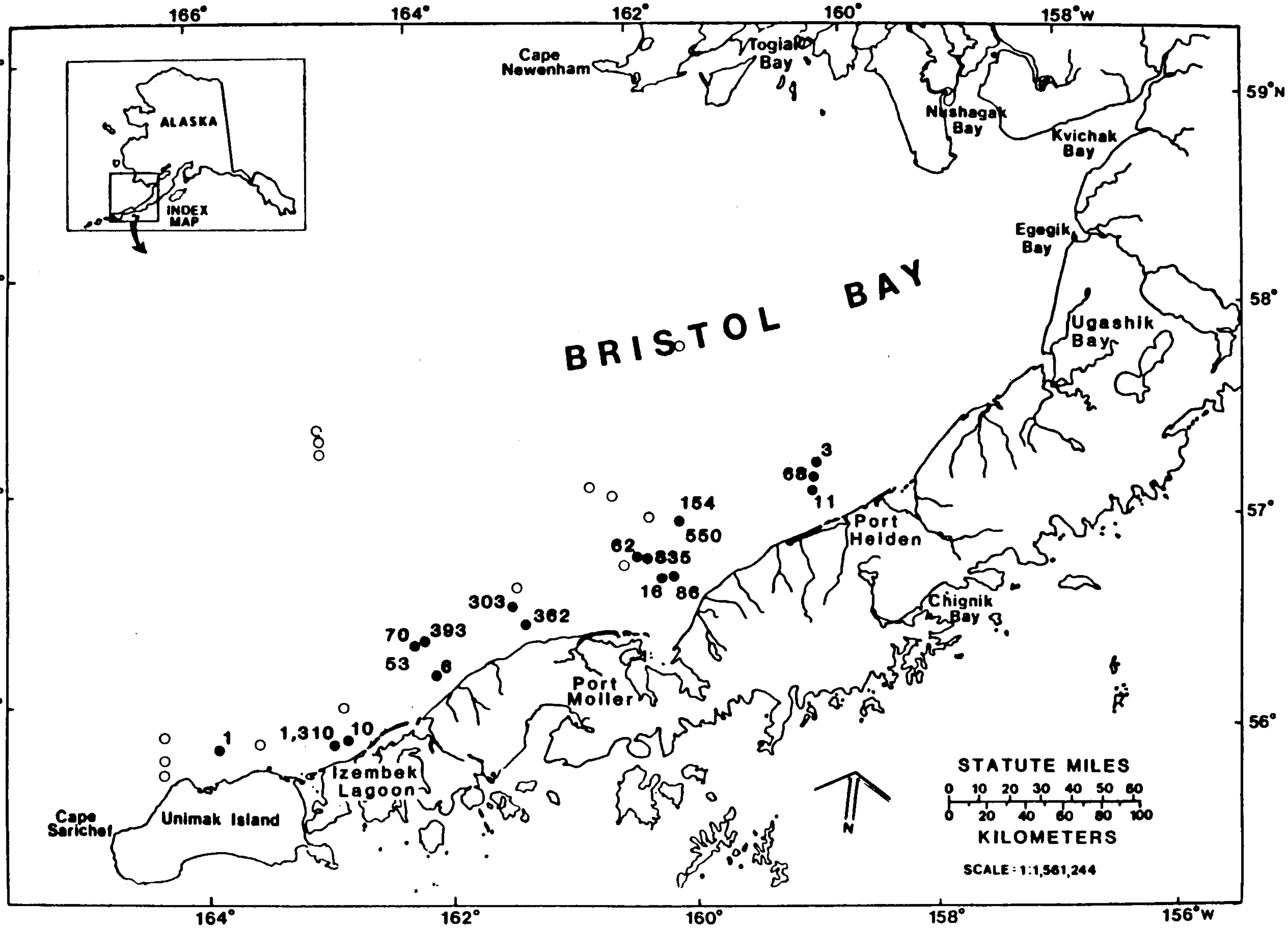


KEY:
○ None of this species taken

Juvenile Sockeye
Salmon Purse Seine Catch
June, 1966

Dames & Moore

Figure F-3

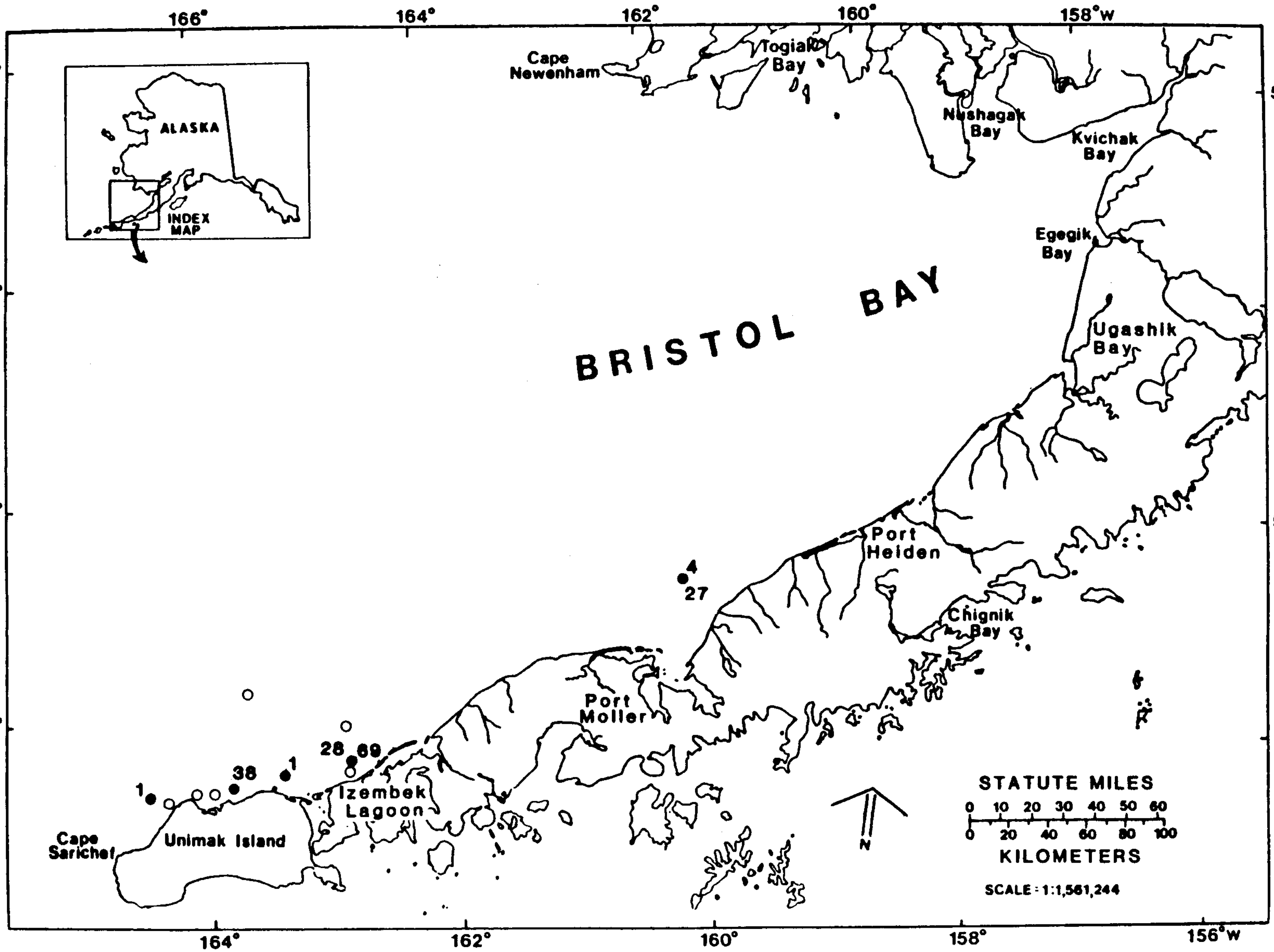


KEY:
○ None of this species taken

Juvenile Sockeye Salmon Purse Seine Catch July, 1966

Figure F-4

Dames & Moore

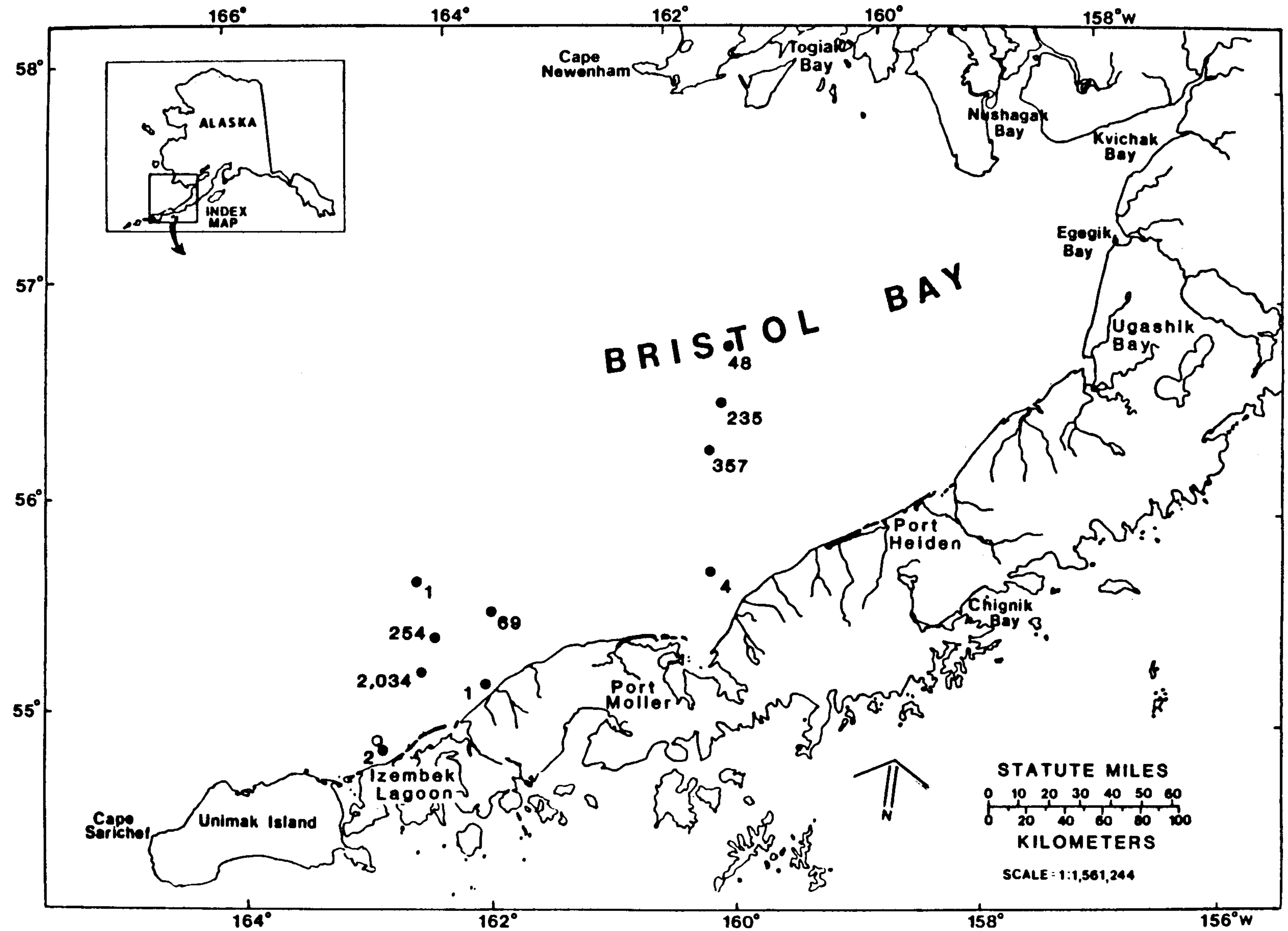


KEY:
○ None of this species taken

Juvenile Sockeye Salmon Purse Seine Catch
August, 1966

Figure F-5

Dames & Moore

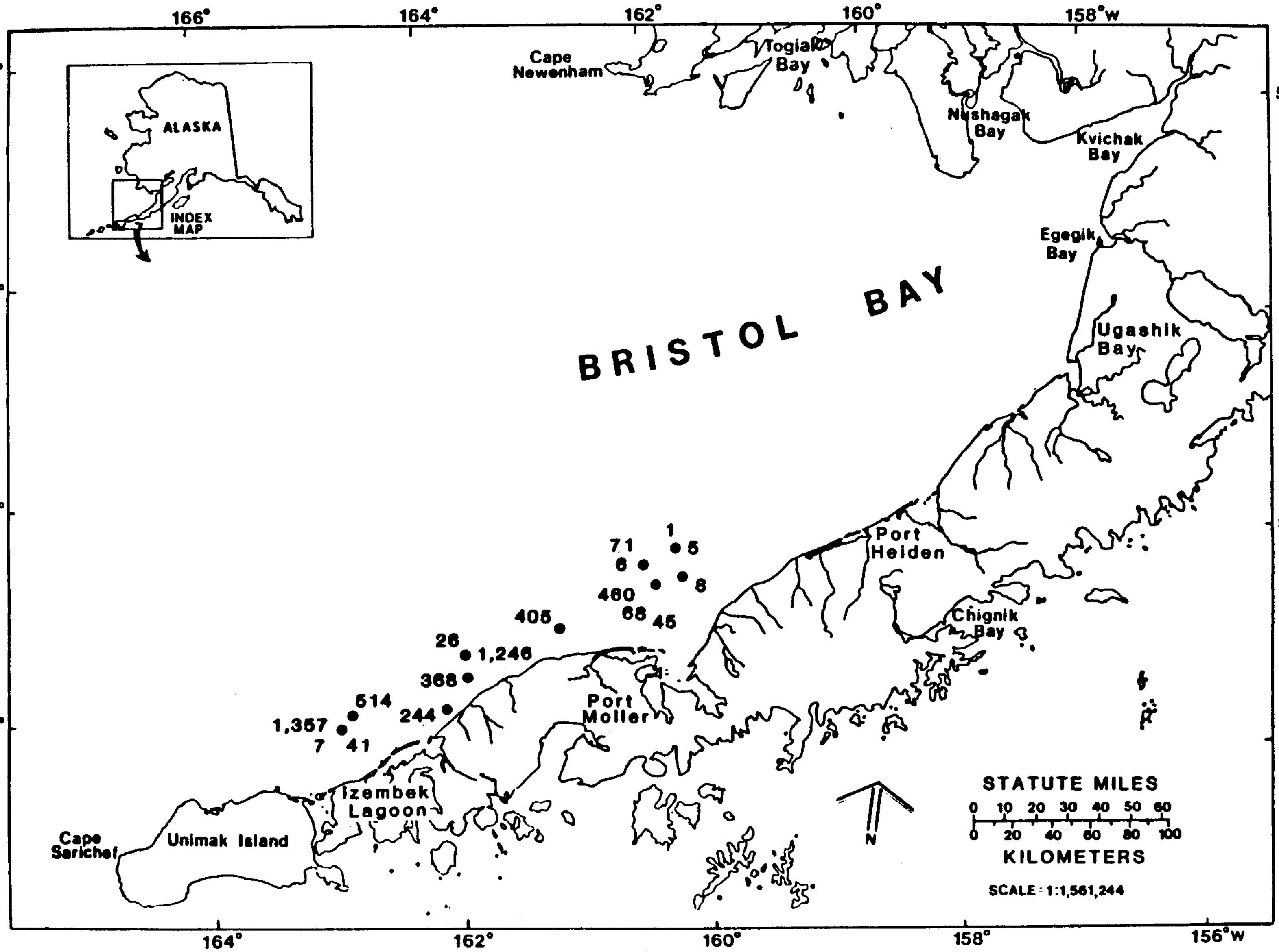


KEY:
○ None of this species taken

Juvenile Sockeye
Salmon Purse Seine Catch
September, 1967

Figure F-6

Dames & Moore

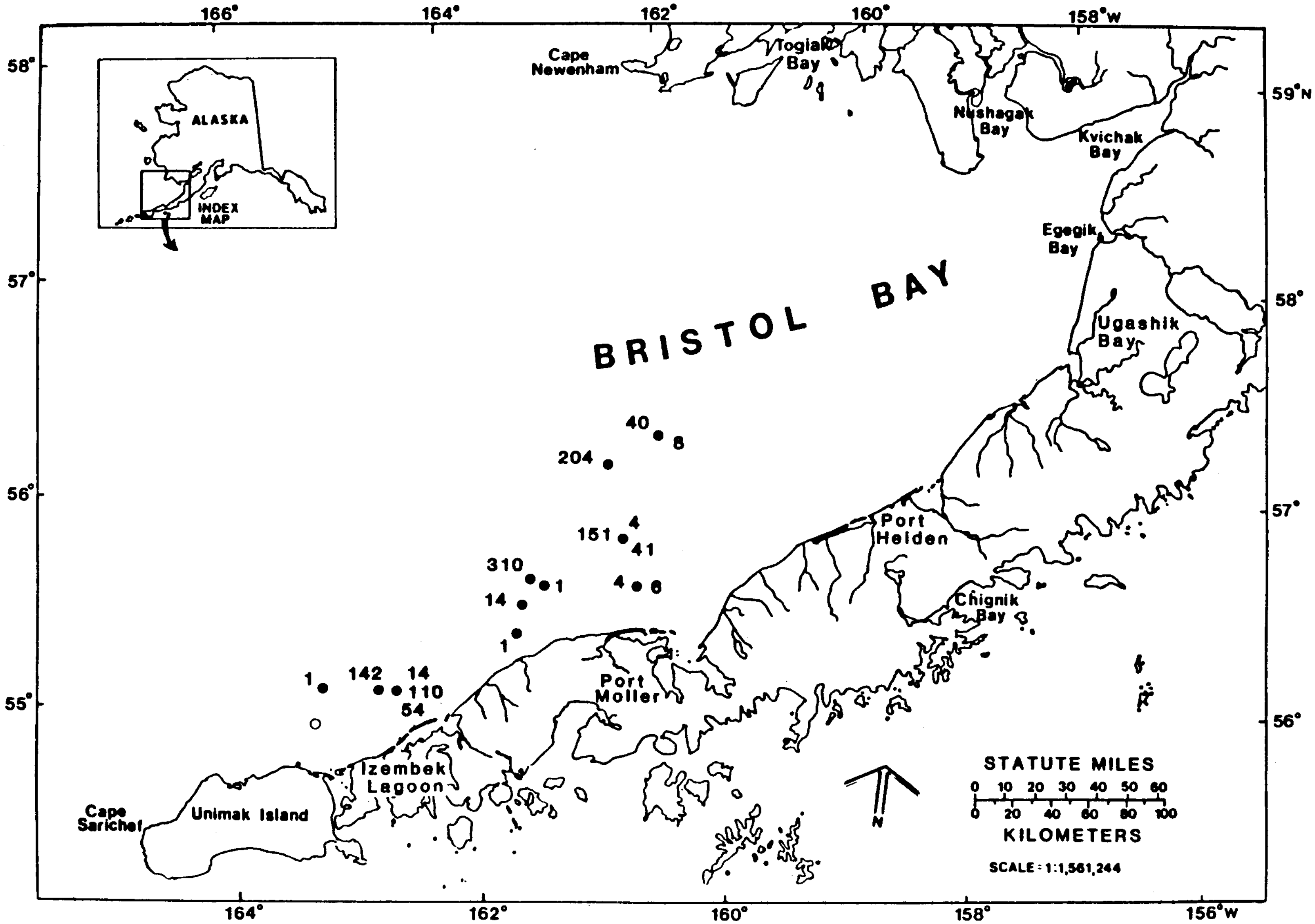


KEY:
○ None of this species taken

Juvenile Sockeye
Salmon Purse Seine Catch
August, 1968

Dames & Moore

Figure F-7

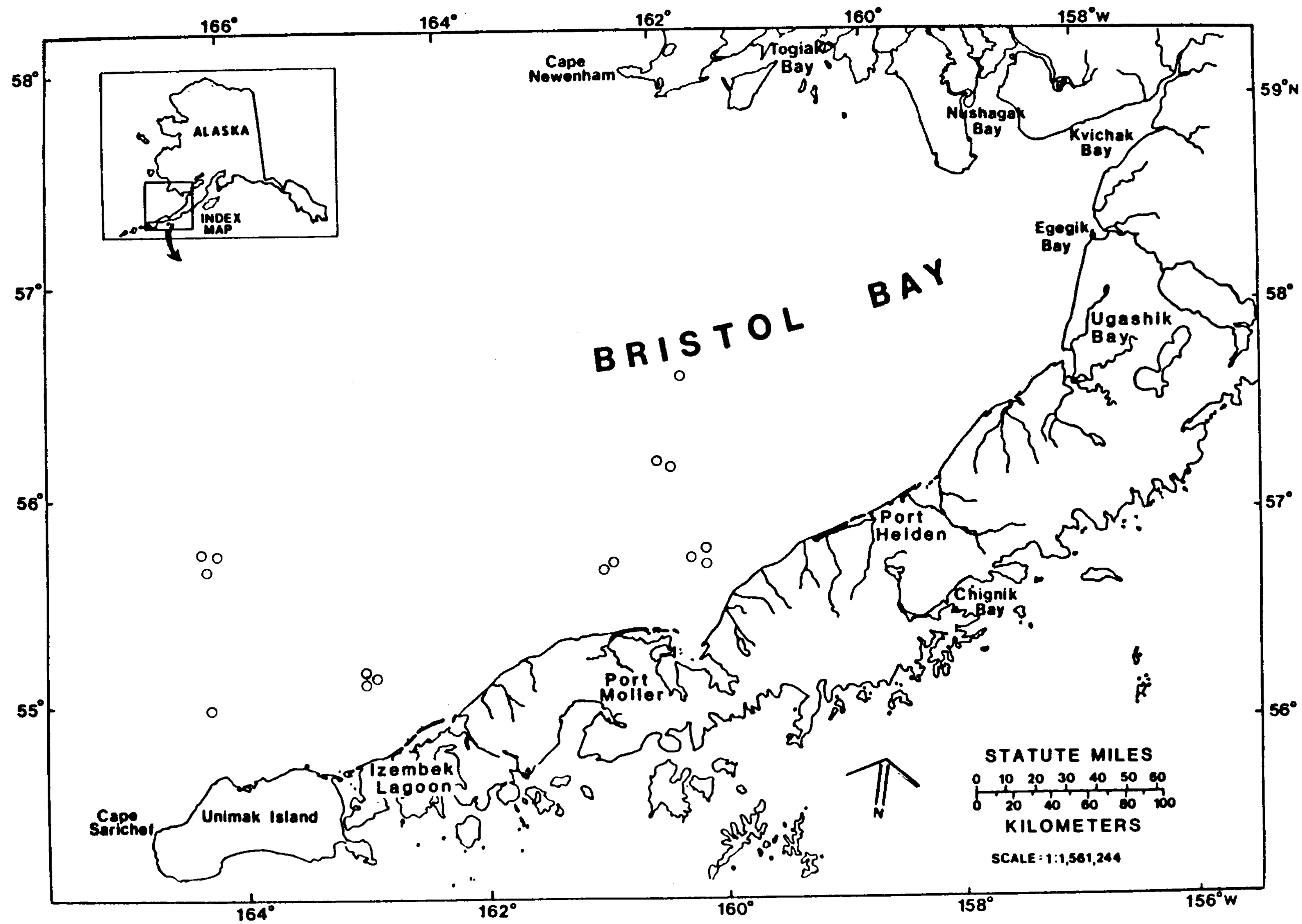


KEY:
○ None of this species taken

Juvenile Sockeye Salmon Purse Seine Catch September, 1968

Dames & Moore

Figure F-8

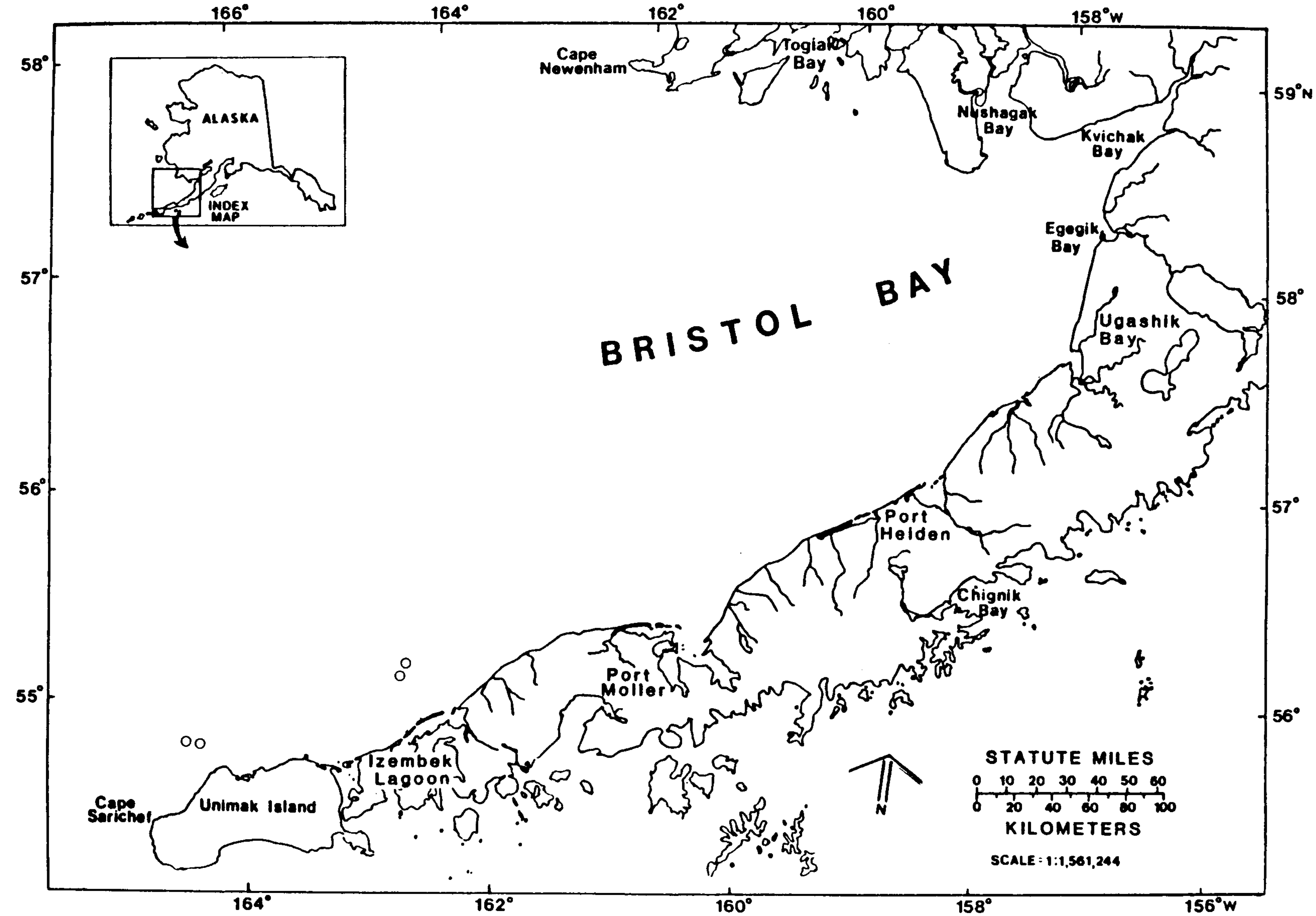


KEY:
○ None of this species taken

Juvenile Chum
Salmon Purse Seine Catch
July, 1962

Figure F-8

Dames & Moore

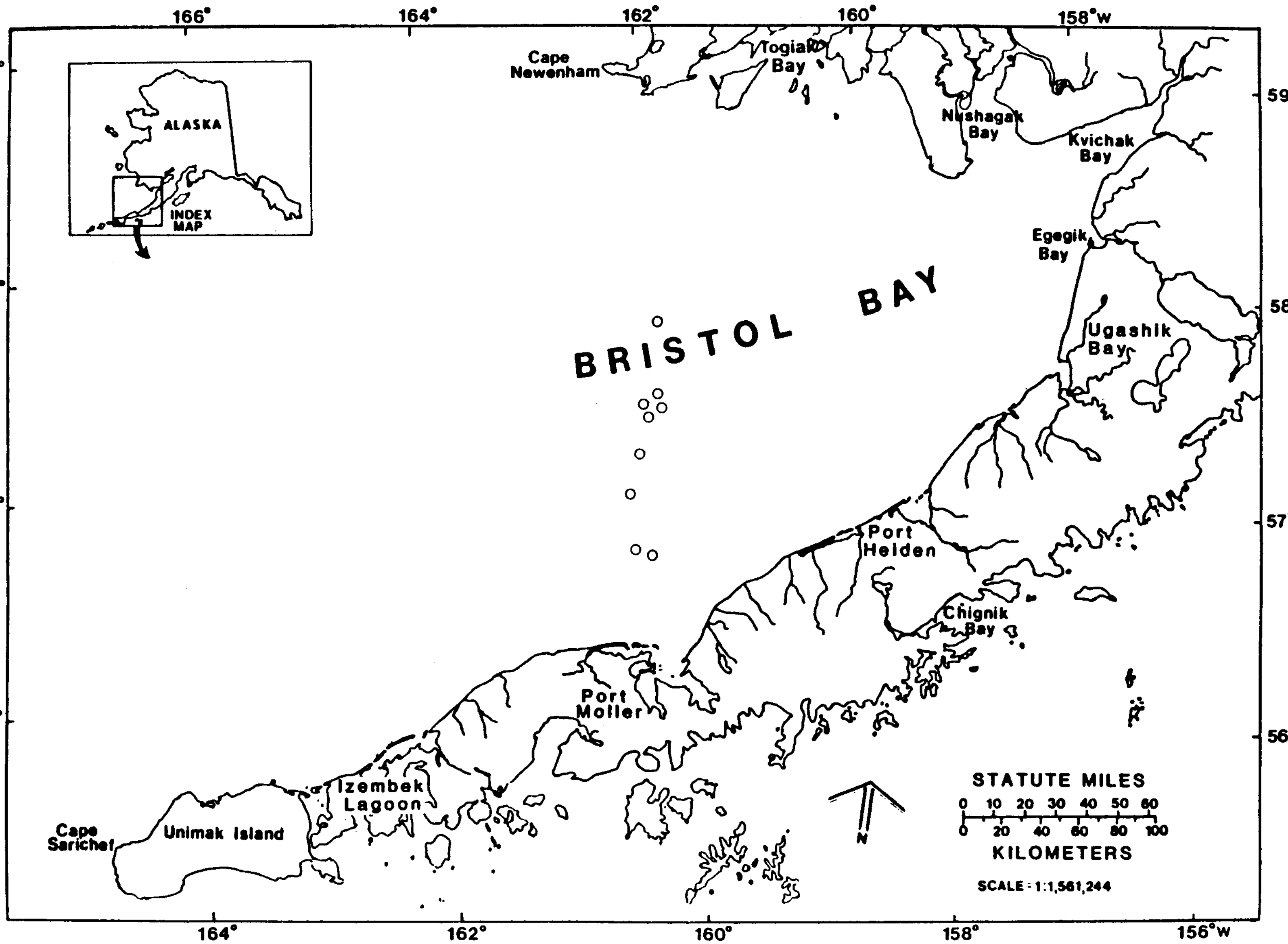


KEY:
○ None of this species taken

Juvenile Chum Salmon Purse Seine Catch August, 1962

Figure F-10

Dames & Moore

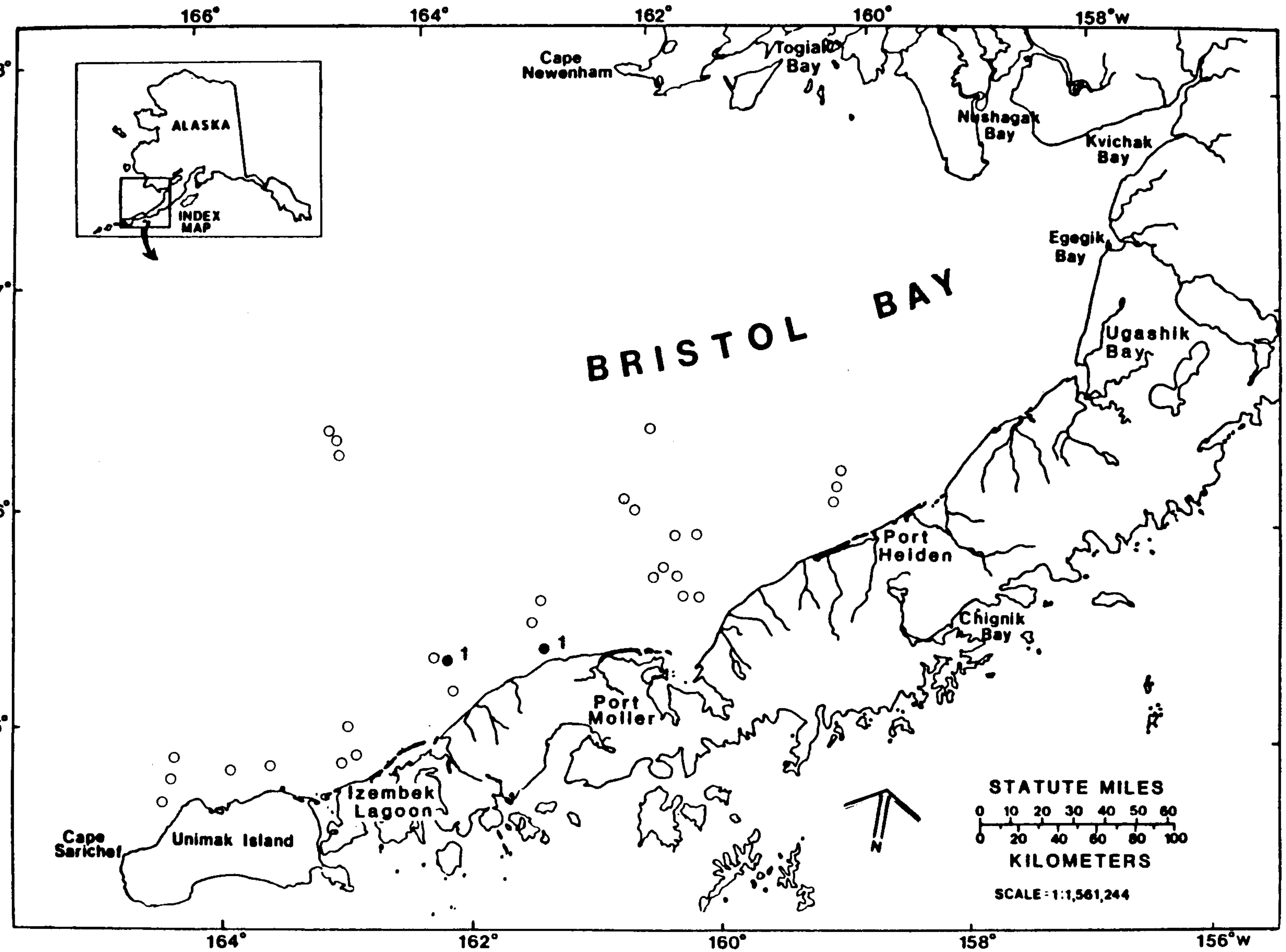


KEY:
○ None of this species taken

Juvenile Chum
Salmon Purse Seine Catch
June, 1966

Dames & Moore

Figure F-11

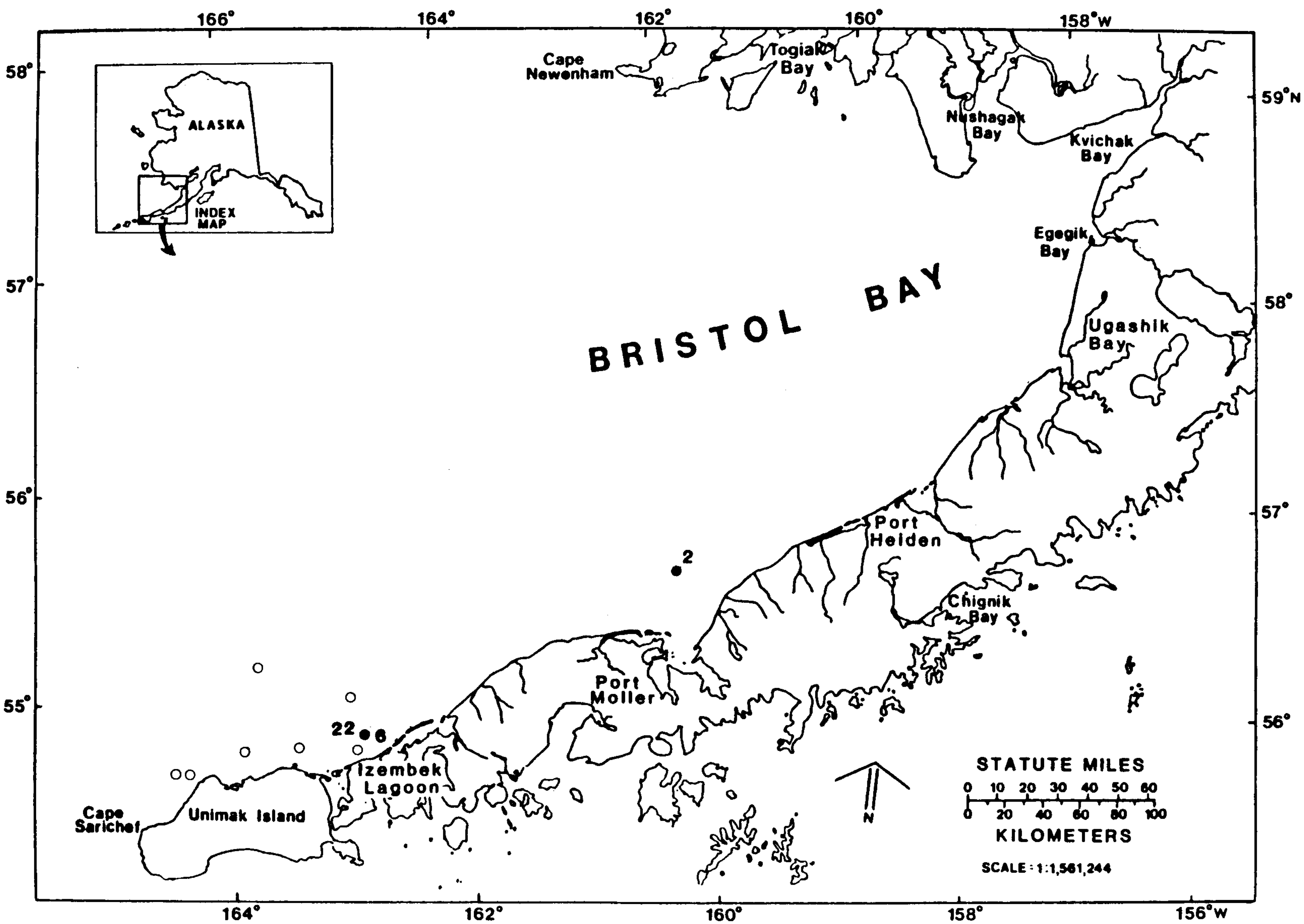


KEY:
○ None of this species taken

Juvenile Chum
Salmon Purse Seine Catch
July, 1966

Dames & Moore

Figure F-12

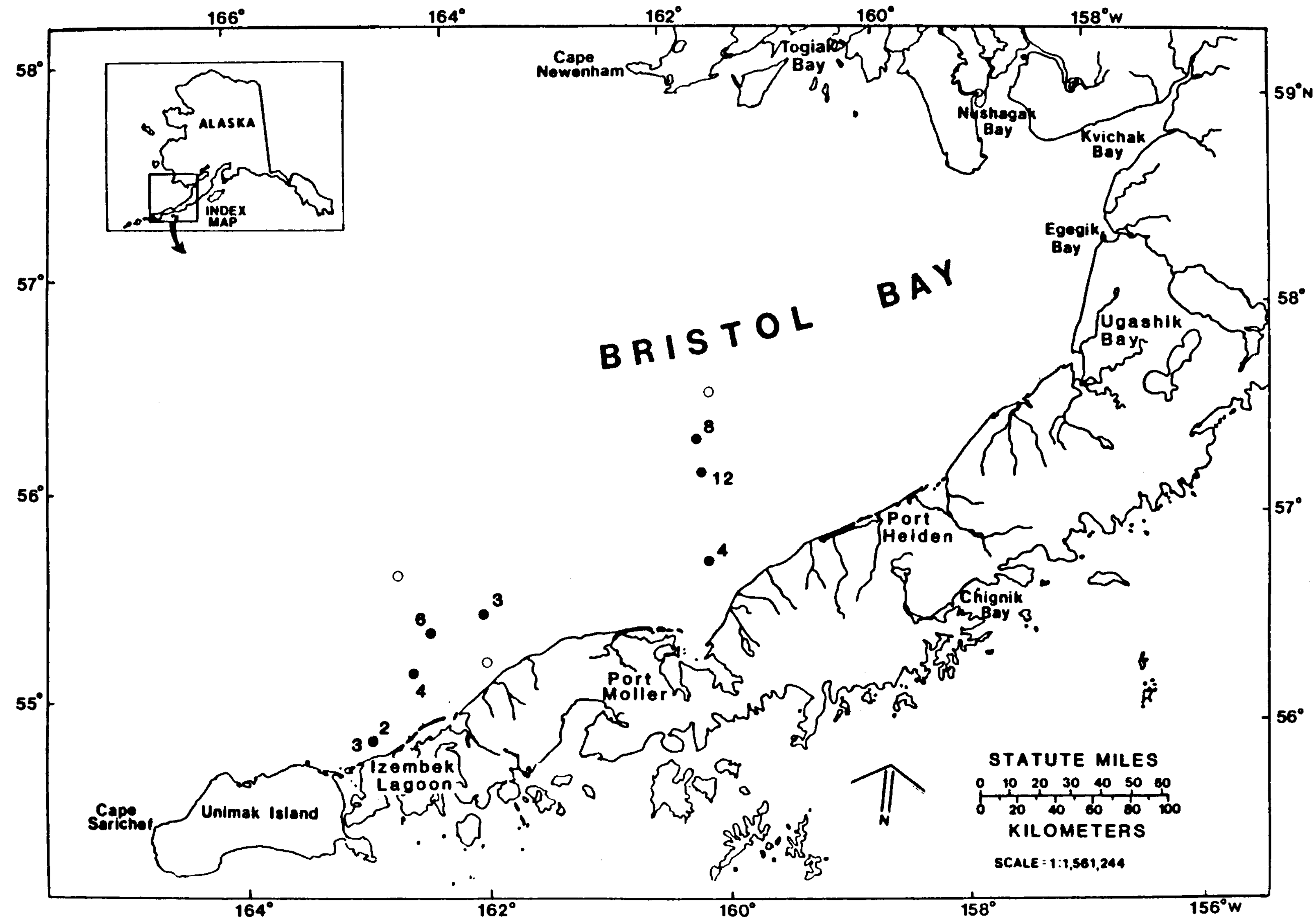


KEY:
○ None of this species taken

Juvenile Chum
Salmon Purse Seine Catch
August, 1966

Figure F-13

Dames & Moore

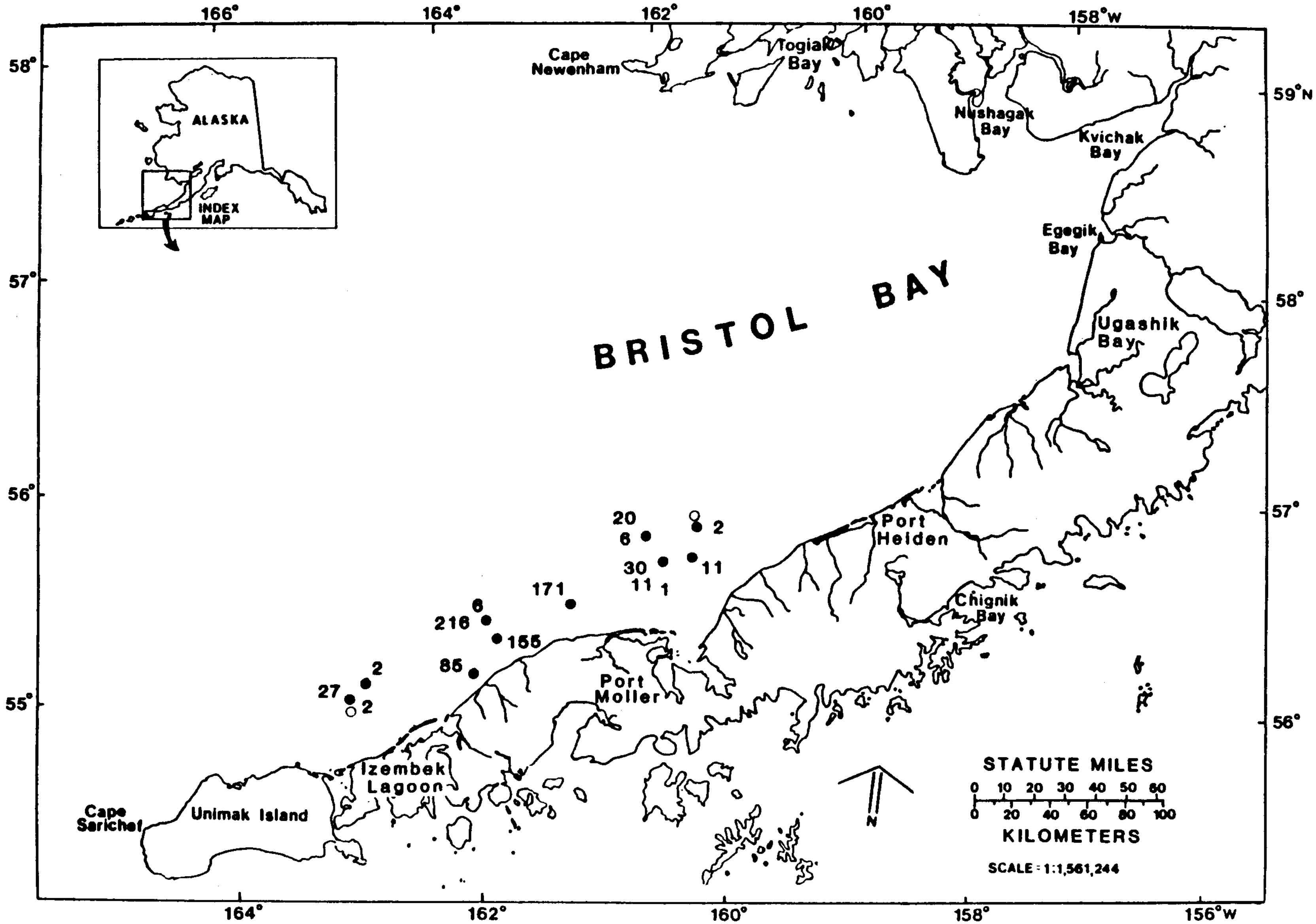


KEY:
○ None of this species taken

Juvenile Chum
Salmon Purse Seine Catch
September, 1967

Figure F-14

Dames & Moore

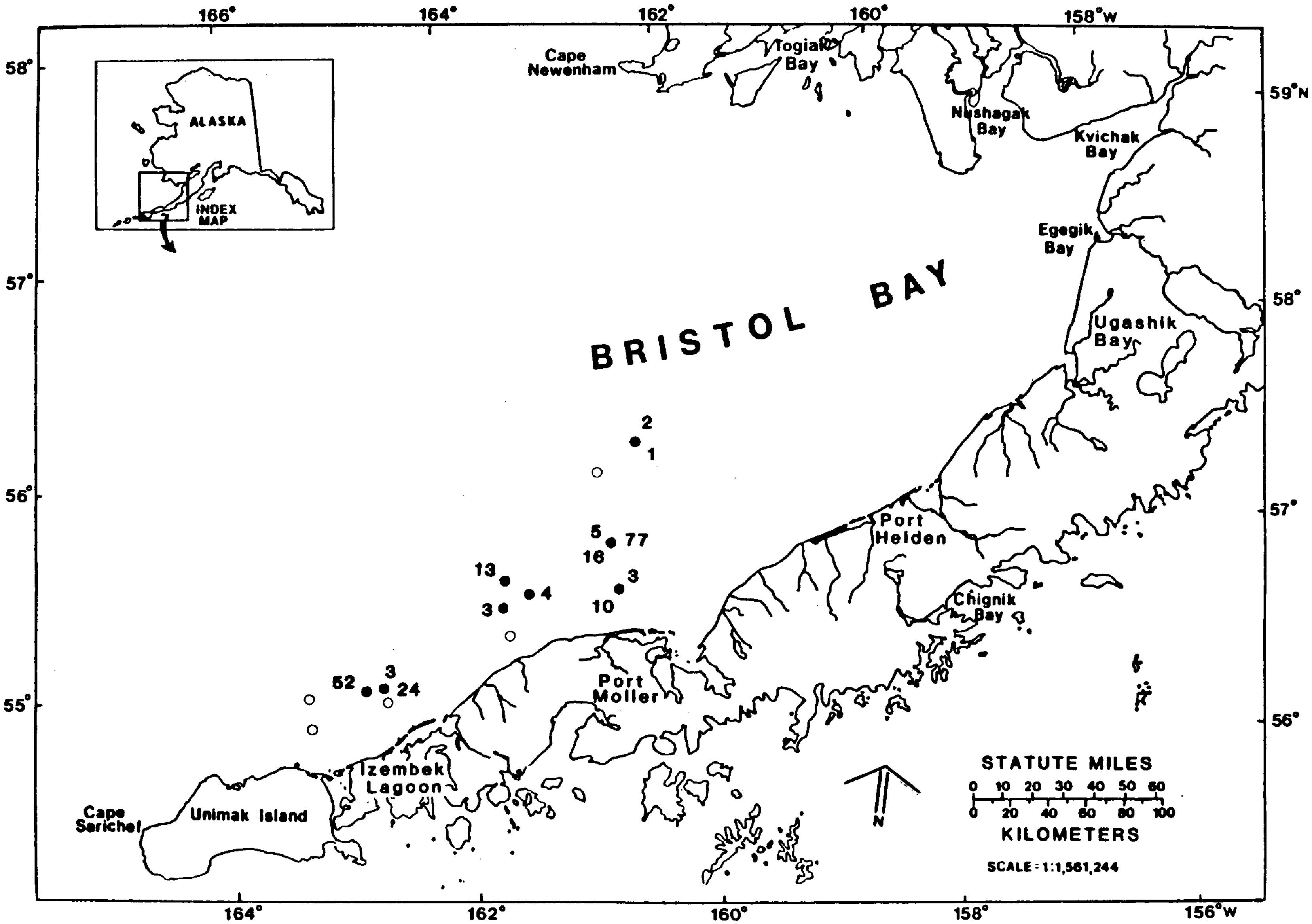


KEY:
○ None of this species taken

Juvenile Chum
Salmon Purse Seine Catch
August, 1968

Figure F-15

Dames & Moore

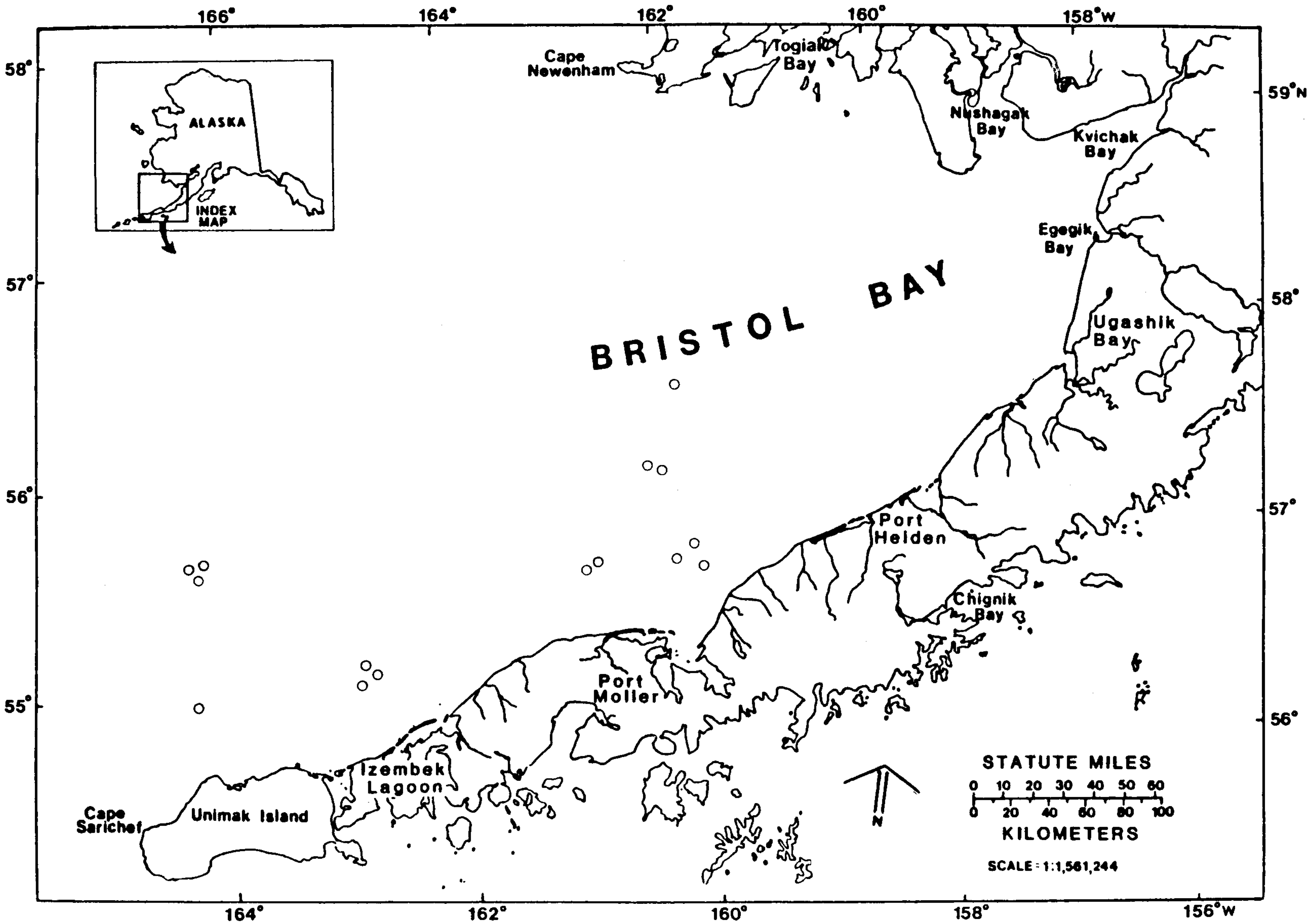


KEY:
○ None of this species taken

Juvenile Chum Salmon Purse Seine Catch
September, 1968

Dames & Moore

Figure F-16

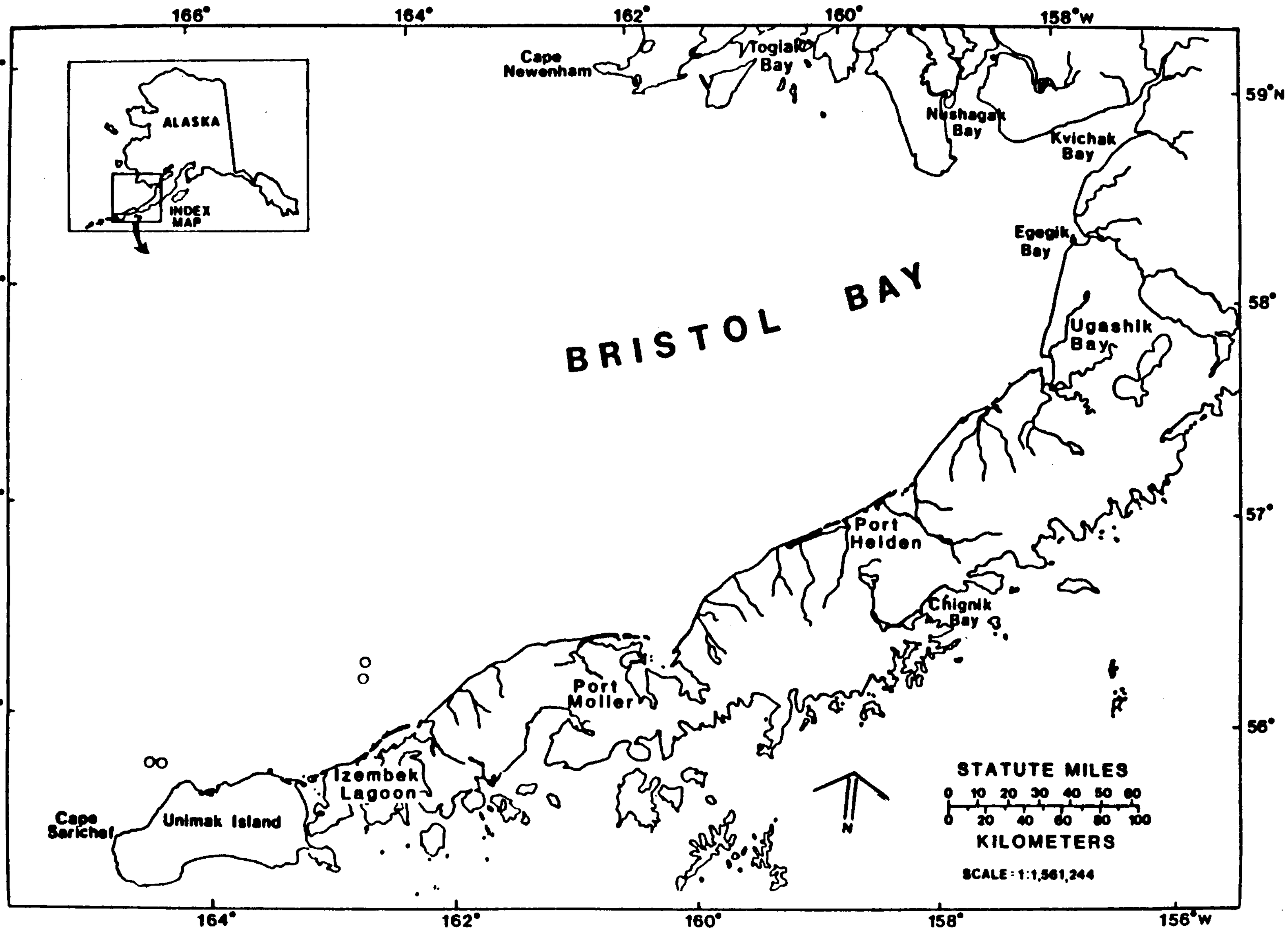


KEY:
○ None of this species taken

Juvenile Coho Salmon Purse Seine Catch July, 1962

Dames & Moore

Figure F-17

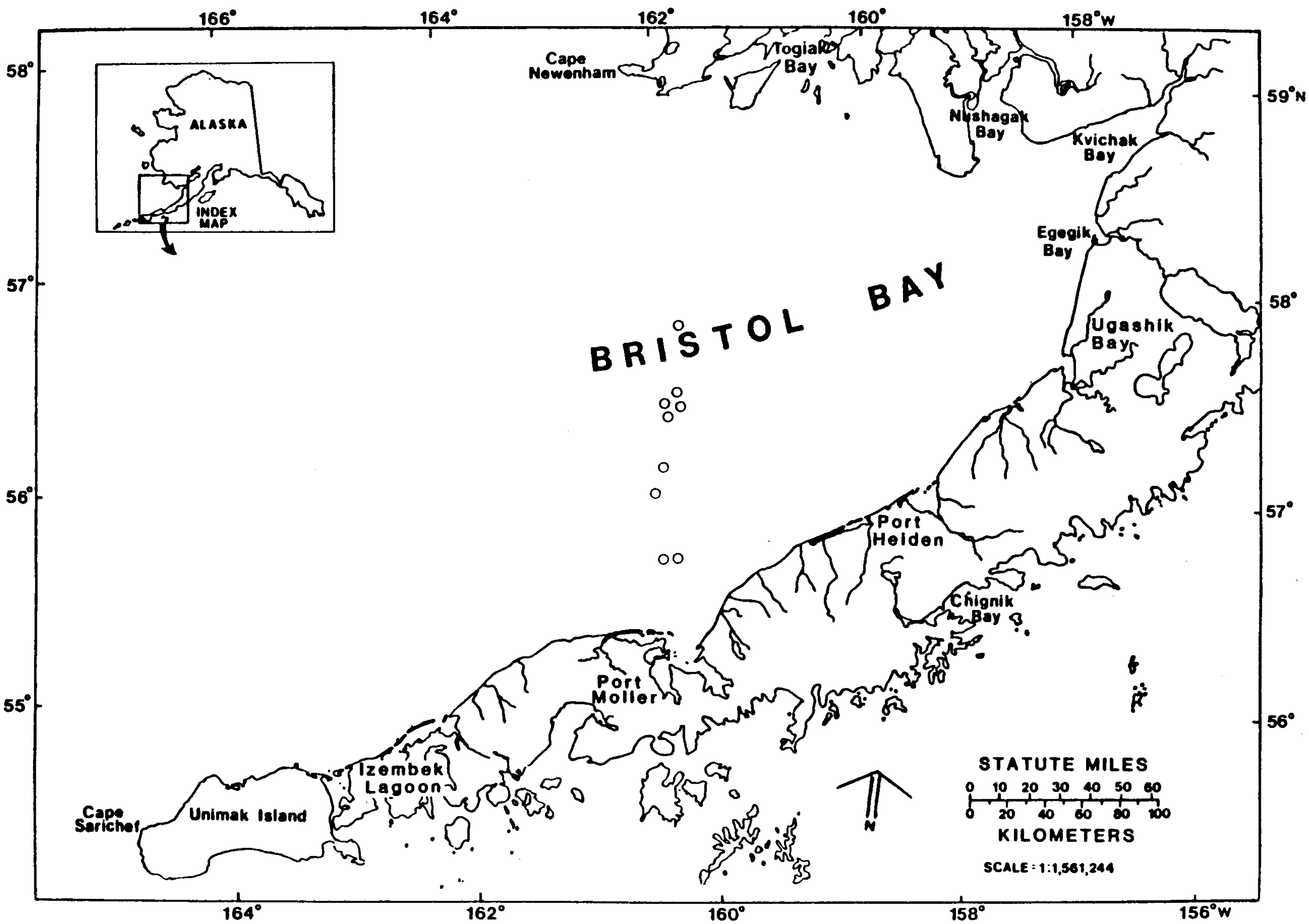


KEY:
○ None of this species taken

Juvenile Coho Salmon Purse Seine Catch August, 1962

Dames & Moore

Figure F-18

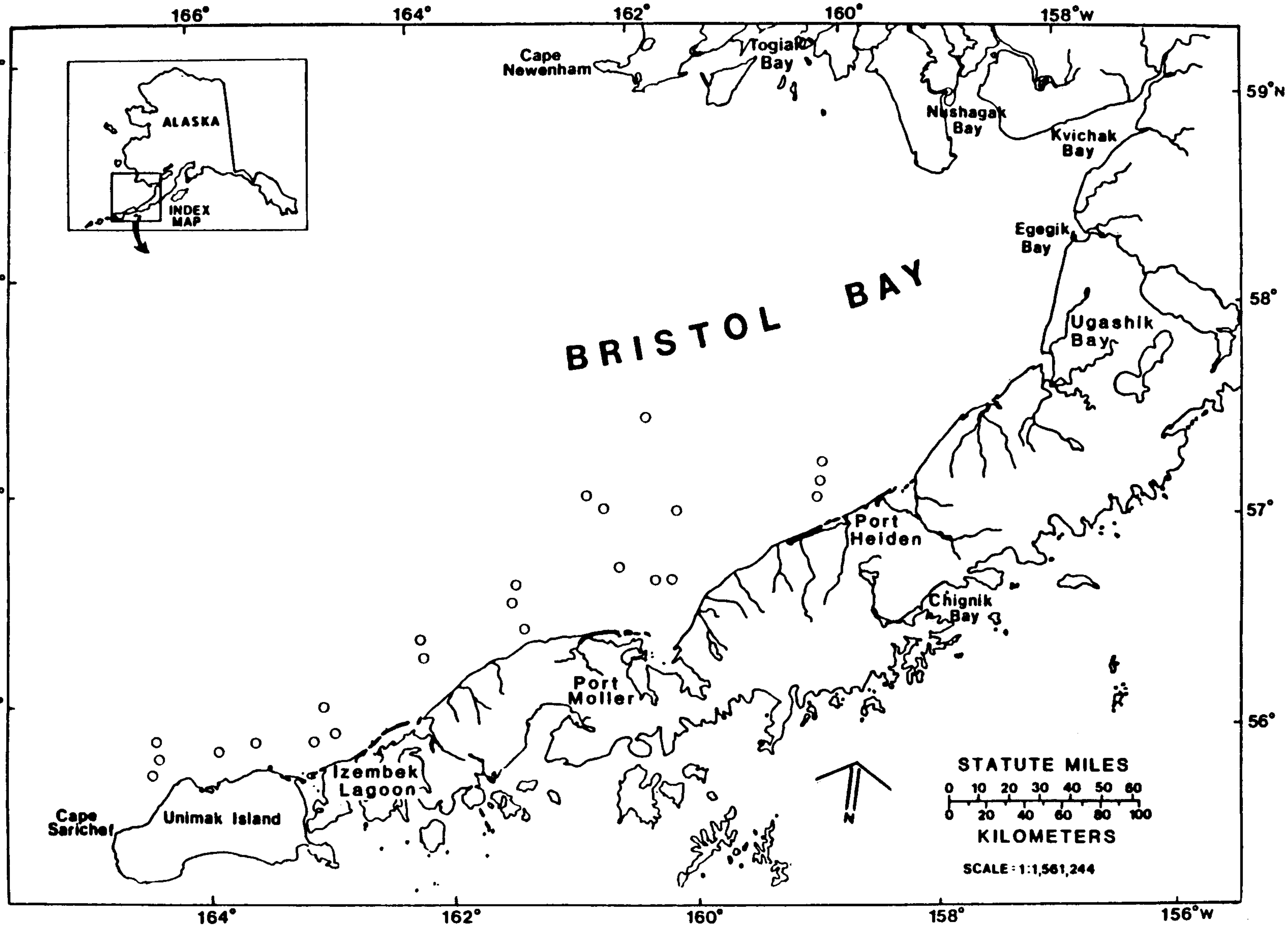


KEY:
○ None of this species taken

Juvenile Coho Salmon Purse Seine Catch June, 1966

Dames & Moore

Figure F-19

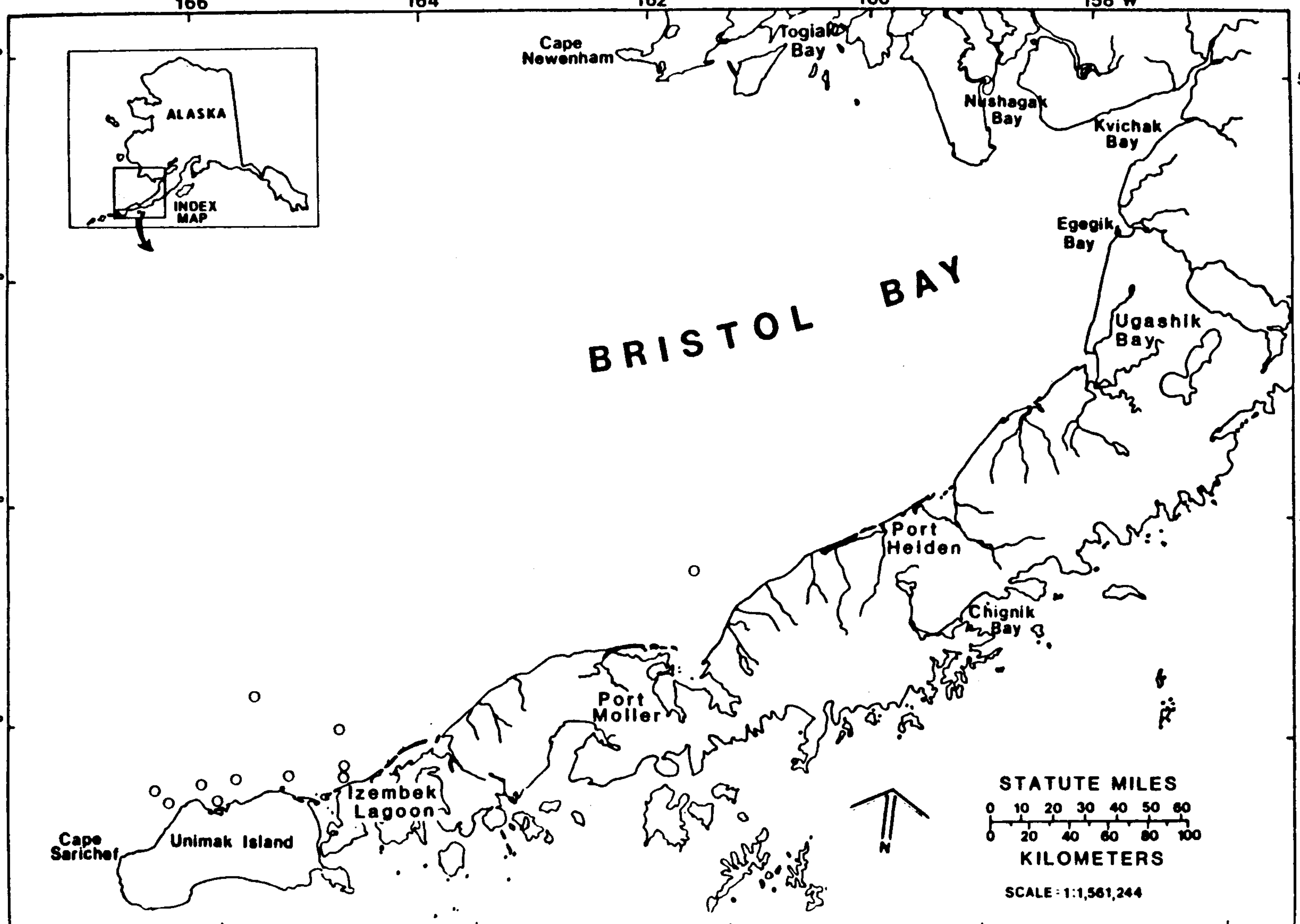


KEY:
○ None of this species taken

Juvenile Coho Salmon Purse Seine Catch July, 1966

Dames & Moore

Figure F-20

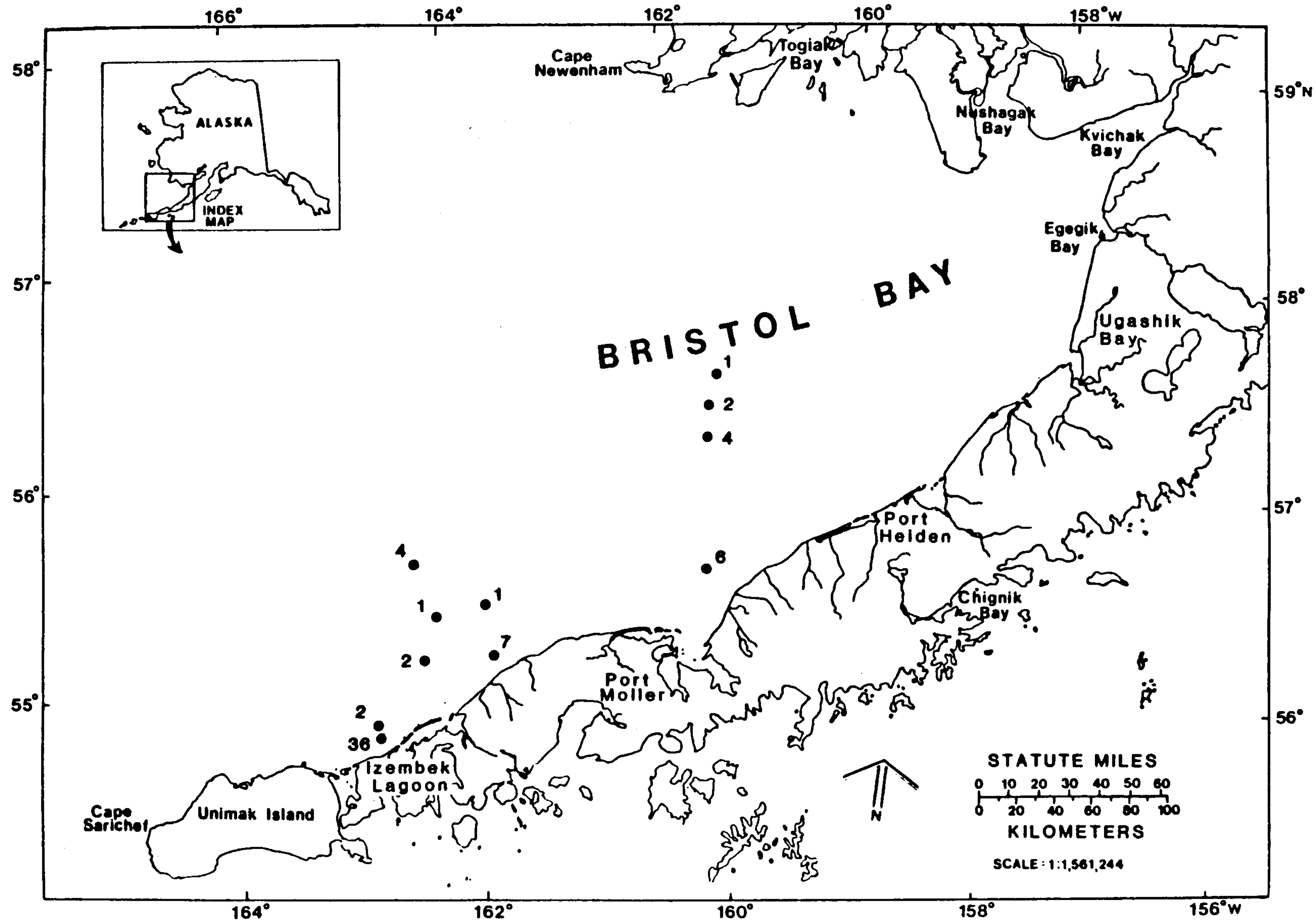


KEY:
○ None of this species taken

Juvenile Coho
Salmon Purse Seine Catch
August, 1966

Dames & Moore

Figure F-21

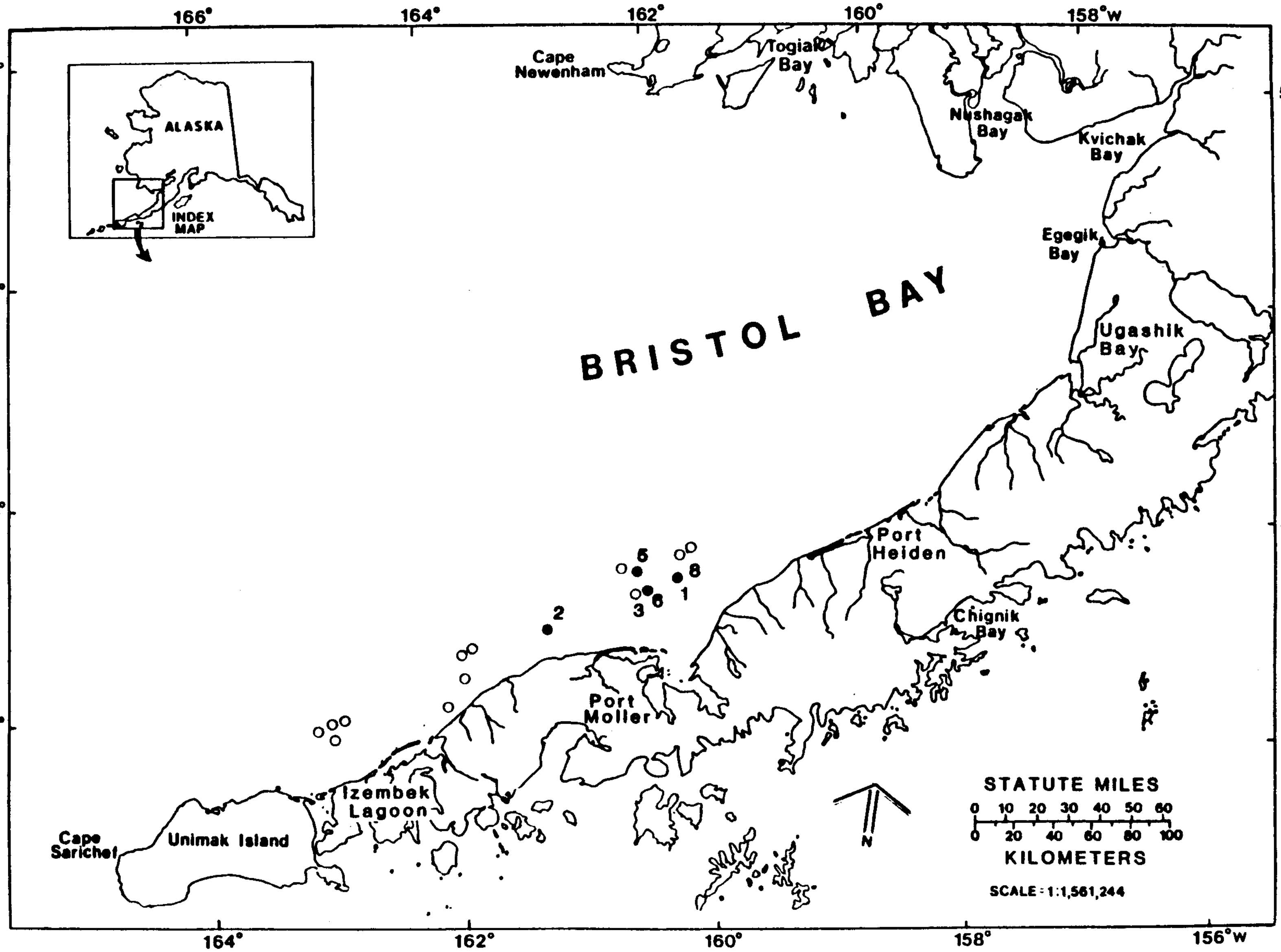


KEY:
○ None of this species taken

Juvenile Coho Salmon Purse Seine Catch September, 1967

Dames & Moore

Figure F-22

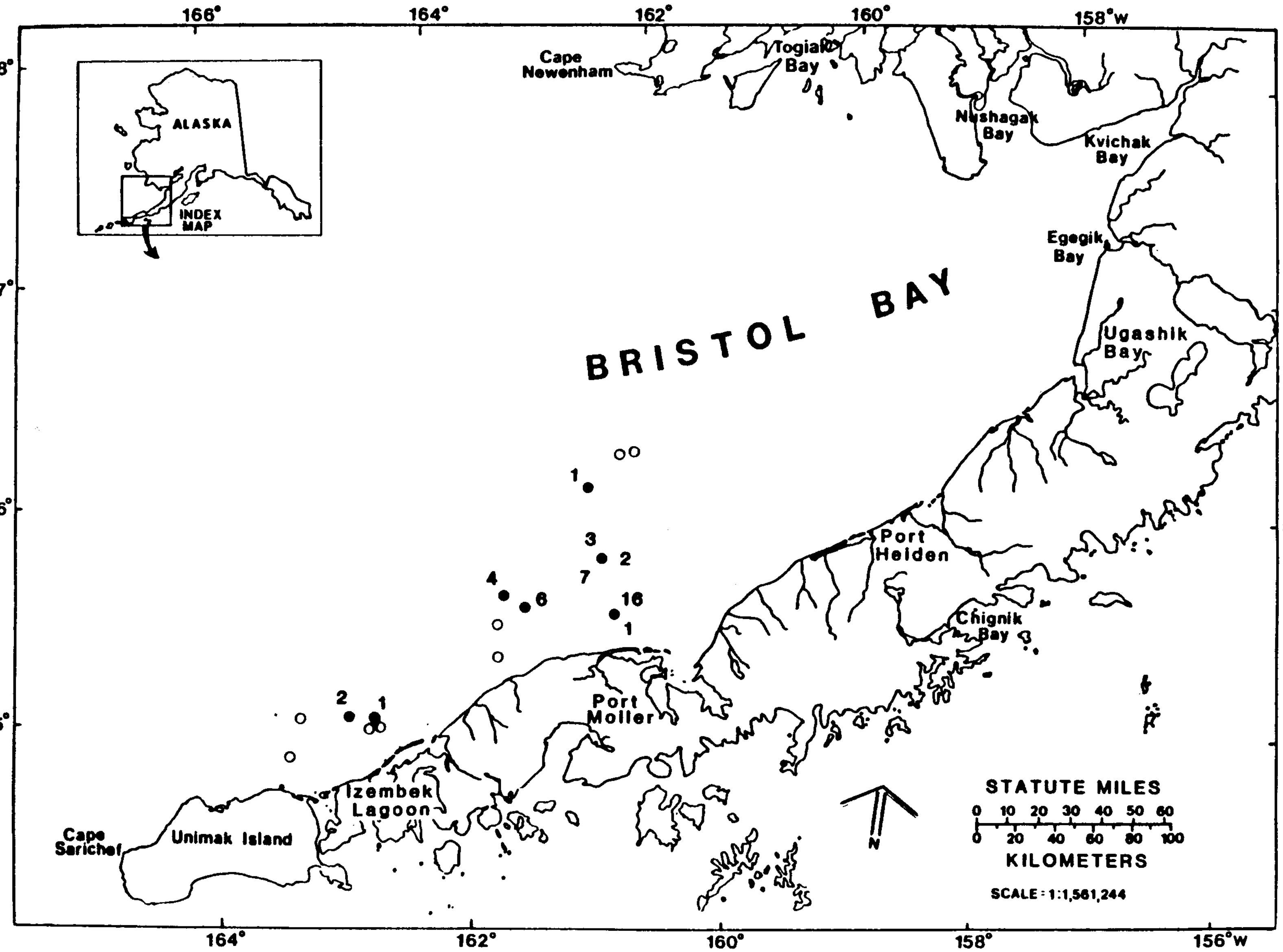


KEY:
○ None of this species taken

Juvenile Coho Salmon Purse Seine Catch August, 1968

Dames & Moore

Figure F-23

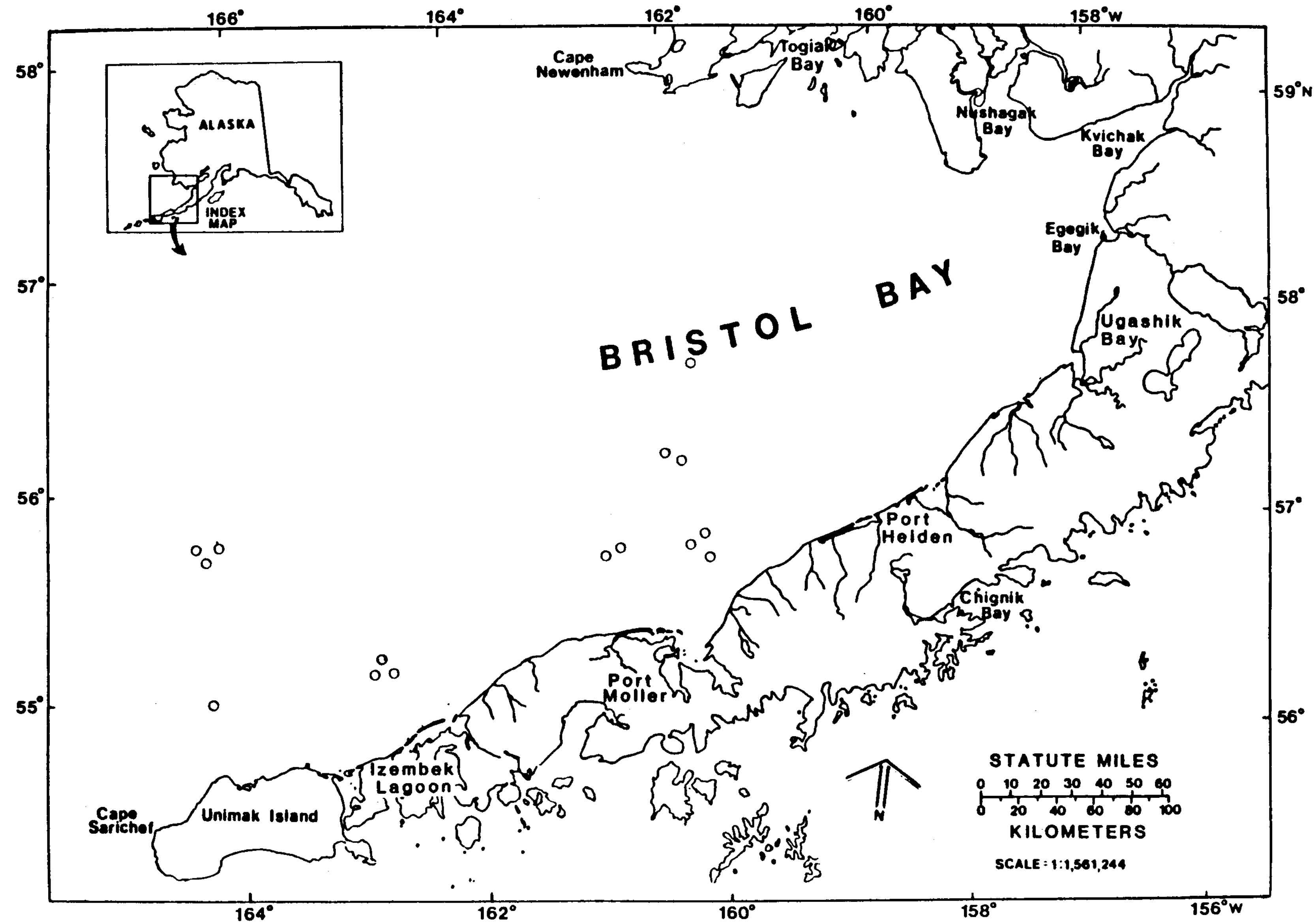


KEY:
○ None of this species taken

Juvenile Coho Salmon Purse Seine Catch September, 1968

Dames & Moore

Figure F-24

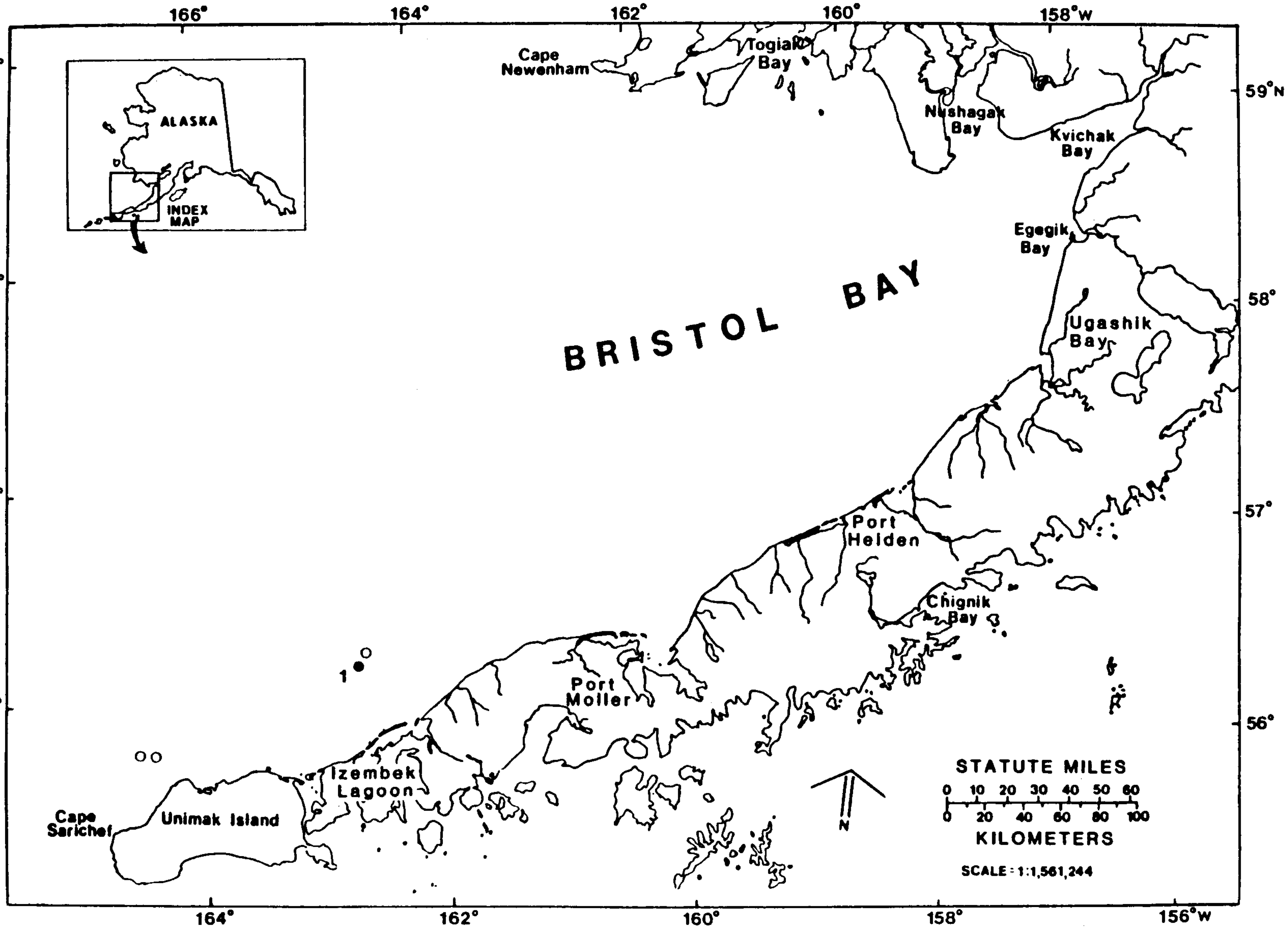


KEY:
○ None of this species taken

Juvenile Chinook Salmon Purse Seine Catch July, 1962

Dames & Moore

Figure F-25

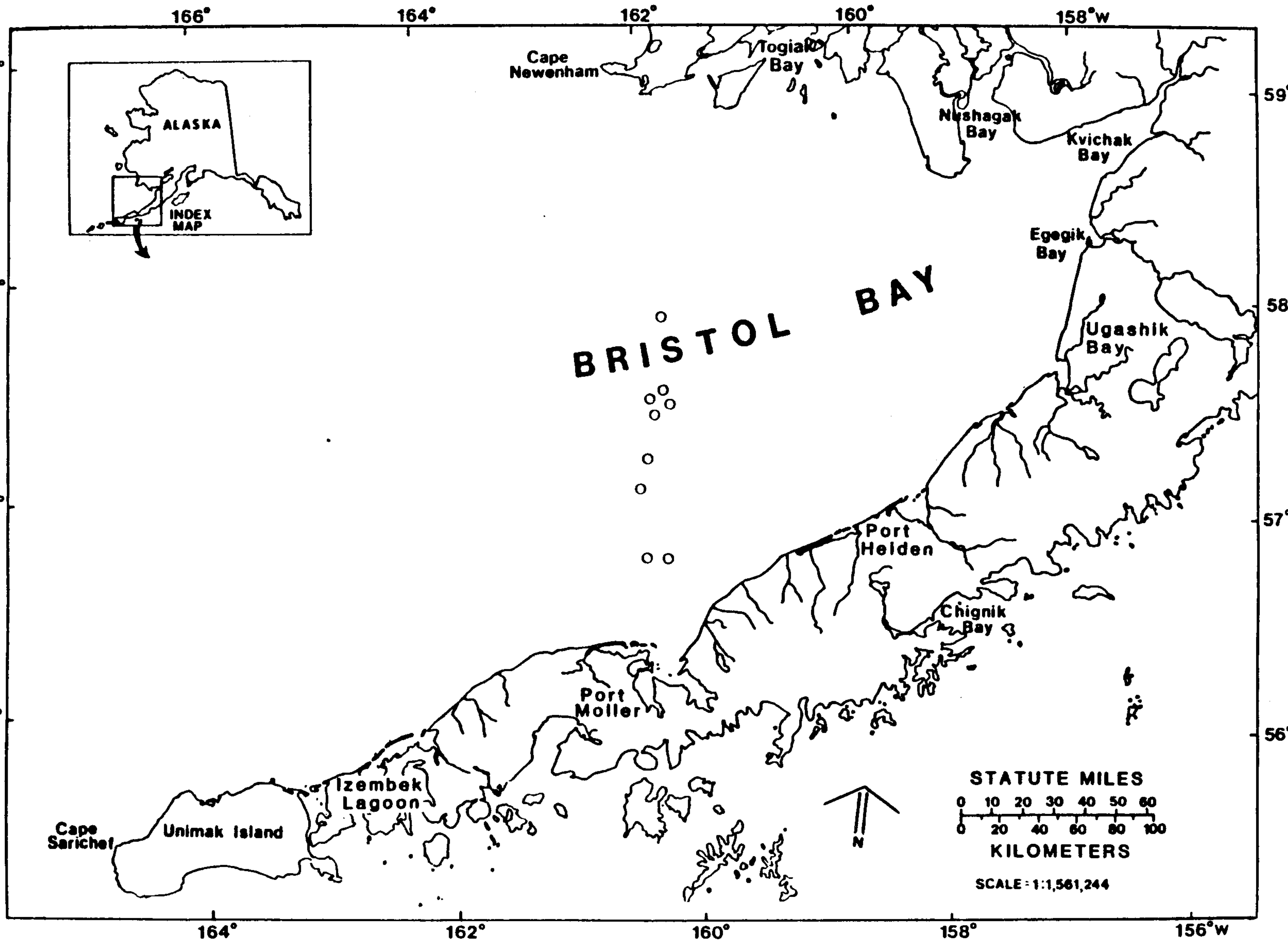


KEY:
○ None of this species taken

Juvenile Chinook Salmon Purse Seine Catch August, 1962

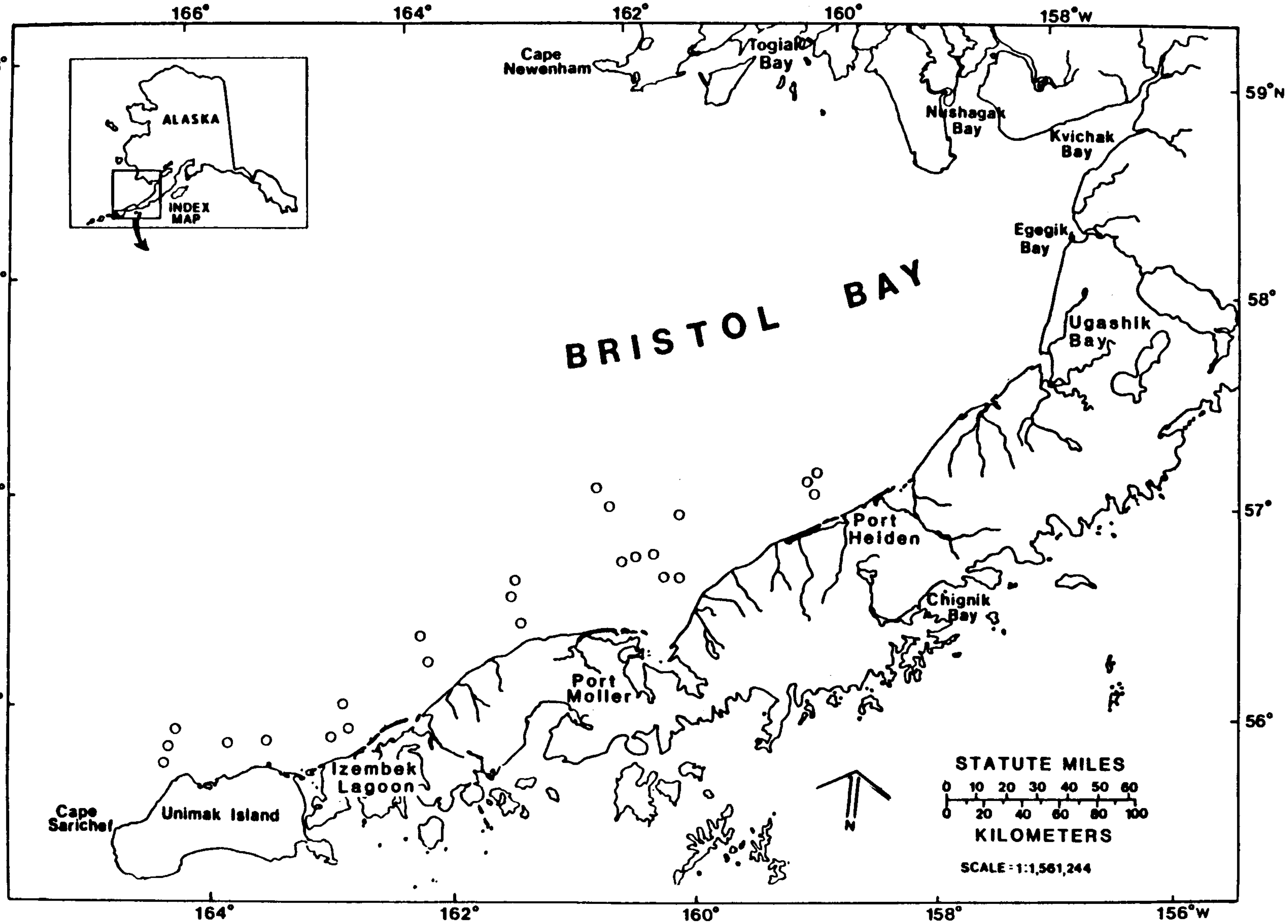
Dames & Moore

Figure F-26



KEY:
○ None of this species taken

Juvenile Chinook
Salmon Purse Seine Catch
June, 1966

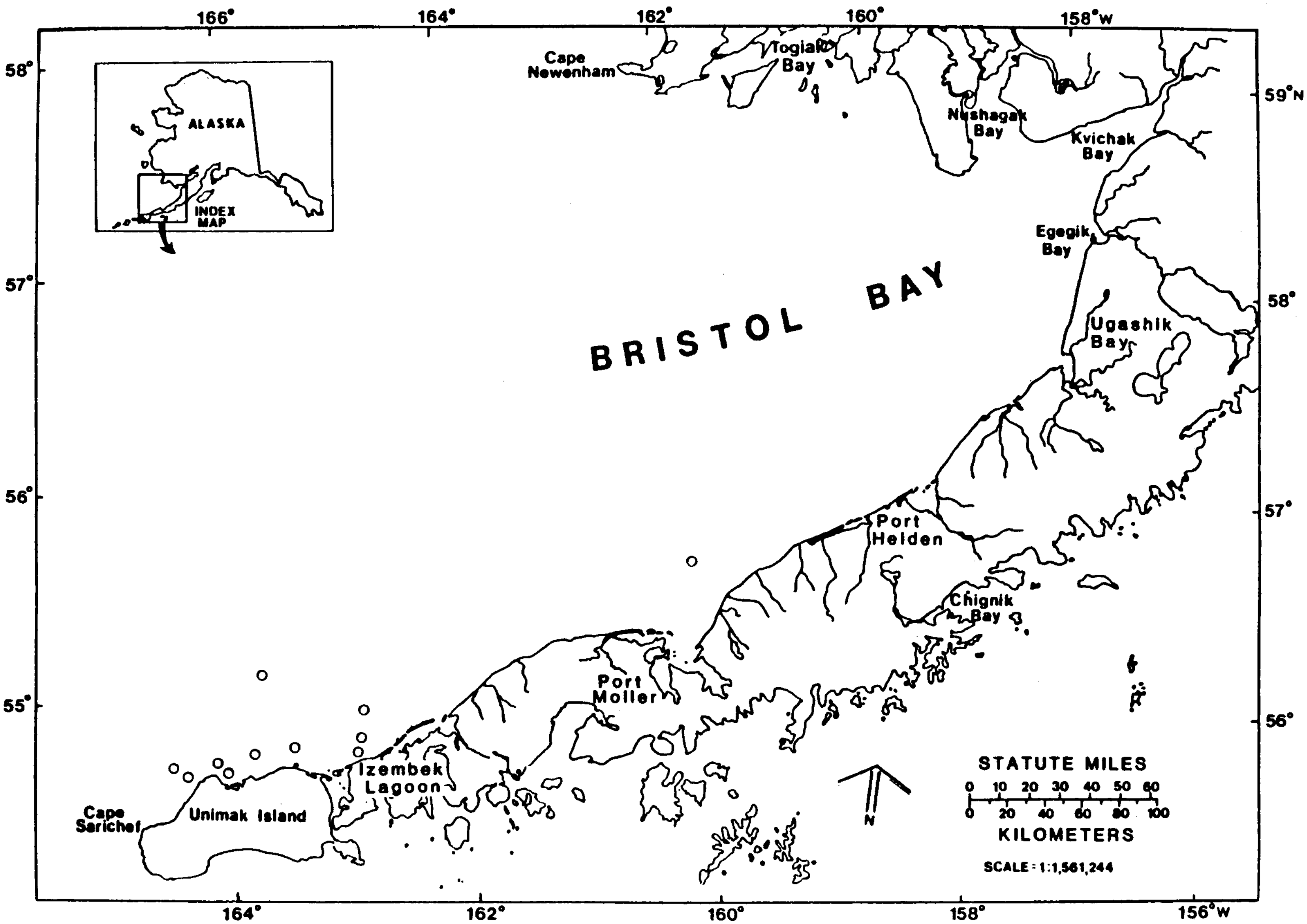


KEY:
○ None of this species taken

Juvenile Chinook
Salmon Purse Seine Catch
July, 1966

Dames & Moore

Figure F-28

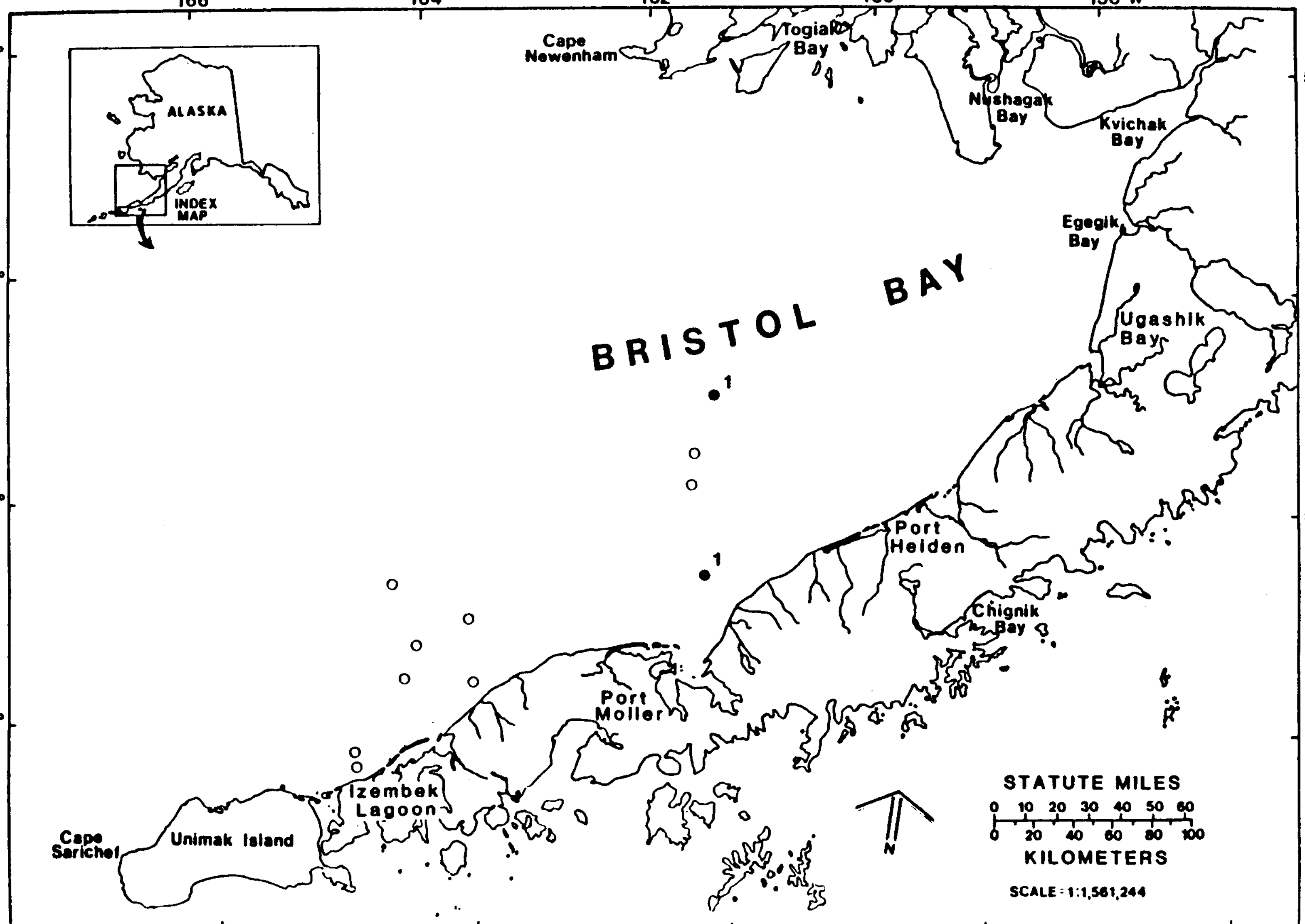


KEY:
○ None of this species taken

Juvenile Chinook Salmon Purse Seine Catch August, 1966

Dames & Moore

Figure F-29

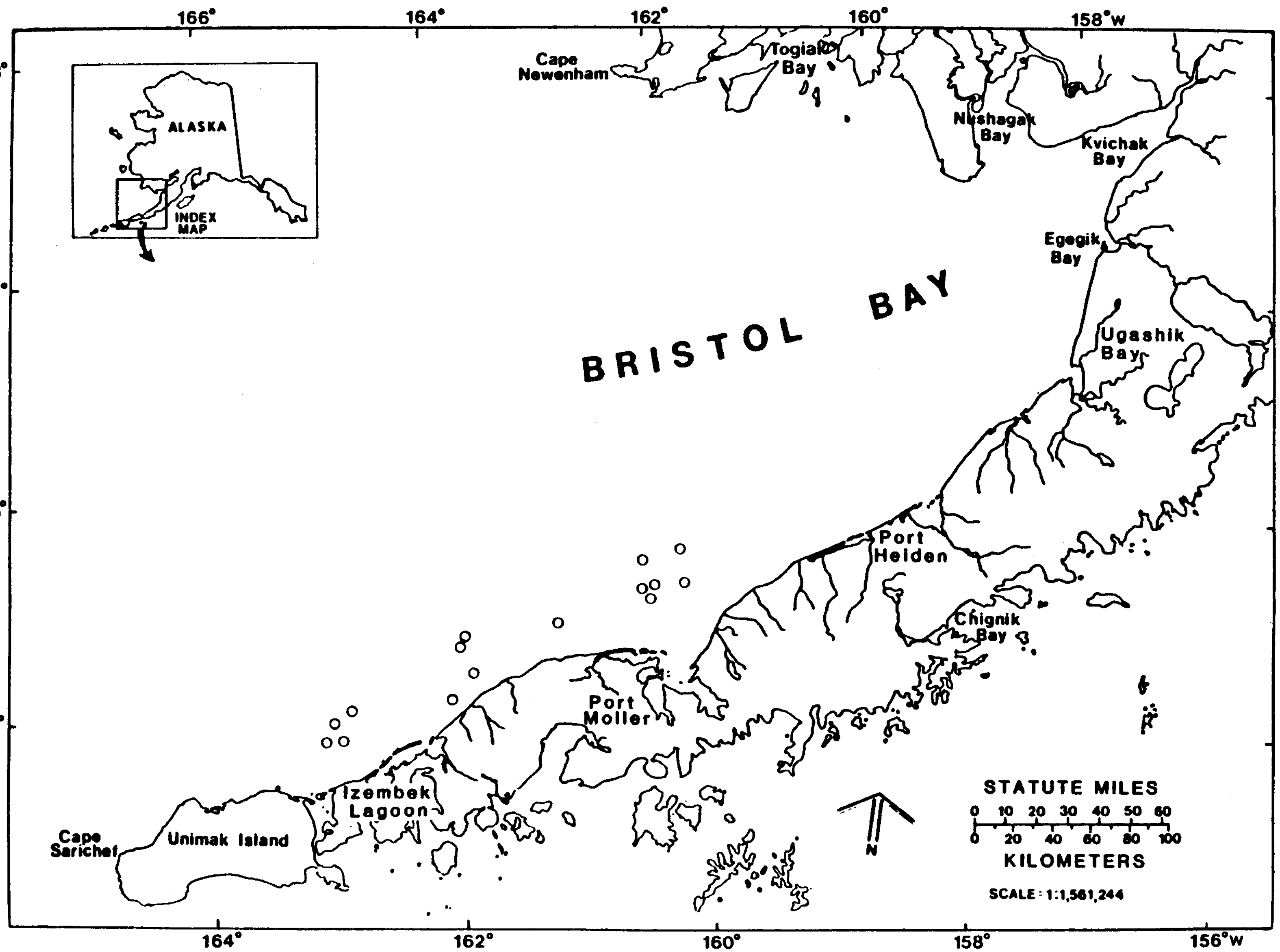


KEY:
○ None of this species taken

Juvenile Chinook Salmon Purse Seine Catch
September, 1967

Dames & Moore

Figure F-30

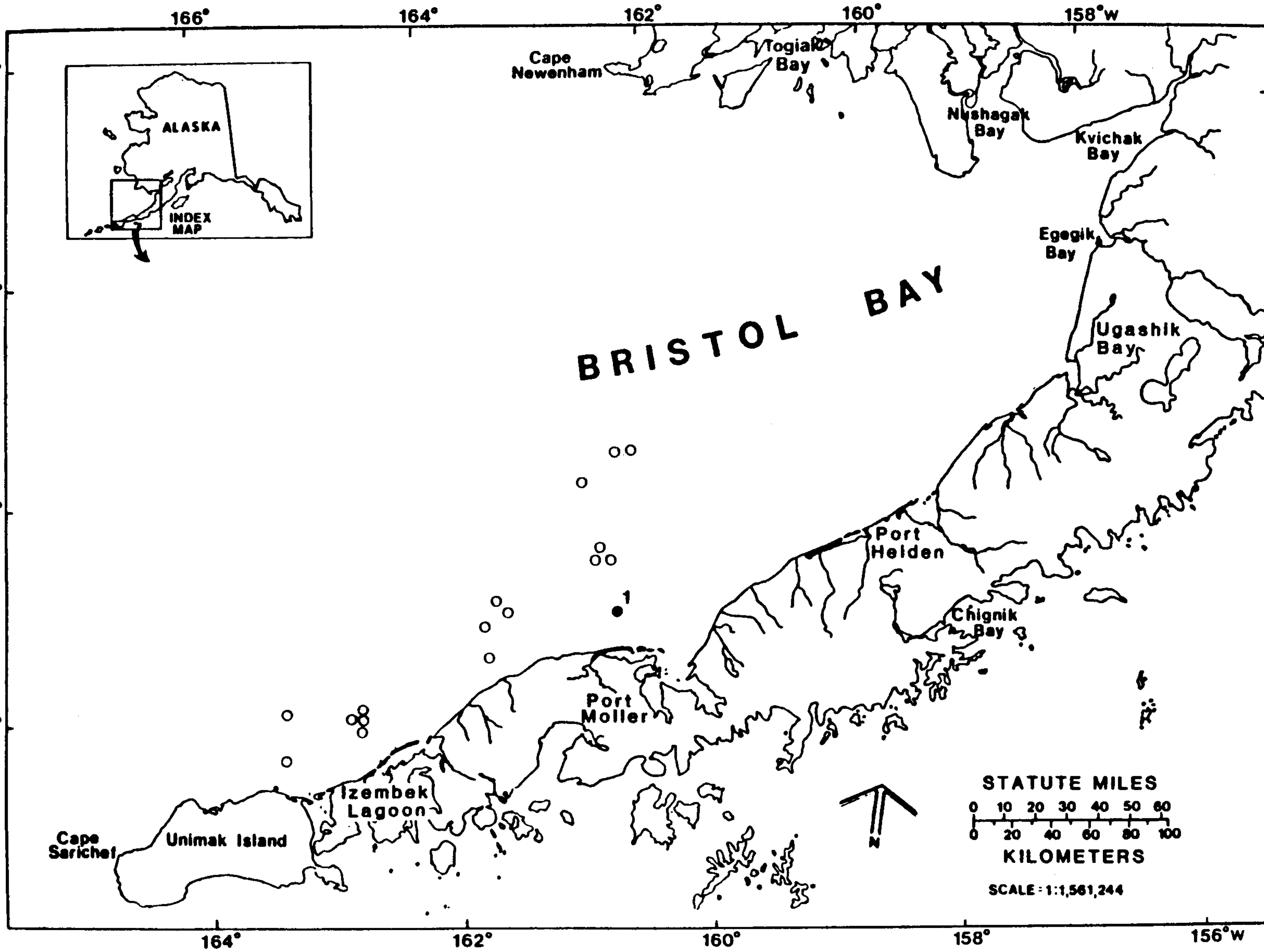


KEY:
○ None of this species taken

Juvenile Chinook Salmon Purse Seine Catch August, 1968

Figure F-31

Dames & Moore

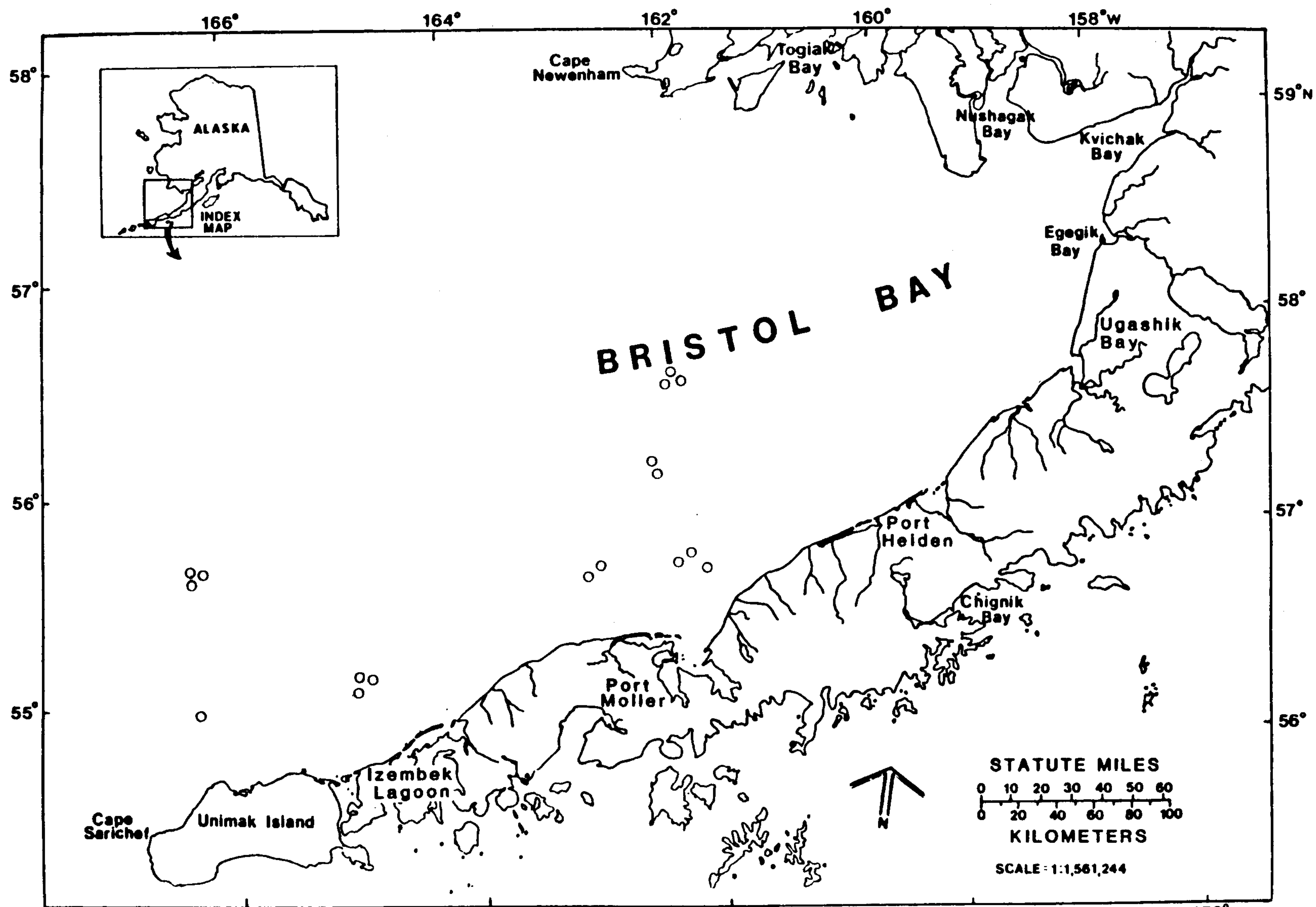


KEY:
○ None of this species taken

Juvenile Chinook Salmon Purse Seine Catch
September, 1968

Dames & Moore

Figure F-32

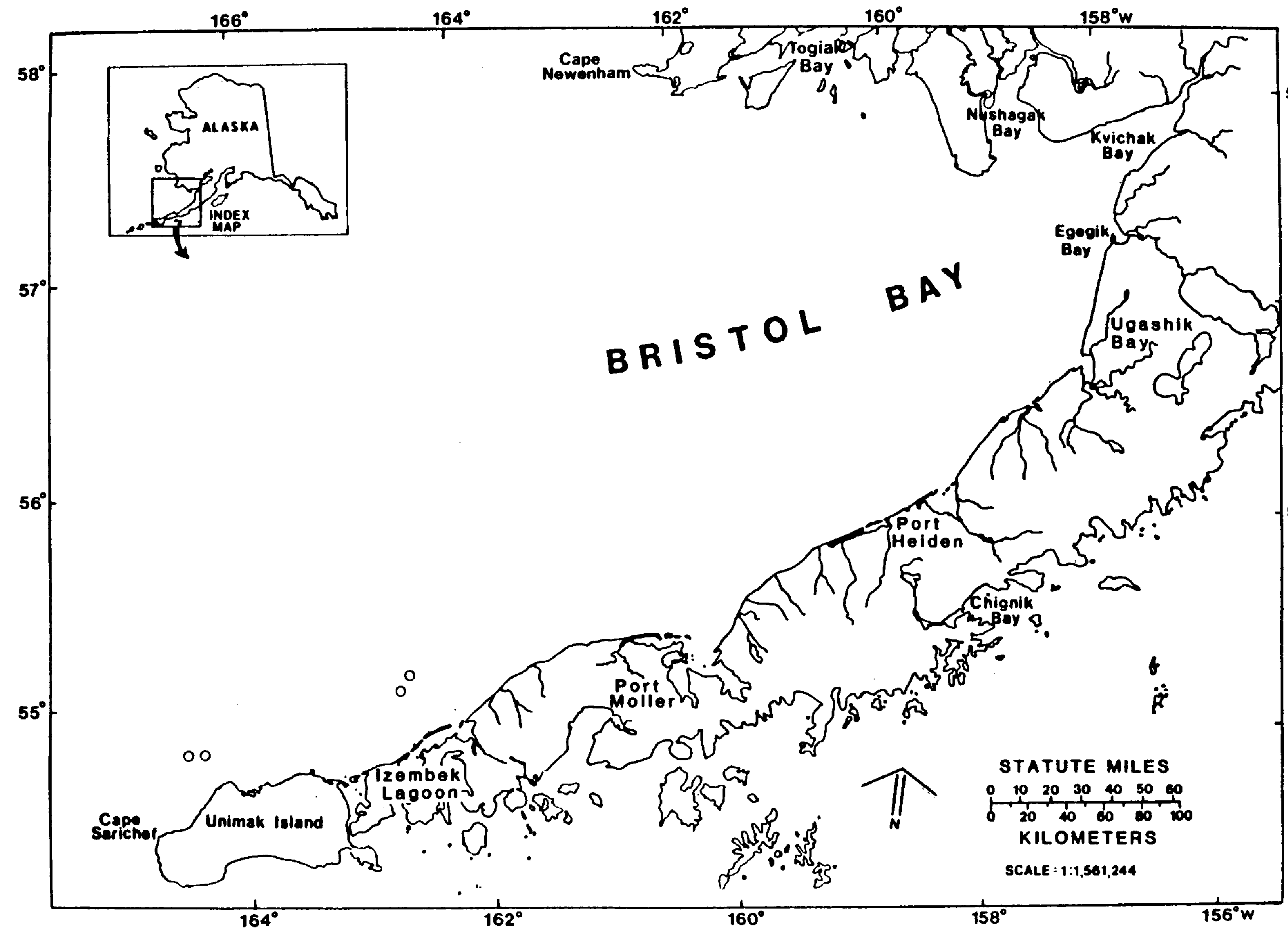


KEY:
○ None of this species taken

Juvenile Pink
Salmon Purse Seine Catch
July, 1962

Dames & Moore

Figure F-33

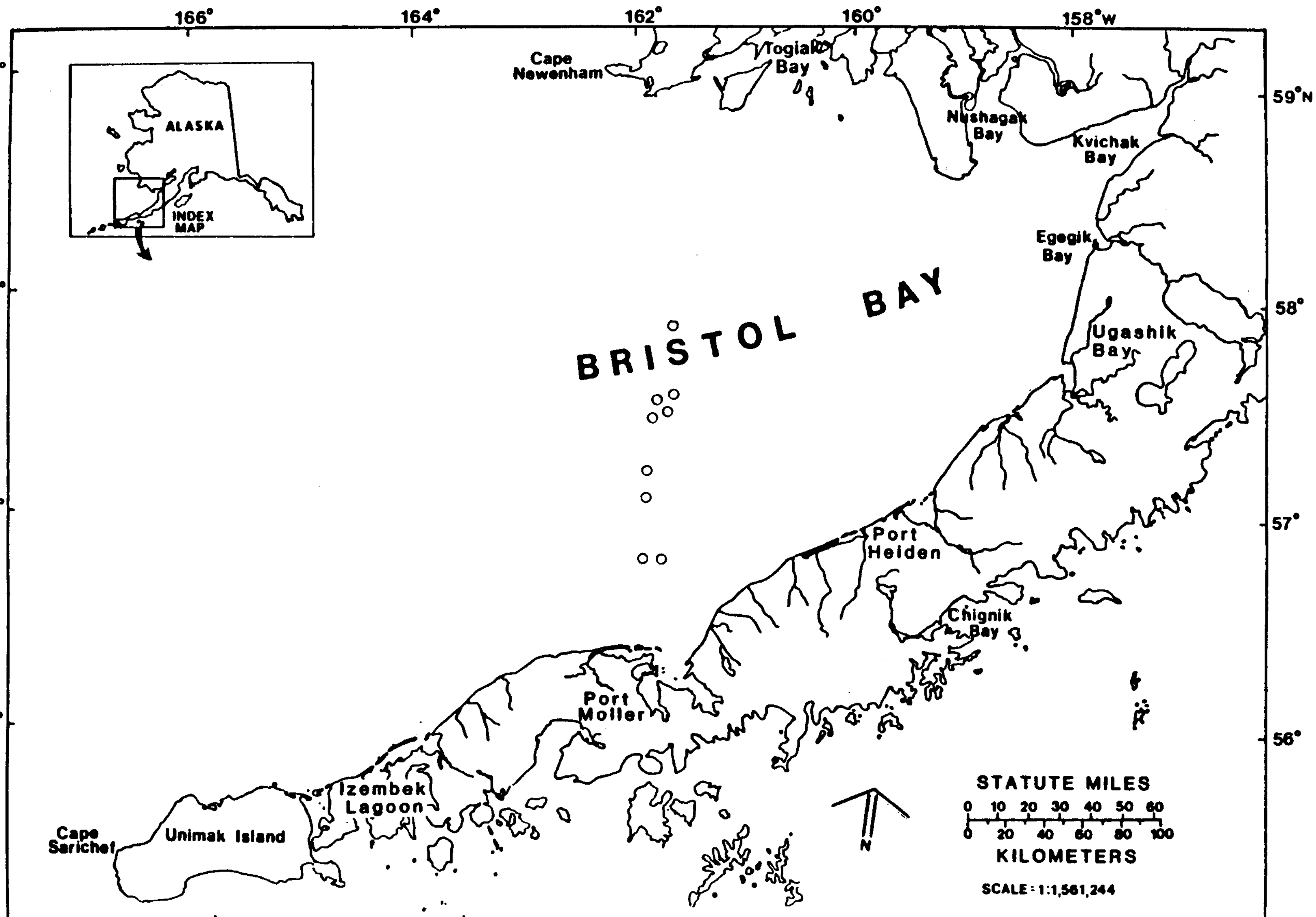


KEY:
○ None of this species taken

Juvenile Pink Salmon Purse Seine Catch August, 1962

Dames & Moore

Figure F-34

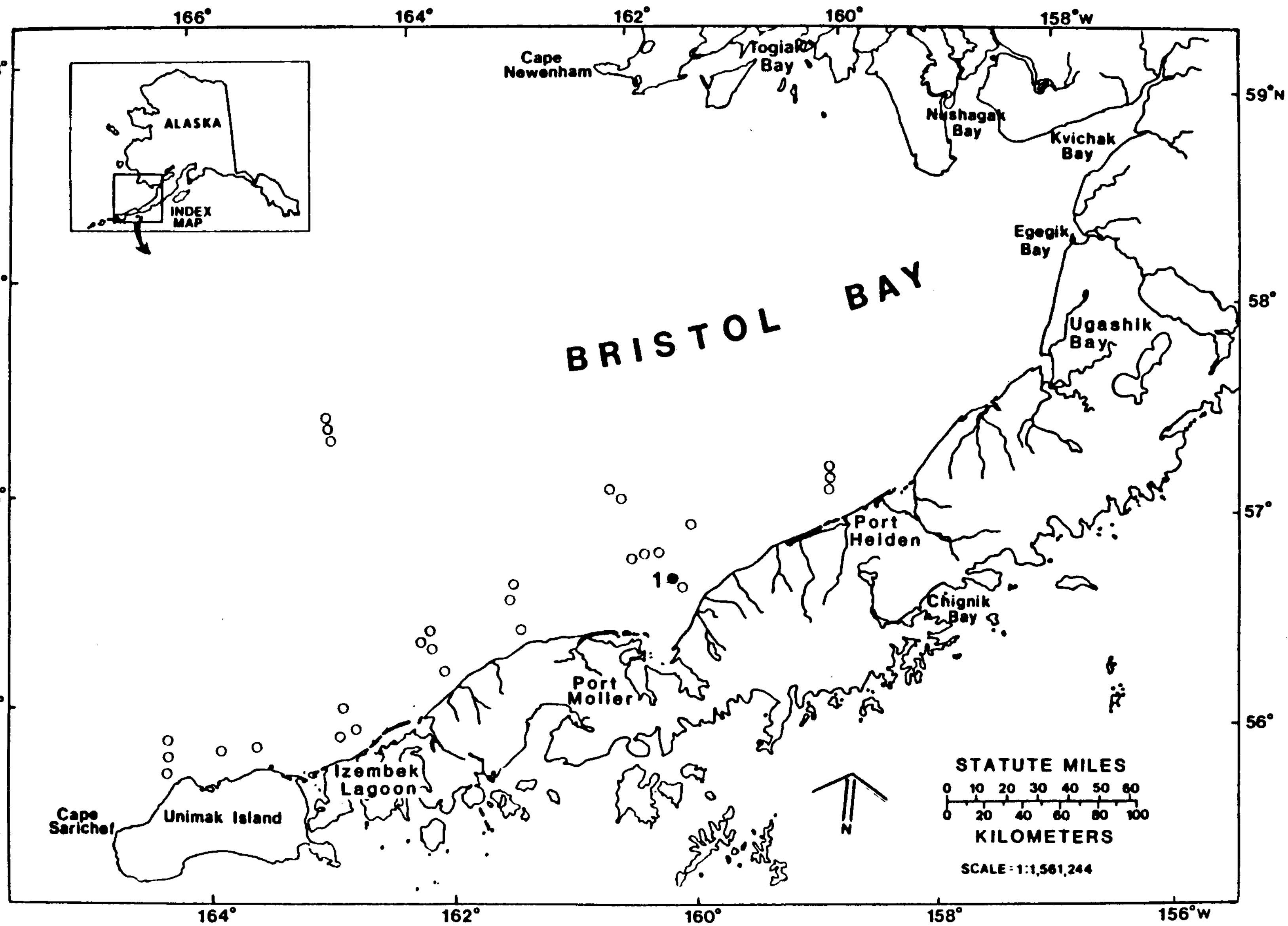


KEY:
○ None of this species taken

Juvenile Pink Salmon Purse Seine Catch June, 1966

Figure F-35

Dames & Moore

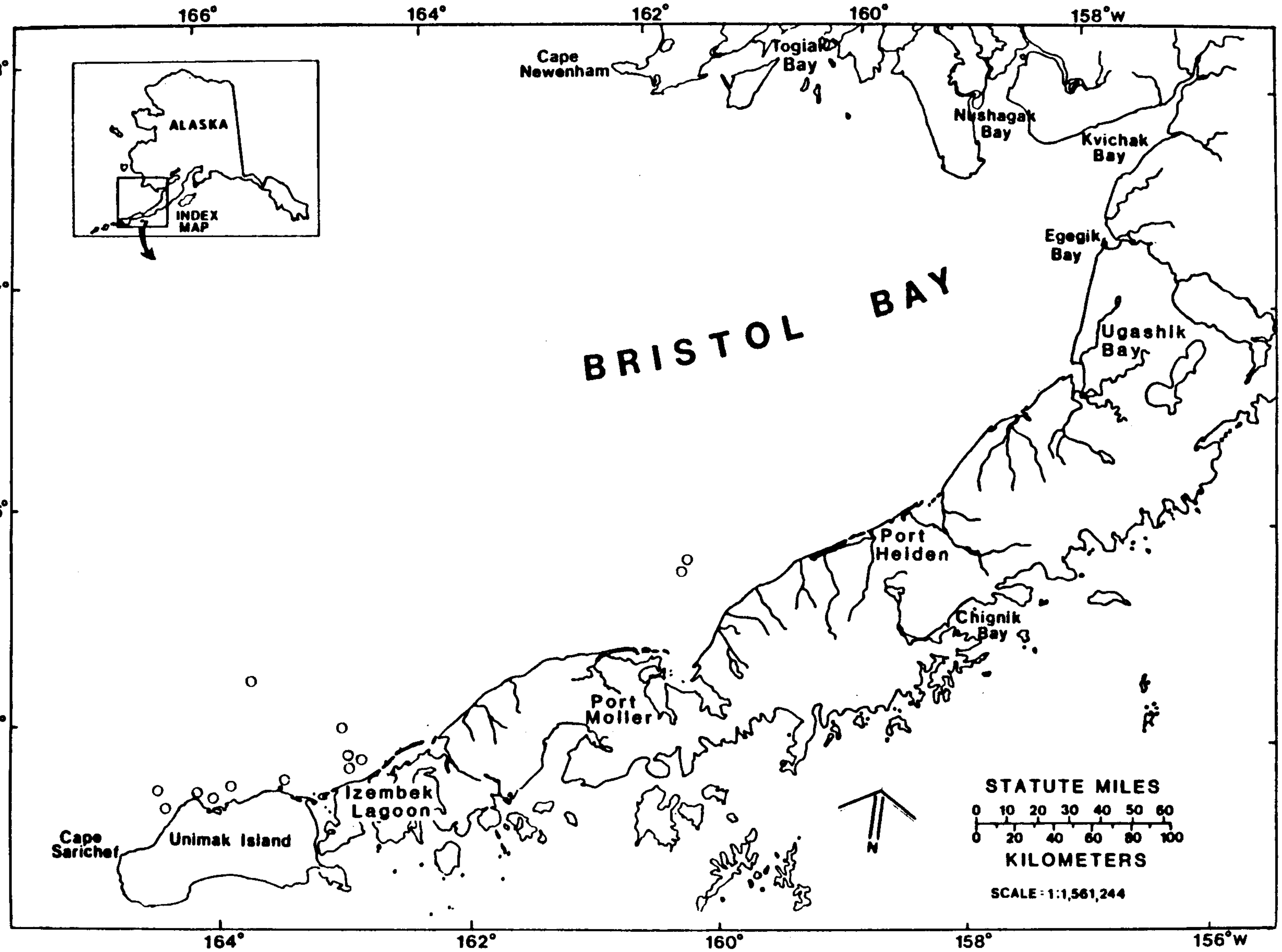


KEY:
○ None of this species taken

Juvenile Pink
Salmon Purse Seine Catch
July, 1966

Dames & Moore

Figure F-36

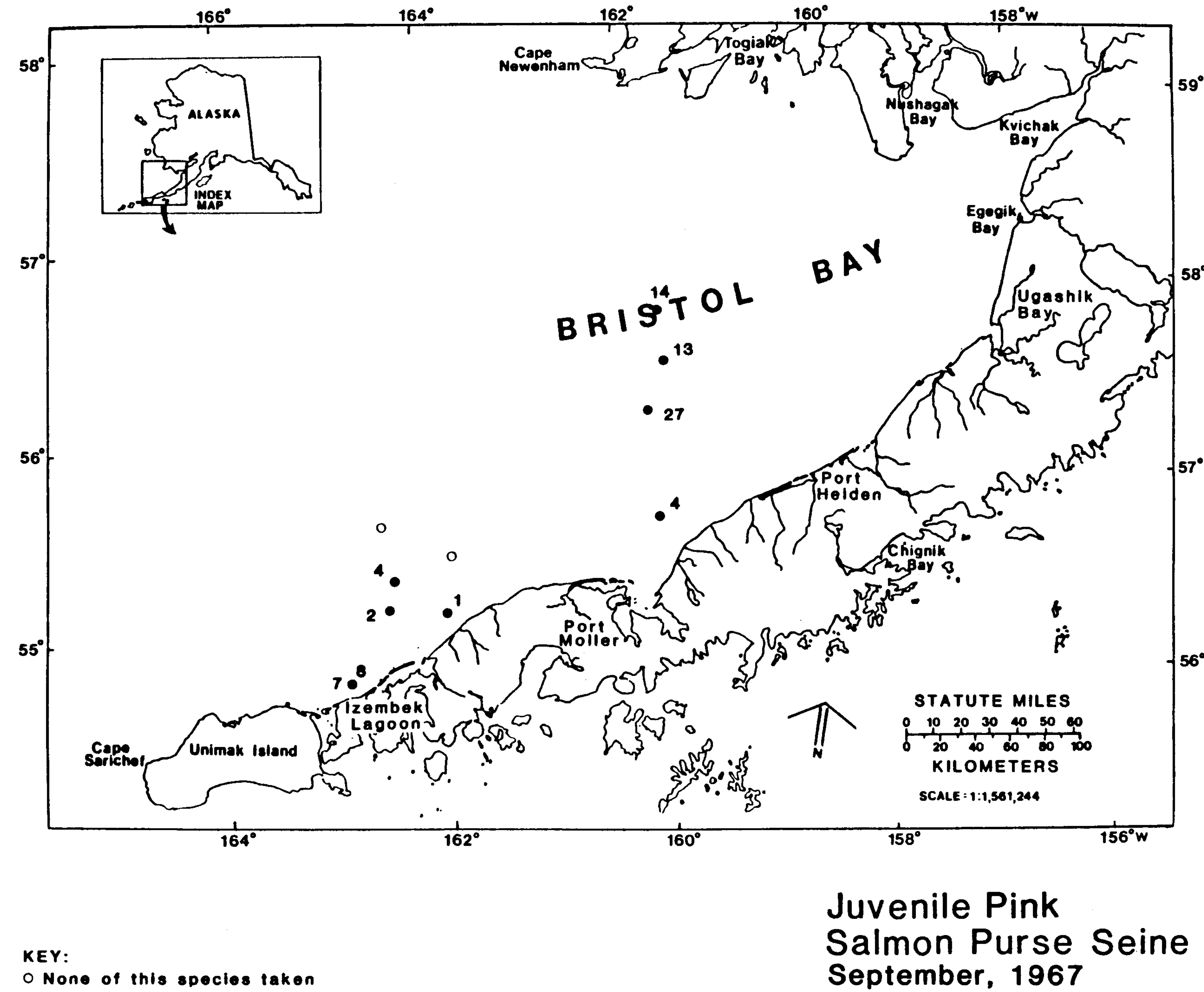


KEY:
○ None of this species taken

Juvenile Pink Salmon Purse Seine Catch August, 1966

Dames & Moore

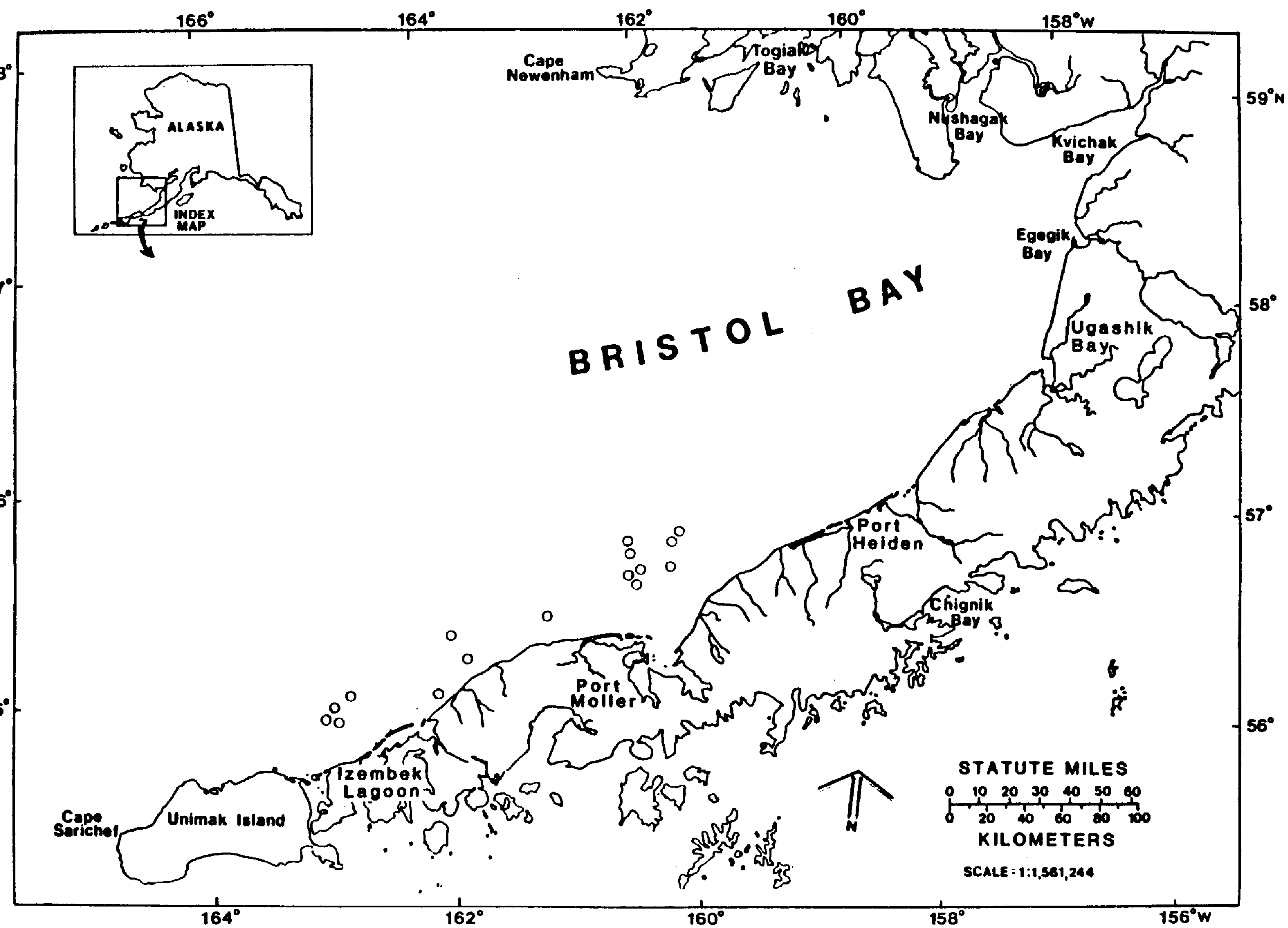
Figure F-37



Juvenile Pink Salmon Purse Seine Catch September, 1967

Figure F-38

Dames & Moore

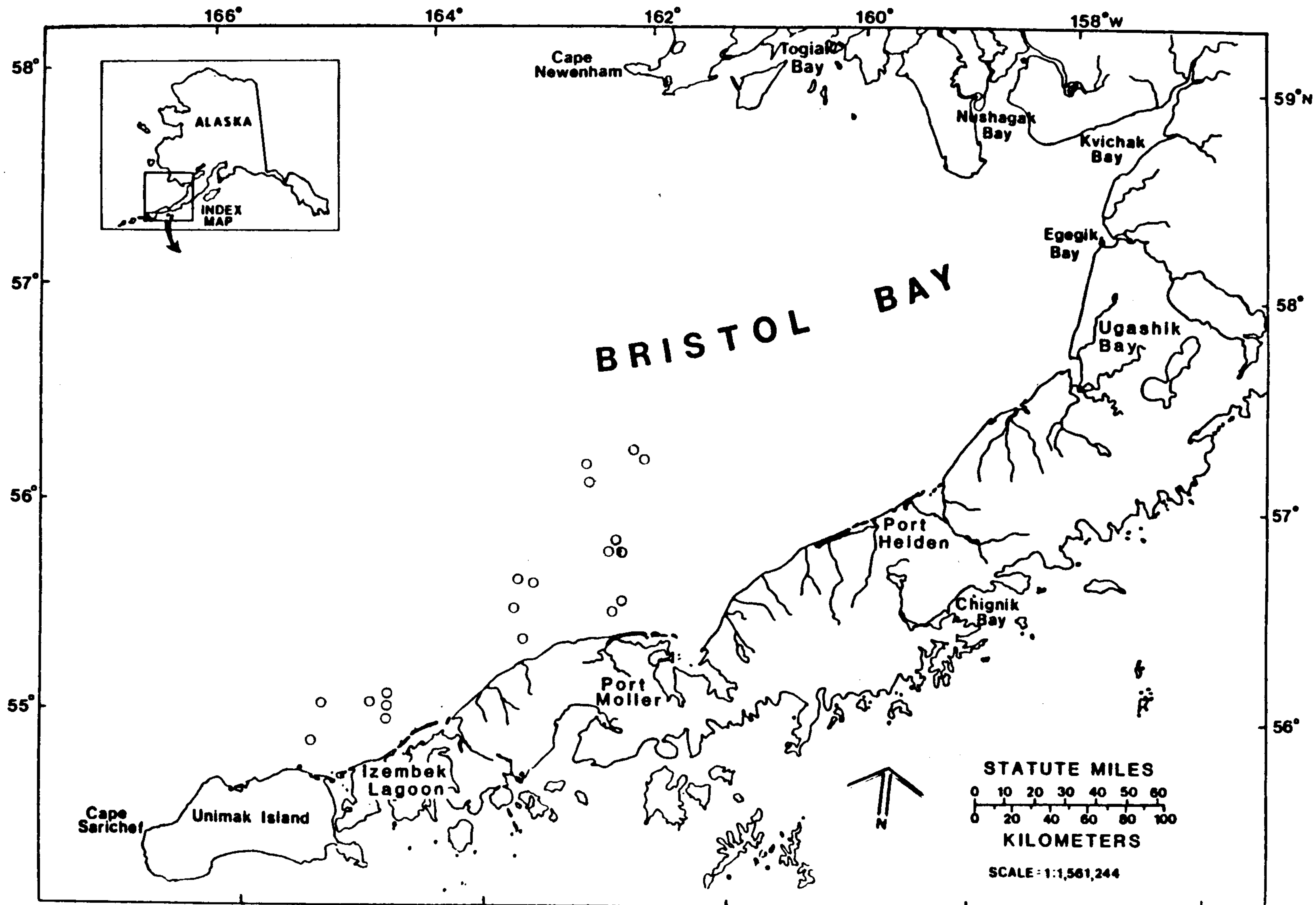


KEY:
○ None of this species taken

Juvenile Pink
Salmon Purse Seine Catch
August, 1968

Figure F-39

Dames & Moore



KEY:
○ None of this species taken

Juvenile Pink
Salmon Purse Seine Catch
September, 1968

Dames & Moore

Figure F-40

APPENDIX G

PURSE SEINE CATCH DATA 1985

APPENDIX TABLE G-1

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4A

Transect 0	Station 0			Station 1			Station 2			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	62.1	1.0	0.7	20.7
SOCKEYE SALMON Juv	1.0	30.0	181.9	3.0	755.2	6789.5	3.0	113.9	586.7	3.0	299.7	2519.4
SOCKEYE SALMON Adult	0.0	0.0	0.0	2.0	75.2	186923.4	1.0	2.0	5637.5	2.0	25.7	64187.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Juv	0.0	0.0	0.0	1.0	12.0	1073.5	2.0	1.6	48.9	2.0	4.5	374.1
DOLLY VARDEN Adult	1.0	1.0	395.9	1.0	1.0	689.5	1.0	1.0	1262.2	3.0	1.0	782.5
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	1.0	1.0	3.8	0.0	0.0	0.0	1.0	0.3	1.3
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.6
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	1.0	1.0	1.5	1.0	2.0	4.5	1.0	1.0	0.8	3.0	1.3	2.3
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	216.7	1.0	0.3	72.2
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	55.6	1.0	0.3	18.5
Number of Species	4.0			6.0			8.0			10.0		
Mean Abundance		33.0			846.4			123.5			334.3	
Mean Weight (gms)			581.0			195484.2			7870.5			67978.6
Number of Sets			3.0			3.0			3.0			9.0

APPENDIX TABLE G-1

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4A

Transect 2	Station 0			Station 1			Station 2			Station 3			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	991.4	1.0	0.3	247.9
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	35.1	0.0	0.0	0.0	1.0	0.3	8.8
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	32.0	254.0	1.0	1165.0	25619.4	1.0	520.0	2081.1	3.0	429.3	6988.6
SOCKEYE SALMON Adult	0.0	0.0	0.0	1.0	1.0	722.4	2.0	2.4	4505.3	0.0	0.0	0.0	2.0	0.9	1306.9
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	39.7	0.0	0.0	0.0	1.0	0.3	9.9
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.0	38.6	1.0	1.3	9.7
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	19.3	2.0	40.8	778.7	2.0	10.5	199.5
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	99.1	1.0	0.5	24.8
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.2
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	26.3	1.0	0.3	6.6
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	11.0	31.6	1.0	2.8	7.9
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	1.0			2.0			5.0			7.0			11.0		
Mean Abundance		1.0			33.0			1170.4			580.8			446.3	
Mean Weight (gms)			0.8			976.4			30218.8			4046.8			8810.7
Number of Sets			1.0			1.0			2.0			2.0			6.0

APPENDIX TABLE G-1

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4A

Transect 4	Station 0			Station 1			Station 2			Station 3			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	1.0	1.0	2184.6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	546.2
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	13.6	485.8	1.0	3.4	121.5
SOCKEYE SALMON Juv	1.0	138.0	1242.4	3.0	50.8	619.0	2.0	86.7	613.5	3.0	29.0	381.1	4.0	76.1	714.0
SOCKEYE SALMON Adult	2.0	4.1	86390.3	0.0	0.0	0.0	1.0	25.0	59511.9	1.0	1.0	1873.4	3.0	7.5	36943.9
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	108.7	1.0	0.3	27.2
DOLLY VARDEN Juv	0.0	0.0	0.0	1.0	1.0	17.5	1.0	5.0	454.6	2.0	4.8	267.2	3.0	2.7	184.8
DOLLY VARDEN Adult	1.0	1.0	596.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	149.2
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	1.0	1.0	0.9	1.0	2.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.8	1.3
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	83.4	0.0	0.0	0.0	1.0	0.3	20.9
PACIFIC SAND LANCE	1.0	2.0	7.9	2.0	1.5	8.5	2.0	61.4	366.4	4.0	106.8	443.2	4.0	42.9	206.5
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	5.0			5.0			5.0			6.0			10.0		
Mean Abundance		146.1			56.3			179.1			156.2			134.4	
Mean Weight (gms)			88238.1			2834.0			61029.8			3559.4			38915.3
Number of Sets			3.0			4.0			4.0			5.0			16.0

APPENDIX TABLE G-1

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4A

Transect 6	Station 0			Station 1			Station 2			Station 3			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	6.0	608.5	1.0	3.0	91.7	2.0	2.3	175.1
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	1.0	10.0	26847.0	0.0	0.0	0.0	1.0	2.5	6711.8
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	5.0	0.0	0.0	0.0	1.0	0.3	1.3
DOLLY VARDEN Adult	1.0	2.0	1417.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	354.3
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	1.0	2.0	3.3	0.0	0.0	0.0	1.0	1.0	0.8	0.0	0.0	0.0	2.0	0.8	1.0
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0	6.0	4.2	3.0	2.0	1.6
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	1.0	1.0	119.1	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	29.8
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	2.0	8.8	51.7	2.0	12.4	70.1	2.0	5.3	30.5
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	3.0			2.0			5.0			3.0			8.0		
Mean Abundance		5.0			2.0			26.8			21.4			13.8	
Mean Weight (gms)			1421.3			120.1			27513.0			166.0			7305.1
Number of Sets			2.0			2.0			2.0			2.0			8.0

APPENDIX TABLE G-2

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 0	Station 0			Station 1			Station 2			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	6.0	1.0	4.6	1.0	0.3	1.5
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	1.0	11.0	1746.4	1.0	3.7	582.1
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.8	3.5	1.0	0.6	1.2
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	855.4	1.0	0.3	285.1
CHUM SALMON Juv	0.0	0.0	0.0	1.0	2.0	4.2	9.0	10.7	25.4	2.0	4.2	9.9
CHUM SALMON Adult	0.0	0.0	0.0	1.0	1.0	3027.3	1.0	1.0	2790.0	2.0	0.7	1939.1
COHO SALMON Juv	0.0	0.0	0.0	1.0	2.0	193.0	9.0	6.8	649.6	2.0	2.9	280.9
SOCKEYE SALMON Juv	5.0	99.2	1751.7	5.0	41.1	420.2	10.0	72.2	492.4	3.0	70.8	888.1
SOCKEYE SALMON Adult	0.0	0.0	0.0	2.0	8.5	20487.5	4.0	19.5	45169.3	2.0	9.3	21885.6
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	4.2	1.0	0.3	1.4
DOLLY VARDEN Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	1.0	4.0	2.6	2.0	0.8	2.1	2.0	1.6	1.6
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	3.0	5.0	0.0	0.0	0.0	3.0	4.7	5.2	2.0	2.6	3.4
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	1.0	35.1	0.0	0.0	0.0	1.0	1.0	71.4	2.0	0.7	35.5
PACIFIC SAND LANCE	0.0	0.0	0.0	1.0	4.0	4.4	2.0	4.8	4.8	2.0	2.9	3.1
YELLOWFIN SOLE	0.0	0.0	0.0	1.0	1.0	2708.9	2.0	0.9	204.0	2.0	0.6	971.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	3.0			8.0			15.0			15.0		
Mean Abundance		103.2			63.6			138.2			101.7	
Mean Weight (gms)			1791.8			26848.1			52028.3			26889.4
Number of Sets			5.0			5.0			10.0			20.0

APPENDIX TABLE G-2

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 2	Station 0			Station 1			Station 2			Station 3			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	11.0	2412.8	1.0	2.8	603.2
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1193.2	1.0	0.3	298.3
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	4.0	23.0	72.9	0.0	0.0	0.0	1.0	5.8	18.2
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	3.0	2.5	100.6	7.0	21.4	189.0	2.0	6.0	72.4
SOCKEYE SALMON Juv	0.0	0.0	0.0	4.0	21.9	257.3	5.0	43.5	349.3	5.0	64.5	540.5	3.0	32.5	286.8
SOCKEYE SALMON Adult	0.0	0.0	0.0	1.0	3.0	5667.8	1.0	2.0	4646.8	3.0	6.1	12489.8	3.0	2.8	5701.1
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	4.8	186.4	1.0	1.2	46.6
PACIFIC COD	0.0	0.0	0.0	1.0	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.2
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	2.0	3.2	1.8	1.0	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.1	0.7
GREENLING UNID	1.0	1.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.2
WHITESPOTTED GREENLING	2.0	3.9	5.1	2.0	2.1	3.0	2.0	0.9	1.3	2.0	9.7	18.9	4.0	4.2	7.1
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	2.6	1.0	0.3	0.7
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.7	1.0	0.3	0.4
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	20.0	1974.1	1.0	5.0	493.5
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.8	26.3	1.0	1.0	6.6
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	520.9	0.0	0.0	0.0	1.0	0.5	130.2
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	354.2	2.0	0.9	438.1	2.0	1.0	198.1
Number of Species	3.0			5.0			7.0			12.0			17.0		
Mean Abundance		8.1			29.0			76.9			145.2			64.8	
Mean Weight (gms)			7.8			5929.7			6046.0			19473.4			7864.2
Number of Sets			5.0			5.0			5.0			5.0			20.0

APPENDIX TABLE G-2

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 4	Station 0			Station 1			Station 2			Station 3			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	5.0	1.0	0.3	1.3
PINK SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	5.7	9847.8	1.0	1.4	2462.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.3	72.4	3.0	7.3	547.4	2.0	2.2	155.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	63.0	864.2	2.0	1.8	15.8	2.0	6.4	58.0	3.0	17.8	234.5
SOCKEYE SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1991.6	1.0	0.3	497.9
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1316.1	0.0	0.0	0.0	0.0	0.3	329.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	1.0	8.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	0.2
WALLEYE POLLOCK	1.0	13.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.3	0.9
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	2.0	5.3	4.8	2.0	6.6	7.5	1.0	1.0	0.9	3.0	3.2	3.3
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	316.7	1.0	0.3	79.2
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	1.0	0.9	0.0	0.0	0.0	1.0	35.0	965.1	1.0	1.0	133.4	3.0	9.3	274.9
PACIFIC SAND LANCE	0.0	0.0	0.0	1.0	15.0	215.0	1.0	117.0	658.0	1.0	1.0	1.7	3.0	33.3	218.7
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	48.3	1.0	0.3	12.1
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	3.0			3.0			6.0			10.0			13.0		
Mean Abundance		22.0			83.3			162.7			26.4			73.6	
Mean Weight (gms)			5.3			1084.0			3034.9			12950.8			4268.8
Number of Sets			1.0			2.0			3.0			4.0			10.0

APPENDIX TABLE G-2

PURSE SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 6	Station 0			Station 1			Station 2			Station 3		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Adult	0.0	0.0	0.0	1.0	1.0	1133.6	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	5.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	6.0	21170.9
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.9	32.0	1.0	2.0	112.5
SOCKEYE SALMON Juv	1.0	1.0	6.7	0.0	0.0	0.0	1.0	24.0	614.2	0.0	0.0	0.0
SOCKEYE SALMON Adult	0.0	0.0	0.0	1.0	1.0	1892.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SMELT UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	1.0	2.0	5.8	1.0	2.0	4.4	1.0	6.0	18.3
GREENLING UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	1.7	1.0	4.0	6.7	1.0	9.0	8.8	1.0	7.0	7.5
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.0	530.8	1.0	5.0	1458.6
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	2.0			4.0			5.0			6.0		
Mean Abundance		2.0			8.0			39.9			29.0	
Mean Weight (gms)			8.4			3038.1			1190.2			22772.8
Number of Sets			2.0			2.0			2.0			2.0

APPENDIX H

SMALL SEINE CATCH DATA 1985

APPENDIX TABLE H-1

SMALL SEINE CATCH DATA SUMMARY FOR CRUISE 4A

Transect 2	Station 3			Station 4			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	2.0	36.0	179.8	2.0	1.9	8.9	2.0	19.0	94.4
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	1.0	0.7	14.5	1.0	0.8	12.3	2.0	0.8	13.4
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	2.0			2.0			2.0		
Mean Abundance		36.7			2.7			19.7	
Mean Weight (gms)			194.3			21.2			107.8
Number of Sets			3.0			2.0			5.0

APPENDIX TABLE H-1

SMALL SEINE CATCH DATA SUMMARY FOR CRUISE 4A

Transect 4	Station 3			Station 4			Station 7			Station 12			Station 13			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	0.5
COHO SALMON Juv	1.0	1.7	62.5	2.0	7.0	330.0	2.0	1.0	46.3	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.9	87.8
SOCKEYE SALMON Juv	2.0	6.1	89.0	2.0	11.1	135.7	3.0	35.2	351.9	0.0	0.0	0.0	1.0	295.7	2365.4	4.0	69.6	588.4
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	1.0	0.8	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	1.7
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	1.0	9.3	389.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.9	77.8
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	201.6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	40.3
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	1.0	0.8	2.5	0.0	0.0	0.0	1.0	11.1	23.2	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.4	5.1
Number of Species	4.0			2.0			6.0			0.0			1.0			7.0		
Mean Abundance		9.4			18.1			58.4			0.0			295.7			76.3	
Mean Weight (gms)			162.3			465.7			1014.4			0.0			2365.4			801.6
Number of Sets			2.0			2.0			3.0			1.0			1.0			9.0

APPENDIX TABLE H-2

SMALL SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 0	Station 8			Station 9			Station 10			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	1.0	0.9	9.3	1.0	0.9	9.3	0.0	0.0	0.0	2.0	0.6	6.2
PACIFIC HERRING	1.0	0.9	5.6	1.0	0.9	13.9	0.0	0.0	0.0	2.0	0.6	6.5
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	1.0	1.9	5.6	1.0	7.4	15.7	1.0	10.2	37.0	3.0	6.5	19.4
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	1.0	0.9	4.6	1.0	1.9	13.9	1.0	1.9	13.9	3.0	1.6	10.8
CHINOOK SALMON Juv	1.0	0.9	3.7	1.0	0.9	13.9	0.0	0.0	0.0	2.0	0.6	5.9
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	1.0	105.6	833.5	1.0	276.0	2593.1	1.0	236.2	2500.5	3.0	205.9	1975.7
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	0.9	3.7	1.0	0.9	2.8	0.0	0.0	0.0	2.0	0.6	2.2
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	1.0	0.9	9.3	0.0	0.0	0.0	1.0	0.3	3.1
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	7.0			8.0			3.0			8.0		
Mean Abundance		112.0			289.8			248.3			216.7	
Mean Weight (gms)			866.0			2671.9			2551.4			2029.8
Number of Sets			1.0			1.0			1.0			3.0

APPENDIX TABLE H-2

SMALL SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 2	Station 4			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	1.0	16.7	37.0	1.0	16.7	37.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	1.0			1.0		
Mean Abundance		16.7			16.7	
Mean Weight (gms)			37.0			37.0
Number of Sets			1.0			1.0

APPENDIX TABLE H-2

SMALL SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 4	Station 4			Station 7			Station 12			Station 13			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	2.0	6.0	105.6	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.5	26.4
PINK SALMON Juv	3.0	8.0	48.2	3.0	3.4	9.2	2.0	27.9	208.5	1.0	12.3	70.2	4.0	12.9	84.0
CHUM SALMON Juv	4.0	88.1	503.1	4.0	25.5	144.6	2.0	51.7	294.4	3.0	26.3	191.4	4.0	47.9	283.4
COHO SALMON Juv	2.0	4.4	313.2	1.0	2.4	134.9	2.0	1.3	39.5	0.0	0.0	0.0	3.0	2.0	121.9
SOCKEYE SALMON Juv	3.0	2.7	17.6	2.0	4.7	26.8	1.0	0.9	8.8	2.0	23.3	251.9	4.0	7.9	76.3
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	1.0	0.9	18.5	1.0	20.4	833.5	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.3	213.0
THREESPINE STICKLEBACK	1.0	0.9	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	1.2
WHITESPOTTED GREENLING	2.0	0.9	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	0.5
STAGHORN SCULPIN	0.0	0.0	0.0	1.0	0.9	222.3	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	55.6
PACIFIC SANDFISH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	1.0	282.5	2825.1	1.0	0.7	7.2	2.0	70.8	708.1
Number of Species	7.0			7.0			5.0			4.0			10.0		
Mean Abundance		105.9			63.3			364.3			62.6			149.0	
Mean Weight (gms)			907.1			1476.9			3376.3			520.7			1570.3
Number of Sets			4.0			4.0			2.0			3.0			13.0

APPENDIX TABLE H-2

SMALL SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 6	Station 10			Station 11			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC LAMPREY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	2.0	1.0	8.1	1.0	11.4	79.0	2.0	6.2	43.6
COHO SALMON Juv	2.0	2.1	68.0	1.0	4.4	280.8	2.0	3.3	174.4
SOCKEYE SALMON Juv	1.0	12.3	184.2	1.0	7.9	87.7	2.0	10.1	136.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPELIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	1.0	0.9	2.6	0.0	0.0	0.0	1.0	0.5	1.3
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SANDFISH	1.0	0.9	17.5	0.0	0.0	0.0	1.0	0.5	8.8
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Number of Species	5.0			3.0			5.0		
Mean Abundance		17.2			23.7			20.5	
Mean Weight (gms)			280.4			447.5			364.0
Number of Sets			2.0			1.0			3.0

APPENDIX I

BEACH SEINE CATCH DATA 1985

APPENDIX TABLE I-1

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 4A

Transect 4	Station 5			Station 6			Station 8			Station 9			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
PACIFIC HERRING	1.0	1.0	180.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	45.0
PINK SALMON Juv	3.0	4.0	4.3	2.0	74.5	68.5	1.0	636.0	641.0	1.0	2.0	3.0	4.0	179.1	179.2
CHUM SALMON Juv	2.0	26.5	80.0	2.0	56.5	74.0	1.0	3257.0	3284.0	1.0	34.0	40.0	4.0	843.5	869.5
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	3.0	14.3	390.0	1.0	1.0	40.0	0.0	0.0	0.0	1.0	3.0	60.0	3.0	4.6	122.5
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
POND SMELT	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	20.0	0.0	0.0	0.0	1.0	0.3	5.0
RAINBOW SMELT	3.0	35.7	426.7	1.0	1.0	12.0	0.0	0.0	0.0	1.0	8.0	255.0	3.0	11.2	173.4
COD UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	1.0	1.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	1.3
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	10.0	1.0	0.3	2.5
THREADED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	10.0	1.0	0.3	2.5
STAGHORN SCULPIN	1.0	1.0	570.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	142.5
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	3.0	1.3	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	1.3
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SADDLEBACK GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	1.0	1.0	1.0	2.0	671.0	1280.0	1.0	253.0	884.0	0.0	0.0	0.0	3.0	231.3	541.3
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	0.0	0.0	0.0	1.0	1.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	25.0
ALASKA PLAICE	0.0	0.0	0.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0	1.0	35.0	2.0	0.5	9.0
Number of Species	9.0			7.0			4.0			7.0			14.0		
Mean Abundance		85.8			806.0			4147.0			50.0			1272.2	
Mean Weight (gms)			1662.3			1575.5			4829.0			413.0			2120.0
Number of Sets			3.0			5.0			1.0			1.0			10.0

APPENDIX TABLE I-2

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 0	Station 4			Station 5			Station 7			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	0.0	0.0	0.0	1.0	7.0	4.0	0.0	0.0	0.0	1.0	2.3	1.3
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SOCKEYE SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHINOOK SALMON Juv	0.0	0.0	0.0	1.0	1.0	2.0	0.0	0.0	0.0	1.0	0.3	0.7
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
POND SMELT	2.0	24.5	112.5	3.0	14.0	51.7	0.0	0.0	0.0	2.0	12.8	54.7
RAINBOW SMELT	2.0	95.5	1962.5	3.0	9.7	233.3	2.0	131.5	1350.0	3.0	78.9	1181.9
COD UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	2.0	1.0	9.0	0.0	0.0	0.0	1.0	0.3	3.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NINESPINE STICKLEBACK	0.0	0.0	0.0	1.0	1.0	5.0	1.0	1.0	1.0	2.0	0.7	2.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	1.0	2.0	360.0	1.0	1.0	310.0	2.0	4.0	67.5	3.0	2.3	245.8
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	2.0	1.5	14.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	4.7
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	2.0	13.5	220.0	1.0	8.0	250.0	2.0	20.0	105.0	3.0	13.8	191.7
SADDLEBACK GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	1.0	1.0	10.0	1.0	1.0	8.0	1.0	1.0	3.0	3.0	1.0	7.0
ARCTIC FLOUNDER	0.0	0.0	0.0	1.0	1.0	9.0	0.0	0.0	0.0	1.0	0.3	3.0
STARRY FLOUNDER	2.0	25.5	385.0	3.0	100.3	1643.3	2.0	46.0	305.0	3.0	57.3	777.8
ALASKA PLAICE	1.0	2.0	2.0	2.0	2.5	4.0	0.0	0.0	0.0	2.0	1.5	2.0
Number of Species	8.0			12.0			6.0			13.0		
Mean Abundance		165.5			147.5			203.5			172.2	
Mean Weight (gms)			3066.0			2529.3			1831.5			2475.6
Number of Sets			2.0			3.0			2.0			7.0

APPENDIX TABLE I-2

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 2	Station 5			Station 6			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	1.0	1.0	30.0	0.0	0.0	0.0	1.0	0.5	15.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	2.0	3.0	3.0	0.0	0.0	0.0	1.0	1.5	1.5
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	2.0	1.5	10.0	0.0	0.0	0.0	1.0	0.8	5.0
SOCKEYE SALMON Juv	1.0	1.0	20.0	0.0	0.0	0.0	1.0	0.5	10.0
CHINOOK SALMON Juv	1.0	1.0	8.0	0.0	0.0	0.0	1.0	0.5	4.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
POND SMELT	1.0	1.0	5.0	1.0	1.0	8.0	2.0	1.0	6.5
RAINBOW SMELT	3.0	204.7	5000.0	3.0	267.7	4740.0	2.0	236.2	4870.0
COD UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	1.0	1.0	15.0	1.0	0.5	7.5
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	1.0	1.0	3.0	0.0	0.0	0.0	1.0	0.5	1.5
NINESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	2.0	3.0	115.0	3.0	3.3	505.0	2.0	3.2	310.0
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	1.0	1.0	20.0	1.0	1.0	40.0	2.0	1.0	30.0
SADDLEBACK GUNNEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC SAND LANCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ROCK SOLE	1.0	10.0	900.0	0.0	0.0	0.0	1.0	5.0	450.0
YELLOWFIN SOLE	2.0	2.5	150.0	1.0	5.0	300.0	2.0	3.8	225.0
ARCTIC FLOUNDER	2.0	3.5	125.0	2.0	42.5	1550.0	2.0	23.0	837.5
STARRY FLOUNDER	3.0	26.0	1880.0	3.0	26.3	490.0	2.0	26.2	1185.0
ALASKA PLAICE	3.0	5.3	376.7	1.0	5.0	30.0	2.0	5.2	203.4
Number of Species	15.0			9.0			16.0		
Mean Abundance		265.5			352.8			309.2	
Mean Weight (gms)			8645.7			7678.0			8161.9
Number of Sets			3.0			3.0			6.0

APPENDIX TABLE I-2

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 4	Station 5			Station 6			Station 8			Station 9			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	1.0	11.0	150.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.8	37.5
PINK SALMON Juv	3.0	10.0	11.0	2.0	1.5	2.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.9	3.3
CHUM SALMON Juv	4.0	66.0	205.0	3.0	9.0	19.7	1.0	3.0	10.0	2.0	4.0	21.0	4.0	20.5	63.9
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1874.0	0.0	0.0	0.0	1.0	0.3	468.5
COHO SALMON Juv	0.0	0.0	0.0	2.0	2.0	29.5	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.5	7.4
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	3.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	1.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
POND SMELT	1.0	1.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	50.0	2.0	0.5	16.3
RAINBOW SMELT	2.0	4.0	57.5	2.0	4.5	96.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.1	38.4
COD UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	1.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.5
NINESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.3	0.5
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	2.0	1.5	197.5	2.0	2.5	151.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	87.1
GREAT SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	1.0	2.0	5.0	2.0	3.5	45.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.4	12.5
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SADDLEBACK GUNNEL	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.3
PACIFIC SAND LANCE	2.0	92.0	194.0	5.0	233.2	2432.4	2.0	227.0	2520.0	2.0	352.0	1628.0	4.0	226.1	1693.6
ROCK SOLE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
YELLOWFIN SOLE	2.0	1.0	33.5	0.0	0.0	0.0	1.0	1.0	80.0	0.0	0.0	0.0	2.0	0.5	28.4
ARCTIC FLOUNDER	0.0	0.0	0.0	1.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.3	0.5
STARRY FLOUNDER	0.0	0.0	0.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0	1.0	650.0	2.0	0.5	162.8
ALASKA PLAICE	0.0	0.0	0.0	2.0	5.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.3	3.3
Number of Species	11.0			12.0			4.0			4.0			20.0		
Mean Abundance		180.5			277.2			232.0			358.0			229.9	
Mean Weight (gms)			723.5			2945.6			4484.0			2349.0			2717.7
Number of Sets			5.0			5.0			2.0			2.0			14.0

APPENDIX TABLE I-2

BEACH SEINE CATCH DATA SUMMARY FOR CRUISE 4B

Transect 6	Station 6			Station 7			Transect Summary		
Common Species Name	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight	Freq	Mean Abund	Mean Weight
empty haul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PACIFIC HERRING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PINK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHUM SALMON Juv	2.0	13.0	75.0	2.0	73.0	415.0	2.0	43.0	245.0
CHUM SALMON Adult	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COHO SALMON Juv	0.0	0.0	0.0	2.0	3.5	12.5	1.0	1.8	6.3
SOCKEYE SALMON Juv	0.0	0.0	0.0	1.0	1.0	4.0	1.0	0.5	2.0
CHINOOK SALMON Juv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DOLLY VARDEN Adult	1.0	1.0	450.0	0.0	0.0	0.0	1.0	0.5	225.0
POND SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RAINBOW SMELT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COD UNID	1.0	2.0	3.0	0.0	0.0	0.0	1.0	1.0	1.5
PACIFIC COD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WALLEYE POLLOCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREESPINE STICKLEBACK	0.0	0.0	0.0	1.0	1.0	3.0	1.0	0.5	1.5
NINESPINE STICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHITESPOTTED GREENLING	1.0	1.0	5.0	0.0	0.0	0.0	1.0	0.5	2.5
SCULPIN UNID	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THREADED SCULPIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STAGHORN SCULPIN	0.0	0.0	0.0	1.0	1.0	20.0	1.0	0.5	10.0
GREAT SCULPIN	2.0	3.0	320.0	1.0	3.0	60.0	2.0	3.0	190.0
STURGEON POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TUBENOSE POACHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SNAKE PRICKLEBACK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SADDLEBACK GUNNEL	0.0	0.0	0.0	1.0	2.0	5.0	1.0	1.0	2.5
PACIFIC SAND LANCE	0.0	0.0	0.0	2.0	2102.0	2597.0	1.0	1051.0	1298.5
ROCK SOLE	0.0	0.0	0.0	1.0	3.0	13.0	1.0	1.5	6.5
YELLOWFIN SOLE	0.0	0.0	0.0	1.0	4.0	140.0	1.0	2.0	70.0
ARCTIC FLOUNDER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STARRY FLOUNDER	2.0	1.0	57.0	2.0	1.0	101.0	2.0	1.0	79.0
ALASKA PLAICE	1.0	5.0	60.0	2.0	1.0	1.5	2.0	3.0	30.8
Number of Species	7.0			12.0			15.0		
Mean Abundance		26.0			2195.5			1110.8	
Mean Weight (gms)			970.0			3372.0			2171.0
Number of Sets			2.0			2.0			4.0

APPENDIX J

ADULT SALMON CATCH DATA 1962-1985

APPENDIX TABLE J-1. RETURNS (IN THOUSANDS) OF ADULT SALMON BY ADF&G COMMERCIAL FISHING DISTRICTS WITHIN THE NAS STUDY AREA. DATA ARE NOT AVAILABLE FOR ALL SPECIES.

	NORTHERN DISTRICT			NORTHWESTERN DISTRICT		
YEAR	SOCKEYE	CHUM	CHINOOK	SOCKEYE	CHUM	PINK
1962	541.1	54.5	9.7	59.8	131.2	34.8
1963	515.1	52.8	9.5	60.9	200.3	10.4
1964	585.7	96.6	29.6	85.0	197.4	21.8
1965	408.9	43.9	28.3	28.4	75.1	2.9
1966	495.0	112.2	11.4	36.2	120.1	17.7
1967	496.8	95.5	16.5	28.2	67.0	1.0
1968	457.1	112.9	19.5	33.5	211.5	26.5
1969	833.4	67.6	17.5	63.1	109.2	4.4
1970	618.7	137.6	9.9	45.8	76.2	18.9
1971	746.0	69.8	7.2	43.3	103.8	8.8
1972	352.9	72.3	6.6	16.8	136.4	1.2
1973	341.6	99.4	7.7	10.8	178.7	0.2
1974	548.8	40.4	8.0	15.6	96.3	33.3
1975	728.0	22.4	6.7	22.3	95.5	0.6
1976	1117.5	155.0	10.9	56.2	212.0	37.3
1977	922.5	330.4	12.6	89.7	478.6	6.4
1978	2025.0	179.6	27.9	85.1	294.3	558.2
1979	3436.6	150.4	32.8	116.6	220.7	10.9
1980	2633.7	697.9	27.8	151.0	772.8	391.9
1981	3068.5	627.7	30.7	123.7	620.1	14.8
1982	2066.9	503.5	50.1	84.6	285.4	56.8
1983	2611.5	378.2	55.2	62.2	363.2	5.2
1984	2268.7	1023.6	40.6	291.1	460.0	42.8
1985	3363.7	547.9	36.6	23.6	343.2	23.0

DISTRIBUTION, SEASONAL ABUNDANCE, AND FEEDING DEPENDENCIES OF JUVENILE SALMON AND NON-SALMONID FISHES IN THE YUKON RIVER DELTA

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Final Report
Outer Continental Shelf Environmental Assessment Program
Research Unit 660

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

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1.0 INTRODUCTION

In autumn 1984 Envirosphere Company was awarded a contract to conduct a one-year investigation of the distribution, seasonal abundance, and feeding dependencies of juvenile salmon and non-salmonid fishes in the Yukon River Delta. Initial field investigation began with a small synoptic survey which was conducted during December 1984. A larger open-water survey was conducted during June through September 1985. This report contains the results of both surveys and includes an assessment of the potential vulnerability of fish and delta habitats to oil and gas development.

The events which led up to this study initially began on March 15, 1983 when the U.S. Department of the Interior accepted 59 bids for oil and gas exploration in Norton Sound (Sale No. 57). This lease sale area is located on the outer continental shelf just north of the Yukon River Delta. Since this region supports a large subsistence and commercial fishery, baseline studies were needed to assess the potential impacts of oil and gas development. In response to this need for scientific information, the Outer Continental Shelf Environmental Assessment Program (OCSEAP), the National Oceanic and Atmospheric Administration (NOAA) contracted with LGL Ecological Research Associates, Inc. to conduct a literature review which resulted in an Ecological Characterization of the Yukon River Delta (Truett et al. 1985). This characterization identified the estuarine environment (including the nearshore delta platform and the delta distributaries influenced by marine water) as most vulnerable to adverse effects of oil in the delta. However, site specific information concerning physical processes, fish distribution, and habitat utilization in the Yukon River Delta was very limited. This information would be necessary to assess potential environmental impacts and to enable management decisions necessary to protect fishery resources. Consequently, OCSEAP initiated a field investigation of the physical processes and fishery resources of the Yukon River Delta during 1984.

1.1 OBJECTIVES

The objectives of this study as specified by NOAA/OCSEAP are to:

1) Describe the population levels, residence times, and feeding dependencies of juvenile salmon in the Yukon Delta estuarine region.

2) Determine the population levels, seasonal distributions, and feeding dependencies of non-salmonid fishes in the delta channels, delta front, and delta platform.

3) Determine the vulnerabilities of these fish populations to the potential effects of proposed OCS oil and gas activities.

1.2 STATUS OF CURRENT KNOWLEDGE

The abundance and seasonal distribution of fishes on the Yukon Delta is largely unknown, except for adult salmon. Two to five million adult salmon annually migrate through the delta environment to spawning areas upriver (Starr et al. 1981). All five species of Pacific salmon are found in the Yukon River with chum salmon being the most abundant (1,900,000-5,300,000), followed by chinook (500,000), pink (less than 300,000), coho (less than 100,000) and sockeye (Geiger et al. 1983, Starr et al. 1981). Studies on adult salmon in the Yukon River system have defined age, sex, size composition, run timing, and spawning areas for chum and chinook (Bucklis 1981, 1982; U.S. Fish and Wildlife Service 1957).

Information on juvenile salmon use of the Yukon Delta is limited to one study conducted by Barton (1983). Barton sampled the lower Yukon River in the vicinity of Flat Island and Kwikluak Pass during 1976 and the main river channel near the mouth of Anuk River in 1977. Catches of juvenile chum and chinook salmon near Anuk occurred immediately after sampling began on June 7. Catches of juvenile chum peaked on June 13, and declined to low levels by June 24. Chinook salmon were caught throughout the study period (June 7 through July 7); however, their numbers were too small (less than 3 per day) to identify a peak. Samples collected near Flat Island indicate juvenile salmon were present in the estuary until mid July. Water temperature in the river during the peak of the chum salmon smolt outmigration ranged between 9-11°C and was 16°C at the end of the outmigration period. Based on these data, the duration of habitat utilization in the immediate nearshore areas of the delta is relatively short (i.e., June 1 through mid July). However, Barton (1983) did not sample intertidal mudflat areas or the shallow waters of the delta platform.

Information on the food habits of juvenile salmon for the Yukon Delta is essentially non-existent. Barton (1983) examined a few salmon (3 chum, 3 chinook) caught near the Anuk River and found freshwater prey items (i.e., aquatic insects and small fish) in the stomachs.

Very little information exists concerning the distribution, abundance, and food habits of non-salmon fishes in the Yukon Delta. Whitefish, sheefish, and blackfish are harvested on a commercial basis and also contribute to an important subsistence fishery throughout the Yukon drainage (Geiger et al. 1983). Barton (1983) caught starry flounder in the South Mouth channel near Flat Island, suggesting that this species is present on the delta platform. Starry flounder probably utilize the delta platform as a nursery ground based on the tendency for juveniles of this species to migrate into brackish, warmer waters. Length-frequency distributions presented by Wolotira et al. (1977b) indicate that fish collected in Norton Sound near the delta platform are smaller. This region could be a major source of larger individuals found in the more northerly regions studied by Wolotira et al. (1977a).

Arctic flounder probably utilize the delta platform, like the starry flounder, since this species is often found well into brackish water. In Wolotira's survey, arctic flounder were found in abundance only off the Yukon Delta. Saffron cod, which was the dominant marine species in Wolotira's survey (both biomass and abundance), would also be expected to be abundant on the delta platform.

Information on the food habits of non-salmon fishes on the Yukon Delta is limited to the unpublished studies of tundra lakes conducted by Rae Baxter (personal communication). A summary of his work indicates, in general, that broad and humpback whitefish are bottom feeders in the tundra lakes and insect larvae and mollusks are their most important prey items. Adult sheefish, pike, and blackfish are all picivorous, and the Bering cisco, least cisco, and ninespine stickleback are plankton feeders.

In summary, the distribution, abundance, and food dependencies of juvenile salmon and non-salmon fishes on the Yukon Delta are largely unknown. Based on the review of relevant literature, it is apparent that significant populations of economically important fish utilize specific habitats on the delta. However, the timing and duration of habitat utilization and food habits of these species need to be defined. This study provides a significant advance in the understanding of the Yukon Delta and its use by fish.

2.0 DESCRIPTION OF STUDY AREA

The Yukon River Delta is located along the southwestern coast of Norton Sound, Alaska, which is located in the northeastern corner of the Bering Sea (Figure 2-1). The study area includes all waters within and adjacent to the fan-shaped delta extending northward from the mouth of the Black River on the southwest coast. The emergent portion of the delta is characterized as a gentle sloping plain (slope of 1:5,000) with active and inactive distributary channels, channel bars, natural levees, interdistributary marshes, and lakes (Dupre 1980). The land is generally flat and contains low willow, alder, cottonwood, sedge, and native grasses as the dominant vegetation types (U.S. Fish and Wildlife Service 1957). Seaward of the emergent edge of the delta, the prograding delta platform extends as far as 30 km offshore with typically shallow water (up to 3 m) and a gentle sloping bottom (1:1000 or less). Adjacent to the delta platform is the steeper delta front with water depth ranging 3 to 14 m (Dupre 1980).

The Yukon River is subdivided into three major distributaries (Kwikluak or South Mouth, Kawanak or Middle Mouth, and Apoon or North Mouth) which are further subdivided into smaller distributaries as it approaches the coast. The larger distributary channels continue as offshore subsea extensions that are typically .5 to 1 km wide, 5-15 m deep, and extend up to 20 km beyond the shoreline (Dupre 1980).

2.1 DYNAMIC PROCESSES

Discharge of the Yukon River has a dynamic seasonal pattern. During the winter, discharge follows a slow declining pattern from 92,000 - 168,000 cfs in November to 38,000 - 50,000 cfs in April (based on USGS water discharge records for Pilot Station, years 1976 - 1983). In spring, runoff causes a rapid increase in discharge to a peak of 750,000 cfs during June. During the summer and autumn, discharge steadily declines again to November levels (based on USGS water discharge records for Pilot Station, years 1976 - 1983). The Yukon River transports a large suspended sediment load which causes water

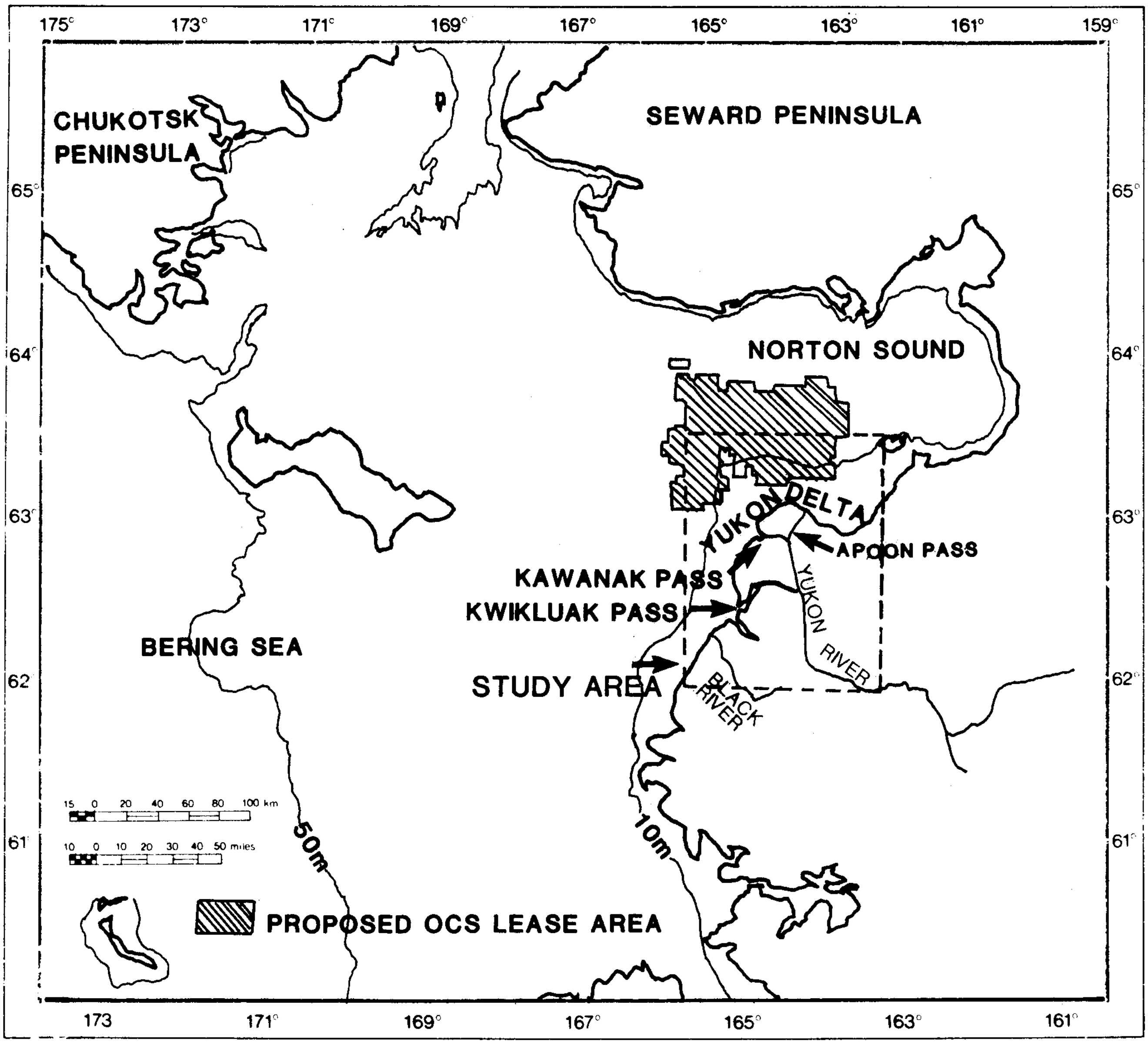

Figure 2-1. Vicinity map of Norton Sound showing the location of the Yukon River Delta study area.

to be opaque in active distributaries and coastal areas as far offshore as the delta front.

The tidal cycle in the Yukon Delta is a mixture of diurnal and semi-diurnal tides depending on location and the time of year (NOAA/NOS 1984). The diurnal tidal range at the face of the delta is about 1-2 m. Water levels are also affected by storm surges which can occur at any time but are more frequent during autumn. Storm surge frequencies of 3.3 m every 100 years, 2.4 m every 10 years, and 0.4 - 1.2 m every year are given by Wise et al. (1981).

The winter ice period begins with ice formulation in October and ends with ice breakup in May. Bottom-fast ice develops to approximately the 1 m isobath and shorefast ice extends to a distance of 15 to 60 km offshore. Spring breakup is initiated by the large increase in river discharge which causes floating ice to lift, both in the river and along the coast. During this period the increased discharge and ice jams cause extensive flooding and river bank erosion. Southerly winds which predominate at this time push warmer water into the region and promote ice melting. Floating and shorefast ice are usually gone by June (Dupre 1980).

3.0 METHODS AND MATERIALS

3.1 STUDY DESIGN

This survey was designed to investigate the seasonal distribution, abundance, and feeding dependencies of juvenile salmon and non-salmon fishes that utilize the Yukon River Delta. Since fisheries information was limited, field surveys were conducted during both winter and summer. The greatest effort, however, was expended during the open water period when juvenile salmon are most abundant and potential vulnerability to oil-related impacts are greatest.

The study region (Figure 2-1) covers a large geographic area and includes a diversity of aquatic habitat types. Therefore, in order to determine habitat utilization patterns, the study region was stratified into eight major habitat types, some of which were partitioned into sub-types to aid in description of sample sites (Table 3-1). Habitats were characterized by differences in morphology, elevation and location. One or more sites representative of each habitat type were sampled during synoptic surveys of the region in order to identify the spatial distribution of fishes.

Greater emphasis was placed on active distributary and coastal habitats (i.e. tidal slough and mudflat) as these areas were more likely to be utilized by juvenile salmon. Also, during the summer survey, a number of sites were sampled repeatedly in order to identify temporal variations in abundance and the duration of habitat utilization. The duration of residence for juvenile chum salmon was further defined through an examination of otolith microstructure.

Vulnerability of these fish populations to the potential effects of oil and gas development was based on species occurrence, relative abundance, and duration of residence within each habitat.

TABLE 3-1

DEFINITION OF AQUATIC HABITAT TYPES INVESTIGATED IN THE YUKON RIVER DELTA

Habitat Major Type Sub-Type	Code	Definition
Delta Front	1	A zone that is approximately 5 km wide and located at the outer margin of the delta platform with water depths ranging from 3 to 14 m.
Delta Platform		The shallow water zone that extends from the outer edge of the coastal mudflats to the delta front. This zone may extend 20-30 km seaward from the coast and may be only 3 m deep.
Mid Delta Platform	2	Portion of delta platform where sub-sea channels pass through the delta platform. Channels range from 0.5 to 1.0 km wide with water depths ranging to 30 m.
Inner Delta Platform	3	Refers to a portion of the delta platform located within 4-8 km of the coast.
Mudflat	4	The narrow intertidal zone extending from the emergent coastal edge to as far as 1 to 1.5 km offshore. Water depth ranges to 1.0 m at high tide.

TABLE 3-1 (Continued)

DEFINITION OF AQUATIC HABITAT TYPES INVESTIGATED IN THE YUKON RIVER DELTA

Habitat Major Type Sub-Type	Code	Definition
Tidal Slough	5	Small dendritic waterways that extend into and drain marsh areas along the coast. The width and length of these channels vary with tidal level and they may become dry at low tide. The outer edge and banks of these channels contain dense marsh grass which becomes flooded during high tide.
Active Distributary		
Major	6	Large river channels ranging from 0.5 to 3 km wide that flow year round.
Minor	7	Smaller river channels (< 0.5 km wide) that flow most of the year.
Inactive Distributary		
Major	11	Large dead-end drainage channel (0.5 to 3 km wide) that connects to an active distributary.
Minor	8	Smaller dead-end drainage channel (< 0.5 km wide).

TABLE 3-1 (Continued)

DEFINITION OF AQUATIC HABITAT TYPES INVESTIGATED IN THE YUKON RIVER DELTA

Habitat Major Type Sub-Type	Code	Definition
Lakes		
Lake Outlet	10	Small channel connecting a lake with an active distributary or slough.
Connected Lake	9	Lentic environment surrounded by the delta marsh that is connected to an active distributary or slough by an outlet channel.
Landlocked Lake	13	Lentic environment surrounded by the delta marsh with no outlet channel.
Inter-Island Channels	12	Small active channels that separate islands and bars along the delta coast line.

Feeding dependencies of juvenile salmon and other important fishes were determined by examination of stomach contents from selected subsamples obtained during the summer survey. The dependence of fish on foods produced in delta habitats was also incorporated into the vulnerability analysis.

3.1.1 Winter Survey

The winter survey of the Yukon River Delta was conducted from December 3rd through December 13th, 1984. Fish were collected during a synoptic survey of active and inactive distributary habitats, most of which were located along the coastline (Figure 3-1). Water quality data were collected in conjunction with the fish sampling program. A list of the geographic coordinates and a description of each sample site is shown in Table 3-2.

An attempt was made to supplement data developed from the sampling program with catch data derived from an inventory of local fishermen. However, after several days of travel to villages on the delta (i.e., Emmonak, Alakanuk and Sheldon's Point) little information concerning catch (i.e., species and location) was obtained from the local people. The inventory crew found that it was difficult to locate and talk to people having direct knowledge of fishing conditions.

3.1.2 Summer Survey

The summer survey extended from June 14th through September 18th, 1985. Field crews were on site by June 3rd, but sampling did not begin until June 14th due to the late breakup of ice in the lower delta. The sample program involved several synoptic (i.e., geographically extensive) surveys of the delta region and repeated sampling at several selected study sites. Samples were collected from 54 sites that were representative of the 13 habitat types identified in Table 3-1 (Figure 3-2). Most of the sample sites, however, were representative

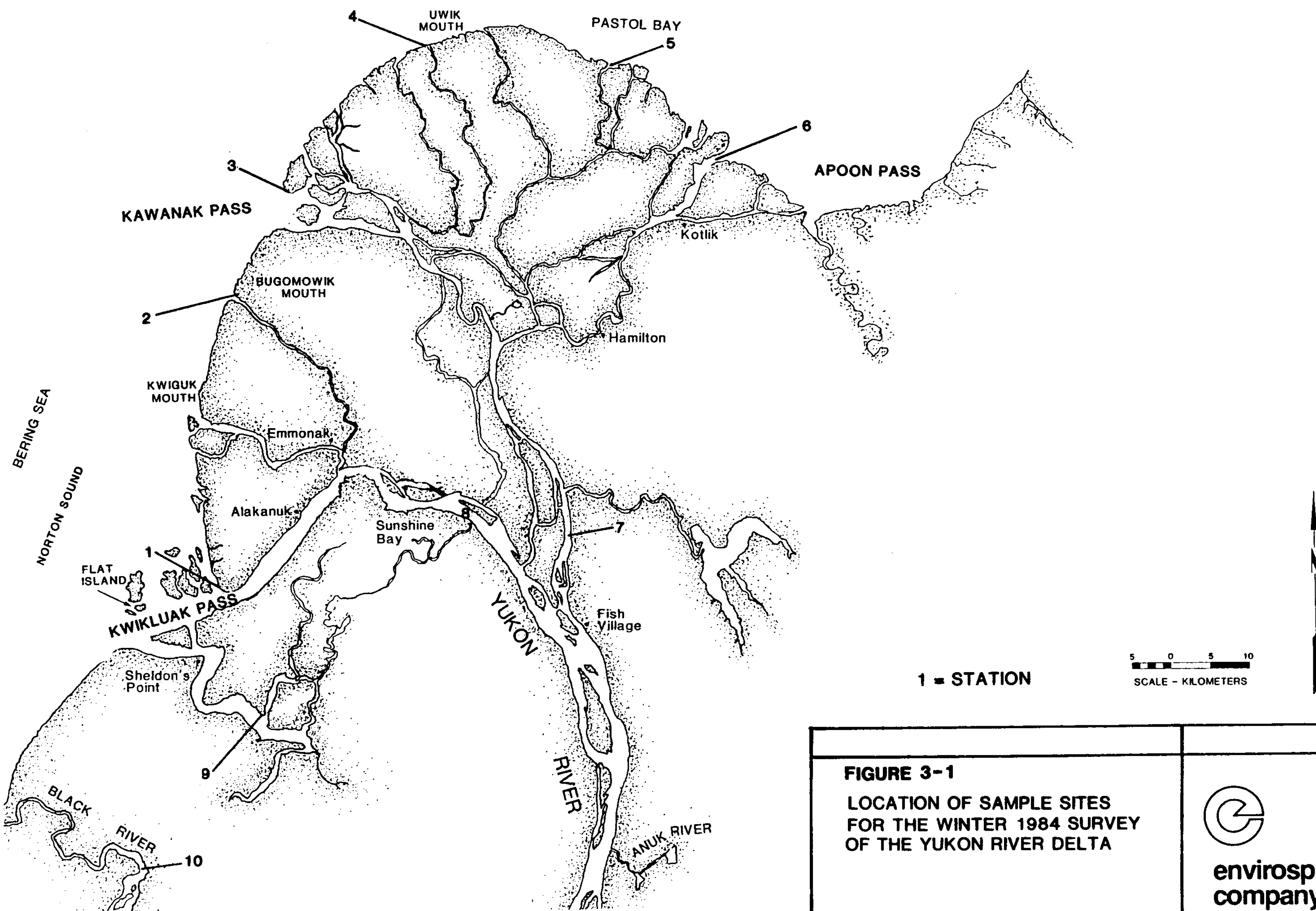

FIGURE 3-1

LOCATION OF SAMPLE SITES FOR THE WINTER 1984 SURVEY OF THE YUKON RIVER DELTA

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TABLE 3-2

LOCATION, DESCRIPTION, AND SAMPLE DATES FOR THE WINTER 1984 SURVEY OF THE YUKON RIVER DELTA

Station Number	Description	Latitude	Longitude	Date Sampled
1	Minor Act. Dist. - Eastside of Casey's Channel	62°36.8	164°47.8	Dec. 9-10
2	Minor Act. Dist. - Bugomowik Slough Mouth	62°57.3	164°46.3	Dec. 8-9
3	Major Act. Dist. - Nunaktuk Island	63°04.3	164°38.2	Dec. 7-8
4	Minor Act. Dist. - Elongozhik Slough Mouth	63°14.1	164°16.6	Dec. 9-10
5	Minor Act. Dist. - Okshokwewhik Pass Mouth	63°12.7	163°49.5	Dec. 10-11
6	Major Act. Dist. - Okwega Pass Mouth	63°06.4	163°32.6	Dec. 11-12
7	Major Act. Dist. - Kwikpuk, Kwikpak Pass	62°40.3	163°55.7	Dec. 12-13
8	Major Act. Dist. - Near Akularak Pass	62°41.8	164°11.1	Dec. 11-12
9	Major Inactive Dist. - Kwemeluk - Kanelik Jct.	62°27.9	164°40.9	Dec. 12-13
10	Minor Act. Dist. - Black River	62°15.9	164°59.0	Dec. 12-13

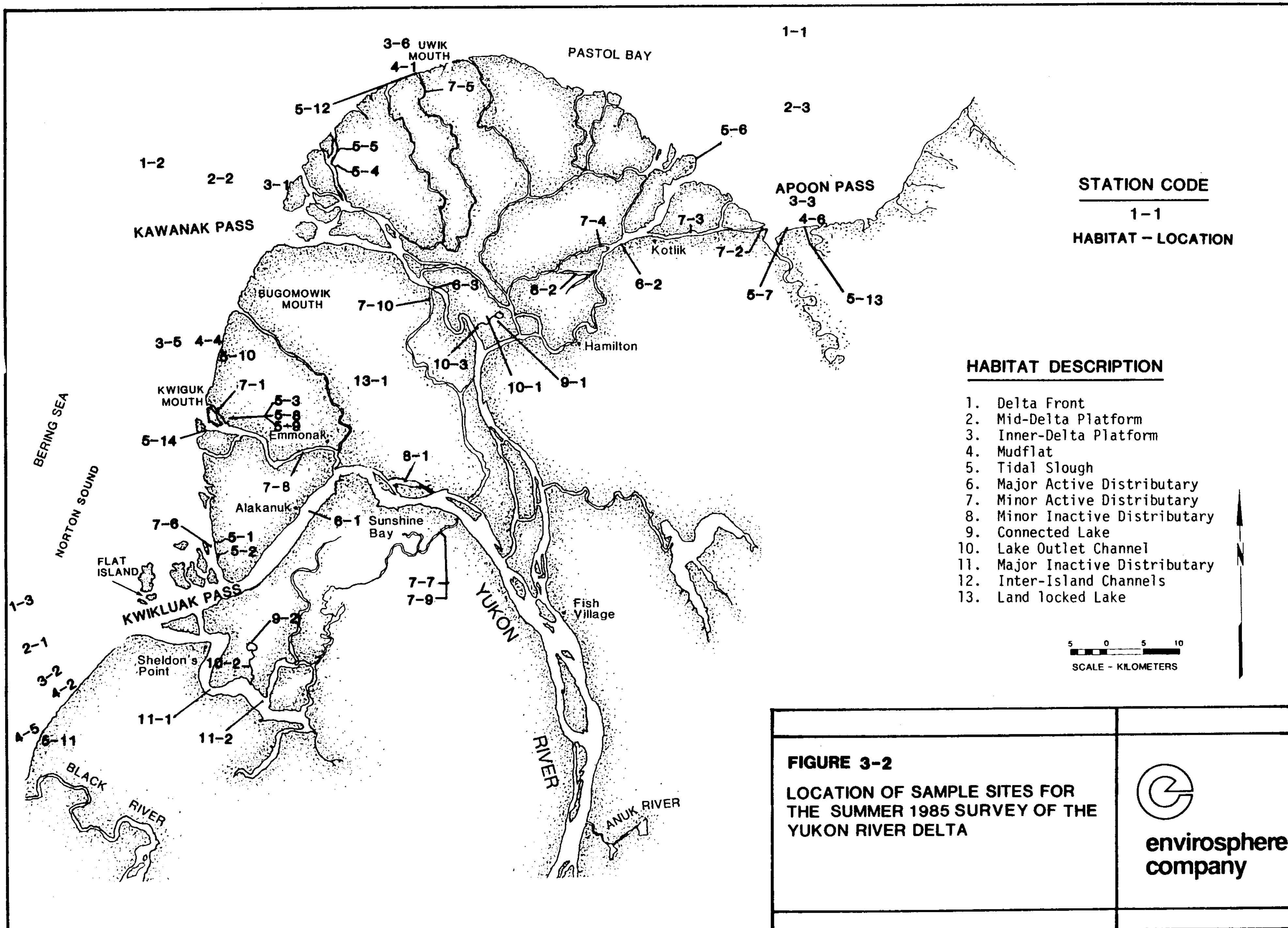

FIGURE 3-2

LOCATION OF SAMPLE SITES FOR THE SUMMER 1985 SURVEY OF THE YUKON RIVER DELTA

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of active distributary and coastal habitats. A description of each sample site,including the geographic coordinates,is listed in Table 3-3.

3.2 SAMPLING TECHNIQUES

3.2.1 Water Quality Measurements

During the winter, water temperature, dissolved oxygen, conductivity, salinity, and water clarity were measured at each fish sampling station. All parameters except water clarity were measured at 1.0 m depth increments. Temperature, conductivity, and salinity were measured with a Beckman R5-3 conductivity/temperature instrument and dissolved oxygen was measured with a YSI model 51B dissolved oxygen meter. Water clarity at the surface was visually categorized as clear, slightly turbid (tea color), or turbid (no visability below surface).

During the summer water quality measurements were made using two basic approaches. The first approach involved the installation of continuously recording physical/water quality instrumentation at selected locations within the Delta. The second method involved taking discrete measurements by field crews in conjunction with fish sampling and other project operations.

Instrumentation was installed at five locations in the study area (Figure 3-3, Table 3-4) in order to provide continuous measurements of water level, temperature, and conductivity. Salinity was then calculated during data processing from conductivity, temperature and depth. SeaData TDR-2A tide gauges equipped with temperature and conductivity sensors were placed near the mouths of the southern most distributary and the northern most distributary. Aanderaa RCM-4 meters fitted with pressure, temperature and conductivity sensors were installed near the entrance to the Middle Mouth, approximately 25 km upriver in Kwikluak Pass near its junction with Kwiguk Pass (Big Eddy), and 50 km upriver in Kwikluak Pass near its junction with Naringolapak Slough.

TABLE 3-3

LOCATION AND DESCRIPTION OF STATIONS SAMPLED

DURING THE 1985 FIELD SEASON OF THE YUKON DELTA FISHERIES STUDY

Station Number	Description	Latitude (N)	Longitude (W)
1-1	Delta front - North Mouth	63 19.74	163 08.21
1-2	Delta front - Middle Mouth	63 08.49	165 05.82
1-3	Delta front - South Mouth	62 26.16	165 37.32
2-1	Mid delta platform - South Mouth	62 30.06	165 15.84
2-2	Mid delta platform - Middle Mouth	63 08.17	164 48.48
2-3	Mid delta platform - North Mouth	63 11.47	163 11.94
3-1	Inner delta platform - Middle Mouth	63 06.07	164 41.24
3-2	Inner delta platform - south of South Mouth	62 31.18	165 11.60
3-3	Inner delta platform - east of Pastolik River	63 04.73	163 15.28
3-5	Inner delta platform - south of Bugomowik	62 54.20	164 48.10
3-6	Inner delta platform - west of Elongozhik	63 18.50	164 17.00
4-1	Mudflat - west of Elongozhik	63 18.50	164 17.00
4-2	Mudflat - south of South Mouth	62 31.18	165 10.00
4-4	Mudflat - south of Bugomowik	62 54.20	164 48.10
4-5	Mudflat - Black River	62 26.50	165 16.90
4-6	Mudflat - east of Pastolik River	63 01.70	163 15.80
5-1	Tidal slough - off Casey's Channel	62 39.19	164 51.13
5-2	Tidal slough - off Casey's Channel	62 38.37	164 51.13
5-3	Tidal slough - north of Kwikuk Mouth	62 50.50	164 49.00
5-4	Tidal slough - trib. to Kochluk Pass, Mid	63 05.80	164 29.00
5-5	Tidal slough - trib. to Kochluk Pass, Mid	63 05.80	164 29.00
5-6	Tidal slough - in outer island at Okwega Pass	63 07.00	164 32.00

TABLE 3-3 (Continued)

LOCATION AND DESCRIPTION OF STATIONS SAMPLED

DURING THE 1985 FIELD SEASON OF THE YUKON DELTA FISHERIES STUDY

Station Number	Description	Latitude (N)	Longitude (W)
5-7	Tidal slough - 1st channel east of Apoon Mouth	63 02.00	163 22.00
5-8	Tidal slough - northwest of Kwiguk Pass	62 48.00	164 47.00
5-9	Tidal slough - same as 5-8	62 48.00	164 47.00
5-10	Tidal slough - south of Bugomowik	62 54.20	164 48.10
5-11	Tidal slough - Black River	62 26.50	165 16.90
5-12	Tidal slough - west of Elongozhik	63 18.30	164 17.00
5-13	Tidal slough - east of Pastolik River	63 01.70	163 15.80
5-14	Tidal slough - Island in Kwiguk Mouth	62 49.00	164 50.00
6-1	Major active dist - near Alakanuk	62 40.82	164 36.62
6-2	Major active dist - south of Kotlik	62 59.70	163 48.96
6-3	Major active - several miles upriver of Sea Gull Point	62 58.75	164 16.61
7-1	Minor active - north of Kwiguk Mouth	62 50.50	164 49.00
7-2	Minor active - at Apoon Mouth	63 02.68	163 24.68
7-3	Minor active - Tatlinguk Pass, NE of Kotlik	63 02.69	163 31.80
7-4	Minor active - Apakshaw jct., east of Kotlik	63 01.28	163 50.86
7-5	Minor active - near Elongozhik Mouth	63 13.80	164 17.29
7-6	Minor active - in Casey's Channel	62 39.29	164 51.18
7-7	Minor active - east of Sunshine Bay	62 40.84	164 17.02
7-8	Minor active - Kwiguk, west of Emmonak	62 45.66	164 38.75
7-9	Minor active - SE of Sunshine Bay	62 40.00	164 17.00
7-10	Minor active - Kwikpakak Slough	63 00.81	164 23.63
8-1	Minor inactive - Utakaht Slough	62 43.80	164 19.50
8-2	Minor inactive - Chapeluk Slough, Apoon	62 59.30	163 52.20

TABLE 3-3 (Continued)

LOCATION AND DESCRIPTION OF STATIONS SAMPLED

DURING THE 1985 FIELD SEASON OF THE YUKON DELTA FISHERIES STUDY

Station Number	Description	Latitude (N)	Longitude (W)
9-1	Lake - 2.5 km east of Choolunawick	62 56.50	164 04.40
9-2	Lake - north of Kwemeluk Pass, west of Kanelik Pass	62 30.40	164 44.20
10-1	Lake outlet - 2.0 km east of Choolunawick	62 57.10	164 05.90
10-2	Lake outlet - north of Kwemeluk Pass, west of Kanelik Pass	62 30.20	164 43.90
10-3	Lake outlet - 0.6 km downstream of Station 10-1	62 57.10	164 07.00
11-1	Major inactive channel - SE of Sheldon's Point	62 28.00	164 50.00
11-2	Major inactive channel - Kwemeluk/Kanelik Jct.	62 27.00	164 41.00
12-1	Inter-island channel - north of South Mouth, east of Flat Island	62 36.80	164 51.80
13-1	Landlocked lake - NE of Emmonak, west of Kravaksarak	62 51.80	164 23.30

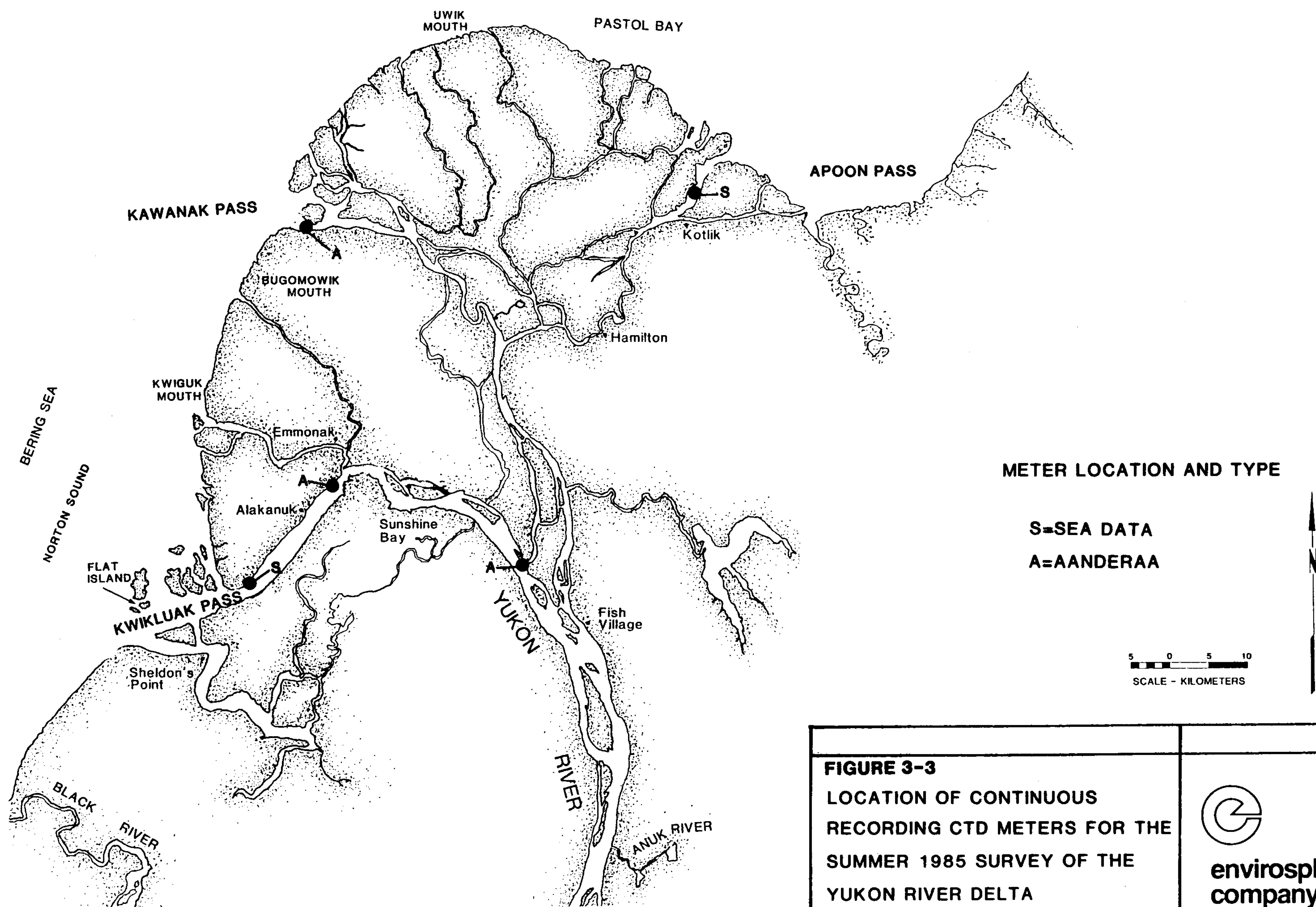

FIGURE 3-3

LOCATION OF CONTINUOUS RECORDING CTD METERS FOR THE SUMMER 1985 SURVEY OF THE YUKON RIVER DELTA

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TABLE 3-4

WATER QUALITY EQUIPMENT DEPLOYMENT AND RECOVERY LOG
FOR THE SUMMER 1985 SURVEY OF THE YUKON RIVER DELTA

Station	Instrument	Date		Location		Meter Depth (m)	Water Depth (m)	Comments
		Deployment	Recovery	Latitude (North)	Longtitude (West)			
South Mouth (Kwikluak Pass)	SeaData TDR-2A	11 June 1985	15 Sep 1985	62° 36.88'	164° 46.17'	7	7.5	>715 feet of bank collapsed removing shore anchor -- groundline found afloat
Big Eddy	Aanderaa RCM-4	11 Jun 1985	-----	62° 43.99'	164° 32.33'	9	9.5	Missing groundline -- meter not recovered after two days effort
Naringolapak Slough	Aanderaa RCM-4	12 Jun 1985	30 Sep 1985	62° 37.60'	164° 02.24'	10	10.5	Meter partially buried due to collapse of bank -- recovered by divers
North Mouth	SeaData TDR-2A	19 Jun 1985	12 Sep 1985	63° 04.28'	163° 37.21'	7	7.5	Okay
Middle Mouth	Aanderaa RCM-4	22 June 1985	9 Sep 1985	63° 02.16'	164° 35.69'	4.5	5	Mooring possibly dragged during September storm surge

1438a

All instruments were bottom mounted in order to provide the highest probability of detecting potential salinity intrusions. Each instrument was vertically mounted on a metal-framed quadrapod such that the sensors were located approximately half a meter from the bottom. Attached to the frame's lifting bridle was a 200-foot, 3/8-inch nylon groundline which was anchored onshore.

All equipment placed in the field was tested by standard set-up and checkout procedures at the base camp prior to deployment. After initial checkout procedures, sampling intervals were programmed into each meter. Each meter was then monitored to assure proper operation.

Sampling intervals for all instruments were set to half hour intervals but the method of data recording differed between the two types of instruments used in this study. The Aanderaas were capable of recording only a single reading of each sensor at each sampling interval. The SeaData meters, however, are capable of sampling each sensor repetitively (bursting) and recording a single averaged value for each sensor. These meters were set to read 128 records at one second intervals during each burst in order to eliminate high frequency noise from the data.

Discrete surface and bottom measurements were taken by field crews throughout the duration of the study. These measurements were taken at the same time that experimental fishing efforts were undertaken, and at the same stations. Discrete measurements were taken at these stations for water depth, conductivity, temperature, and turbidity.

A Beckman RS-5 conductivity/temperature instrument was used for part of these discrete measurements, with handheld thermometers and a YSI Model 31 conductivity meter used for the rest of the measurements. Water depths were measured with a Echotec fathometer. A standard Secchi disc (200 mm diameter) was used to measure water transparency.

3.2.2 Fish Sampling

In order to sample the diversity of habitats encountered in the Yukon River Delta a variety of sampling gears was deployed. The specifications for each fishing gear are listed in Table 3-5 and a description of how each gear was deployed is shown in Figure 3-4. During the winter all habitats were sampled with a 16 m long variable mesh gill net. Nets were positioned in a horizontal configuration just beneath the ice and were fished for a period of 20-26 hours. In addition, gee-type minnow traps baited with salmon eggs were deployed at all but three sample sites. However, no fish were caught at these sites.

During the summer a 136.8 m purse seine was used to sample the delta front, mid-delta and major active distributary habitats where the water was greater than 7 m deep. The purse seine was set in a "C" shaped configuration by two boats and towed with the open end of the "C" directed into the current for a period of ten minutes (Figure 3-4e). Two seine hauls were usually collected at each sample site.

The inner delta platform was sampled with a double-bodied fyke net which consists of two single-body fyke nets attached at the opposite ends of a center lead (Figure 3-4a). Fyke nets were set 5-9 km offshore in water 1-2 m deep and were fished for a period of 4-30 hours. Nets were positioned with the center lead parallel to the direction of the current. Attempts to position the center lead perpendicular to the current direction were unsuccessful because fine organic debris clogged the nets causing it to rip or break loose from the anchor. These nets were deployed from a rubber raft (Zodiac) because water depth over the inner delta platform was too shallow for operation of a larger craft. Consequently, the number of net sets was often limited by poor weather which inhibited operations of the raft.

The mudflats, inactive distributaries, and lake habitats were sampled by a single-body fyke net with either a 60.8 m (used in mudflats) or a 30.4 m (used in other habitats) center lead. The nets were positioned

TABLE 3-5

SPECIFICATIONS FOR FISH SAMPLING GEAR USED FOR THE WINTER 1984 AND SUMMER 1985 SURVEYS OF THE YUKON RIVER DELTA

Gear		Specification
Purse Seine	Overall size:	136.8m long x 7.3 m deep
	Outer lead:	45.6 m long x 7.3 m deep, 31.75 mm (stretch) knotless mesh
	Body:	76 m long x 7.3 m deep, 19.05 mm (stretch) knotless mesh
	Bunt:	15.2 m long x 7.3 m deep, 6.35 mm (stretch) knotless mesh
Beach Seine	Overall size:	22.8 m long x 2.4 m deep at center and tapered to 1.8 m deep at end of wings.
	Bag:	7.7 m long x 2.4 m deep, 6.35 mm (stretch) knotless mesh
	Wings:	2 each, 7.7 m long x 2.4 m deep near center and tapered to 1.8 m deep at end, 12.7 mm (stretch) knotless mesh.
Hook Seine	Overall size:	45.6 m long x 3.0 m deep at center and tapered to 2.4 m deep at end of wings
	Bag:	15.5 m long x 3.0 m deep, 6.35 mm (stretch) knotless mesh
	Wings:	2 each; 15.5 m long x 3.0 m deep near center and tapered to 2.4 m deep at end, 12.7 mm (stretch) knotless mesh.
Double-Body Fyke Net	Each Body:	4.3 m long with 7 square frames, 2-mouth frames 0.9 m x 0.9 m 5 body frames 0.6 m x 0.6 m with 6.35 mm (stretch) knotless mesh, and 2-throats with a 15.2 cm x 25.4 cm opening
	Wings:	Two 4.6 m long x 2.1 m deep with 25.4 mm (stretch) knotless mesh
	Lead:	30.4 m long x 2.1 m deep with 25.4 mm (stretch) knotless mesh

TABLE 3-5 (Continued)

SPECIFICATIONS FOR FISH SAMPLING GEAR USED FOR THE WINTER 1984 AND SUMMER 1985 SURVEYS OF THE YUKON RIVER DELTA

Gear		Specification
Single-body fyke net	Body:	4.3 m long with 7 frames, 2-mouth frame 0.9 x 0.9 m, 5 body frames 0.6 m x 0.6 m with 6.35 mm (stretch) knotless mesh, and 2-throats with a 15.2 cm x 25.4 cm opening
	Wings:	Two 4.6 m long x 1.2 m deep with 25.4 mm stretch mesh
	Lead:	60.8 m long x 1.2 m deep for mudflats, 30.4 m long x 1.2 m deep for lakes, 25.4 mm stretch mesh
Gill net, Summer	Size:	45.6 m long x 1.8 m deep monofilament
	Panels:	5 each, 9.1 m long x 1.8 m deep with variable mesh 25, 50, 75, 100, and 150 mm stretch
Gill net, Winter	Size:	16.0 m long x 2.5 m deep multifilament
	Panels:	4 each, 4 m wide x 2.5 m deep with variable mesh 25, 75, 100, and 150 mm stretch
Gee Minnow Trap, Winter	Size:	44.4 cm long x 22.9 cm diameter with 6.35 mm square wire mesh

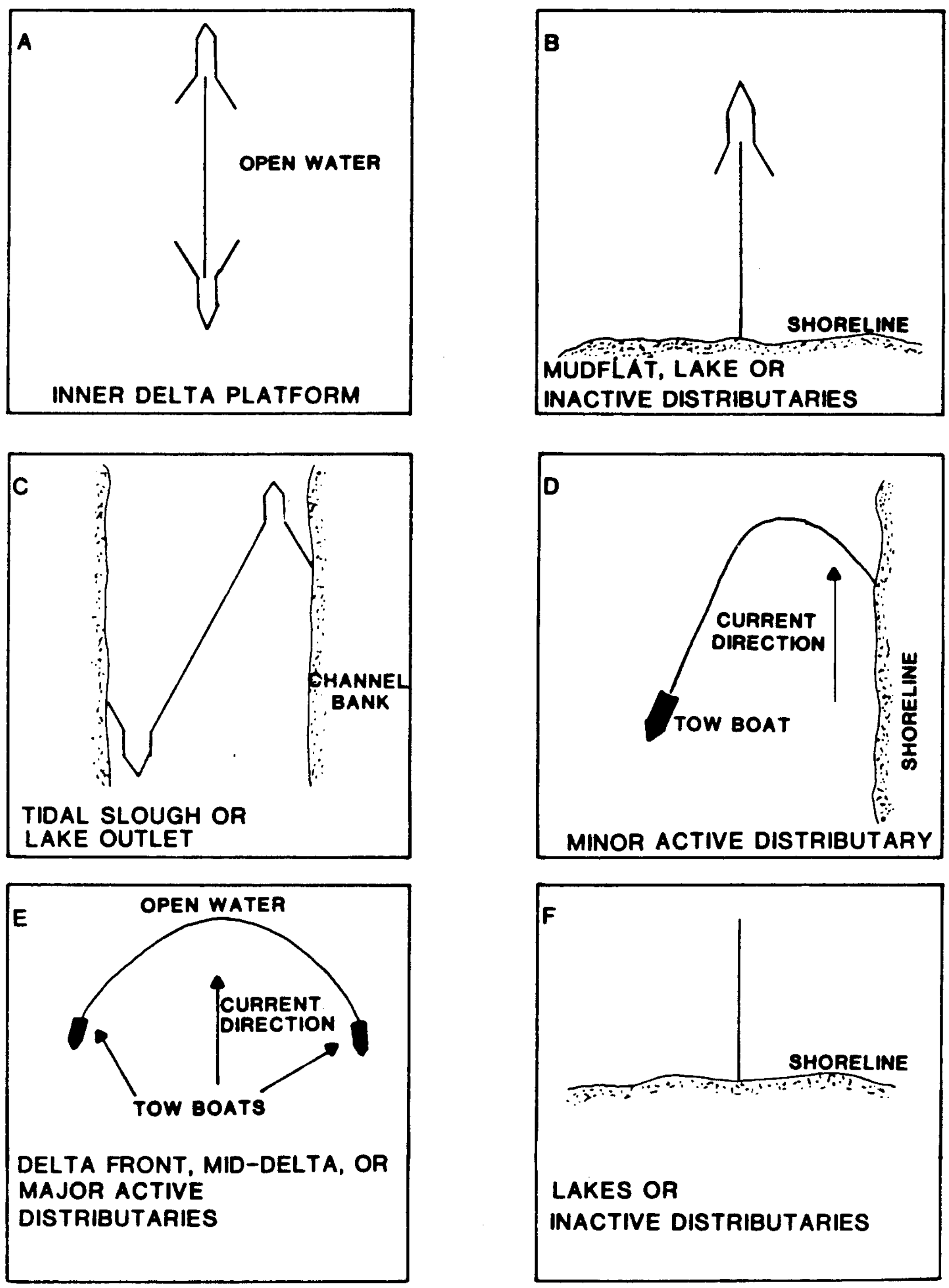

Figure 3-4. Net configurations used to sample the various aquatic habitats in the Yukon River Delta: A) double-body fyke net; B) single-body fyke net; C) tidal net or lake outlet trap; D) hook seine; E) purse seine; and F) gill net.

perpendicular to the shoreline with the center lead attached to shore (Figure 3-4b). Nets were set for periods ranging 17-34 hours and nets located in the mudflats became dewatered for an unknown period during the low tide. Predation was not considered to be a significant problem during the low tide period because of the small mesh size. However, in one case, a gull was found trapped in the net.

Tidal sloughs and lake outlet channels were sampled with two single-body fyke nets that were zipped together in a "Z" shaped configuration (Figure 3-4c). The net extended across the entire channel width, thus enabling the direction of fish movement to be determined from the catch. Nets were fished for periods ranging 18-36 hours in all cases except for one site located in a lake outlet channel. In the latter case, a net was set at station 10-1 (Figure 3-2) and fished continuously from June 30th through August 9th. This net was checked at intervals of 1-4 days depending on the size of the catch.

Tidal sloughs were initially sampled (i.e. prior to July 9th) with a 22.8 m long beach seine (Table 3-5). The seine was pulled for distances ranging 50-100 m and sampled the entire width of the slough. This procedure was replaced, however by the "Z" configuration fyke net because catch data obtained by the latter method were more comparable with catch data from fyke nets which were used for sampling other habitats.

Minor active distributaries were too narrow or too shallow to be sampled with the purse seine. Therefore, these habitats were sampled with a 45.6 m long beach seine that was anchored to the shore and held open against the current in a hook shaped configuration (Figure 3-4d). After a 10 minute set, the net was retrieved on shore with a procedure similar to a beach seine haul.

Inactive distributaries, lakes, lake outlet channels and some tidal sloughs were sampled with a 45.6 m long variable mesh gill net (Table 3-5). Nets were positioned perpendicular to the shoreline (Figure 3-4f) with the smallest mesh panel located near shore. Nets were set for periods ranging 15-33 hours.

3.2.3 Catch Processing, Data Recording and Archival

Fish were processed in one of two ways depending on the number of individuals in the catch. When catches were small (less than 1000) each individual was identified to species and counted. When catches were large (greater than 1000) a random subsample was collected to determine the relative proportion of each species in the catch. The total number of fish in the catch was estimated from measurements of the volume of the total catch and from the volume and number of fish in a subsample. All fish except rare marine species, juvenile whitefish, and juvenile cisco less than 100 mm were identified to species. Rare specimens were classified to family or genera, and juvenile coregonids were listed as unidentified whitefish or unidentified cisco.

Fish lengths were measured from a random subsample (minimum of 40 individuals unless fewer than 40 fish were present in the catch) of each species from each sampling effort.

Samples of at least five specimens of each target fish species were collected from selected sites for stomach and/or otolith analysis. Chum salmon juveniles were preserved in 70 percent ethyl alcohol in order to maintain the integrity of the otoliths. All other fish were preserved in 10 percent buffered formalin. The stomachs of larger specimens (eg. sheefish) were removed from the body cavity and preserved separately while smaller fish were preserved whole.

All field data were recorded on a polycorder. The polycorder is a portable computer with its own operating system and programming language designed specifically for data logging in the field. An electronic data sheet, formatted specifically for this project, was programmed into the polycorder. The data from the polycorder were downloaded daily onto floppy disks. Minor editing (e.g. editing station number, date, time, etc.) was performed on the raw data file immediately after downloading and a backup copy of the edited data file was made and archived. Also, a hard copy of the edited data files was made daily and stored separately from the rest of the data.

3.3 LABORATORY PROCEDURE

3.3.1 Stomach Analysis

Fish stomach contents analyses were performed using a systematic procedure (Terry 1977). This procedure identifies the occurrence, numerical, and gravimetric composition of prey organisms in the stomach contents, the stage of contents' digestion, and the degree of stomach fullness.

For individual stomach specimens, prey items were sorted to the lowest phylogenetic and life history stage possible under an illuminated dissecting microscope. These taxa/life history categories were enumerated and weighed. Stomach fullness was evaluated and coded from 1 (empty) to 7 (distended) and digestion of stomach contents coded similarly from 1 (all unidentifiable) to 6 (no digestion evident). Data were recorded directly onto modified NODC format 100, record type 6 computer forms using the NODC taxonomic and other codes. In the final reporting to NOAA, these data will be reformated to NODC format 123, in accordance with the other project data.

3.3.2 Otolith Analysis

Five juvenile chum salmon from each of six collection sites were measured for fork length and dissected to remove their otoliths (sagittae). Otoliths were cleaned with 95 percent ethanol. One otolith from each fish was prepared for analysis by grinding both sides on 600 grit sandpaper, then polishing with one micron diamond paste. After preparation, otoliths were cleaned ultrasonically in 95 percent ethanol and placed on a microscope slide in immersion oil.

Sagittae were first examined at 100x to determine the possible presence of distinguishable microstructure patterns which may correspond to the migration of these fish from a riverine to an estuarine environment (Volk et al. ms., Neilson et al. 1984). Once the hypothesized transition zone was identified, its size was measured with an ocular micrometer along the same standard radius as that used by Volk et al. (1984). The number of otolith increments was also counted in this zone at a magnification of 500x.

3.4 ANALYTIC PROCEDURES

3.4.1 Water Quality

Pressure measured by each CTD meter is the total hydrostatic pressure of the water column which fluctuates with the tide, storm surge, and river level, plus the atmospheric pressure. Atmospheric pressure obtained from National Weather Service six-hour weather maps was subtracted from the gauge pressure before converting to water elevations. A linear interpolation was used between each six-hour reading.

Using a first order low pass recursive filter with a cut-off frequency of 0.5 cycles/hour, the water level data was processed, decimating the data to hourly intervals. A Doodson filter, a low pass filter designed to pass only tidal frequencies,was then passed over the decimated time series and finally the mean was removed. The resulting time series then contained variations in water level due only to tidal components. These methods were applied only to data from meters set at the mouths of the distributaries since tidal influence, although evident, was minimal in the inner delta.

Seven tidal constituents (O1, K1, N2, M2, S2, M4, M6) were fitted to the tidal height time series using a least squares harmonic analysis program developed by NOS/NOAA with further developments added by U.S.G.S., Menlo Park, California.

The surge time series was obtained by taking the water level time series (data after initial decimation of the time series) and subtracting the tidal height time series. The surge is then the change in water level due to storm surge and river flow relative to the pressure transducer for that time series. Time series plots of temperature, water level, tide elevation and storm surge are presented for each meter (except for the meter deployed at the Naringolapak station near the Head of the Passes where only temperature and water level were plotted).

Discrete measurements were corrected by appropriate sensor calibration factors and then tabulated by station.

3.4.2 Species Characterization

Anadromous, marine, and freshwater fish species important to the commercial and subsistence fisheries were characterized in terms of their size composition, relative abundance, run timing, and spatial distributions. Size composition was determined from length frequency analysis. Fish were sorted by 10mm size groups and length frequency distributions were computed for each habitat and for each semi-monthly time interval. Relative abundance was expressed as catch per unit effort (CPUE) for each sample gear. The unit of effort was variable and depended upon gear. Catch in all fyke net configurations and gill nets were standardized to a 24 hour period; catch in the purse seine and hook seine were standardized to a 10 minute haul; and, catch in the beach seine was standardized to a 50m haul. All replicate samples taken at a site on the same date were combined and expressed as one CPUE. Run timing was identified with histogram plots of CPUE versus time. Graphs for each species and station were compared in order to identify differences and similarities in the temporal utilization of habitat. Temporal and spatial distribution were determined from the histogram plots, and from tables of species occurrence by semi-monthly time interval and habitat category.

3.4.3 Chum Residence Time

Residence time for juvenile chum salmon was determined from an analysis of the number of daily growth increments occurring in the otolith edge zone. The otolith edge zone is defined as the outer zone of an otolith where increment width is markedly greater than the increment widths of the interior growth increments. The point of transition from narrow increment widths to wide increment widths was assumed to mark the point of transition from freshwater growth to estuarine growth. This assumption was based on a previous study that showed the growth of juvenile chinook salmon increased greatly upon entry into the estuary and this growth was reflected in greater otolith increment widths (Neilsen et al. 1984). The number of increments in the edge zone reflect the recent growth history and provide a measure of residence time in the delta estuarine environment. Residence time estimates for each habitat are based on the average number of growth increments in the edge zone. Residence time within the delta was also identified from an otolith increment frequency histogram.

3.4.4 Fish Stomach Contents Data

Tabulation and basic statistical description of the stomach analysis data were performed using an FRI computer program package, GUTBUGS/IRI (Swanson and Simenstad, 1984) developed specifically for the NODC-type stomach analysis data format. This program package tabulates the sources (identification numbers, sample numbers, location numbers), numbers of specimens from each sample, and the time of collection. All stomach samples are itemized according to life history stage. Empty stomachs are listed, the percentages of empty stomachs are calculated and the adjusted sample size (stomachs containing prey) determined. Only stomachs containing prey are utilized in the subsequent tabulation and statistical description. The mean, range, and standard deviation of the fullness and digestion indices, total contents weight, total contents abundance, fish length and weight, and percent ratio of contents weight to fish weight ("instantaneous ration") are tabulated. For each prey taxon and life history stage identified from the combined stomach sample, the following statistics are given: frequency of occurrence, mean, range, and standard deviation of the prey abundance and biomass, the mean and standard deviation of the average individual prey biomass, and the percentage composition by abundance (numerical composition), total biomass (gravimetric composition), and standardized biomass (biomass less the unidentified material). The total number of prey categories and common diversity indices (Shannon-Weaver, Brillouin) were also computed to summarize the taxonomic, numerical, and gravimetric diversity of the stomach contents sample.

GUTBUGS/IRI is designed to be operated at any one of four common truncation levels (species, genus, family, class) of the NODC taxonomic code, facilitating comparisons between stomach contents samples with differing stages of contents digestion. The IRI version of GUTBUGS utilizes a modification of Pinkas et al. (1971) Index of Relative Importance (IRI) to rank the importance of prey taxa to a selected sample or group of samples of fish stomach contents data (Cailliet 1977). Utilizing the GUTBUGS data summary, the IRI values for prey taxa categories (which can be set at one of the three code truncation levels) are computed and displayed both graphically and in tabular form.

Comparisons of diet composition were based upon a standardized measure of prey taxa importance, percent SIRI, which is the percentage which a discrete prey taxa constitutes of the sum of all IRI values in the prey spectrum. The degree of overlap in fish diet composition was quantitatively evaluated using the PSI overlap index, which is calculated by summing the lowest percent SIRI of each taxa pair between two diet spectra (Cailliet and Barry 1979).

3.4.5 Relationships Between Catch and Physical Parameters

Relationships between fish catch and habitat were identified through an association of species occurrence at each station with the environmental characteristics observed at each station and habitat. Correlations are assumed from qualitative associations rather than from quantitative associations (e.g. regression) because standardization of fishing gear was not possible, resulting in non-comparable catches between gear types.

3.4.6 Potential Impacts of Oil and Gas Development

An assessment of the potential impact of oil pollution on fish and fish habitats of the Yukon River Delta was based on indices of habitat importance and sensitivity of fish to petroleum oil contamination. These indices were developed from the study results and from literature information concerning oil impacts. Consideration was given to the time spent in a habitat by a particular species, the relative abundance of that species, the contribution made to the local community by that species, and the relative sensitivity of a species to petroleum hydrocarbons or its weathered derivatives. A matrix of index values for each of these factors was developed and then combined to form an index of relative impact for each habitat. This index provides a relative measure of the magnitude of potential impact on the fish community if a specific habitat is contaminated by oil. This analysis is based on the assumption that all habitats in the Yukon Delta could be contaminated by oil and does not evaluate the likelihood that such an accident would occur. An assessment of the latter would require information on tidal dynamics, currents and storm surge which is not available at this time.

The magnitude of potential impacts to the fish community was expressed on a scale ranging from 0 to 10. A high value implies that a large number of important fish species would be vulnerable to oil pollution impacts if a spill occurred in a specific habitat during a specific time period. On the other hand, a low value indicates that either a small number of fish and/or fish species of little importance would be vulnerable to impact in a specific habitat during a specific time period. This impact index varies from that used by the Mineral Management Service (Truett and Craig 1985) in that it indicates the relative size and importance of the population that may be vulnerable to an impact rather than indicating the relative size of the population impacted if an oil spill occurs.

Species considered in index calculations included chinook, pink, and chum salmon, sheefish, whitefish, cisco, northern pike, burbot, saffron cod, herring, blackfish, smelt, and starry flounder. These species represented 91 percent of the total catch and all are species of importance to the commercial and subsistence fisheries. Other species occurred infrequently and were not considered to contribute significantly to habitat rankings.

3.4.6.1 Index of Duration of Occurrence and Abundance

Index values for duration of occurrence and abundance for each species and habitat combination were developed by month and for the whole sampling season using weekly and monthly catch per unit effort values. Index values were not determined for major and minor inactive distributaries, connected lakes, and inter-island channels because these habitats were not sampled on a frequent enough basis to determine seasonal trends in distribution and abundance.

The relative abundance of a species was assigned to three levels of abundance (1 to 3) which represent low, moderate, and high abundance. The assignment of relative abundance values was done on a gear by gear basis (Table 3-6). Abundance levels assigned to catch in the purse seine were partitioned into two groups because of differences in catch efficiency between habitats. There was an insufficient degree of overlap of gear types within each habitat to permit the standardization of units of effort. As a result, it was necessary to assume that the ranges of abundance levels assigned to each gear type represented similar concentrations of fish.

Levels of abundance for each species were assigned on a weekly basis for each habitat. In cases where no sample was taken in a particular habitat during a one week interval, relative abundance was estimated by

TABLE 3-6

RANGES OF MONTHLY CATCH PER UNIT EFFORT ASSIGNED TO ABUNDANCE LEVELS BY GEAR TYPE

Gear Type	Abundance Level 1 (Low)	2 (Moderate)	3 (High)
Purse Seine			
Delta Platform	< 25	25-49	≥ 50
Major Active Distributary	< 10	10-24	≥ 25
Double Fyke	< 25	25-49	≥ 50
Single Fyke	< 50	50-99	≥ 100
Beach Seine	< 25	25-49	≥ 50
Gill Net	< 10	10-24	≥ 25
Lake Outlet Trap	< 10	10-19	≥ 20
Tidal Net	< 50	50-99	≥ 100
Hook Net	< 25	25-49	≥ 50

iteration between two dates when samples were taken assuming any change in population level was constant between samples. Duration of occurrence was calculated as the proportion of a monthly time period during which a species occurred in a given habitat.

When samples were not taken in a habitat during a one week interval, duration of occurrence was estimated by observing the existence or absence of a species in the catch. If a species occurred or was missing in the periods before and after a period in question, the species was considered to occur or to be missing continuously. Where presence of a species changed between periods, the period at which the species first or last occurred in a habitat was determined to be the midpoint between sampled periods.

Cisco and whitefish were assumed to occur continuously in river channels. This assumption was based on knowledge of the distribution and life history of these species and was partially confirmed by the observed distribution of these species in both the summer and winter studies. In sampling periods where no catches of these species were observed in the river habitats, the abundance of these species was assumed to be low and was assigned the lowest value of relative abundance.

The landlocked lakes were only sampled in August. Blackfish were the only species found in these lakes; thus their existence and abundance were assumed to be constant within this habitat type given the impossibility of migration into or out of these lakes during the summer.

The inner delta platform was not sampled during July; therefore assumptions were made about species presence and abundance during this period. Species distribution on the inner delta platform generally was similar to that on the mid-delta platform. The same species which occurred on the mid-delta platform were assumed to occur on the inner delta platform. These included chinook salmon, chum salmon, pink salmon, sheefish, ciscoes, whitefish, and cod. Each of these species was found in low abundance on the mid-delta platform; therefore, low abundance was assumed to occur on the inner delta platform.

Additional assumptions concerning the distribution and abundance of fish were as follows. In the month of September, cod were observed in catches everywhere from the delta front to the mudflats and into tidal sloughs except along the mid-delta platform. This seemed improbable, and cod were therefore assumed to occur on the mid-delta platform in low abundances. Additionally, it was apparent that small numbers of chum were continuing to migrate down the river through the end of the sampling season. During the late periods of the season, no chum were observed on the delta platform. Earlier in the season, when chum abundances were considerably larger, chum were found on the delta platform and appeared to migrate through this habitat. It was assumed that the small numbers of chum migrating late in the season continue to use the platform as a migration route, and low abundance levels were assigned to those habitats despite the lack of chum in catches.

3.4.6.2 Index of Contribution to the Local Community

An index of importance of each species to the local community was developed using historical records of commercial and subsistence catch. To determine relative contribution of each species to the total fish harvest by the community, a ten year average catch (1974-1983) of saltwater and anadromous species and 5-year average catch (1979-1983) of freshwater species taken in the lower Yukon area, District 1, as reported by the Alaska Department of Fish and Game (ADF&G, 1983b) were used. Values for the subsistence catch of blackfish, burbot, northern pike, and saffron cod were estimated using relative contribution rates calculated from household harvests reported by R.J. Wolfe (1981). Catches of smelt and starry flounder were not reported and contribution rates for these species were set to 0, although low levels of subsistence catch are known to be taken. The total average catch (commercial plus subsistence) was calculated and the abundance of each species in the catch was determined relative to the catch of chum salmon which had the highest harvest of all species.

3.4.6.3 Index of Sensitivity to Oil

An index of sensitivity of exposure to petroleum hydrocarbons or its weathered derivatives was developed by relating literature on oil impacts on Arctic fish to important species in the Yukon delta. Information regarding the species inhabiting the waters of the Yukon delta was found to be limited. Nevertheless, information for similar species was used and the probable impact of exposure to oil was evaluated for each of the major fish species. The relative level of sensitivity for each species was based on the assumption that all habitats had come into contact with substantial quantities of crude oil in a catastrophic event. No consideration was given to the probability that this event might occur, or to the relative probability of exposure of a given habitat in the event of a spill. Potential sensitivity levels were ranked as negligible, low, medium, or high, and were assigned a corresponding numerical ranking from 1 to 4.

3.4.6.4 Index of Relative Impact

An index of relative impact was developed for each habitat for each month and for the entire season using the indices of abundance, duration of occurrence, contribution to the local community, and sensitivity to spilled oil. The values for abundance and duration of occurrence were multiplied together resulting in a measure of habitat use for each species by month and habitat. A matrix of community importance of the habitats with respect to the local commercial and subsistence fisheries was created by multiplying the value in the habitat use matrix just described with the previously determined community importance values. This matrix represents the relative values of each habitat to the community fisheries.

An index of relative impact was created by weighting the matrix just described by the sensitivity values assigned to each species, by summing the values across month and species, and by scaling the resulting values from 0 to 10. The equation is:

$$I_i = \frac{\sum_{jk} A_{ijk} * O_{ijk} * S_j * (C_j)}{\max_i \sum_k [A_{ijk} * O_{ijk} * S_j * (C_j)]} * 10$$

Where, I_i = Impact index value of habitat i

A_{ijk} = Abundance rating of species j in habitat i during month k

O_{ijk} = Duration of occurrence value of species j in habitat i during month k

C_j = Community importance factor of species j

S_j = Sensitivity to oil ranking of species j

A second index of relative impact was created without regard to importance of species to the local community fisheries using the same methods but excluding C_j, the community importance factor.

4.0 RESULTS

4.1 HABITAT CHARACTERIZATION

As explained above in the overall study strategy, prior to initiation of the field program, the study area was stratified into thirteen potentially separate habitat types. This initial partitioning of the study area was based primarily on differences in elevation and location relative to the coast. These factors were expected to have the greatest influence on the extent of saltwater mixing, river flooding, water clarity, degree of tidal influence, and water velocities.

4.1.1 Winter Studies - Discrete Physical Measurements

Water quality measurements were conducted during December 6 through December 13, 1984 in conjuction with fish sampling efforts. Six sites (Figure 3-1) located along the coast between the South Mouth and North Mouth, and four inland sites were occupied during this survey. Transportation to and from St. Mary's,the base of operations, was accomplished with a NOAA supplied and operated helicopter. Navigation and relocation of survey sites was achieved with the GPS navigation system on board the helicopter.

The survey sites were selected to sample a variety of different habitat types. These included freshwater and brackish water habitats, major distributaries, and sloughs. Water quality data collected at each survey site included the following: temperature, conductivity, salinity, dissolved oxygen, and water clarity. The results of the discrete winter measurements are summarized in Table 4-1.

TABLE 4-1

WATER DEPTH, TEMPERATURE, CONDUCTIVITY, SALINITY, DISSOLVED OXYGEN, AND WATER CLARITY DURING WINTER 1984 IN THE YUKON RIVER DELTA

Habitat Type	Location	Date	Time	Depth (m)	Temperature (°C)	Conductivity (mmhos/cm)	Salinity (o/oo)	D.O. (pm)	Clarity (visual)
Major Active	Nunaktuk Island,	12-07-84	13:45	0	0	2.2	0.7	--	--
Distributary	Middle Mouth			1	0	2.2	0.7	--	--
				2	-0.3	13.0	13.5	--	--
				3	-0.3	13.8	14.4	--	--
Minor Active	Bugomowik Slough	12-08-84	13:00	0	-1.5	14.1	15.0	12.0	Slightly Turbid
Distributary				1	-1.5	15.5	16.7	12.2	--
				2	-1.5	15.3	16.7	12.2	--
Major Active	Caseys Channel	12-09-84	11:45	0	0	0.1	0	13.2	Clear
Distributary	East Side			1	0	0.1	0	13.2	--
				2	0	0.1	0	13.5	--
				3	0	0.1	0	13.6	--
				4	0	0.1	0	13.8	--
Minor Active	Elongozhik	12-09-84	15:00	0	-1.0	12.6	13.8	12.8	Slightly Turbid
Distributary	Slough			1	-1.0	13.1	14.3	12.8	--
				2	-1.5	16.9	19.3	13.5	--
Minor Active	Okshokwewhik	12-10-84	14:30	0	0	0.2	0	--	Clear
Distributary	Slough			1	0	0.2	0	--	--
				2	0	0.2	0	--	--
				3	0	0.2	0	--	--
				4	0	0.2	0	--	--
Major Active	Okwega Pass	12-11-84	12:45	0	0	0.1	0	13.3	Clear
Distributary				1	0	0.1	0	13.7	--
				2	0	0.2	0	13.8	--
Major Active	Kwikpuk,	12-13-84	14:15	0	0	0.1	0	--	Clear
Distributary	Kwikpuk Pass			1	0	0.1	0	--	--
				2	0	0.1	0	--	--
				3	0	0.1	0	--	--
Major Active	Akulurak Pass,	12-11-84	16:15	0	0	0	0	10.5	Clear
Distributary	east of			1	0	0.1	0	12.0	--
	Sunshine Bay			2	0	0.1	0	12.0	--
Major Inactive	Kwemeluk-Kanelik	12-12-84	15:10	0	0	0.4	0	14.0	Clear
Distributary	Jct			1	0	0.6	0	12.8	--
				2	0	0.6	0	12.3	--
Minor Active	Black River	12-12-84	13:55	0	0	0.5	0	14.0	Clear
Distributary				1	0	0.8	0	13.4	--
				2	0	7.7	12.5	13.2	--
				3	0	8.7	14.1	14.2	--

4.1.2 Summer Studies - Discrete Physical Measurements

A summary of summer water quality conditions within each habitat is presented in Table 4-2. Water quality conditions (temperature, salinity, conductivity, and Secchi depth) are further delineated by sampling date and habitat in Tables 1 and 2 in Appendix A. Routine measurements of temperature and salinity were the primary physical measurements used to describe conditions in each habitat. Electrical conductivity measurements were utilized when describing habitats which were primarily freshwater in character.

4.1.3 Summer Studies - Continuous Recorders

Continuous recording instrumentation was deployed at five locations in the study area (see Figure 3-3). Instrumentation consisted of three Aanderaa RCM-4's and two SeaData CTDR-2A's which were bottom mounted. These recording gauges measured pressure, temperature, and conductivity. Sampling locations included sites at the mouths of the three major distributaries and at two inland locations. One of the inland sites near Emmonak was lost as a result of slumping of the river bank. All other stations were recovered in good condition. Instrumentation was deployed in mid-June and retrieved in mid to late September.

The highest salinity that was recorded at any of these sites was 0.2 ppt; therefore no plots were produced for this parameter. This salinity maximum occurred on 1-2 September 1985 during a positive storm surge event which was recorded at all of the recording meters.

Temperatures at all of the meters were very highly correlated throughout the whole sampling period as seen in Figure 4-1. Maximum difference in temperatures between all meters was less than 1°C for the same sampling time. At the time of deployment of the first meter on 11 June 1985 water temperature in the river was 10.0°C. Temperatures steadily increased through June and July reaching a maximum of over

TABLE 4-2

SUMMARY OF WATER QUALITY CONDITIONS WITHIN HABITATS DURING SUMMER 1985 IN THE YUKON RIVER DELTA

Water Quality Paramter	Habitat													
	Delta Front	Mid-Delta Plat-form	Inner Delta Plat-form	Mud-flats	Tidal Slough	Inter-Island Channel	Major Act. Distrib-utary	Minor Act. Distrib-utary	Major Inact. Distrib-utary	Minor Inact. Distrib-utary	Con-nected Lake	Lake Outlet Channel	Land-locked Lake	Overall
Water Depth (m)														
mean	7	8	2	1	1	9	3	2	1	1	1	1	1	
range	6-9	4-10	2-3	0-1	0-2	5-15	1-6	2	1	1-2	1	1	1	
Conductivity (mmhos/cm)														
Surface														
mean	10.4	0.6	0.8	1.6	1.8	0.7	0.1	0.1	0.2	0.2	0.1	0.1	0.1	1.0
range	1.0-23.9	0.1-1.5	0.0-3.5	0.2-6.1	0.1-3.7	0.0-7.9	0.0-0.3	0.1	0.1-0.4	0.0-0.3	0.1	0.0-0.1	0.0-0.1	0.0-23.9
Bottom														
mean	20.0	0.9	0.5			0.4	0.2	0.1						2.3
range	1.0-29.5	0.0-3.4	0.1-1.9			0.0-1.3	0.0-0.3	0.1						0.0-29.5
Temperature (°C)														
Surface														
mean	12.4	14.8	14.6	11.7	10.5	14.6	15.8	13.5	12.5	14.1	13.7	12.0	10.5	13.5
range	9.0-15.0	10.0-19.0	12.0-18.0	5.0-21.0	6.0-18.0	9.0-19.0	8.0-20.0	12.0-15.0	9.0-16.0	10.0-19.0	13.0-15.0	12.0	10.0-11.0	5.0-21.0
Bottom														
mean	10.6	14.7	12.8			14.7	16.0	11						14.7
range	4.0-15.0	9.0-19.0	12.0-13.0			9.0-19.0	11.0-20.0	11						4.0-20.0
Salinity (ppt)														
Surface														
mean	6.5	0.3	0.4	0.9	1.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0		0.5
range	0.5-15.8	0.0-0.8	0.0-2.0	0.0-3.6	0.0-2.1	0.0-0.6	0.0-0.1	0.0	0.0-0.2	0.0-0.1	0.0	0.0	0.0	0.0-15.8
Bottom														
mean	13.2	0.4	0.2			0.1	0.0	0.0						1.4
range	0.5-19.9	0.0-1.9	0.0-1.0			0.0-0.7	0.0-0.1	0.0						0.0-19.4
Secchi (depth cm)														
mean	70.0	14	13	15	27	16	17	75	82	120	27	10	125	47
range	20-120	10-20	10-20	10-30	10-60	10-20	10-20	60-90	40-120	50-220	20-30	10	120-130	10-220

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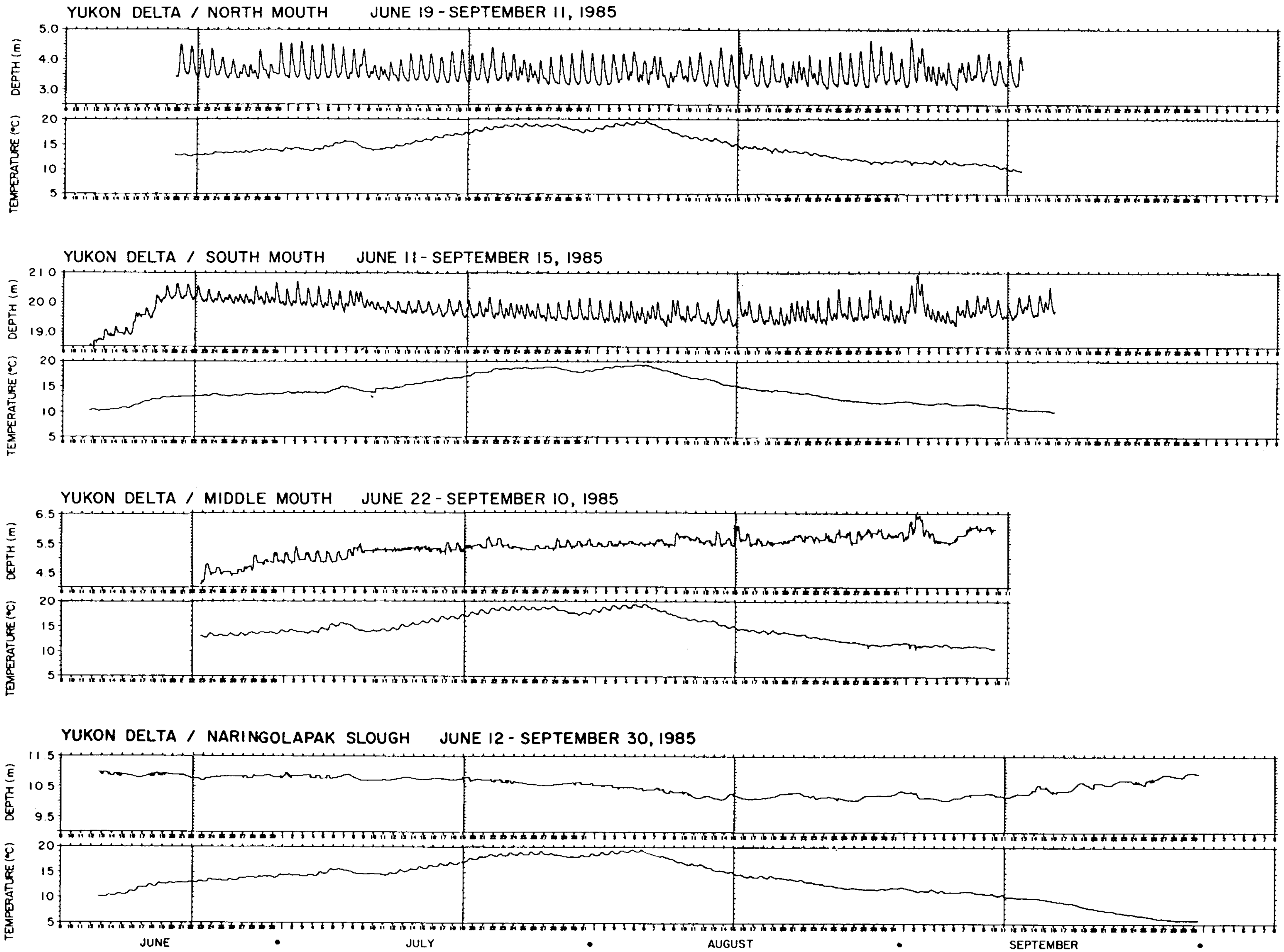

Figure 4-1. Temperature and Total Water Depth Time Series Plots for the Yukon River Delta.

19°C at all meters on 5 August. Water temperature then began to decline quickly, dropping to 14.0°C on 16 August. Temperatures continued to decline at all meters through August and September reaching a minimum of 5.7°C at Naringolapak Slough on 30 September, which was the location of the last instrument to be retrieved.

Diurnal water temperature fluctuations occurred at all four meters to different degrees as a result of warm air temperatures and high insolation during the morning and afternoon hours. The depth of each meter seemed to be the governing factor of whether the instrument measured large diurnal fluctuations in water temperature. The instrument which was deployed in 20 meters of water at South Mouth showed the least amount of fluctuation with less than a 0.2°C daily temperature oscillation. Similarly the meter which was deployed at Naringolapak Slough near the Head of the Passes in 11 meters of water, showed smaller diurnal temperature fluctuations than the instruments at either the Middle or North Mouth sites which were deployed in approximately 5 meters of water. Maximum daily fluctuations at these two locations were 1.5°C. Diurnal fluctuations were greatest in June and July during periods of increasing water temperature, declining in August along with the fall in water temperature.

Total water depth is also depicted in Figure 4-1 along with water temperature. The total water depth was then decomposed into tide and surge level series for the meters located near the coast according to procedures outlined in the Methods and Materials section of this report. The inland meter at Naringolapak Slough did not measure any tidal oscillations in the water level as it was located 50 km from the coast, which was too far upstream to be influenced by tidal forcing. The only surge level event at this inland site which correlates with the coastal instrumentation is that which occurred on September 1 and 2. Water level increased 0.2 m for a period of 48 hours then returned to the previous level following the surge event. Winds during this period ranged from 10 to 23 knots from the southwest at Emmonak. Surface weather observations at Emmonak were only taken for a 12 hour period each day which made cross-correlations with physical oceanographic parameters impossible.

Water level at the Naringolapak Slough site stayed fairly steady through June and most of July. The water level began to decline in late July with a few short term reversals which can probably be related to increased river discharge due to rain. In early September the water level began to increase, rising 0.9 m by the end of the month. This increase in discharge during September can probably be attributed to the higher rainfall during the fall in the Alaskan interior.

Surge level data from the three coastal locations at the mouths of the main distributaries are depicted in Figure 4-2 along with the tidal time series. Surge levels at the South Mouth and the North Mouth were found to correlate quite well, while the measured surge at the Middle Mouth had a lower correlation with the other two. The Middle Mouth meter shows a steady increase in water level through the whole period of record which was believed to be caused by the meter sliding down the steep bank along which it was moored. Also, most of the water level fluctuations at the Middle Mouth are much smaller than those measured at the other sites. The South Mouth meter also shows a vertical displacement during the first week of measurement resulting from the mooring sliding deeper into the river channel. The mooring seems to have stabilized after that point since no other anomalous vertical changes were seen in the record. Since high quality meteorological time series data were not available for cross-correlation purposes, surge levels could not be analyzed to determine wind speed and direction influences.

Tide levels depicted in Figure 4-2 indicate large differences in both range and type of tide between stations. The tides at the North Mouth were found to be almost entirely diurnal with the semidiurnal component

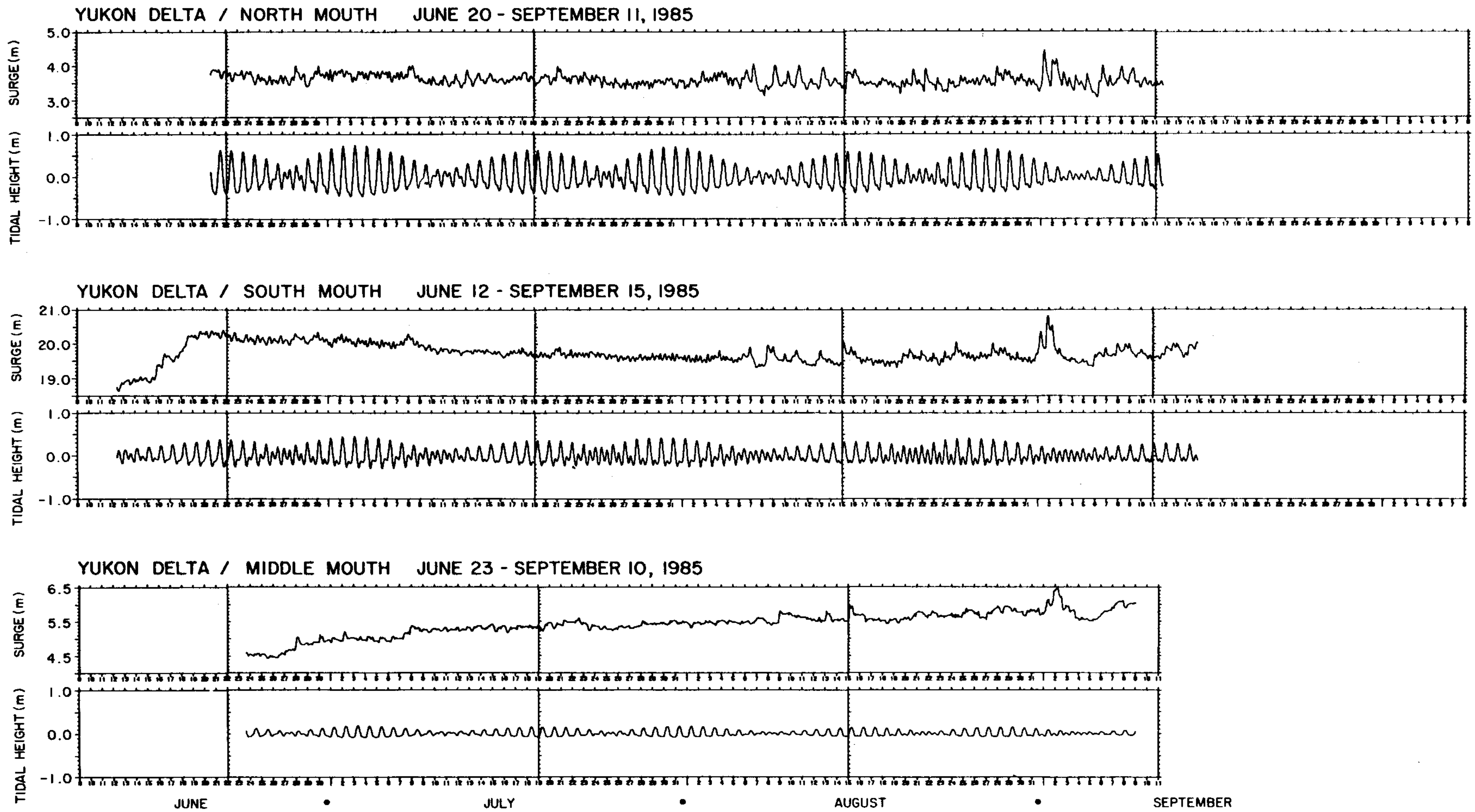

Figure 4-2. Surge Level and Tidal Level Time Series Plots for the Yukon River Delta.

being very small. Maximum range of the tide during the period of record was 1.2 m at the North Mouth. Large differences between the ranges of spring and neap tide can be seen with a mean neap tide range of only 0.3 to 0.4 m. Tides at the Middle Mouth were much smaller in amplitude with a maximum range of 0.25 m. The tides at the Middle were also mainly diurnal but becoming more mixed. The tidal record from the South Mouth pressure gauge show mixed tides with a large diurnal inequality. Maximum range was 0.75 m at the South Mouth. These results agree with the Tide Tables for the region (NOAA/NOS 1984) which show a diurnal range of 4.0 ft for Apoon Mouth (North Mouth), 2.7 ft for Kawanak Pass (Middle Mouth), and 2.3 ft for Kwikluak Pass (South Mouth). The tide tables also indicate a change from mixed tides in the southern delta region to diurnal tides in the northern portion bordering Norton Sound which is also diurnal.

Principal tidal constituents for the three stations are shown in Table 4-3. The diurnal components can be seen to be much more important at the North Mouth where the amplitudes of the principal solar (O1) and lunar (K1) diurnal constituents are both larger than the principal lunar (M2) semidiurnal constituent. At the South Mouth the M2 constituent has the largest amplitude.

4.2 CATCH SUMMARY - WINTER SURVEY

4.2.1 Distribution and Abundance

The winter survey resulted in the capture of 85 fish comprising 9 species (Table 4-4). Anadromous species (i.e., sheefish, whitefish, cisco, and smelt) accounted for 86 percent of the total catch of which sheefish and boreal smelt were the most abundant. Freshwater fish (i.e., northern pike and burbot) and one marine species (fourhorn sculpin) accounted for 13 percent and 1 percent of the catch, respectively.

TABLE 4-3

PRINCIPAL TIDAL CONSTITUENTS, YUKON RIVER DELTA

Station	Constituent	Frequency Cycles/Day	Amplitude Meters	Phase, * Degrees
North Mouth	O1	0.92954	0.20577	159.41
	K1	1.00274	0.30478	-20.25
	N2	1.89598	0.04030	-59.76
	M2	1.93227	0.13916	133.15
	S2	2.00000	0.01268	-176.78
	M4	3.86455	0.01431	-174.97
	M6	5.79682	0.00008	-10.44
Middle Mouth	O1	0.92954	0.04665	147.50
	K1	1.00274	0.06614	-34.67
	N2	1.89598	0.00838	-105.80
	M2	1.93227	0.03477	113.02
	S2	2.00000	0.00561	-105.77
	M4	3.86455	0.00739	70.56
	M6	5.79682	0.00094	13.44
South Mouth	O1	0.92954	0.10133	121.71
	K1	1.00274	0.14973	-71.79
	N2	1.89598	0.03954	-145.09
	M2	1.93227	0.13169	70.26
	S2	2.00000	0.01142	-12.84
	M4	3.86455	0.02060	64.61
	M6	5.79682	0.00285	43.00

* Note: Phase in degrees referenced to time = 000 Jan. 1, 1985, ADST.

TABLE 4-4

SUMMARY OF GILL NET CATCH DURING DECEMBER 1984

IN THE YUKON RIVER DELTA

Habitat	Station	Effort (Hrs)	Species[a/]									
			SHE	HBW	BRW	BRC	LSC	BSM	PIK	BUR	FHS	Total
Minor Active Distributory	Caseys Channel	23.25	1	--	--	--	--	--	--	--	--	1
Minor Active Distributory	Bugomowik Slough	24.00	--	--	--	--	--	--	--	--	--	0
Major Active Distributory	Nunaktuk Island	24.00	11	--	--	5	--	--	--	--	--	16
Minor Active Distributory	Elongozhik Slough	22.00	--	--	--	--	--	9	--	--	1	10
Minor Active Distributory	Okshokwewhik Pass	22.83	1	3	--	--	--	--	--	1	--	5
Major Active Distributory	Okwega Pass	22.42	1	2	1	--	--	--	--	3	--	7
Major Active Distributory	Kwikpuk, Kwikpuk Pass	25.92	--	1	--	--	--	--	1	2	--	4
Major Active Distributory	Near Akularak Pass	20.58	--	--	--	--	4	--	--	2	--	6
Major Inactive Distributory	Kuemeluk-Kanelik Jct.	20.83	4	--	1	1	--	---	--	--	--	6
Minor Active Distributory	Black River	21.42	9	--	--	2	1	16	1	1	--	30
			27	6	2	8	5	25	2	9	1	85

a/ SHE - Sheefish
HBW - Humpback whitefish
BRW - Broad whitefish
BRC - Bering cisco
LSC - Least cisco
BSM - Boreal smelt
PIK - Northern pike
BUR - Burbot
FHS - Fourhorn sculpin

Sheefish, Bering cisco, least cisco, northern pike and burbot were caught at sites with either brackish or freshwater (Table 4-1 and Table 4-4). Boreal smelt and fourhorn sculpin were only caught at sites with brackish water, and whitefish (i.e., humpback and broad) were only caught at sites with freshwater. Sheefish were the most widely distributed of all species. The greatest diversity of species was found at the Black River site which had stratified salinity levels. Differences in abundance among species and stations were not identified because the number of samples was too small for a meaningful analysis.

4.2.2 Size Composition

The number of fish caught during the winter survey was not sufficient for a meaningful length-frequency analysis. However, a summary of fish lengths for each species is listed in Table 4-5 . Most of the fish caught were large individuals which indicates that adult populations utilize both coastal and inner delta habitats during the early winter. Smaller individuals of all species except least cisco and boreal smelt were absent in the catch. Small fish may utilize this habitat, but were not caught because of size selectivity of the gear.

4.3 CATCH SUMMARY - SUMMER SURVEY

4.3.1 Effort

Sampling effort was partitioned among four synoptic surveys of the entire delta region and a series of repetitive surveys at several selected study sites (Table 4-6). The first synpotic survey extended from June 14 through July 3, and included 31 sample sites. This survey provided an initial understanding of the diversity of aquatic habitats in the Yukon Delta and resulted in the improvement of sample

TABLE 4-5

MEAN, STANDARD DEVIATION, AND RANGE OF FISH LENGTHS FOR FISH CAUGHT IN GILL NETS DURING DECEMBER 1984 IN THE YUKON RIVER DELTA

Species	Number	Fork Length (mm)		
		Mean	S.D.	Range
Sheefish	27	575.9	137.1	306-790
Humpback whitefish	6	326.8	29.9	279-367
Broad whitefish	2	303.5	0.7	303-304
Bering cisco	8	347.2	31.9	279-378
Least cisco	5	155.0	80.3	108-296
Boreal smelt	25	154.2	18.4	133-204
Northern pike	2	502.5	130.8	410-595
Burbot	9	501.3	129.7	390-774
Fourhorn sculpin	1	165.0	--	--

TABLE 4-6

SUMMARY OF SAMPLING EFFORT BY FISHING GEAR[a], STATION, AND BY DATE DURING THE SUMMER 1985 SURVEY OF THE YUKON RIVER DELTA

Station (Stations 1–5)

Date	1	1	1	2	2	2	3	3	3	3	3	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	1	2	3	1	2	3	1	2	3	5	6	1	2	4	5	6	1	2	3	4	5	6	7	8	9	10	11	12	13	14
6/14																	T,L	G												
6/15																														L
6/16				P															G											
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7/31																														

Station (Stations 6–13)

Date	6	6	6	7	7	7	7	7	7	7	7	7	7	8	8	9	9	10	10	10	11	11	12	13
	1	2	3	1	2	3	4	5	6	7	8	9	10	1	2	1	2	1	2	3	1	2	1	1
6/14	P								1															
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6/18*																								
6/19		P												G,1						G,1				
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TABLE 4-6 (Continued)

SUMMARY OF SAMPLING EFFORT BY FISHING GEAR[a], STATION, AND DATE DURING THE SUMMER 1985 SURVEY OF THE YUKON RIVER DELTA

Station

Date	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3	3-5	3-6	4-1	4-2	4-4	4-5	4-6
8/1																
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8/5												1				
8/6																
8/7																1
8/8																1
8/9*																
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8/11					P											
8/12																
8/13	P															
8/14									2							
8/15																
8/16			P	P												
8/17*																
8/18																
8/19										2						
8/20														1		
8/21														1		
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8/26																
8/27														1		
8/28														1		
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8/31*																
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9/4			P	P												
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9/15*																
9/16												1				
9/17															1	
9/18																

Date	5-1	5-2	5-3	5-4	5-5	5-6	5-7	5-8	5-9	5-10	5-11	5-12	5-13	5-14	6-1	6-2	6-3
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9/17											T						
9/18																	

Date	7-1	7-2	7-3	7-4	7-5	7-6	7-7	7-8	7-9	7-10	8-1	8-2	9-1	9-2	10-1	10-2	10-3	11-1	11-2	12-1	13-1
8/1								H							0						
8/2			H							H											
8/3		H																			
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8/6									H												
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8/9*																					
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8/21																					
8/22								H							0						
8/23													1								
8/24													G,1								
8/25														1	0	0					
8/26															0	0				G,1	
8/27																					
8/28																					1
8/29															0						
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9/13		H																			
9/14*																					
9/15*																					
9/16																					
9/17																					
9/18								H													

a/ Gear Codes: 1 = single-body fyke net; 2 = double body fyke net; G = gill net; H = hook seine; L = beach seine; 0 = lake outlet trap; P = purse seine; T = tidal slough trap; * = no effort.

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procedures. Subsequent synpotic surveys were shorter in duration (i.e., July 17 - July 26, August 2 through August 14, and September 4 - September 18) and included a lesser number of stations. Sites excluded from the latter surveys were either replicates of similar habitat in the same vicinity or had poor access.

In the interim between synpotic surveys, stations 2-1, 6-1, 7-8, and 10-1 were sampled on an intermittent but more frequent basis (Table 4-6). Also samples were collected one time from a number of lesser important habitats (e.g., stations 9-2, 10-2, 12-1, and 13-1) which were not sampled during the synpotic surveys.

Table 4-6 indicates the variety of fishing gear used to sample the various habitats on the Yukon Delta. The large variability in physical conditions (i.e., depth, current, and tide) among different habitats made it necessary to deploy different gear in each habitat. Since each gear had a different catch efficiency and there was very little overlap of gear types in each habitat it was not possible to standardize CPUE between gear. Consequently, comparisons of effort and catch among stations and dates could only be made within each gear type. A summary of effort for each gear is shown in Table 4-7.

4.3.2 Species Composition and Catch by Gear

The summer survey resulted in the capture of 32 species of fish comprising 13 anadromous species, 9 freshwater species, and 10 marine species (Table 4-8). The humpback, broad, and round whitefish were considered as freshwater species in spite of the fact that many were collected from brackish waters in nearshore areas of the delta. The char were listed as *Salvelinus malma* although it was possible that the specimens caught were *Salvelinus alpinus*. Bering cisco and arctic cisco were very difficult to differentiate in the field. Therefore both species were listed as caught but the majority of the catch was recorded as Bering cisco. The pricklebacks were identified as *Lumpenus fabricii* and *L. mackayi* (Rae Baxter, personal communication).

TABLE 4-7

NUMBER OF GEAR HAULS OR GEAR SETS COLLECTED DURING SUMMER 1985 IN THE YUKON RIVER DELTA

Habitat	Gear								All	Percent
	Purse Seine	Hook Seine	Beach Seine	Tidal Net	Gill Net	Single Body Fyke	Double Body Fyke	Lake Outlet Trap		
Delta Front	13								13	(5)
Mid Delta Platform	20								20	(8)
Inner Delta Platform							6		6	(2)
Mudflats						19			19	(8)
Tidal Slough			7	38	3	1			49	(19)
Inter-Island Channels					1	1			2	(<1)
Major Active Distributory	30								30	(12)
Minor Active Distributory		53				2			55	(22)
Major Inactive Distributory					2	1			3	(1)
Minor Inactive Distributory					2	3			5	(2)
Connected Lake					3	5			8	(3)
Lake Outlet Channel					1	2		38	41	(16)
Land-Locked Lake					1	1			2	(<1)
All	63	53	7	38	13	35	6	38	253	
(Percent)	(25)	(21)	(3)	(15)	(5)	(14)	(2)	(15)		

TABLE 4-8

LIST OF COMMON AND SCIENTIFIC NAMES OF FISH SPECIES CAUGHT DURING THE WINTER 1984 AND SUMMER 1985 SURVEYS OF THE YUKON RIVER DELTA

Common Name	Scientific Name
Anadromous	
Chinook Salmon	*Oncorhynchus tshawytscha*
Chum Salmon	*Oncorhynchus keta*
Coho Salmon	*Oncorhynchus kisutch*
Pink Salmon	*Oncorhynchus gorbuscha*
Dolly Varden/Arctic Char	*Salvelinus malma*
Sheefish	*Stenodus leucichthys*
Arctic Cisco	*Coregonus autumnalis*
Bering Cisco	*Coregonus laurettae*
Least Cisco	*Coregonus sardinella*
Boreal Smelt	*Osmerus eperlanus*
Threespine Stickleback	*Gasterosteus aculeatus*
Ninespine Stickleback	*Pungitius pungitius*
Arctic Lamprey	*Lampetra japonica*
Freshwater	
Humpback Whitefish	*Coregonus pidschian*
Broad Whitefish	*Coregonus nasus*
Round Whitefish	*Prosopium cylindraceum*
Pond Smelt	*Hypomesus olidus*
Longnose Sucker	*Catostomus catostomus*
Northern Pike	*Esox lucius*
Burbot	*Lota lota*
Alaska Blackfish	*Dallia pectoralis*
Trout-Perch	*Percopsis omiscomaycus*
Marine	
Starry Flounder	*Platichthys stellatus*
Arctic Flounder	*Liopsetta glacialis*
Saffron Cod	*Eleginus gracilis*
Arctic Cod	*Boreogadus saida*
Fourhorn Sculpin	*Myoxocephalus quadricornis*
Pacific Herring	*Clupea harengus pallasi*
Capelin	*Mallotus villosus*
Bering Poacher	*Occella dodecaedron*
Pricklebacks	*Lumpenus* sp.
Whitespotted Greenling	*Hexagrammos stelleri*

Most fish (i.e., 33 percent) were caught in the single-body fyke net, but the largest number of species (84 percent) were caught in the purse seine (Table 4-9). Whitefish accounted for the largest proportion of the catch (36 percent) and were caught with all types of gear. Juvenile salmon only accounted for approximately 3 percent of the total catch and were most frequently caught with active types of gear (i.e., purse seine and hook seine).

4.3.3 Catch by Habitat

Fish collected from coastal mudflats and tidal sloughs accounted for more than 53 percent of the total catch during the summer survey (Table 4-10). The portion caught from other habitats were: active distributaries (17 percent), lake outlet channel (12 percent), delta front (11 percent), delta platform (7 percent), and all remaining habitats (less than 1 percent). The greatest number of species were caught in the tidal slough (22 species) most of which were comprised of anadromous fish (12 species). The active distributaries, coastal habitats, and offshore habitats all had 15 or more species. The inactive distributaries and lake associated habitats had 11 or less species. Anadromous fish were present in all habitats. Freshwater species were present in all habitats except the delta front and mid-delta platform. Marine fish were concentrated in the coastal and offshore habitats except for flounder and the fourhorn sculpin which also occurred in a minor active distributary.

4.4 SPECIES CHARACTERIZATION - SUMMER SURVEY

Descriptions of the distribution, timing, abundance, and size composition of selected fish species are presented in this section. Species of fish that occurred in low numbers or were not important to the commercial and subsistence fishery were omitted. However, a summary of the catch per unit effort for all species, including those omitted from this section, is presented in Appendix B. Length-frequency tables for selected species grouped by habitat and time period are given in Appendix C.

TABLE 4-9
NUMBER OF FISH CAUGHT BY SPECIES AND GEAR, AND NUMBER SPECIES CAUGHT BY GEAR
DURING SUMMER 1985 IN THE YUKON RIVER DELTA

	Catch By Gear									
Species	Beach Seine	Lake Outlet Trap	Tidal Net	Gill Net	Purse Seine	Single Fyke Net	Double Fyke Net	Hook Seine	All	Percent
Chinook Salmon					15	9	4	1	29	0.1
Chum Salmon	1	29	3	4	310	10	129	392	878	2.0
Coho Salmon					1			1	2	<0.1
Pink Salmon	6				29	3	16	47	101	0.2
Unidentified Mixed Pink and Chum						13		256	269	0.6
Unidentified Dolly Varden/Arctic Char					1	1			2	<0.1
Sheefish	8	648	441	29	308	1,372	134	241	3,181	7.1
Humpback Whitefish	119	2	394	89	3	215	14	33	869	1.9
Broad Whitefish	10	3	41	18	1	33		5	111	0.2
Round Whitefish						1			1	<0.1
Unidentified Whitefish		1,448	2,908		219	9,946	27	387	14,935	33.4
Arctic Cisco			1	1					2	<0.1
Bering Cisco	1	4	13			221	4	2	245	0.5
Least Cisco	17	25	229	41	3	331	12	33	691	1.5
Unidentified Cisco		221	1,327	2	208	1,160	42	120	3,080	6.9
Unidentified Whitefish and Cisco	198	2,504	514		638	52		1,833	5,739	12.9
Boreal Smelt			10		3,226	39	340	35	3,650	8.2
Pond Smelt			17		416	16	29	75	553	1.2
Unidentified Smelt					99		156	1,614	1,869	4.2
Threespine Stickleback			1			1			2	<0.1
Ninespine Stickleback	3	234	1,780		561	222	28	98	2,926	6.6
Arctic Lamprey	2				7		2	21	32	0.1
Unidentified Lamprey								38	38	0.1
Longnose Sucker	2	5	58	2	1	25		13	106	0.2
Northern Pike		39	3	40	1	16		13	112	0.2
Burbot	18	86	65	3	22	90	51	953	1,288	2.9
Blackfish		61		12		36		1	110	0.2
Trout-Perch		8						1	9	<0.1
Starry Flounder	3		93		6	379	9	12	502	1.1
Arctic Flounder			477		51	383	587	1	1,499	3.4
Saffron Cod		305	178		563	282	80		1,408	3.2
Arctic Cod					1				1	<0.1
Fourhorn Sculpin			2		27	2	90	1	122	0.3
Unidentified Sculpin							7		7	0.1
Pacific Herring					279				279	0.6
Capelin					3				3	<0.1
Bering Poacher					1				1	<0.1
Pricklebacks					3				3	<0.1
Whitespotted Greenling					3				3	<0.1
Unidentified Fish								3	3	<0.1
TOTAL NUMBER INDIVIDUALS	388	5,622	8,555	241	7,006	14,858	1,761	6,230	44,661	
TOTAL NUMBER SPECIES	12	13	18	10	27	22	16	21	32	

TABLE 4-10

NUMBER OF FISH CAUGHT BY SPECIES AND HABITAT, AND NUMBER OF SPECIES CAUGHT BY HABITAT DURING SUMMER 1985 IN THE YUKON RIVER DELTA

Species	Habitat														
	Delta Front	Mid-Delta Platform	Inner Delta Platform	Mudflats	Tidal Slough	Inter-Island Channel	Major Act. Distributary	Minor Act. Distributary	Major Inact. Distributary	Minor Inact. Distributary	Connected Lake	Lake Outlet Channel	Landlocked Lake	All	Percent
Chinook Salmon		9	4	1			6	9						29	0.1
Chum Salmon	3	182	129	4	7		125	398		1		29		878	2.0
Coho Salmon							1	1						2	<0.1
Pink Salmon	12	4	16		6		13	50						101	0.2
Unidentified Mixed Pink and Chum					13			256						269	0.6
Unidentified Dolly Varden/Arctic Char		1		1										2	<0.1
Sheefish	1	112	134	1,321	464		195	241	13	1	51	648		3,181	7.1
Humpback Whitefish			14	137	582		3	59	20	36	7	11		869	1.9
Broad Whitefish				26	59		1	5	12	6		2		111	0.2
Round Whitefish					1									1	<0.1
Unidentified Whitefish		2	27	9,943	2,934	2	217	387			1	1,422		14,935	33.4
Arctic Cisco					2									2	<0.1
Bering Cisco			4	221	18			2						245	0.5
Least Cisco		1	12	225	306		2	60	31	36	2	16		691	1.5
Unidentified Cisco	119	7	42	1,160	1,335		82	120		1		214		3,080	6.9
Unidentified Whitefish and Cisco	1	213		1	712		424	1,833	2		49	2,504		5,739	12.9
Boreal Smelt	2,958	251	340	20	11		17	53						3,650	8.2
Pond Smelt	380	3	29	16	17		33	75						553	1.2
Unidentified Smelt		93	156				6	1,614						1,869	4.2
Threespine Stickleback				1	1									2	<0.1
Ninespine Stickleback	378	178	28	210	1,863		5	100		3	1	160		2,926	6.6
Arctic Lamprey	1	1	2		2		5	21						32	0.1
Unidentified Lamprey								38						38	0.1
Longnose Sucker				13	66		1	14	4	2	1	5		106	0.2
Northern Pike				1	5		1	13	2	9	30	51		112	0.2
Burbot			51	61	86		22	972	3		8	85		1,288	2.9
Blackfish								1			9	61	39	110	0.2
Trout-Perch								1				8		9	<0.1
Starry Flounder		6	9	377	98			12						502	1.1
Arctic Flounder	8	43	587	383	477			1						1,499	3.4
Saffron Cod	562	1	80	281	484									1,408	3.2
Arctic Cod	1													1	<0.1
Fourhorn Sculpin	2	25	90	1	3			1						122	0.3
Unidentified Sculpin			7											7	0.1
Pacific Herring	279													279	0.6
Capelin	3													3	<0.1
Bering Poacher	1													1	<0.1
Pricklebacks	3													3	<0.1
Whitespotted Greenling	3													3	<0.1
Unidentified Fish								3						3	<0.1
TOTAL NUMBER INDIVIDUALS	4,715	1,132	1,761	14,404	9,552	2	1,159	6,340	87	95	159	5,216	39	44,661	
TOTAL NUMBER OF SPECIES	17	15	16	19	22	1	15	21	7	8	8	11	1		
(Percent)	(11)	(3)	(4)	(32)	(21)	(<1)	(3)	(14)	(<1)	(<1)	(<1)	(12)	(<1)		

4.4.1 Juvenile Salmon

4.4.1.1 Distribution, Timing, and Abundance

Chinook Salmon

Catches of juvenile chinook salmon were small (29 fish) and only accounted for a 0.1 percent of the total catch (Table 4-10). Most of the fish were caught during late June in active distributary and delta platform habitats (Figure 4-3). A few fish were also caught in July and August, one of which occurred at Station 4-4 on the coastal mudflats.

Catches of chinook were too small for identification of any temporal patterns in the outmigration. However, this low abundance suggests the major portion of the outmigration may have preceded the period of sampling.

Chum Salmon

Chum salmon were the most abundant and most widely distributed of all salmon species (Table 4-10). Chum were caught at two stations in the delta front, three stations on the delta platform, five stations in coastal habitats, and almost all stations in active distributaries (Figure 4-4). Chum also occurred in a lake outlet channel and a major inactive distributary.

The greatest abundance of chum was observed during later June in active distributaries (Fig. 4-4f and 4-4g). Peaks in abundance also occurred at about the same time in the inner delta platform and delta platform stations (Fig. 4-4b and 4-4c). Abundance declined rapidly by early July in all habitats and low numbers of fish were caught

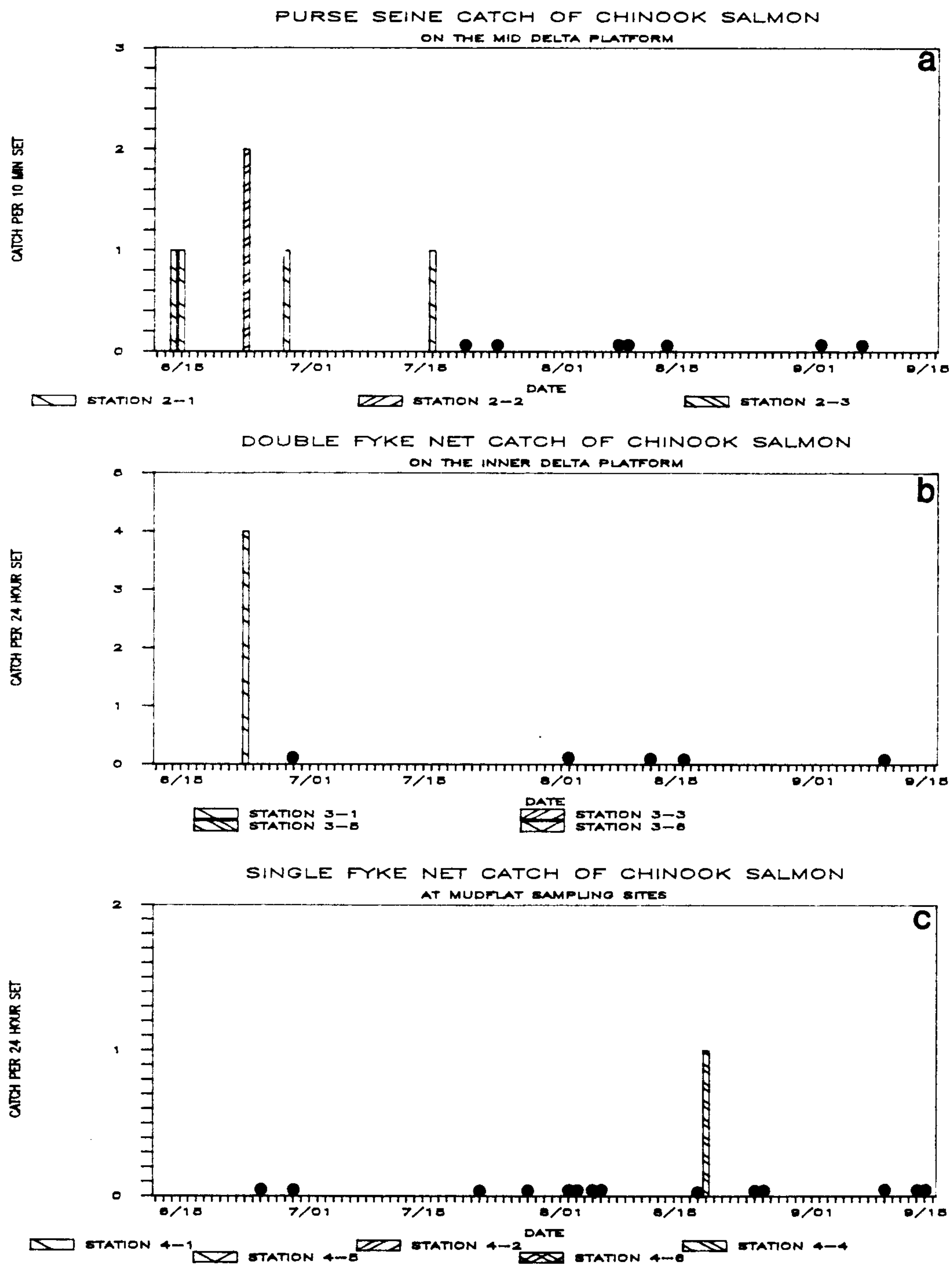


Figure 4-3. Catch Per Unit Effort of Chinook Salmon in (a) Mid Delta Platform, (b) Inner Delta Platform, and (c) Mudflat Sampling Sites.

(●) = Effort but no catch.

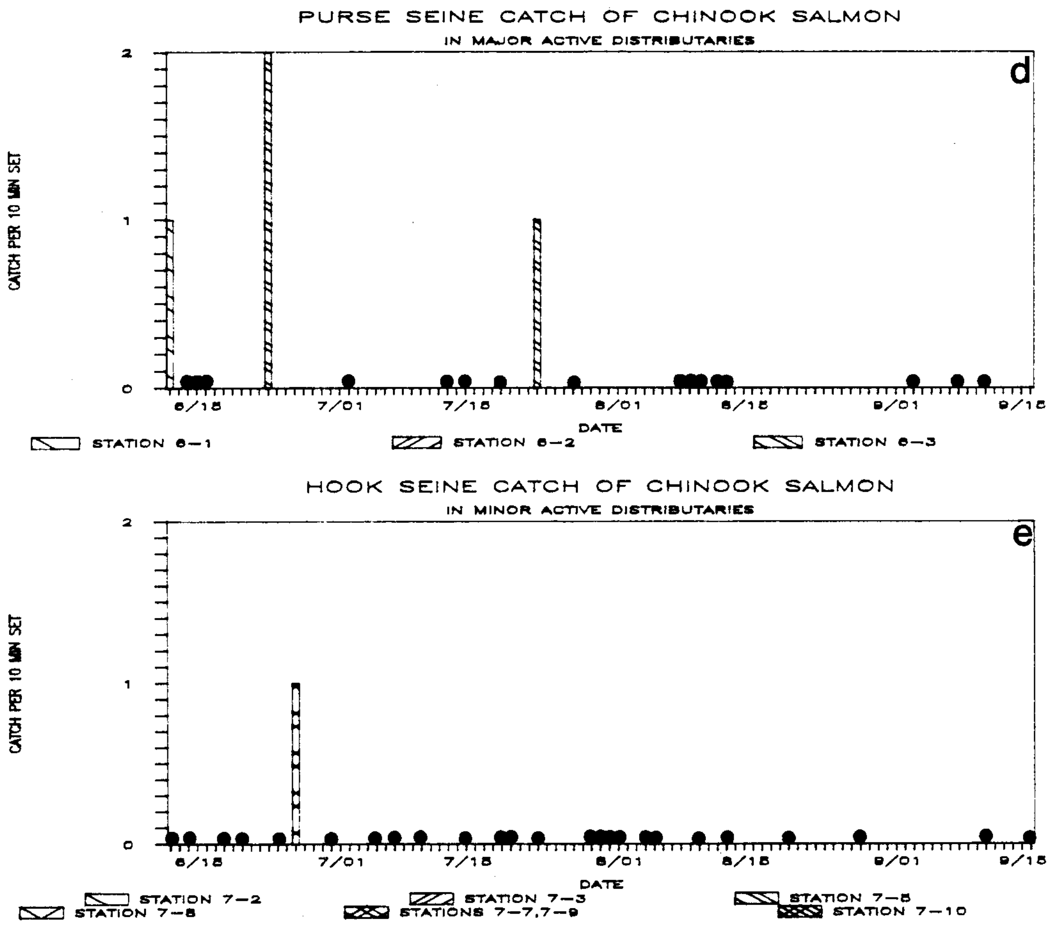


Figure 4-3. Catch Per Unit Effort of Chinook Salmon in (d) Major Active Distributaries and (e) Minor Active Distributaries.

(●) = Effort but no catch.

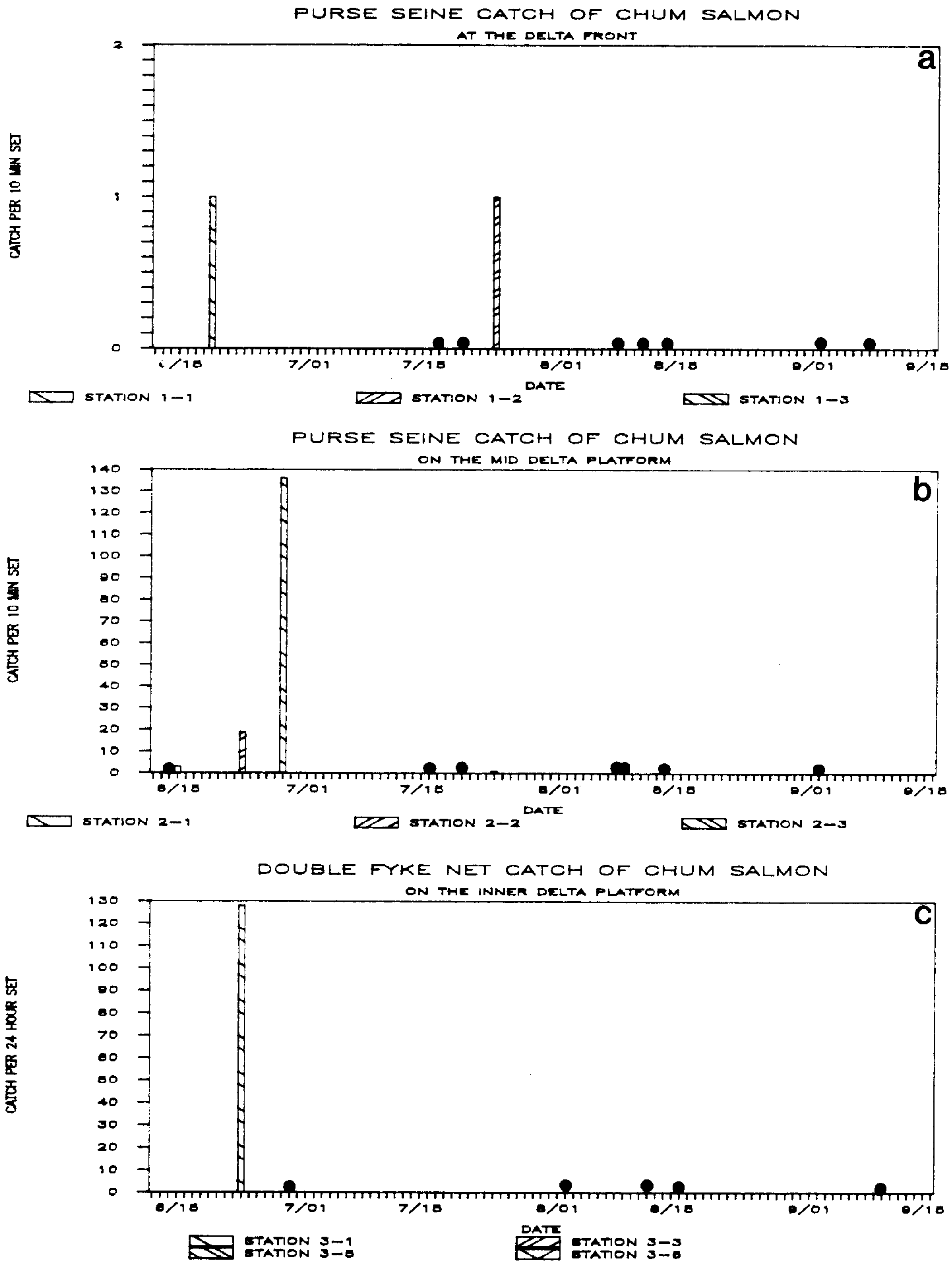


Figure 4-4. Catch Per Unit Effort of Chum Salmon in (a) Delta Front, (b) Mid Delta Platform, and (c) Inner Delta Platform.

(●) = Effort but no catch.

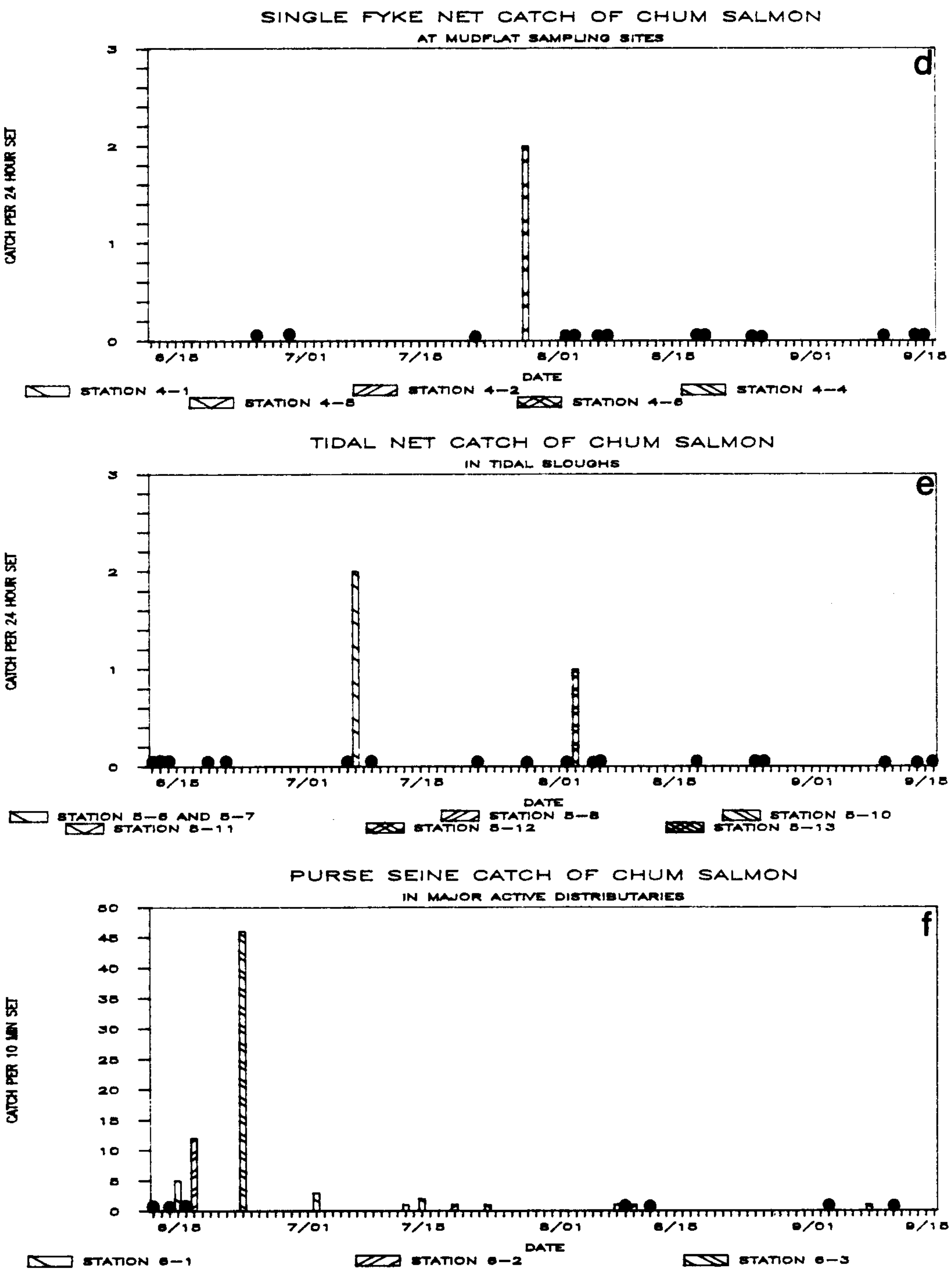


Figure 4-4. Catch Per Unit Effort of Chum Salmon in (d) Mudflat Sampling Sites, (e) Tidal Sloughs, and (f) Major Active Distributaries.

(●) = Effort but no catch.

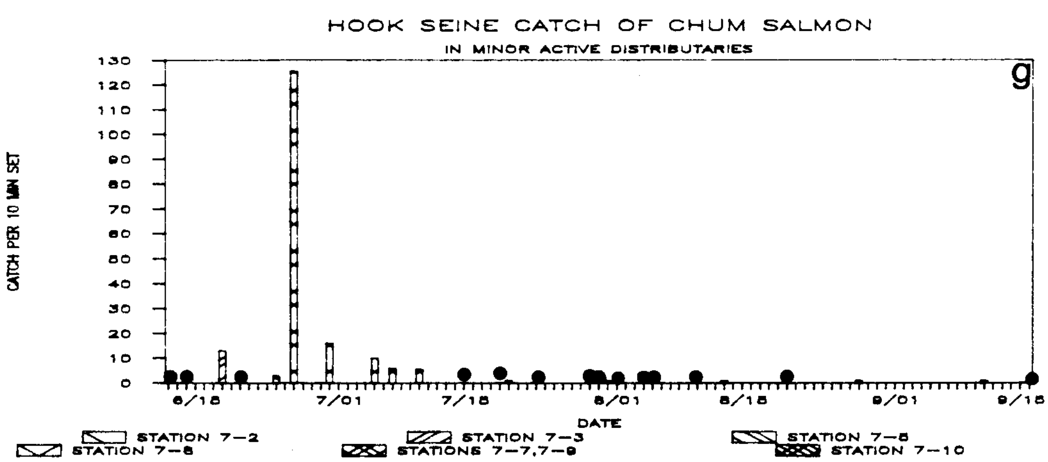


Figure 4-4. Catch Per Unit Effort of Chum Salmon in (g) Minor Active Distributaries.

(●) = Effort but no catch.

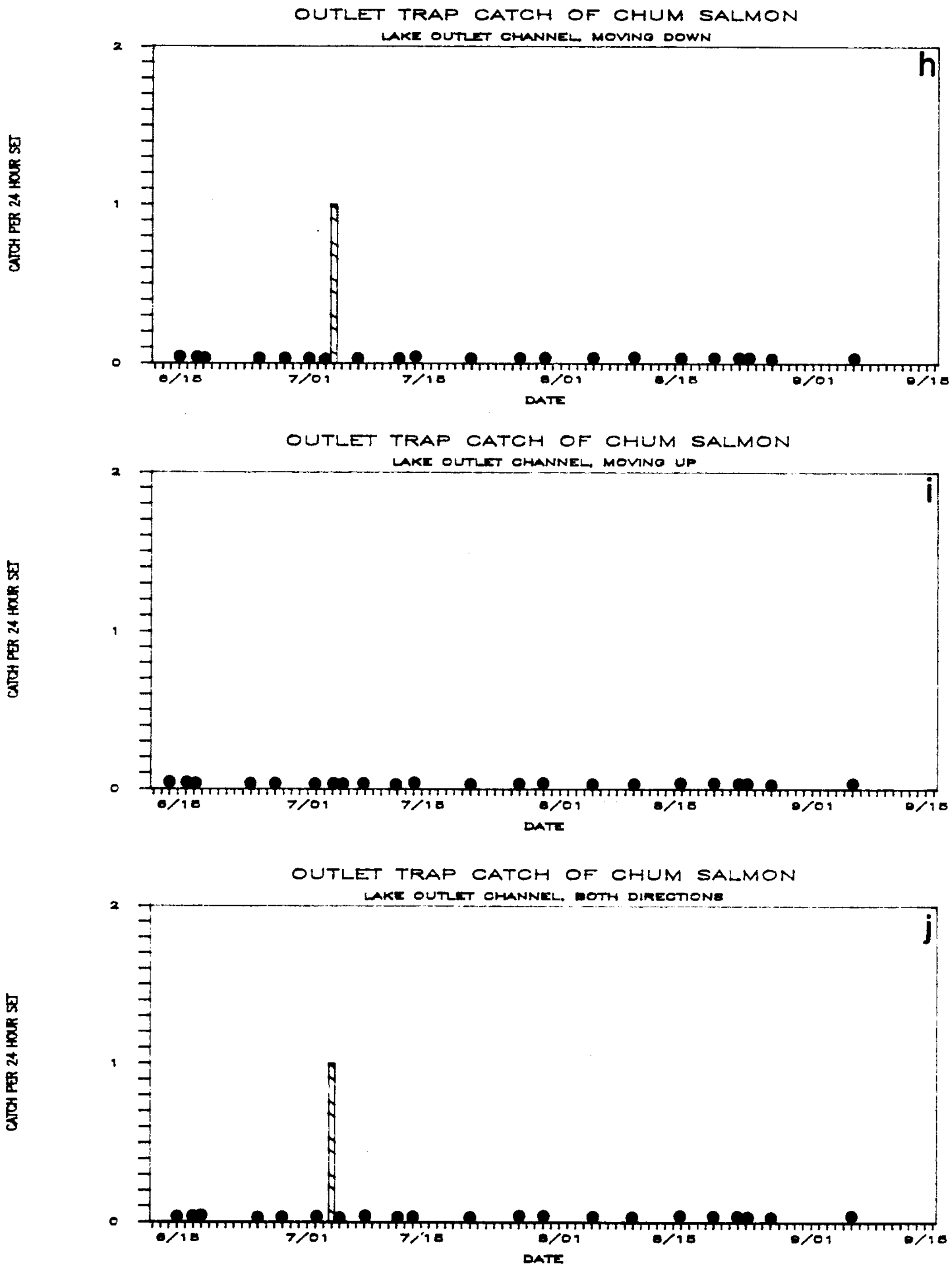


Figure 4-4. Catch Per Unit Effort of Chum Salmon in (h) Lake Outlet Channel Moving Down, (i) Lake Outlet Channel, Moving Up, and (j) Lake Outlet Channel, Both Directions.

(●) = Effort but no catch.

intermittently through the remainder of the summer. Only seven fish were caught in all coastal, delta platform and delta front habitats during July and early August. No chum were caught in any habitat except active distributaries during late August and September.

Coho Salmon

Only one juvenile coho salmon was caught. This fish was taken with a hook seine at Station 7-10 on July 25 (Appendix B, Table 5).

Pink Salmon

Juvenile pink salmon were the second most abundant species of salmon and were collected at 15 stations located in active distributary, tidal slough, delta platform, and delta front habitats. This distribution was similar to that observed for juvenile chum salmon except for the absence of pink salmon in mudflat or lake outlet channel habitats. The greatest abundance of pink salmon was observed in minor active distributaries and the greatest single catch (16 fish) occurred at the inner delta platform on June 25 (Figure 4-5c).

Pink salmon were caught primarily during late June (Figure 4-5). Juveniles were initially caught in the active distributaries immediate after sampling began. Catch rapidly peaked at all other habitats between June 17th to June 20th. Few fish were observed after July 1st and no fish were observed after August 2nd. This pattern of fish abundance suggests that pink salmon moved quite rapidly through the delta habitats to the delta front. The occurrence of the largest catches at the beginning of sampling suggests the outmigration was already in progress by June 14th. The peak in the smolt outmigration may have occurred prior to June 14th, since catches declined soon after sampling was begun.

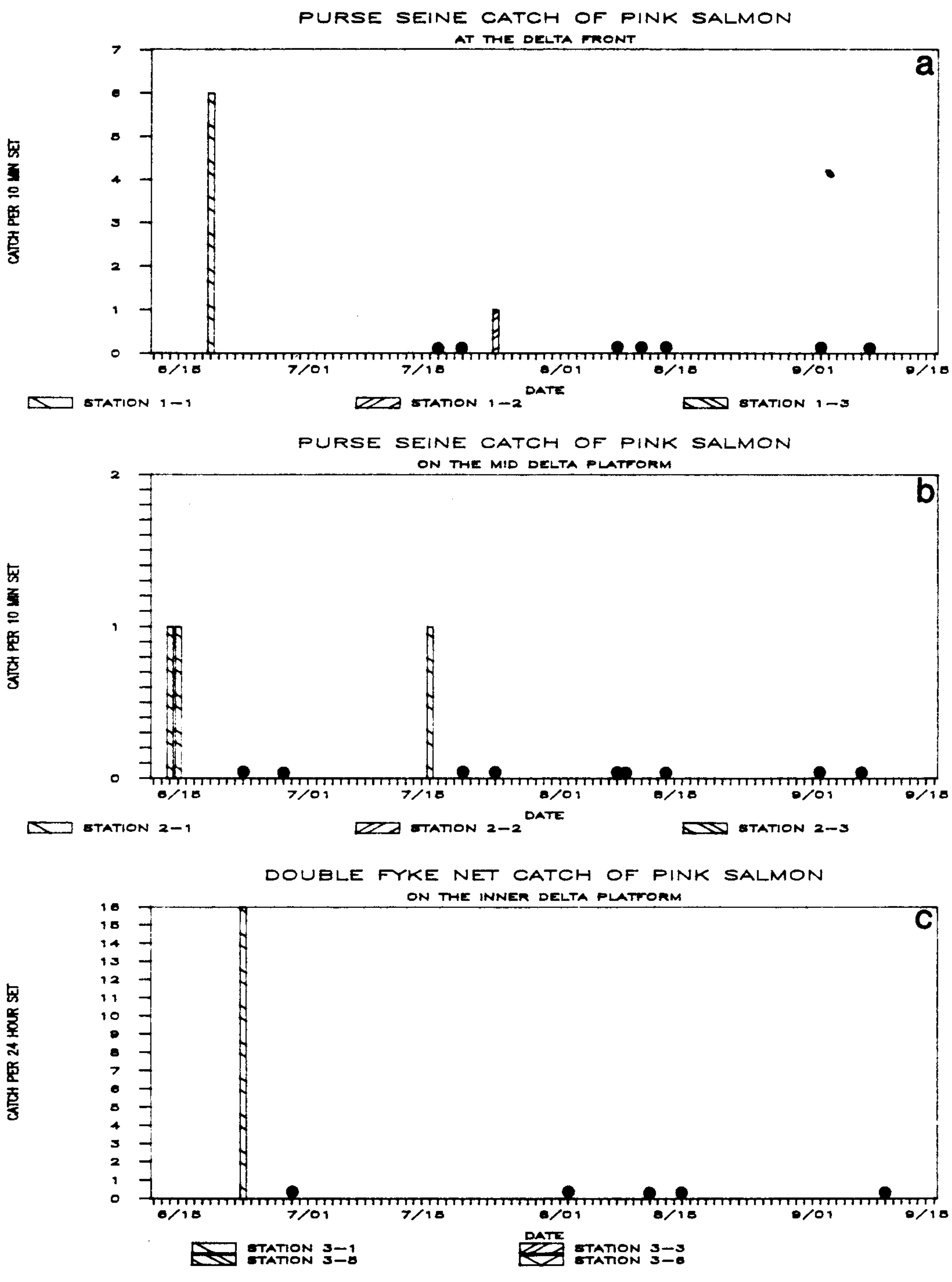


Figure 4-5. Catch Per Unit Effort of Pink Salmon in (a) Delta Front, (b) Mid Delta Platform, and (c) Inner Delta Platform.

(●) = Effort but no catch.

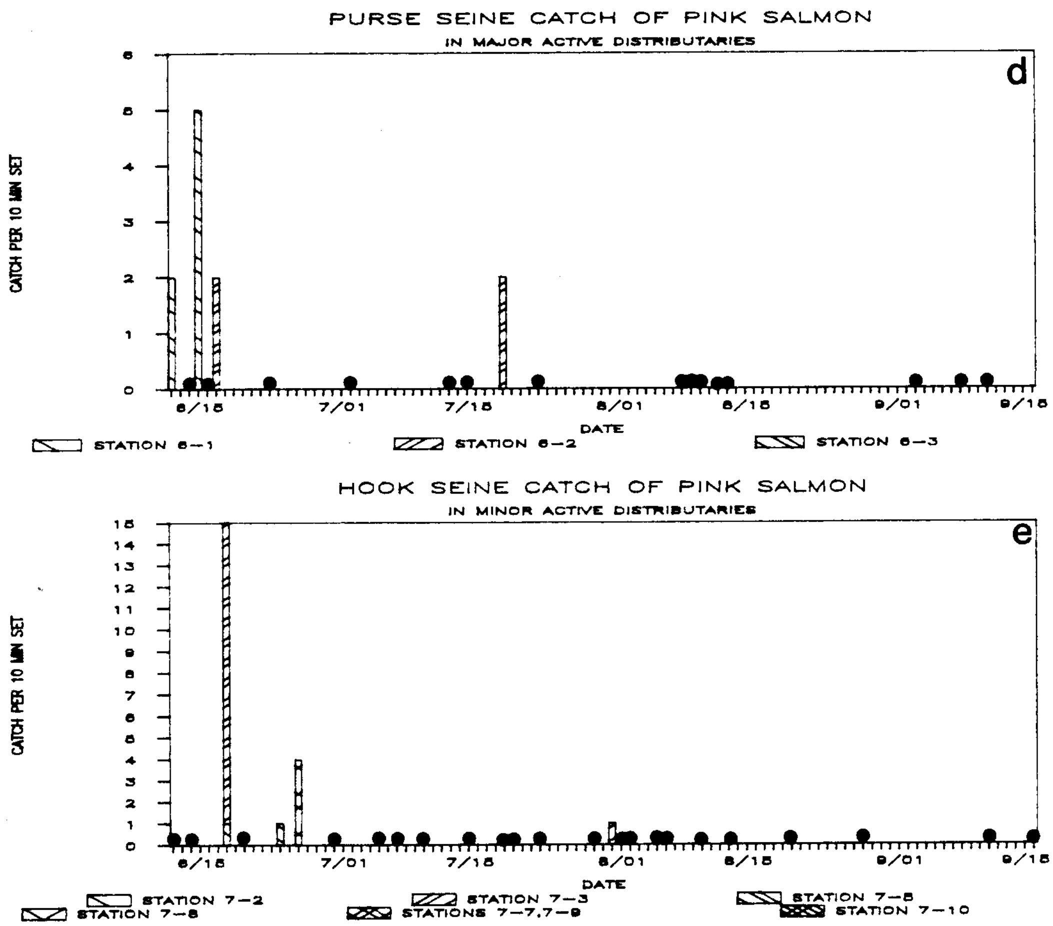


Figure 4-5. Catch Per Unit Effort of Pink Salmon in (d) Major Active Distributaries and (e) Minor Active Distributaries.

(●) = Effort but no catch.

4.4.1.2 Size Composition

Chinook Salmon

Juvenile chinook salmon ranged in size from 60 to 119 mm fork length (Appendix C, Table 1). Smaller individuals (i.e., 70 to 109 mm) occurred most frequently during late June, while the individuals caught in late July tended to be larger (90 to 119 mm).

Chum Salmon

Juvenile chum salmon ranged in size from 30 to 109 mm fork length with the majority of fish falling into the 30 to 59mm size group (Appendix C, Table 2). Most larger fish ranged from 60 to 89 mm and were caught during June, July, and early August. One juvenile greater than 100 mm was caught during late June. Chum in the smaller size group had a modal length of 40-49 mm during later June and a modal length of 50-59 mm during late July.

Pink Salmon

Juvenile pink salmon ranged in size from 30-69 mm fork length with the majority of fish in the 30-39 mm size group (Appendix C, Table 3).

4.4.1.3 Residence Time

The results of the otolith analysis were based on the examination of 30 otoliths taken from juvenile chum salmon that were collected at 5 stations. In all fish examined, three distinct zones were identified by characteristic difference in otolith microstructure. An inner zone was located near the otolith primordia and was characterized by irregularly spaced dark bands which were intensely expressed. Following this zone was a relatively large middle region where otolith increments were difficult to discern. When increments were visible in this region, they were regular and very closely spaced. Surrounding the middle zone was an outer zone (edge zone) where otolith increment width showed a step-wise increase over the preceding increments. In this zone the dark organic components were distinct and increments were regularly spaced. The increment width and increment frequency in this zone provided the data which were analyzed for residence time.

The size of juvenile chum that were examined ranged from 38.2 to 58.0 mm in fork length and the number of otolith increments ranged from 13 to 29 (Table 4-11). The frequency of otolith increments among the entire sample was skewed by a high portion of fish with 14 edge zone increments. The average number of edge zone increments for each station ranged from 15.6 at station 6-2 to 23.6 at Station 2-1. Fish with 14 edge zone increments were the most frequent (five fish) (Figure 4-6). Nineteen and 22 increments were the next most common (three fish) and the remaining increment frequencies were seen in one and two fish each.

A comparison of the mean number of otolith increments among stations was performed with an analysis of variance test (ANOV) on data that were transformed to base 10 logarithms. Differences among stations were significant and two groups of stations were identified with a multiple range test (Table 4-12). The results indicate that chum at stations 7-8 and 2-1 had significantly more otolith increments than chum at station 6-2. Chum at stations 1-1, 6-3, and 2-2 were not significantly different from chum at either station 6-2 or stations 7-8 and 2-1.

4.4.2 Other Salmonid Fishes

4.4.2.1 Distribution, Timing, and Abundance

Sheefish

Sheefish were caught at 32 stations and were widely distributed among all major habitats. Sheefish were also fourth in abundance (7.1 percent) of all fish caught during the summer survey (Table 4-10).

TABLE 4-11
NUMBER OF OTOLITH INCREMENTS IN THE EDGE ZONE AND MEAN WIDTH OF OTOLITH INCREMENTS FOR JUVENILE CHUM SALMON CAUGHT DURING THE SUMMER 1985 SURVEY OF THE YUKON RIVER DELTA

Station	Date	Fork Length (mm)	Edge Zone Increments Number	Edge Zone Increments Group Mean	Edge Zone Increments Group 95% C.L.	Mean Increments Width (um)
1-1	6/21/85	46.0	25			2.11
		40.0	14			2.15
		38.5	14			2.15
		56.1	13			2.32
		44.6	20			1.89
				17.2	10.8-23.6	
2-1	6/30/85	51.8	21			3.95
		51.5	28			2.15
		43.8	18			2.93
		47.6	25			2.71
		58.0	26			3.19
				23.6	18.6-28.6	
2-2	6/25/86	52.5	23			3.28
		48.3	19			-
		38.2	16			1.89
		45.2	19			2.78
		45.0	19			1.98
				19.2	16.1-22.3	
6-2	6/19/85	43.7	16			2.36
		43.7	17			1.77
		40.0	17			2.66
		40.8	14			2.15
		40.5	14			2.15
				15.6	13.7-17.5	
6-3	6/25/86	45.0	29			2.08
		43.9	14			2.69
		47.0	15			2.01
		48.4	20			2.26
		49.4	18			2.93
				19.2	11.8-26.6	
7-8	6/28/85	48.5	24			2.51
		51.8	22			2.74
		45.2	23			1.97
		45.0	22			2.74
		44.4	22			2.40
				22.6	21.5-23.7	

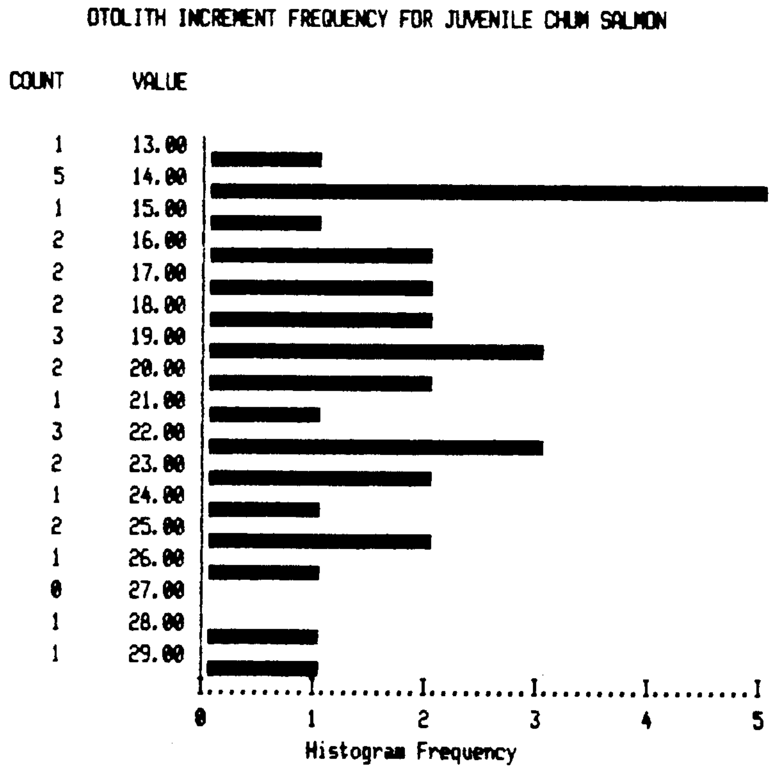


Figure 4-6. Otolith Increment Frequency for Juvenile Chum Salmon Collected During Summer 1985 from the Yukon River Delta.

TABLE 4-12

RESULTS OF ANALYSIS OF VARIANCE AND MULTIPLE-RANGE TESTS ON THE NUMBER OF EDGE ZONE INCREMENTS IN CHUM SALMON OTOLITHS

	Analysis of Variance				
Source	P.F.	Sum of Squares	Mean Square	F Ratio	F Prob.
Between Groups	5	.1228	.0246	3.5138	.0159
Within Groups	24	.1678	.0070		
Total	29	.2906			

MULTIPLE-RANGE TEST

Group	Stations				
1	6-2	1-1	6-3	2-2	
2		1-1	6-3	2-2	7-8	2-1

The greatest number of sheefish were caught with fyke nets in mudflats and tidal sloughs. The single largest catch of 587 fish was recorded on July 24 at mudflat Station 4-4 (Appendix B, Table 2). Large numbers of sheefish were caught in the lake outlet channel, as well, where daily catches ranged up to 78 fish.

The abundance of sheefish was highly variable over the summer. Low numbers of sheefish were initially found during late June in tidal slough, minor active distributary, lake outlet channel, and major inactive distributary habitats (Figure 4-7). During early July, the abundance of sheefish increased dramatically in active distributary and lake outlet channel habitats (Figures 4-7f to 4-7j) as a result of the downstream movement of juvenile fish. Fish utilized the lake outlet channel primarily from July 3 to July 16. During this period fish tended to move into and out of the channel in about equal numbers (Figures 4-7h to 4-7j). After mid-July, sheefish began to occur in large numbers in tidal slough, mudflat, and inner delta platform habitats (Figures 4-7c, d, and e). A high abundance of sheefish continued to be observed in these habitats through the summer sample period. Lower numbers of sheefish were also observed in the mid-delta platform and delta front during late July and early August. However, no sheefish were found in these habitats during late summer (Figures 4-7a and b).

Humpback and Broad Whitefish

Humpback and broad whitefish had similar distributions and were found in lake, inactive distributary, active distributary, and coastal habitats (Table 4-10). Humpback whitefish also occurred in the inner delta platform and were generally more abundant than broad whitefish in all habitats. Humpback and broad whitefish were caught in most habitats from late June through to the end of the summer sampling period (Figure 4-8 and 4-9). Fish catch was consistently low in active distributary habitats with no indication of any significant peaks in abundance. On the other hand, catch in the tidal slough, mudflat, and inner delta platform habitats were highly variable between species and

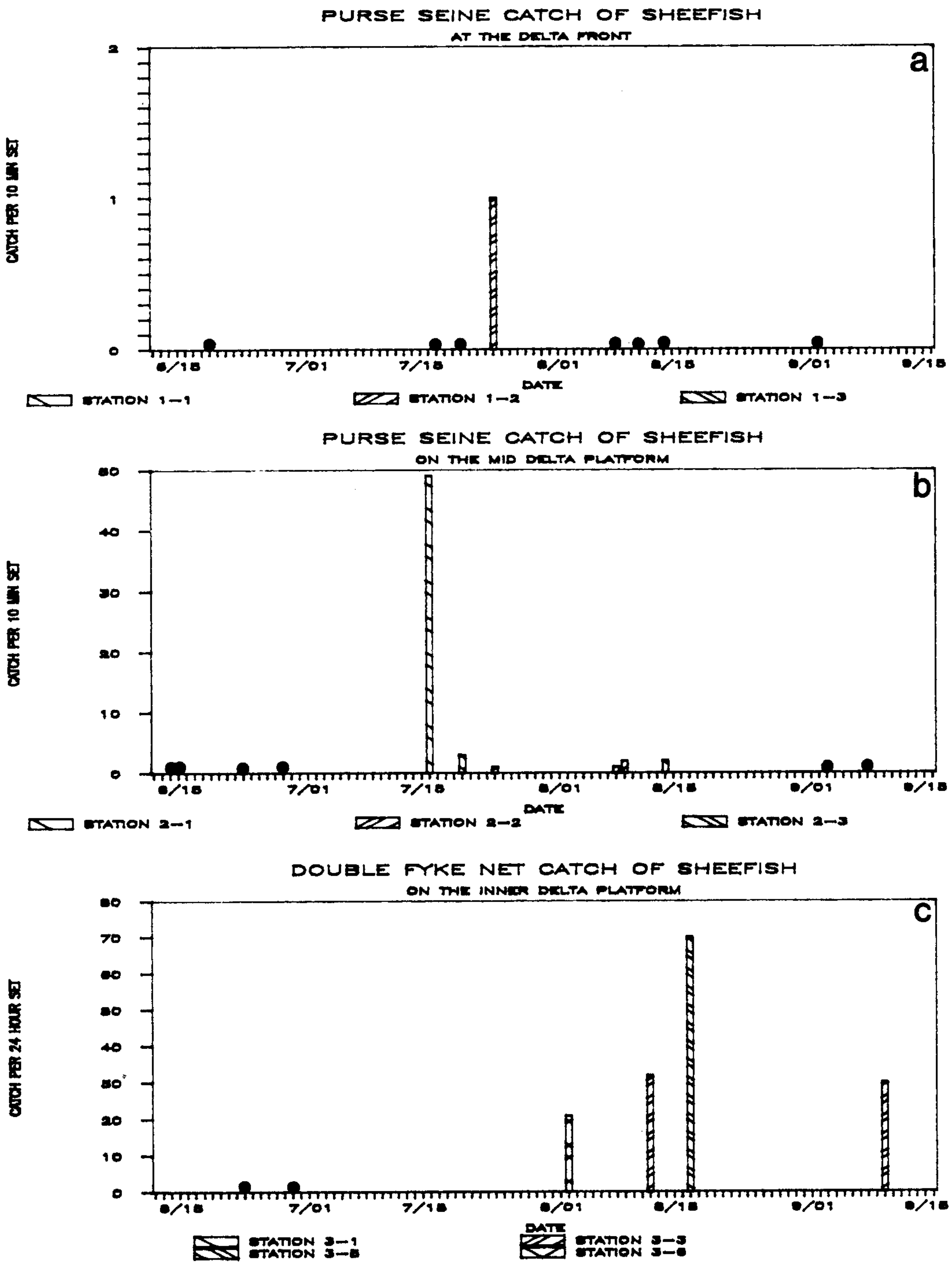


Figure 4-7. Catch Per Unit Effort of Sheefish in (a) Delta Front, (b) Mid Delta Platform, and (c) Inner Delta Platform.

(●) = Effort but no catch.

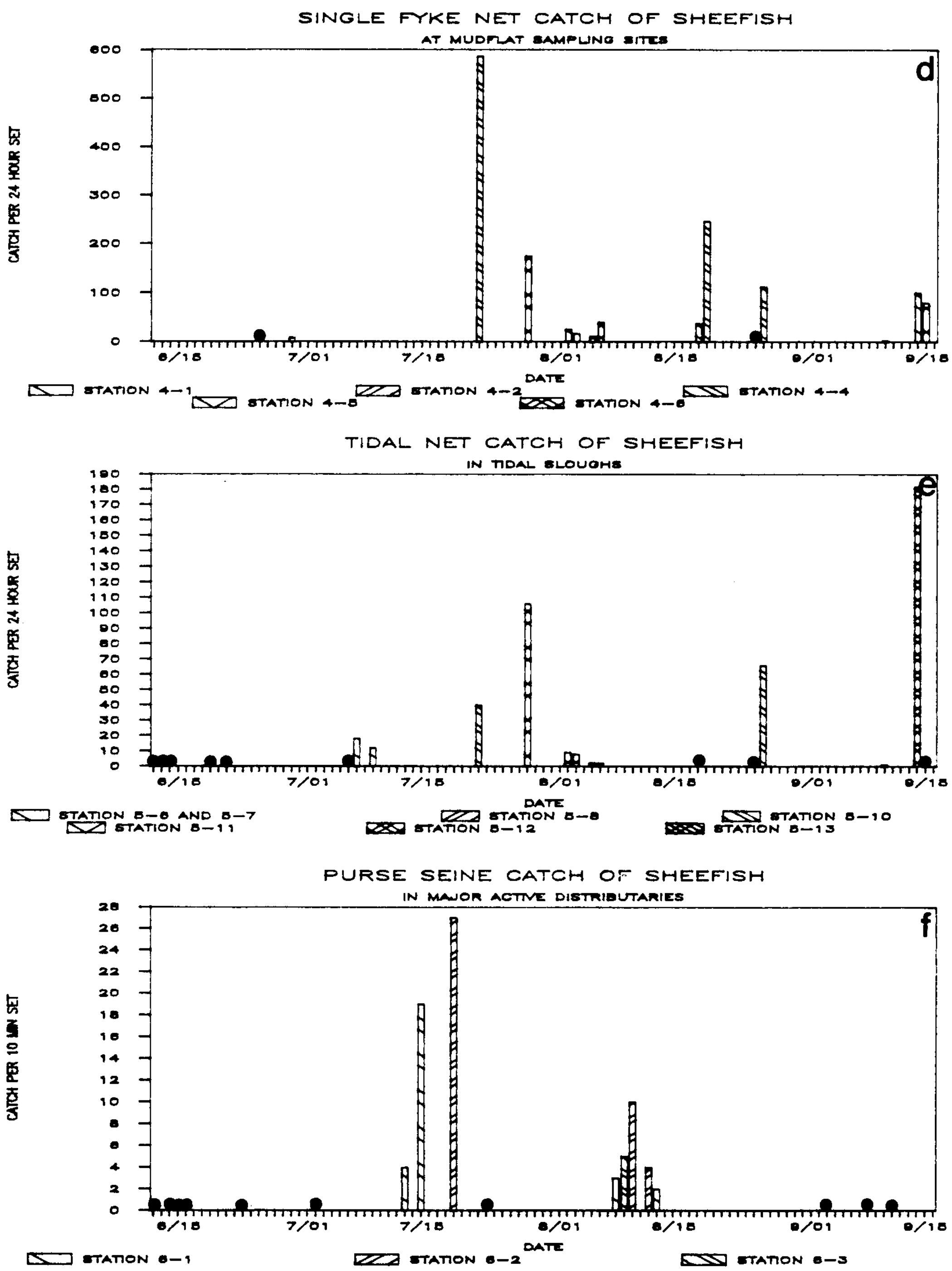


Figure 4-7. Catch Per Unit Effort of Sheefish in (d) Mudflat Sampling Sites, (e) Tidal Sloughs, and (f) Major Active Distributaries.

(●) = Effort but no catch.

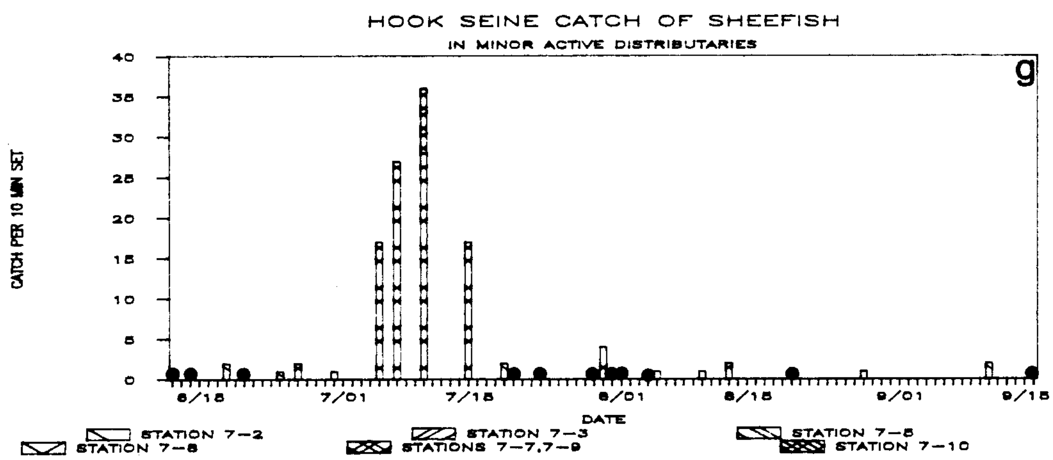


Figure 4-7. Catch Per Unit Effort of Sheefish in (g) Minor Active Distributaries.

(●) = Effort but no catch.

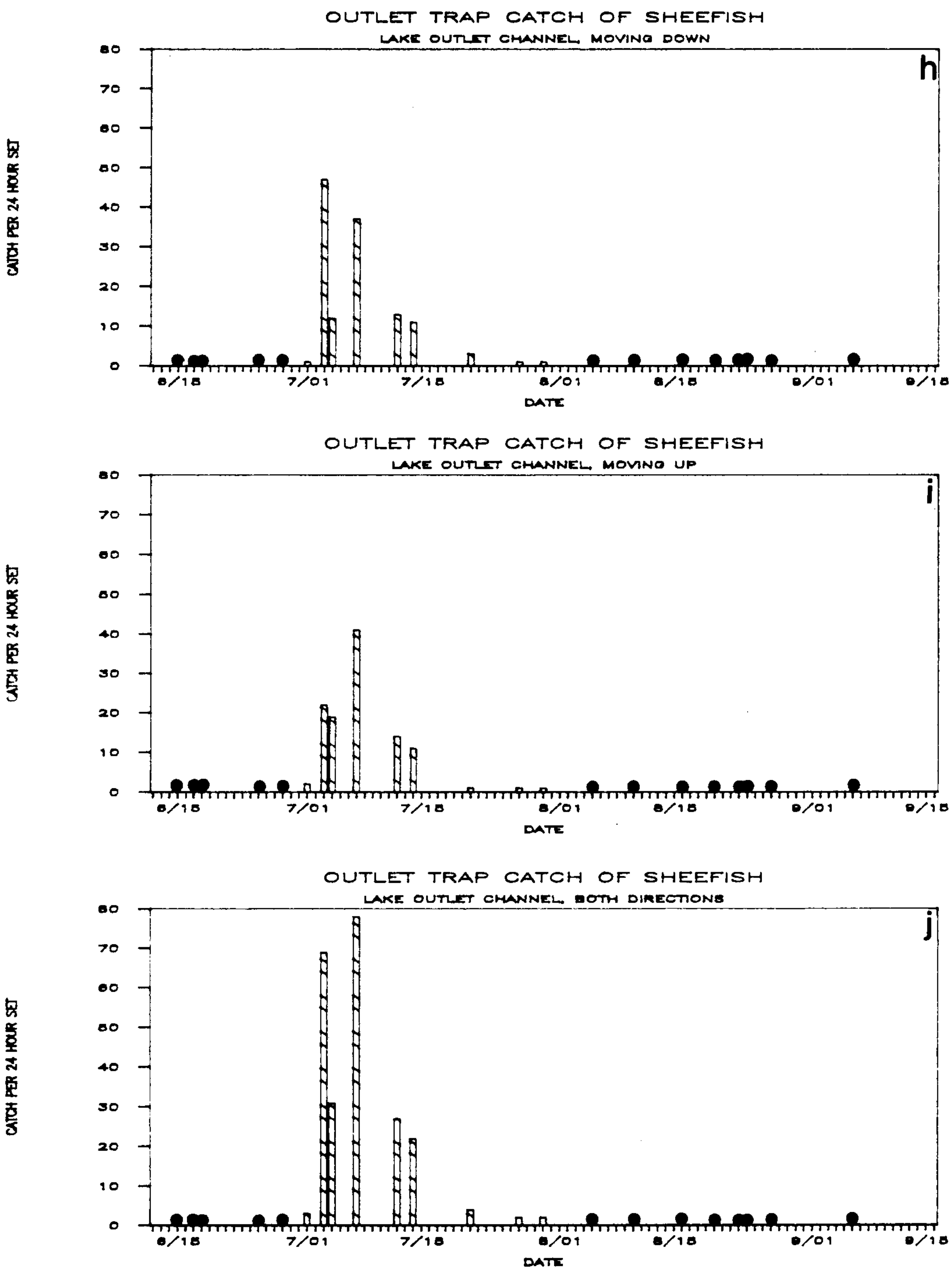


Figure 4-7. Catch Per Unit Effort of Sheefish in (h) Lake Outlet Channel, Moving Down, (i) Lake Outlet Channel, Moving Up, and (j) Lake Outlet Channel, Both Directions.

(●) = Effort but no catch.

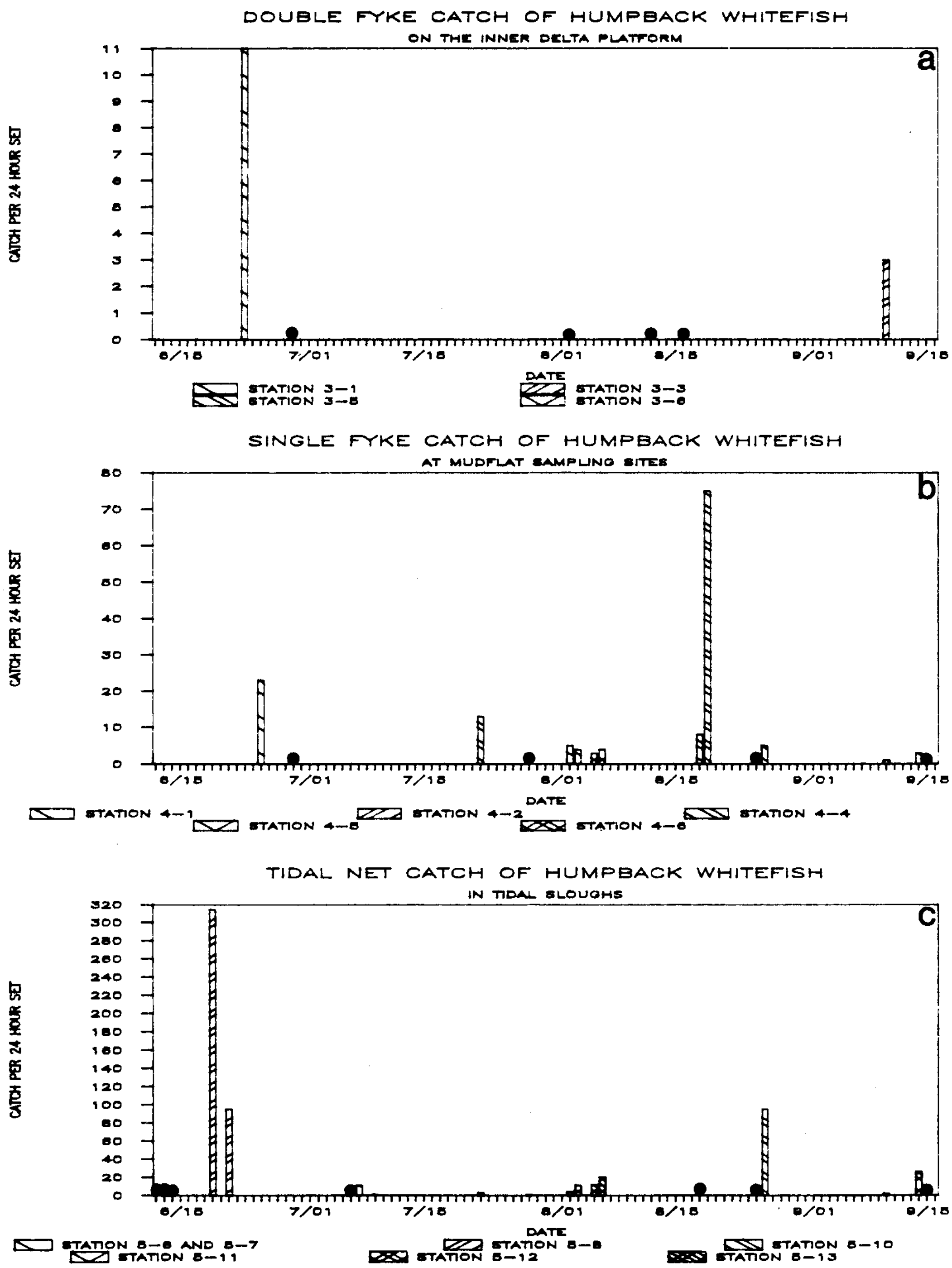


Figure 4-8. Catch Per Unit Effort of Humpback Whitefish in (a) Inner Delta Platform, (b) Mudflat Sampling Sites, and (c) Tidal Sloughs.

(●) = Effort but no catch.

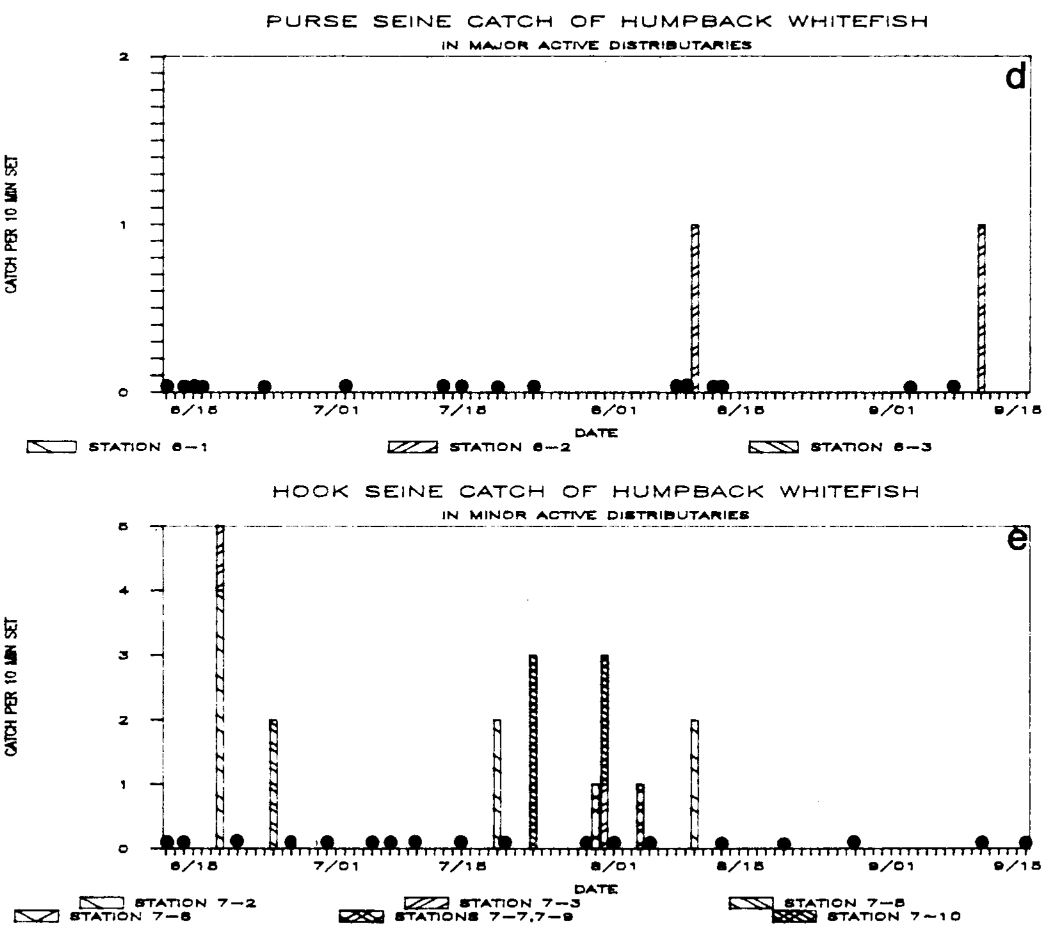


Figure 4-8. Catch Per Unit Effort of Humpback Whitefish in (d) Major Active Distributaries and (e) Minor Active Distributaries.

(●) = Effort but no catch.

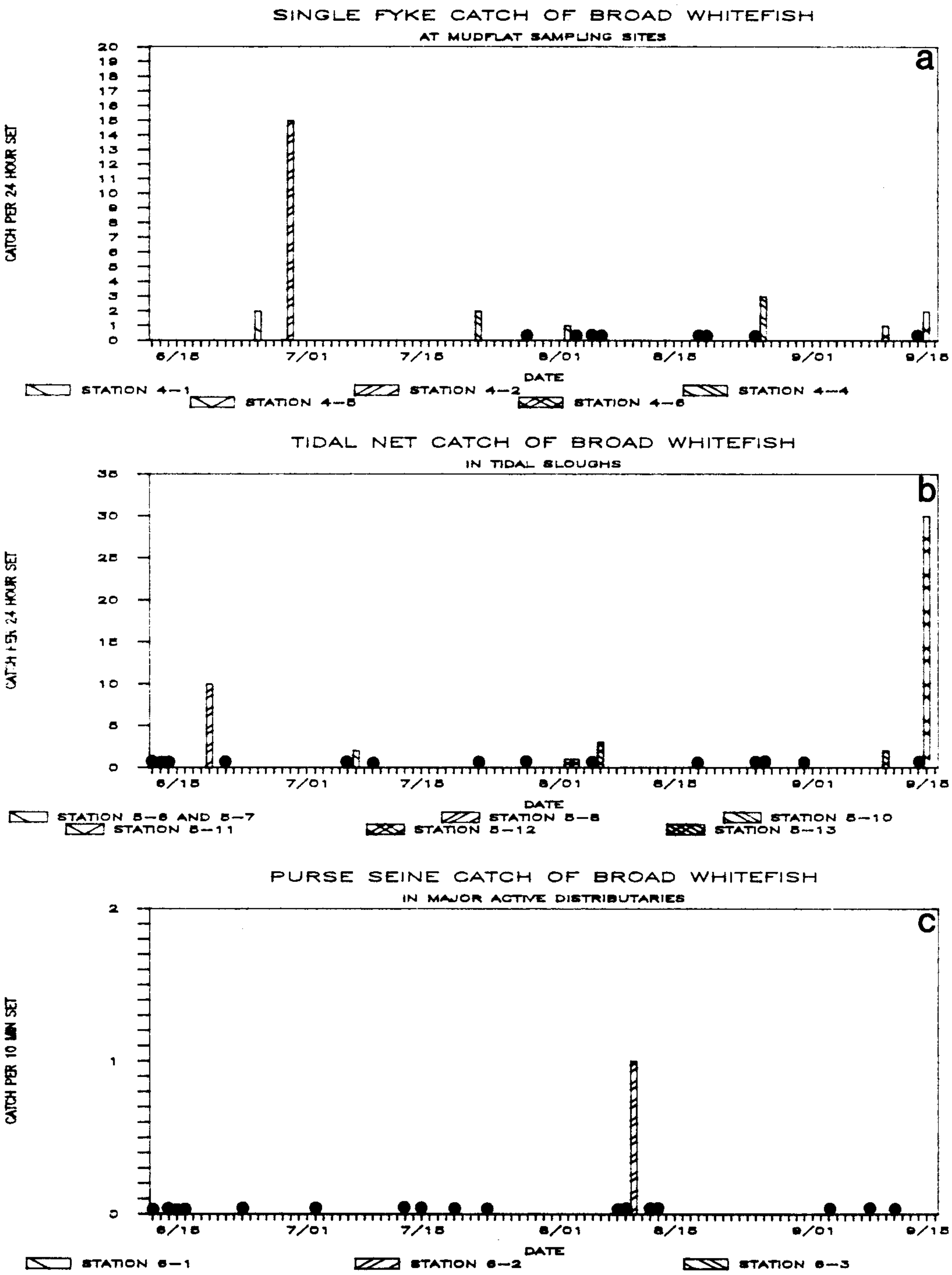


Figure 4-9. Catch Per Unit Effort of Broad Whitefish in (a) Mudflat Sampling Sites, (b) Tidal Sloughs, and (c) Major Active Distributaries.

(●) = Effort but no catch.

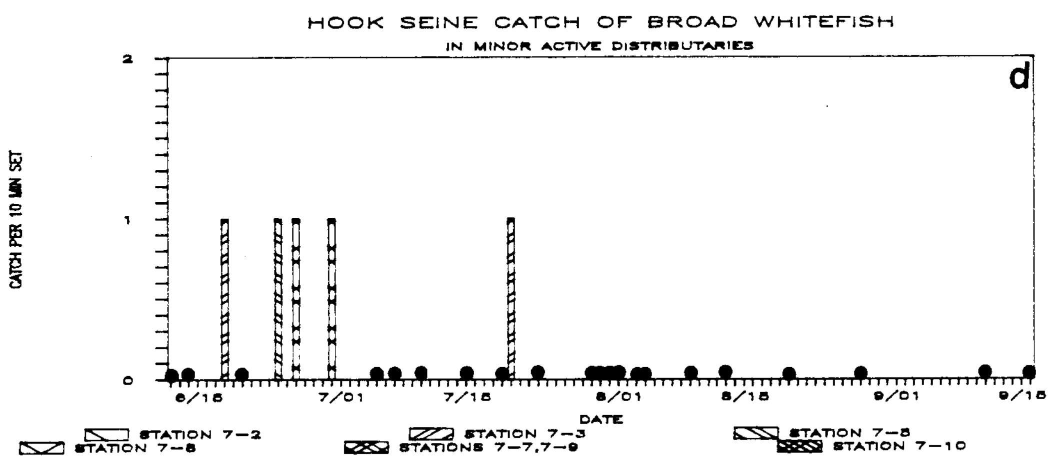


Figure 4-9. Catch Per Unit Effort of Broad Whitefish in (d) Minor Active Distributaries.

(●) = Effort but no catch.

over time. Humpback whitefish were more abundant during late June in the delta platform and tidal slough than during the late summer (August and September) periods (Figures 4-8a and c). An opposite trend in abundance was observed in the mudflat habitat because a large number of humpback whitefish were caught on August 21 (Figure 4-8b). Fish were less abundant during early summer and more abundant late in the summer. The abundance of broad whitefish similarly was variable in tidal slough and mudflat habitats during the summer (Figure 4-9a and b).

Unidentified Whitefish

Unidentified whitefish were by far the most abundant group of fish (accounted for 33 percent of total catch) caught during the summer survey (Table 4-10). Unidentified whitefish, which were primarily composed of juvenile humpback and broad whitefish, showed a more distinct pattern in distribution and timing than adult whitefish (Figure 4-10). Large numbers of juvenile fish occurred almost simultaneously in all habitats after mid-July. Active distributaries showed a peak in abundance between the first and fifteenth of August and a rapid decline in abundance to almost zero during the remaining season (Figure 4-10d and e). The lake outlet channel showed a similar short-term utilization which occurred between July 23 and August 7 (Figures 4-10g h, and i). Fish movements into the tidal slough and mudflat habitats were extensive during late July and early August. Daily catches of whitefish ranged into the thousands (Figure 4-10c and d), but catches in these habitats declined to a low-level by mid-August and remained low throughout the rest of the summer. Fish occurred in the delta platform during August and were present through the end of sampling.

Bering Cisco and Least Cisco

Bering cisco and least cisco were moderately abundant and accounted for two percent of the total catch (Table 4-10). The distribution of the two species was different and least cisco was much more abundant than Bering cisco. Least cisco were widely distributed and found in all

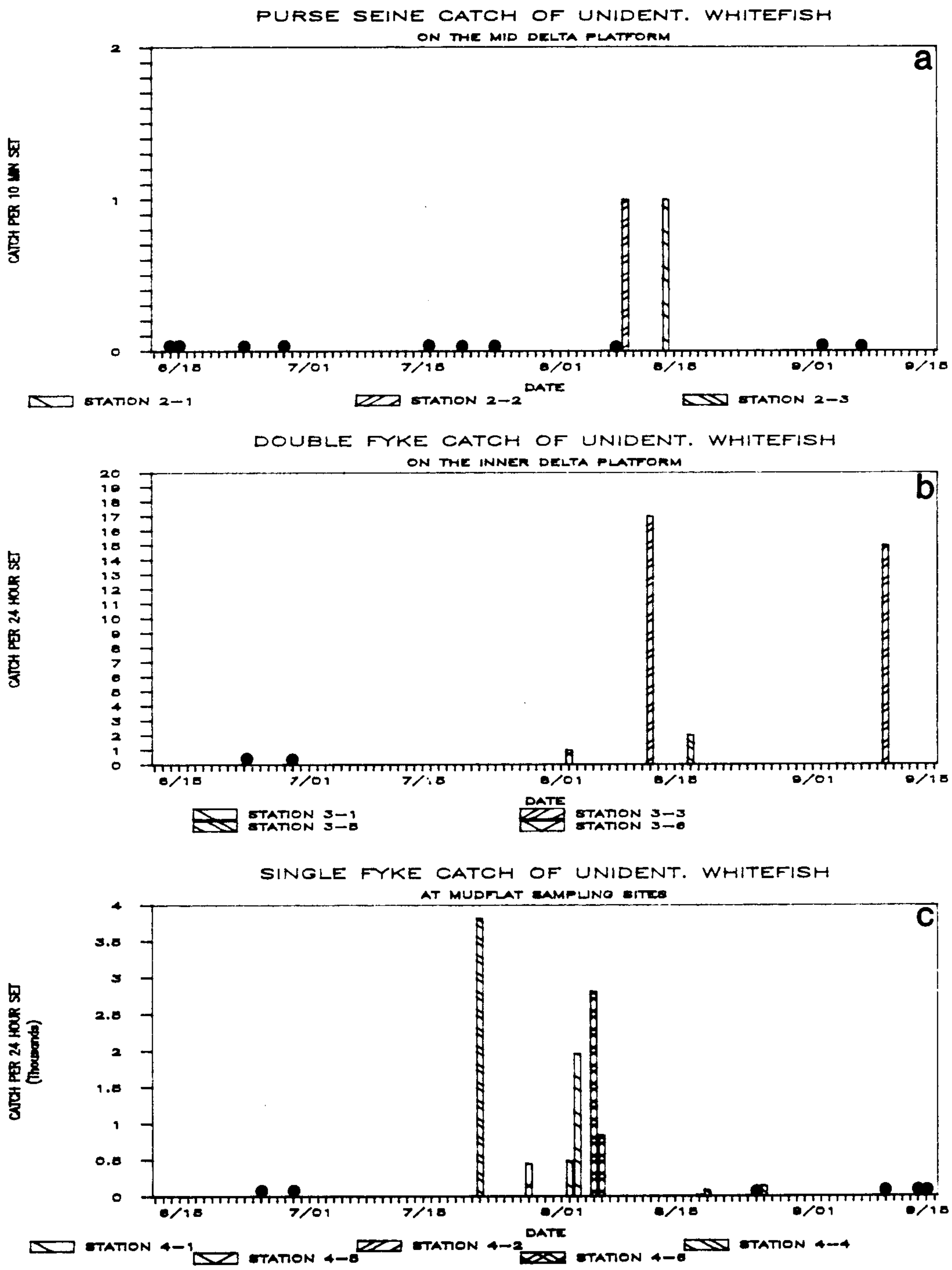


Figure 4-10. Catch Per Unit Effort of Unidentified Whitefish in (a) Mid Delta Platform, (b) Inner Delta Platform, and (c) Mudflat Sampling Sites.

(●) = Effort but no catch.

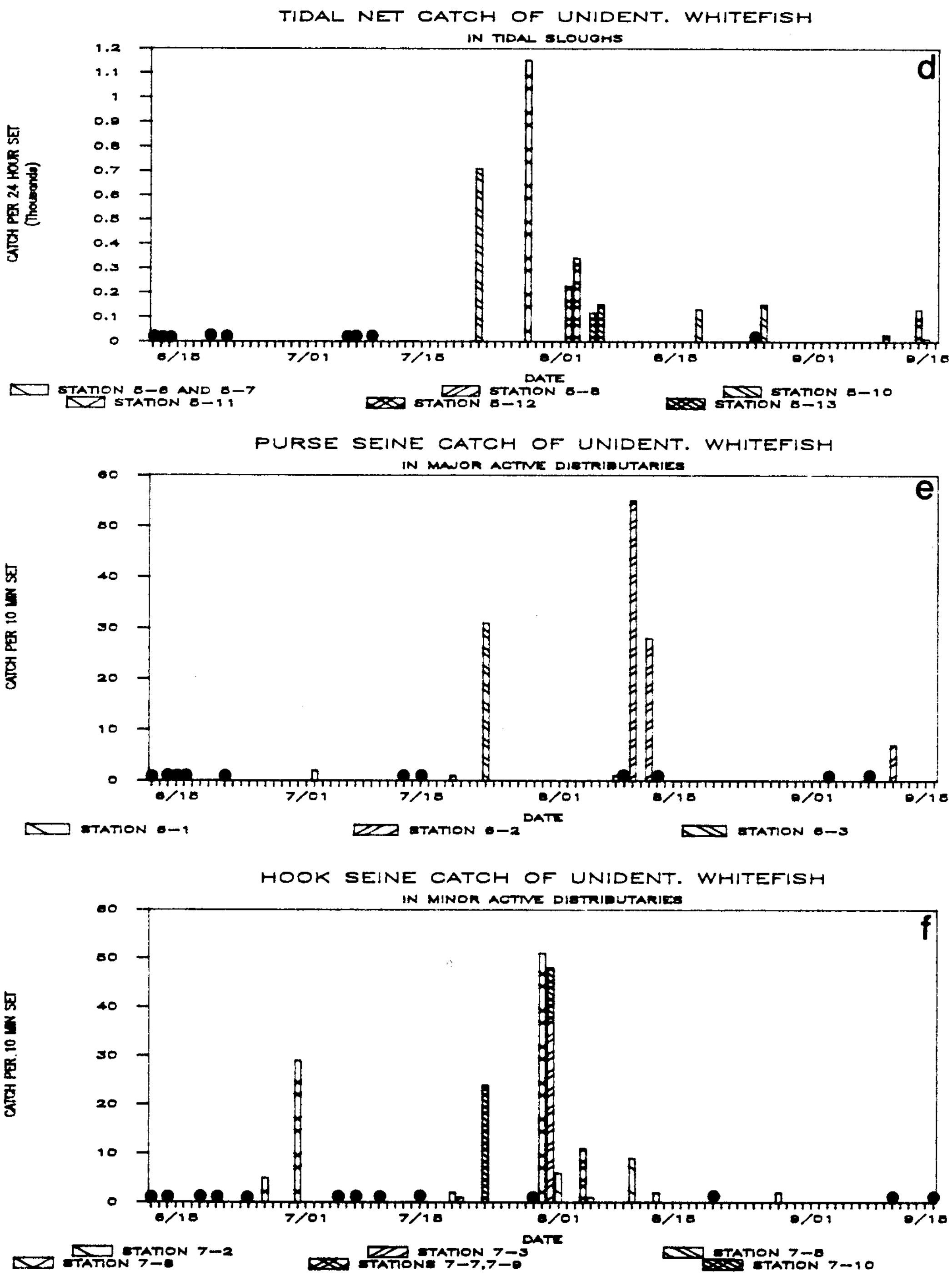


Figure 4-10. Catch Per Unit Effort of Unidentified Whitefish in (d) Tidal Sloughs, (e) Major Active Distributaries, and (f) Minor Active Distributaries.

(●) = Effort but no catch.

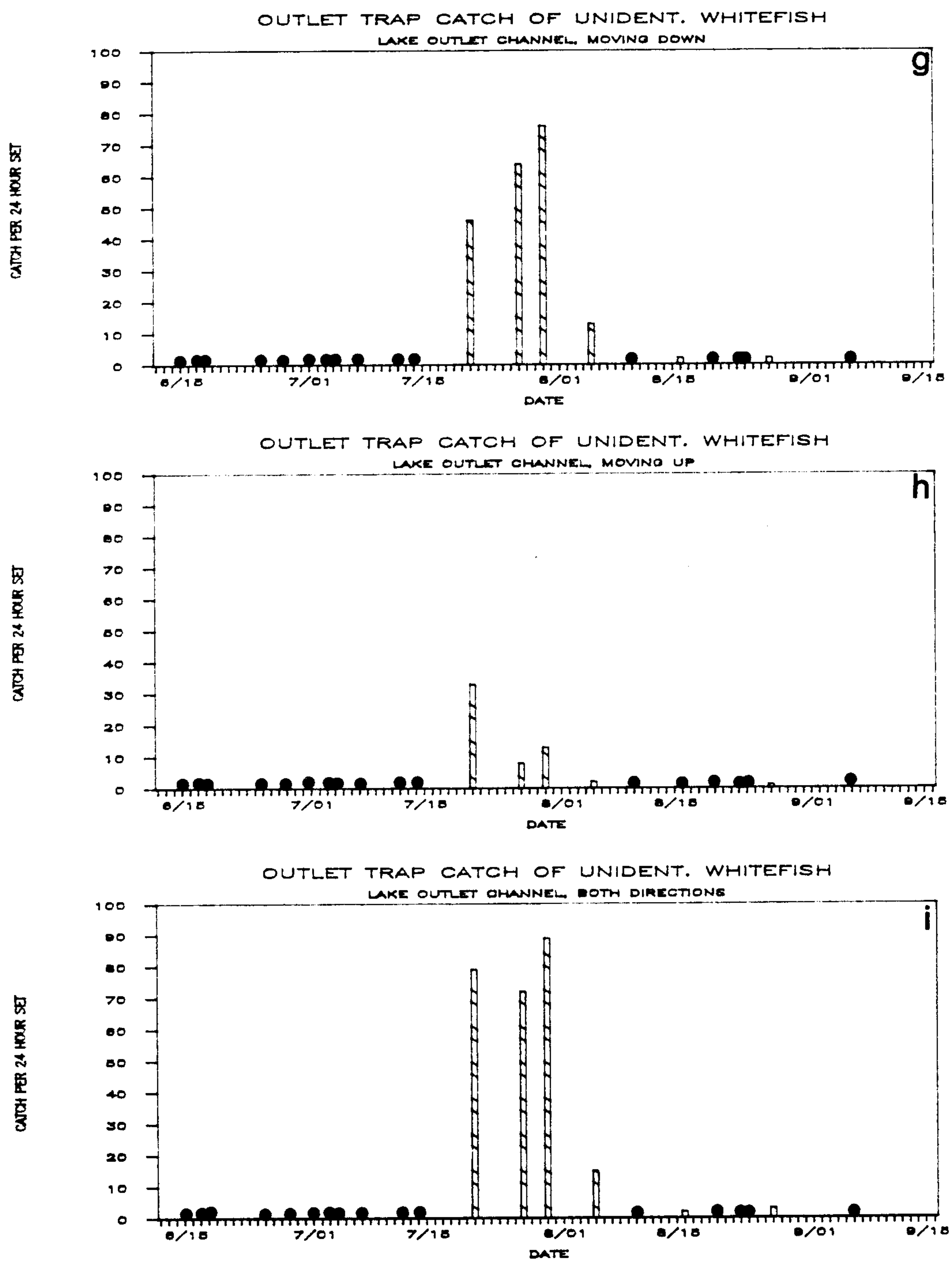


Figure 4-10. Catch Per Unit Effort of Unidentified Whitefish in (g) Lake Outlet Channel, Moving Down, (h) Lake Outlet Channel, Moving Up, and (i) Lake Outlet Channel, Both Directions.

(●) = Effort but no catch.

major habitats except the delta front. Bering cisco had a more restricted distribution which only included inner delta platform, mudflat, tidal slough, and minor active distributary habitats.

The timing of habitat utilization was different between both species of cisco. Bering cisco were virtually absent from all catches until late July (Figure 4-11). From late July to the end of the sampling period, Bering cisco were relatively abundant in tidal slough and mudflat habitats (Figure 4-11b and c) and only occasionally present in the inner delta platform. On the other hand, least cisco were relatively abundant in the mudflat, tidal slough, and minor active distributary habitats before the end of June (Figures 4-12c, d, and f). Catches on the delta platform were low, but cisco were present in this habitat throughout the summer. Fish were most abundant in the mudflat and tidal slough habitats and were observed in these habitats all summer.

Unidentified Cisco

Unidentified cisco were the third most abundant group of fish (6.9 percent of total catch) caught during the summer survey (Table 4-10). Unidentified cisco were similar to the unidentified whitefish in that they occurred simultaneously in all habitats on or about July 25th. Relatively high numbers of cisco occurred in the delta front and delta platform at this time and remained in these habitats throughout the summer (Figure 4-13a, b, and c). Very large numbers of fish were caught in tidal sloughs and mudflats during the same period (Figures 4-13d and e). Unidentified cisco continued to be present in active distributaries during August and September, unlike the declining trend which was observed for unidentified whitefish. Cisco moved into and rapidly out of the lake outlet channel similar to the movements patterns observed for sheefish and unidentified whitefish (Figures 4-13h, i, and j).

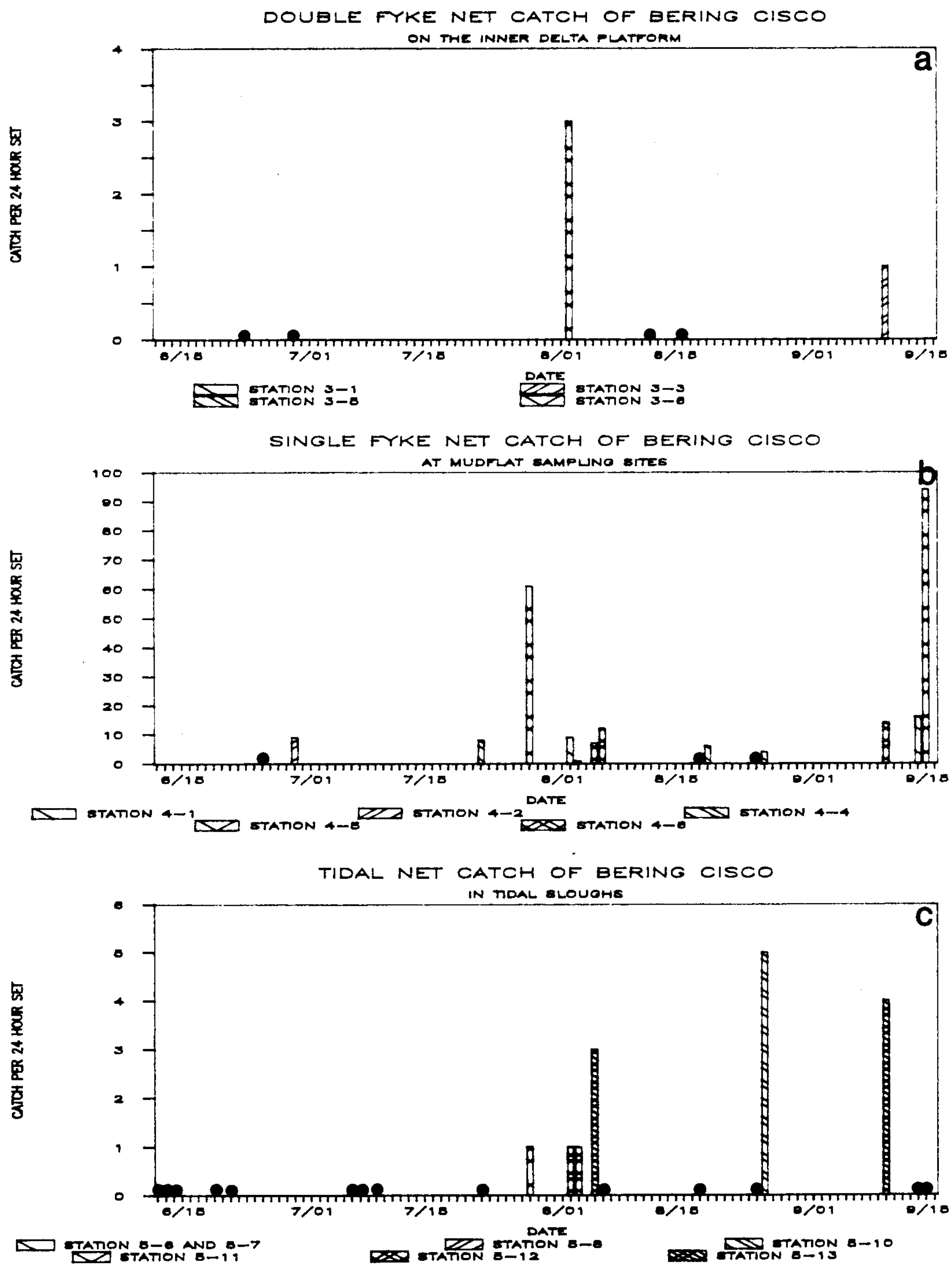


Figure 4-11. Catch Per Unit Effort of Bering Cisco in (a) Inner Delta Platform, (b) Mudflat Sampling Sites, and (c) Tidal Sloughs.

(●) = Effort but no catch.

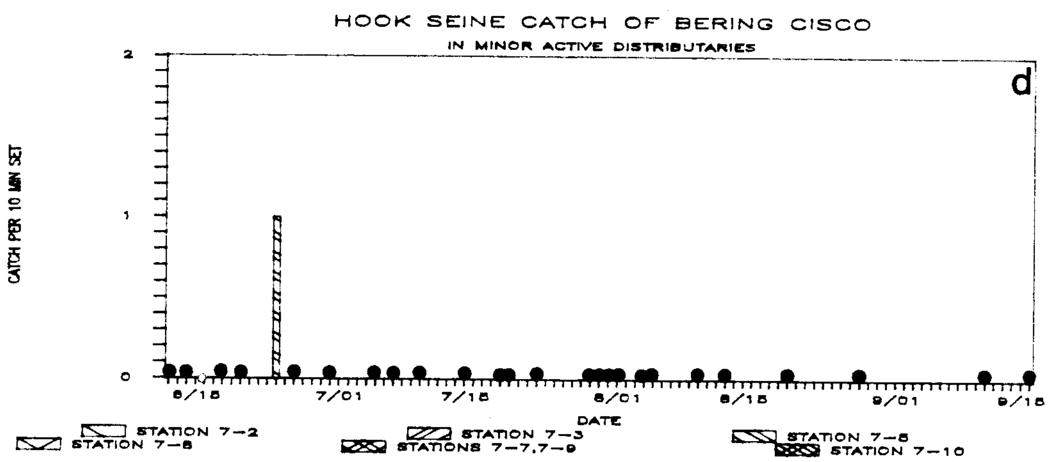


Figure 4-11. Catch Per Unit Effort of Bering Cisco in (d) Minor Active Distributaries.

(●) = Effort but no catch.

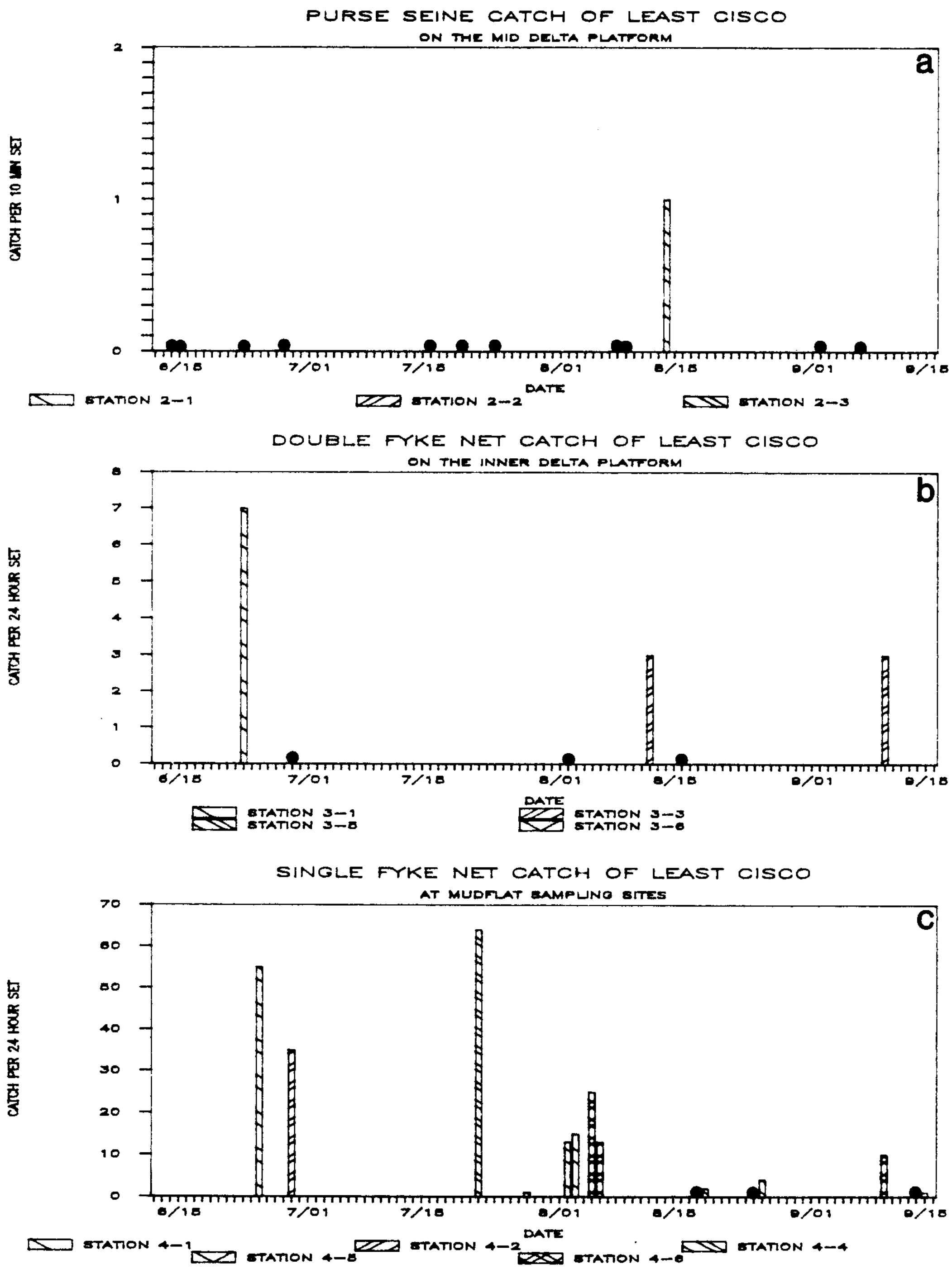


Figure 4-12. Catch Per Unit Effort of Least Cisco in (a) Mid Delta Platform, (b) Inner Delta Platform, and (c) Mudflat Sampling Sites.

(●) = Effort but no catch.

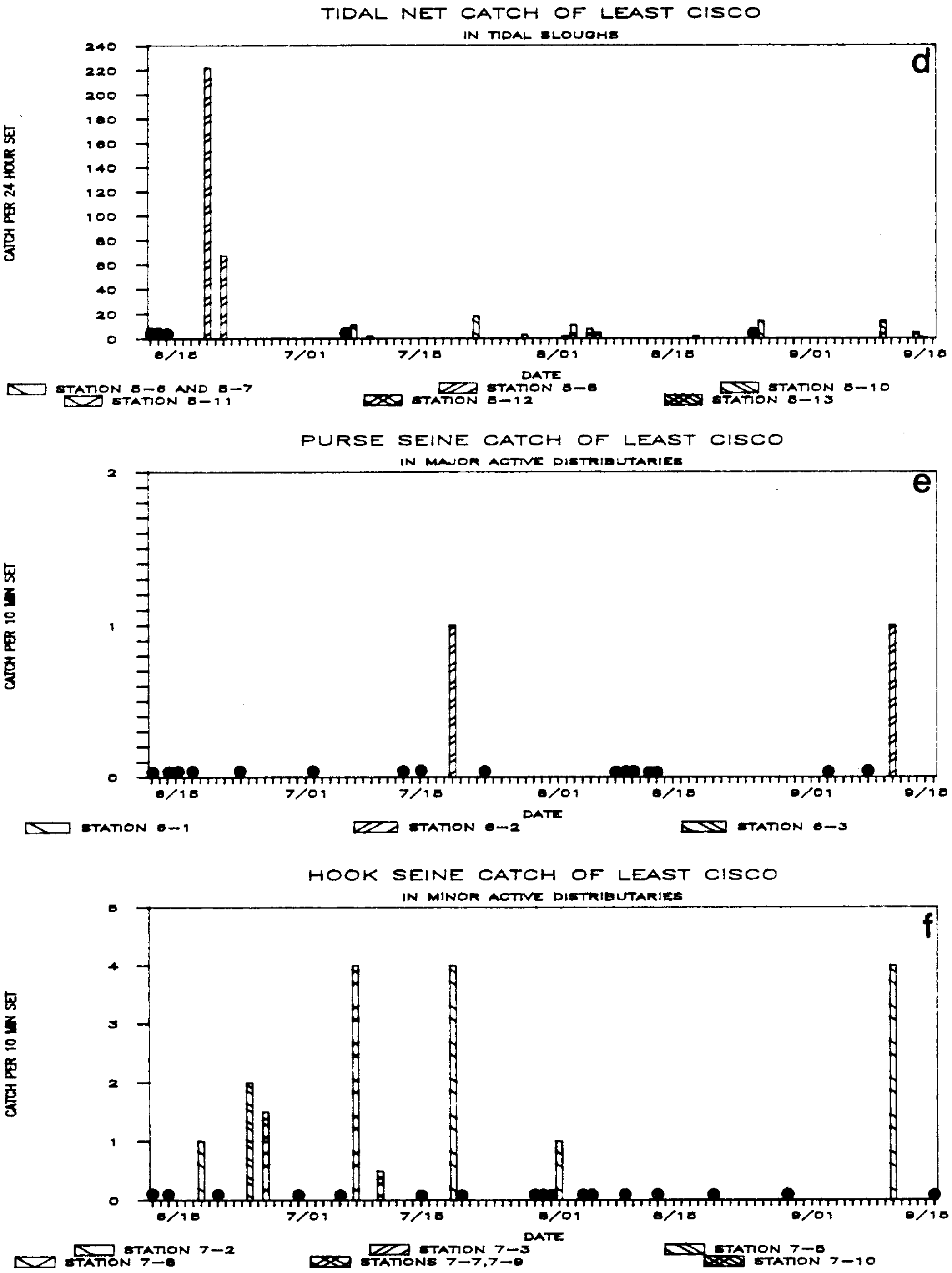


Figure 4-12. Catch Per Unit Effort of Least Cisco in (d) Tidal Sloughs, (e) Major Active Distributaries, and (f) Minor Active Distributaries.

(●) = Effort but no catch.

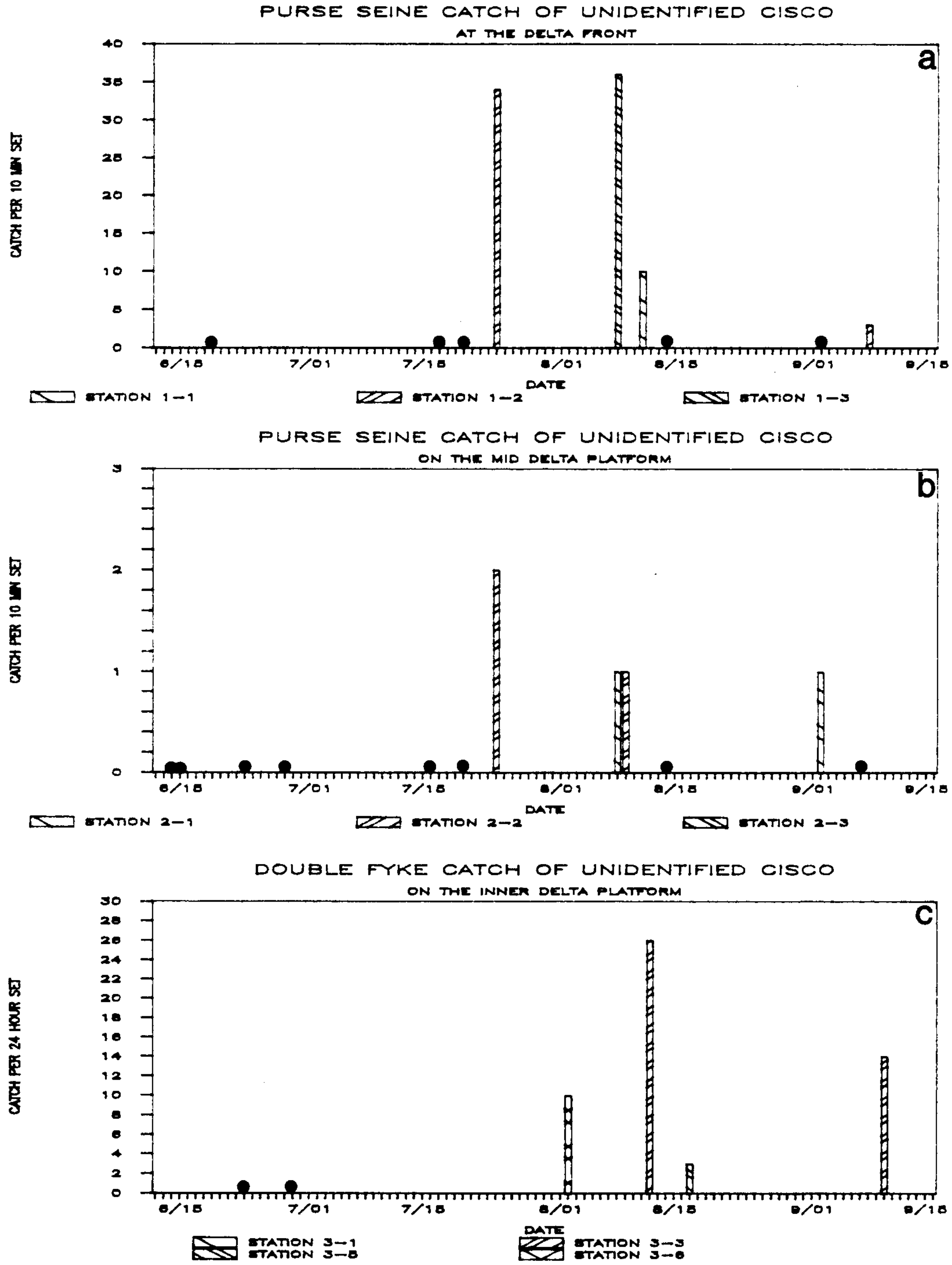


Figure 4-13. Catch Per Unit Effort of Unidentified Cisco in (a) Delta Front, (b) Mid Delta Platform, and (c) Inner Delta Platform.

(●) = Effort but no catch.

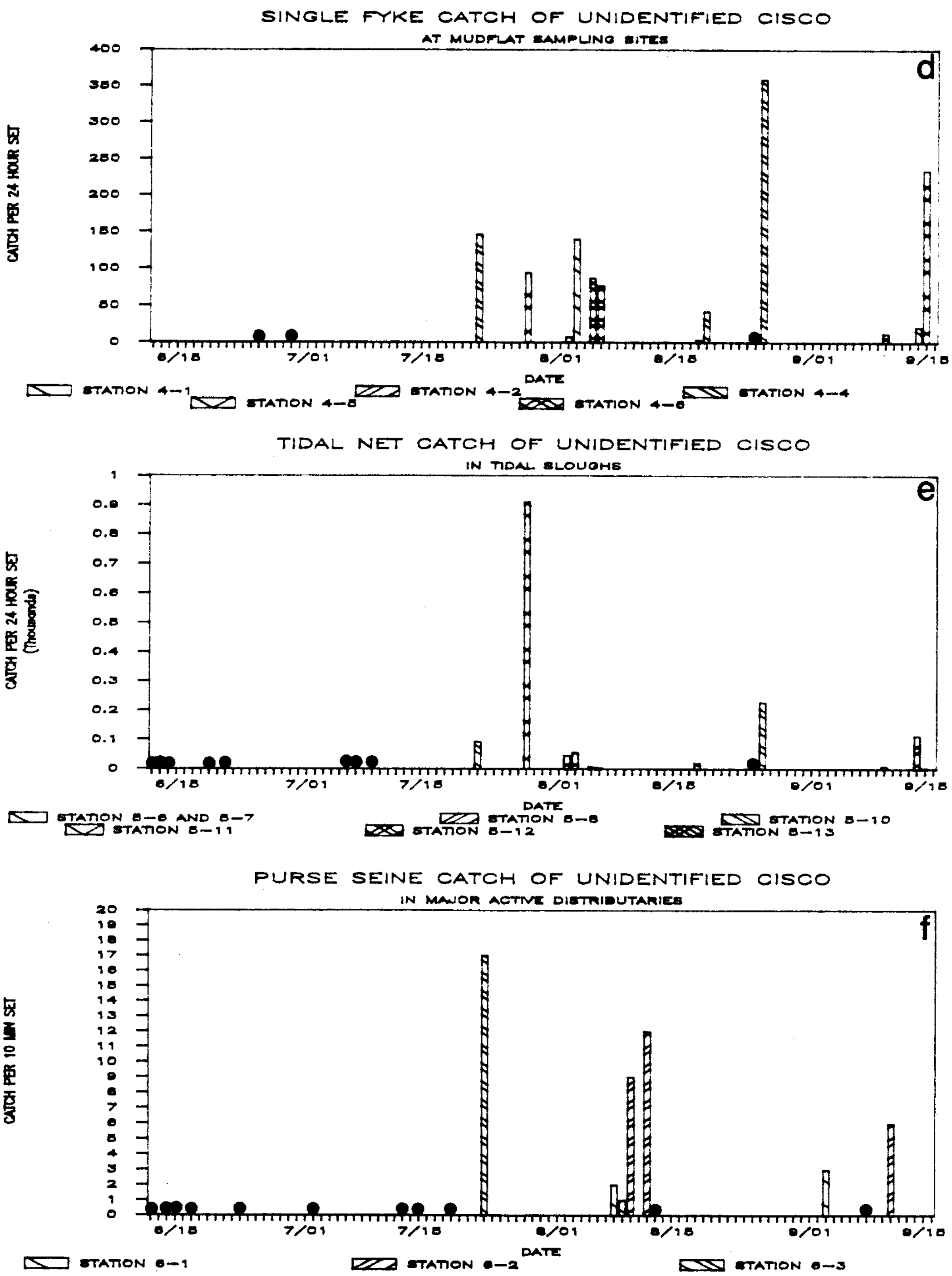


Figure 4-13. Catch Per Unit Effort of Unidentified Cisco in (d) Mudflat Sampling Sites, (e) Tidal Sloughs, and (f) Major Active Distributaries.

(●) = Effort but no catch.

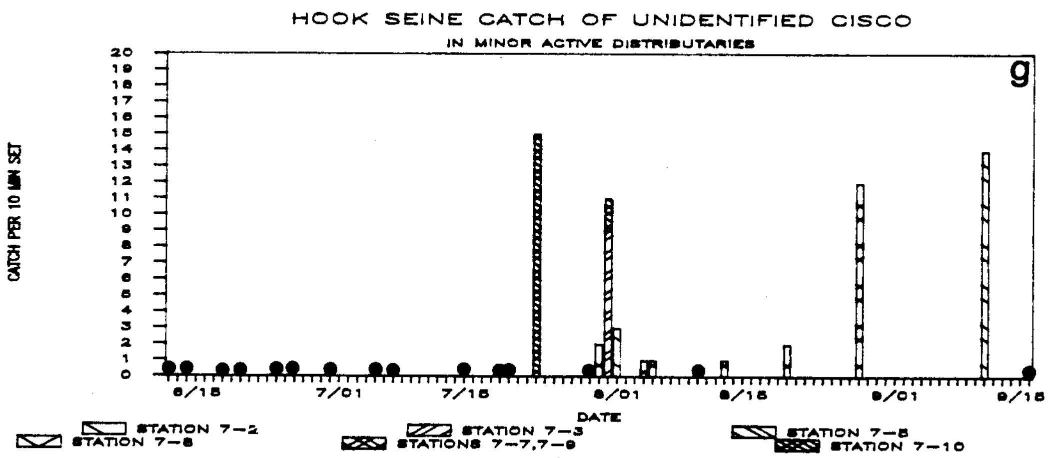


Figure 4-13. Catch Per Unit Effort of Unidentified Cisco in (g) Minor Active Distributaries.

(●) = Effort but no catch.

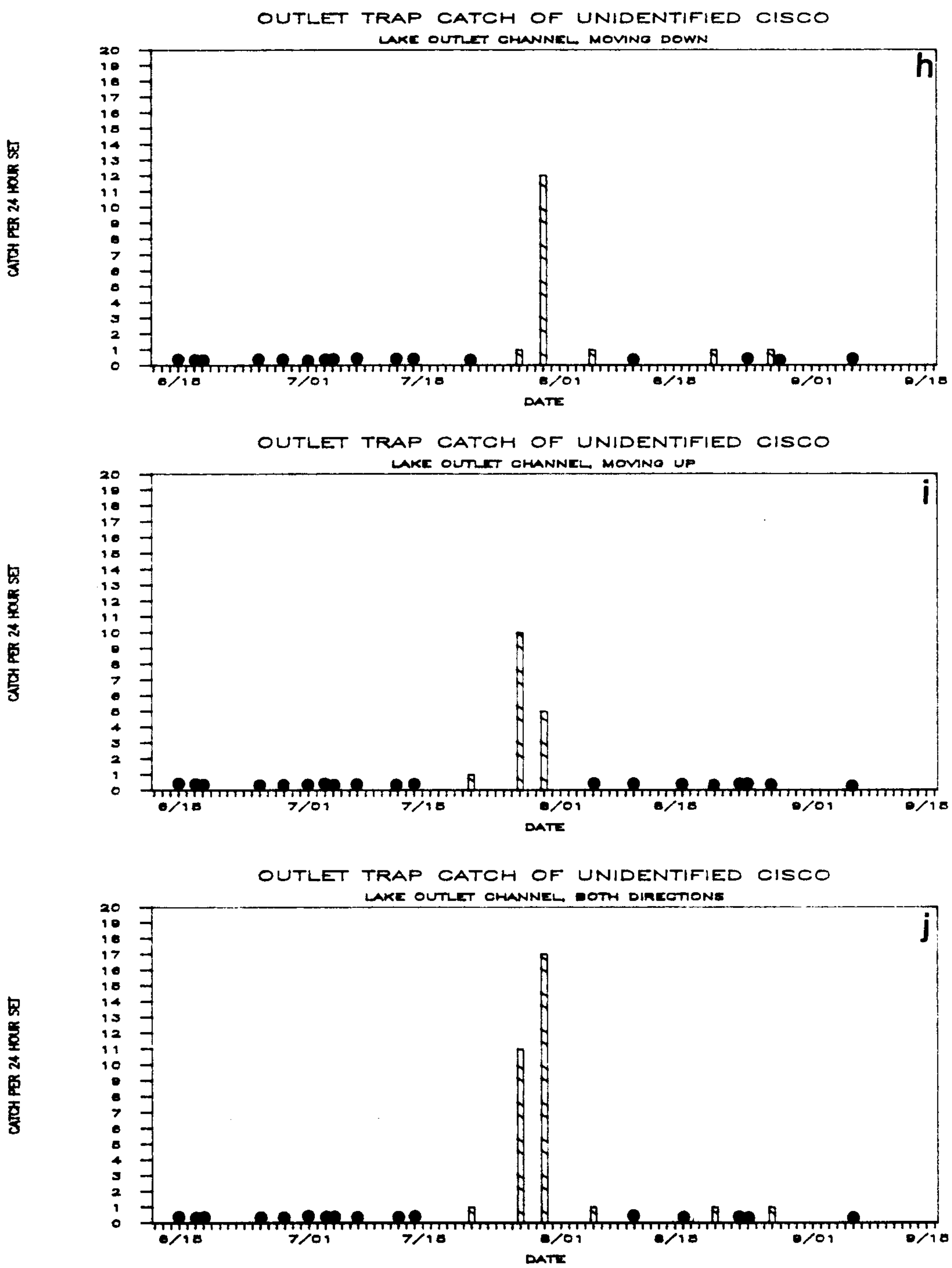


Figure 4-13. Catch Per Unit Effort of Unidentified Cisco in (h) Lake Outlet Channel, Moving Down, (i) Lake Outlet Channel, Moving Up, and (j) Lake Outlet Channel, Both Directions.

(●) = Effort but no catch.

4.4.2.2 Size Composition

Sheefish

Sheefish ranged in size from 10-729 mm in fork length (Appendix C, Table 4). The catch was composed of juvenile and adult size groups of which the young-of-the-year fish were dominant. Juveniles ranged from 30-70 mm in early July and grew rapidly to a size range of 100-150 mm by early September. Catch during late June was almost entirely composed of adult sheefish, whereas, catches during the remainder of the summer were dominated by juvenile fish. Juvenile fish were caught in all habitats, but the large adult fish were found predominantly in mudflat, tidal slough, minor active distributary, and major inactive distributary habits.

Humpback Whitefish

Humpback whitefish ranged in size from 10 to 469 mm in fork length (Appendix C, Table 5). A minimum of five size groups can be identified from the length frequency distribution of which the yearling fish were dominant in abundance. Yearling fish ranged from 70 to 119 mm. Size group ranges for older fish were 120-159 mm, 160-229 mm, 230-299 mm, and greater than 300 mm. Yearling fish were most abundant in tidal slough and mudflat habitats throughout the summer. Larger fish tended to be present in all habitats at all times except in the lake outlet channel where they were only found in late June.

Broad Whitefish

Broad whitefish ranged in size from 80 to 399 mm in fork length (Appendix C, Table 6). Data for length frequency distribution tables were limited. Therefore, the catch could only be broken into yearling fish (90-139 mm) and larger fish (less than 130 mm). Distribution of these size groups was similar to that identified for humpback whitefish.

Unidentified Whitefish

The unidentified whitefish ranged in size from 20 to 239 mm in fork length (Appendix C, Table 7). These fish were comprised of three size groups. Juvenile fish ranged from 30 to 99 mm in early July and from 60 to 109 mm in early September. Yearling fish ranged from 100 to 149 mm and older fish were greater than 150 mm. Juvenile fish were found in delta platform, coastal, active distributary, and lake outlet habitats. With the exception of the delta platform, yearling fish were found in the same habitats as the juveniles.

Bering Cisco

Bering cisco ranged in size from 80 to 439 mm in fork length (Appendix C, Table 8). Data for length frequency distribution were limited by the low catch of Bering cisco. Therefore, a description of the size composition is difficult and interpretations of the results are limited. Nevertheless, two size groups ranging from 130 to 179 mm and from 280 to 319 mm were dominant in the catch. These larger fish were mostly caught in the mudflats and were present in the catch throughout the summer.

Least Cisco

Least cisco ranged in size from 30 to 299 mm in fork length (Appendix C, Table 9). Fish in the size range 70-120 mm were dominant and were most likely comprised of yearlings. Larger fish could not be partitioned into specific size groups. Yearlings were most frequently found in mudflats and tidal sloughs during all time periods. The larger least cisco were present in all habitats during late June-early July, but were restricted to mudflat and tidal slough habitats later in the summer.

Unidentified Cisco

Unidentified cisco ranged in size from 30 to 159 mm in fork length (Appendix C, Table 10) which indicates a predominance of juvenile size fish. Juvenile cisco grew from a modal size of 50-59 mm in late July to a modal size of 80-89 mm in early September. Juvenile cisco occurred in all habitats after mid-July, whereas, larger cisco were mostly found in tidal sloughs.

4.4.3 Non-salmonid Fishes

4.4.3.1 Distribution, Timing, and Abundance

Boreal Smelt

A total of 3,650 boreal smelt were taken from offshore, coastal, and active distributary habitats (Table 4-10). The majority were caught in June (1,993 fish). Catches in July, August, and September were 324, 1104, and 229 respectively. All fish caught in September were from the delta front. The majority of the mid-delta fish were taken in July, and most of the fish from the inner delta and mud flats in August. The majority of the coastal sloughs and major and minor active distributary fish were caught in June.

Most of the boreal smelt were caught in 10 minute purse seine sets in the delta front and mid-delta (Figure 4-14). The largest purse seine catch per unit effort (CPUE) occured in the delta front where a 10 minute set yielded 930 fish (Figure 4-14a). The CPUE of six other sets in the delta front produced 50 to 380 fish during the survey. Only one purse seine set in the mid-delta produced a large CPUE (243 fish), and very few boreal smelt were caught with this gear in the major active distributaries. The 24 hour double fyke net in the inner delta platform yielded a substantial CPUE of 49 and 273 fish on two occasions (Figure 4-11c). Small catches of boreal smelt were produced from 24

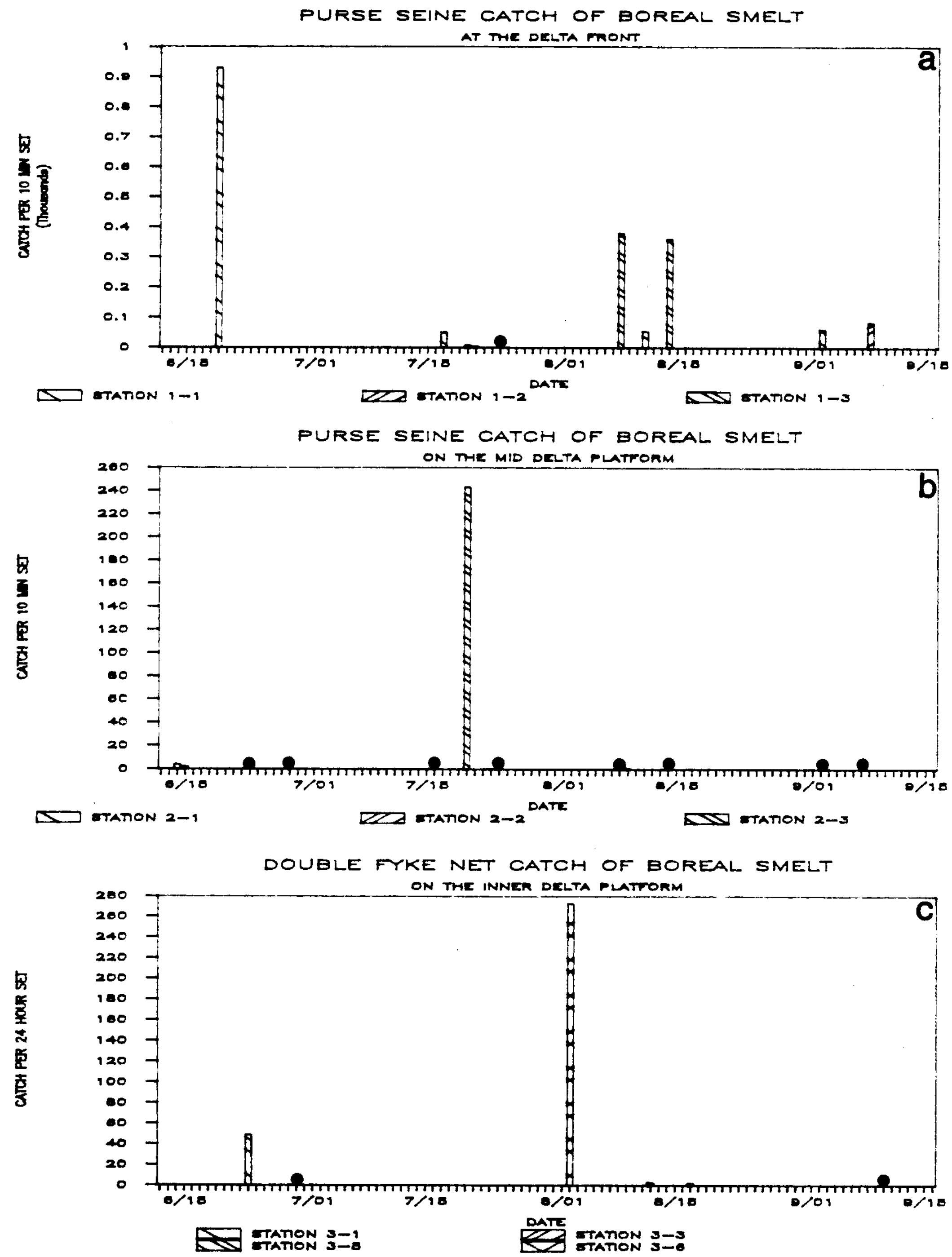


Figure 4-14. Catch Per Unit Effort of Boreal Smelt in (a) Delta Front, (b) Mid Delta Platform, and (c) Inner Delta Platform.

(●) = Effort but no catch.

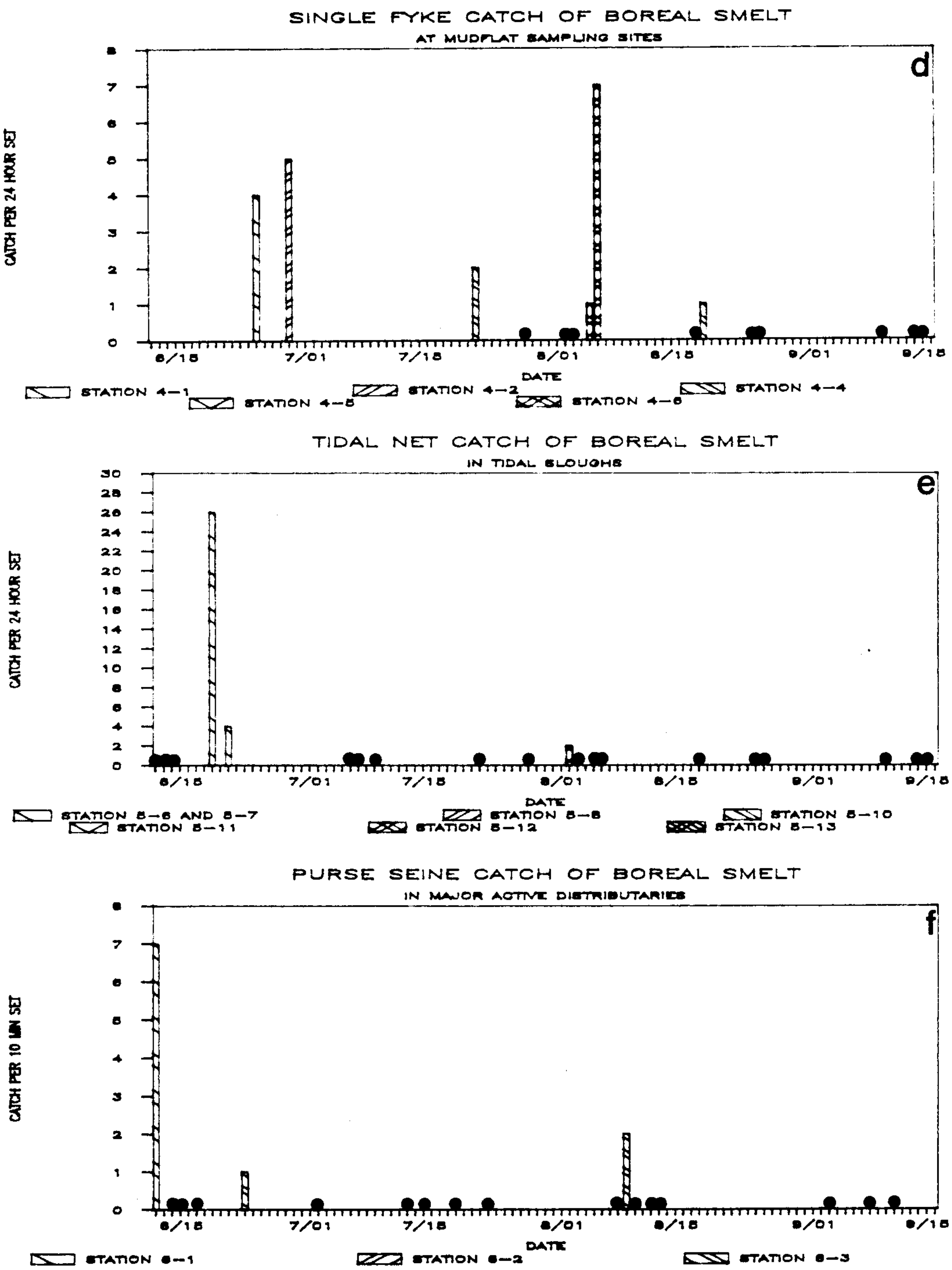


Figure 4-14. Catch Per Unit Effort of Boreal Smelt in (d) Mudflat Sampling Sites, (e) Tidal Sloughs, and (f) Major Active Distributaries.

(●) = Effort but no catch.

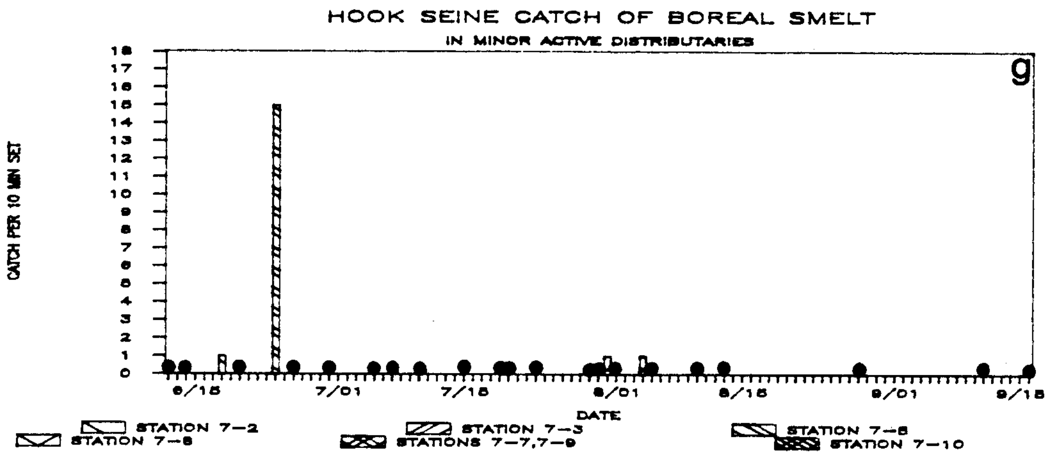


Figure 4-14. Catch Per Unit Effort of Boreal Smelt in (g) Minor Active Distributaries.

(●) = Effort but no catch.

hour single fyke net sets in the mud flats, from the coastal sloughs with tidal net sets, and in 10-minute hook seine sets in minor active distributary habitats (Figures 4-14d, e, f, and g).

Pond Smelt

Pond smelt were not as abundant as boreal smelt but were collected in most of the same habitats (Table 4-10). The greatest number of pond smelt were caught in September, followed by August, and only a few in June and July. During June and July, pond smelt were absent from all habitats except the tidal slough (Figure 4-15) and the minor active distributaries. In contrast, pond smelt were present in all habitats except the tidal slough during August and September.

The 10-minute purse seine sets in the delta front produced the most pond smelt (Figure 4-15a). In this habitat the CPUE in three different seine sets yielded 51 to 116 fish. Purse seine sampling effort in the mid-delta platform and major active distributaries produced only low catches, as did the single fyke net sets in the mudflat habitats (Figures 4-15b, d, and f). The double fyke net sets in the inner delta platform produced low CPUE, the largest being 18 fish. A CPUE of 53 fish occurred in one 24 hour tidal net set in the coastal sloughs, and this was the only substantial catch from this habitat (Figure 4-15e). One of the hook seine sets in the minor active distributary habitats produced a CPUE of 32 fish (Figure 4-15g).

Unidentified Smelt

A total of 1,869 unidentified smelt were taken from four habitats which were representative of the delta platform and active distributary environments (Table 4-10). These smelt were likely composed of juvenile pond and/or boreal smelt which were migrating downstream. The majority of the unidentified smelt were caught in August (1,778 fish) and most were taken from the minor active distributary habitat with hook seine sampling gear (Figure 4-16). Few were taken from the major active distributaries with the purse seine (Fig. 4-16 c and d).

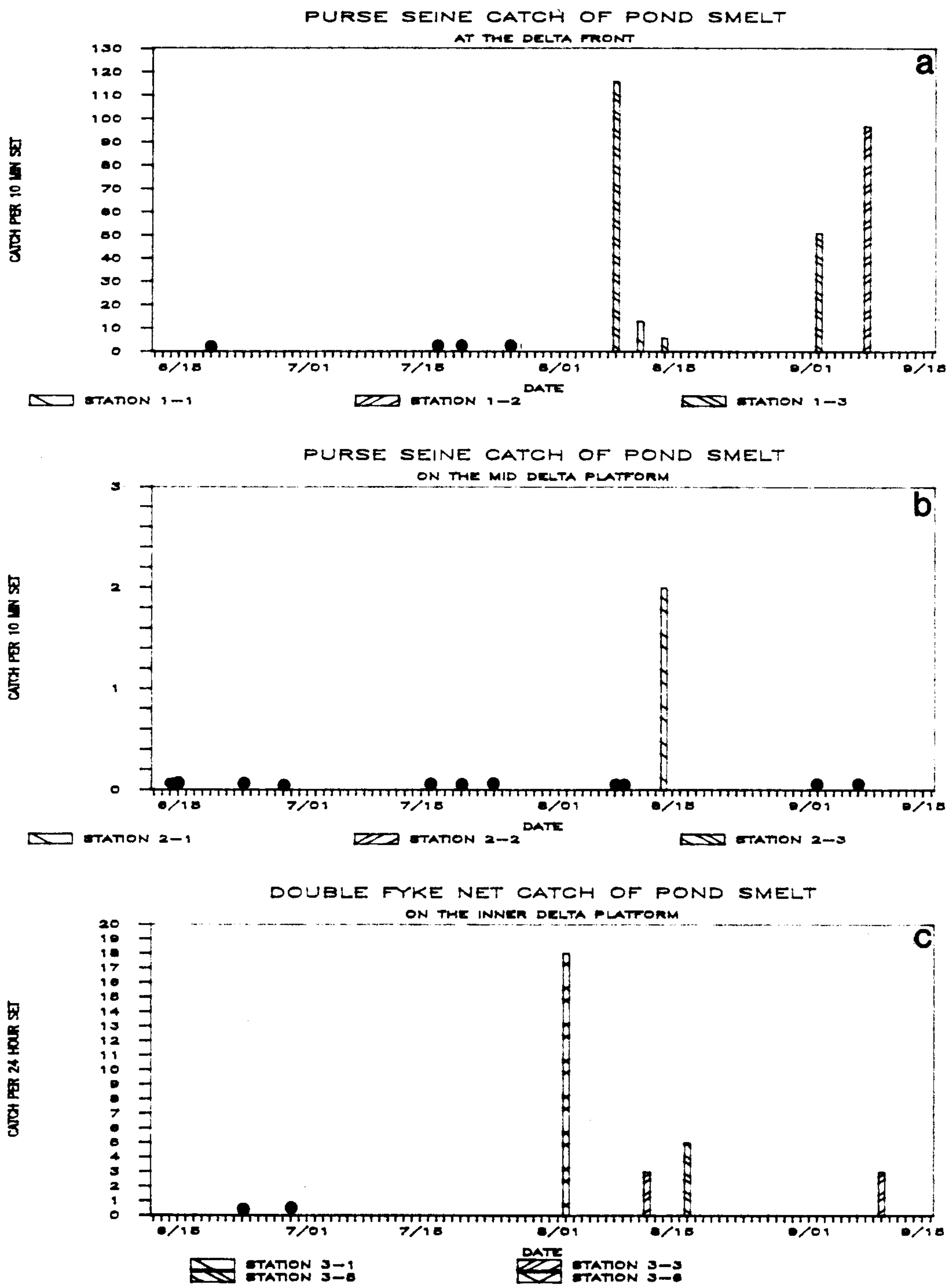
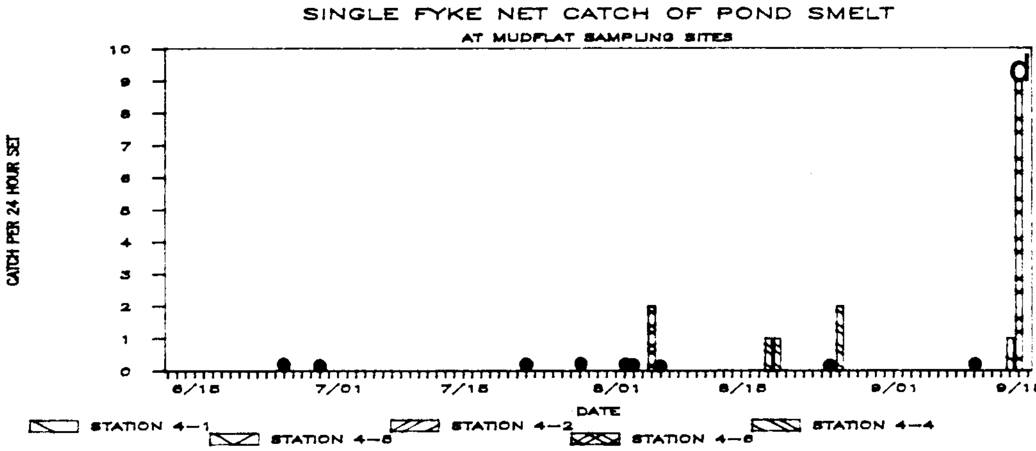
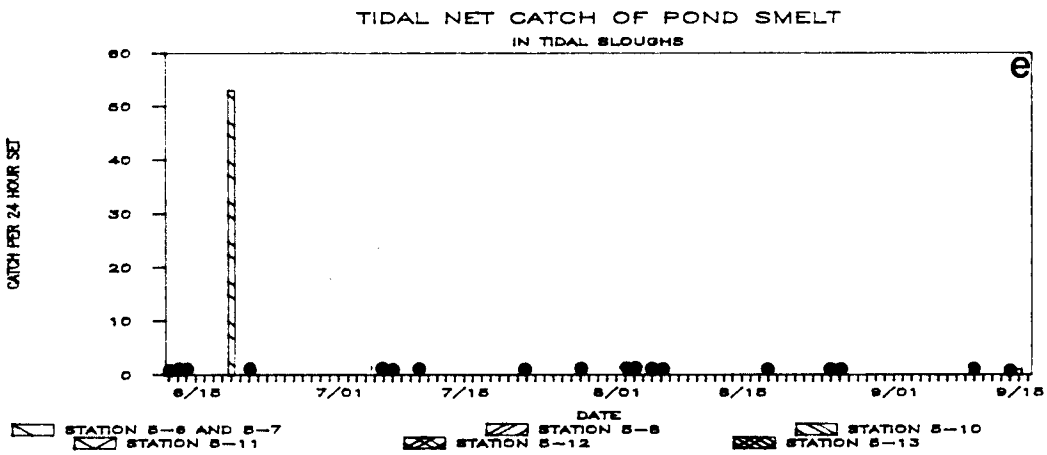


Figure 4-15. Catch Per Unit Effort of Pond Smelt in (a) Delta Front, (b) Mid Delta Platform, and (c) Inner Delta Platform.

(●) = Effort but no catch.





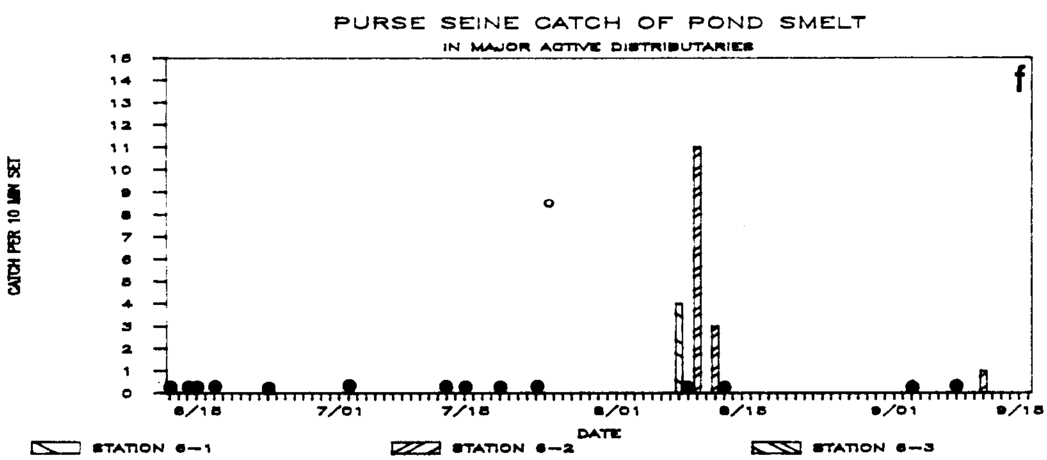


Figure 4-15. Catch Per Unit Effort of Pond Smelt in (d) Mudflat Sampling Sites, (e) Tidal Sloughs, and (f) Major Active Distributaries.

(●) = Effort but no catch.

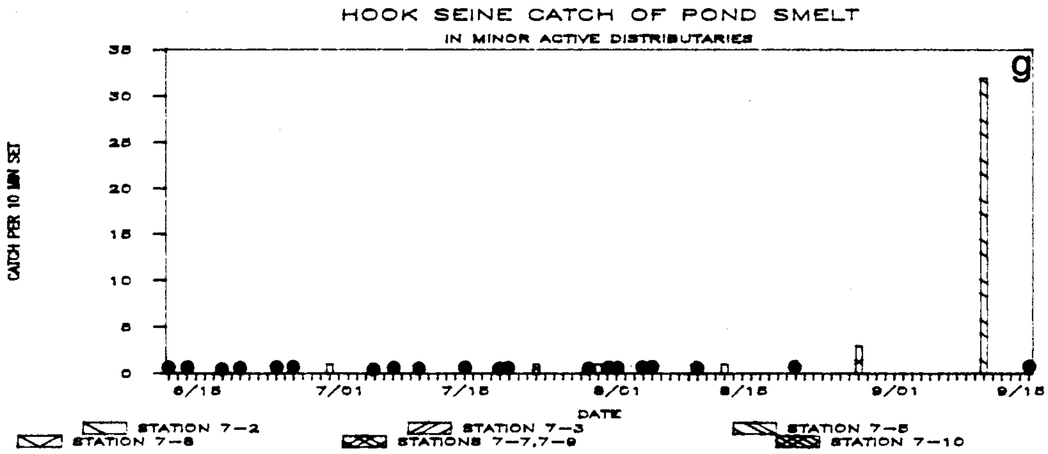


Figure 4-15. Catch Per Unit Effort of Pond Smelt in (g) Minor Active Distributaries.

(⊖) = Effort but no catch.

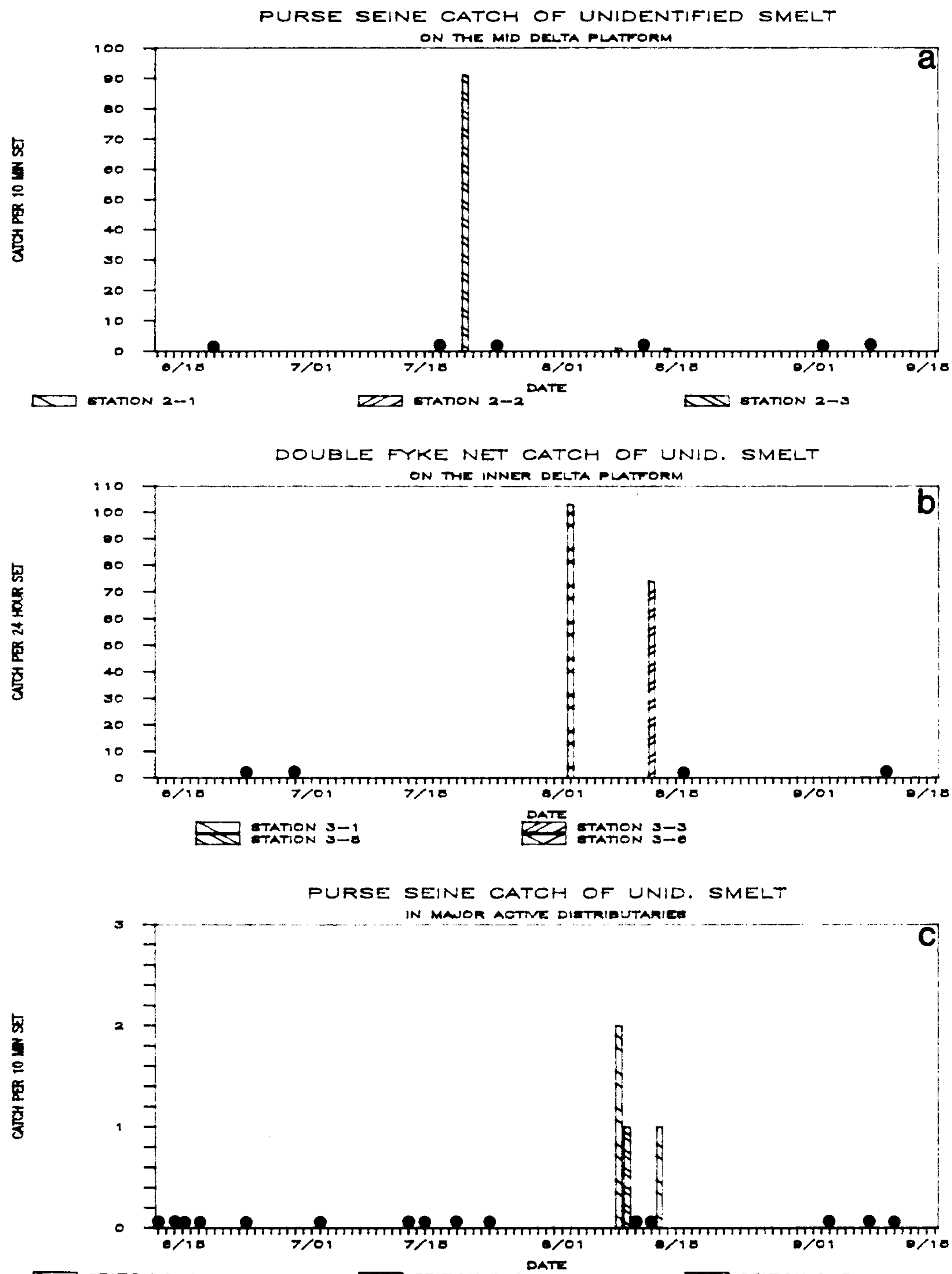


Figure 4-16. Catch Per Unit Effort of Unidentified Smelt in (a) Mid Delta Platform, (b) Inner Delta Platform, and (c) Major Active Distributaries.

(●) = Effort but no catch.

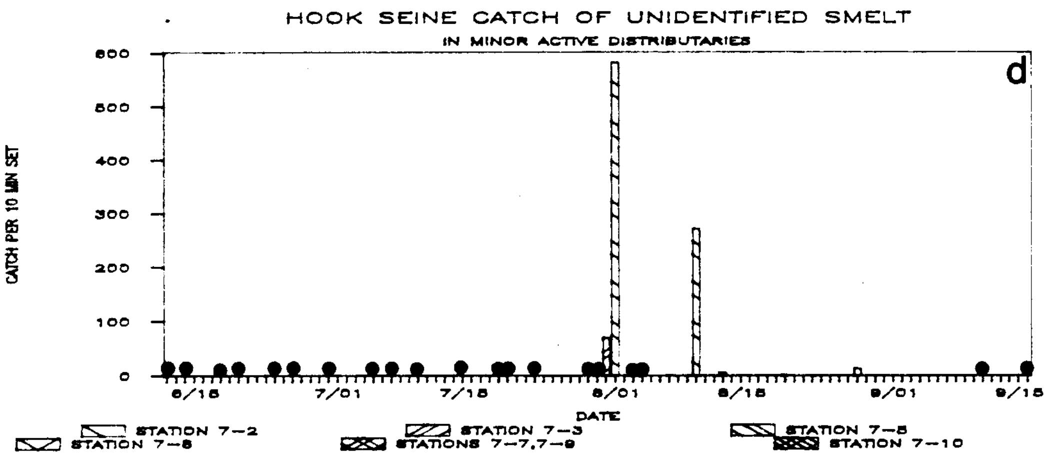


Figure 4-16. Catch Per Unit Effort of Unidetnfied Smelt in (d) Minor Active Distributaries.

(●) = Effort but no catch.

Double fyke nets in the inner delta produced a CPUE of 74 and 103 fish on two separate 24-hour sets (Fig. 4-16d). Catches of unidentified smelt were not recorded because most fish after early August were not large enough for positive identification at this time.

Ninespine Stickleback

This species was the most ubiquitous of the non-salmonids surveyed during the summer of 1985. A total of 2,926 fish were found in 10 of the 13 habitat types surveyed (Table 4-10). Sticklebacks were most abundant in the nearshore and offshore habitats, and the greatest catches occurred during August and September (Appendix B).

Arctic Lamprey

A total of 32 Arctic lamprey were taken during the summer. None were taken after July and all were collected from active distributary, coastal, and offshore habitats (Table 4-10).

Longnose Sucker

The longnose sucker was one of the most omnipresent non-salmonid species caught through the summer of 1985. A total of 106 suckers were found in 8 of the 13 habitat types surveyed (Table 4-10). Most of the suckers from the mudflats, coastal sloughs, and minor active distributaries were caught in August. The suckers from the minor and major inactive distributaries were caught in June.

Northern Pike

The northern pike was widely distributed and was found in the same habitats as were the longnose sucker. A total of 102 pike were found in 8 of the 13 habitat types surveyed (Table 4-10). The greatest number of pike were caught in August (45 fish), followed by 31 in July and 26 in June. No pike were caught in September.

Burbot

Burbot were widely distributed among inner delta and coastal habitats (Table 4-10). Most of the burbot from the inner delta, lake outlet, coastal sloughs, and mudflats were taken in August. The majority of burbot taken from a minor active distributary were caught in July (770 fish), and a small number (174) were taken in August.

The purse seine sampling gear produced small catches of burbot in the major active distributaries (Figure 4-17). Relatively small catches were produced from 24-hour single fyke net sets in the mudflats and minor inactive distributaries, from tidal net sets in the coastal sloughs, and lake outlet traps. The largest CPUE of burbot occurred in the minor active distributaries where seven different 10 minute hook seine sets produced 20 to 146 fish. Several other sets in this habitat yielded smaller CPUE. The CPUE in the inner delta platform was dominated by one double fyke net set that produced 53 fish.

Alaska Blackfish

The majority of the blackfish were caught in the lake outlet channel or the landlocked lakes. Most fish were caught in August.

Trout Perch

Only nine trout perch were caught throughout the summer of 1985 (Table 4-10). They were caught primarily in a lake outlet in early July. Only one was caught in a minor active distributary in late June.

Starry Flounder

Starry flounder were found in offshore, coastal and active distributary habitats (Table 4-10). Most fish were caught in July and August, and most were caught in the mudflat and tidal slough habitats.

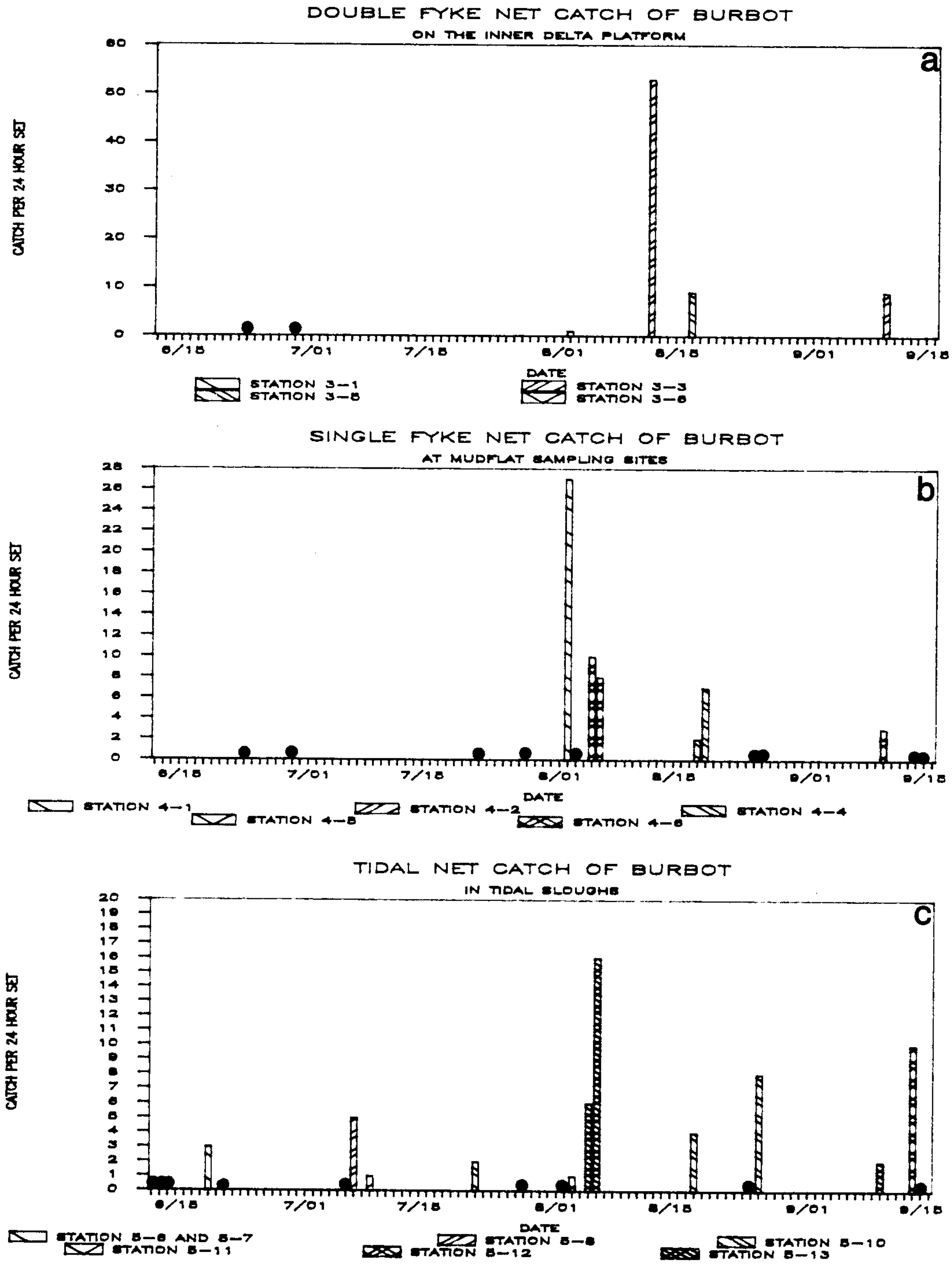


Figure 4-17. Catch Per Unit Effort of Burbot in (a) Inner Delta Platform, (b) Mudflat Sampling Sites, and (c) Tidal Sloughs.

(●) = Effort but no catch.

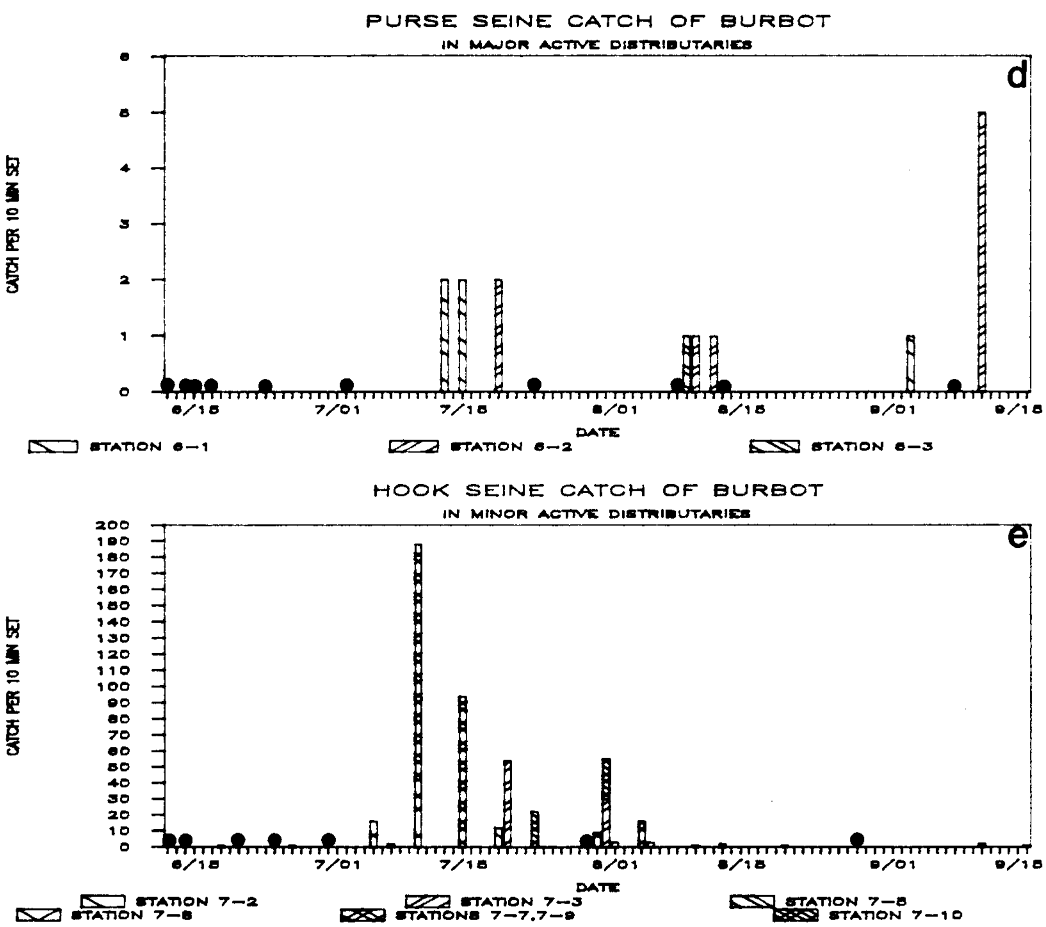


Figure 4-17. Catch Per Unit Effort of Burbot in (d) Major Active Distributaries and (e) Minor Active Distributaries.

(●) = Effort but no catch.

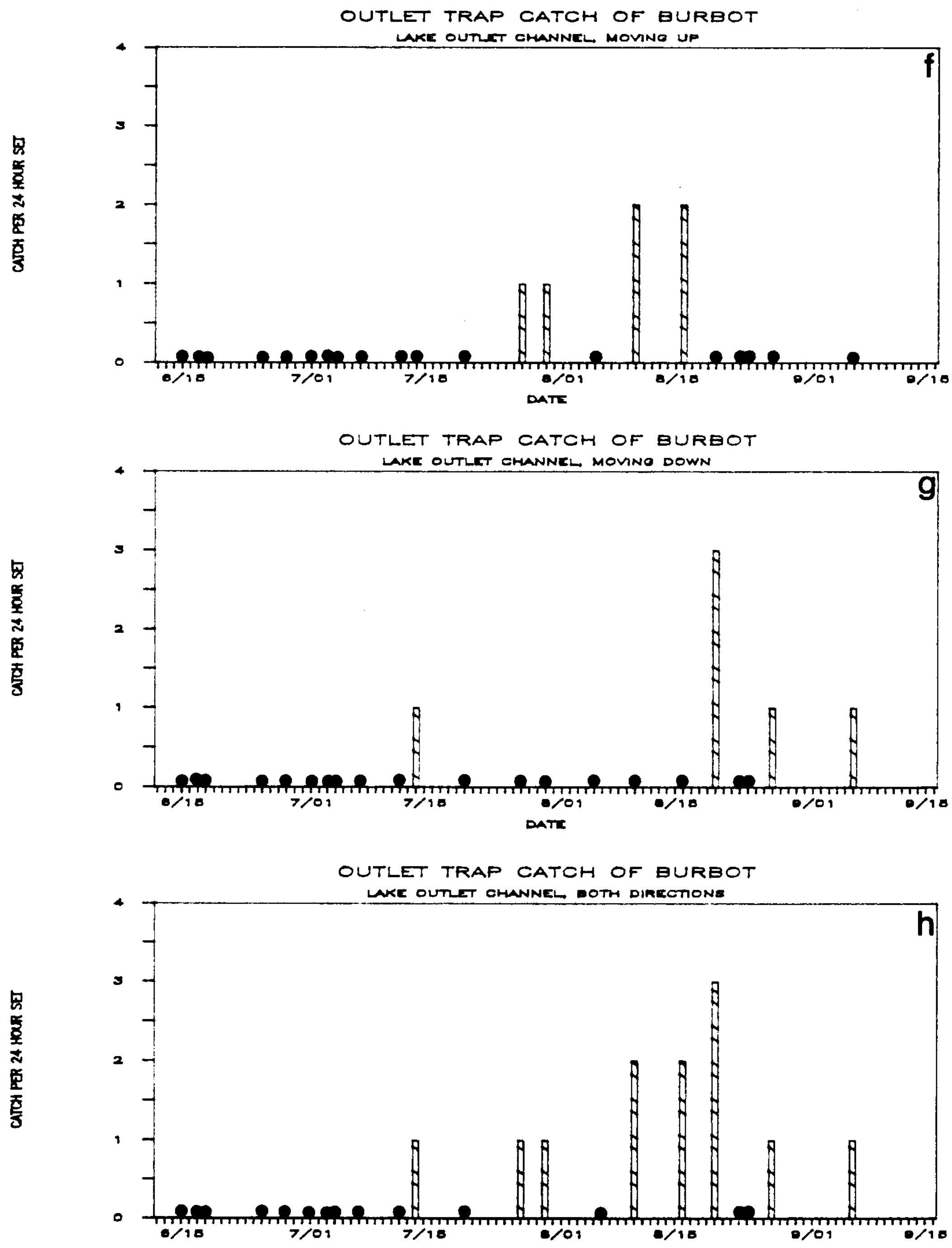


Figure 4-17. Catch Per Unit Effort of Burbot in (f) Lake Outlet Channel, Moving Up, (g) Lake Outlet Channel, Moving Down, and (h) Lake Outlet Channel, Both Directions.

(●) = Effort but no catch.

The 10-minute purse seine sets in the mid-delta platforms and the double fyke sets in the inner delta platforms produced low CPUE (Figure 4-18). The hook seine sets in the minor active distributaries also produced low catches. The largest catches of starry flounder were produced from single fyke nets in the mudflat habitats. The CPUE in six different sets yielded 21 to 190 fish. The tidal net sets in the coastal slough habitats also produced a moderate number of fish. The largest tidal net CPUE from this habitat was 33 fish, and five other sets produced 7 to 30 fish.

Arctic Flounder

The distribution of Arctic flounder was similar to that for starry flounder. Flounder were caught in six habitats with the majority of the catch occurring in the nearshore environment (Table 4-10). All 8 individuals from the delta front were caught in August. Most of the fish from the mid-delta were caught in August and September. All the fish from the inner delta were taken in August. The majority of Arctic flounder taken in the mudflats and coastal sloughs were caught in July (Figure 4-19).

Low catches in the delta front and mid-delta platform were produced from 10 minute purse seine sets (Figure 4-19). Double fyke nets yielded catches of 210 and 369 Arctic flounder in 24-hour sets in two different samples of the inner delta platform. The CPUE of single fyke nets in the mud flat habitats was fairly large as 74 to 138 fish were caught in four different 24 hour sets and smaller numbers were taken in other sets. The tidal net sampling gear produced the largest catches of Arctic flounder, as 26 to 317 fish in 24-hour sets were caught on four different sets. A low CPUE was yielded by the hook seine sets in the minor active distributaries.

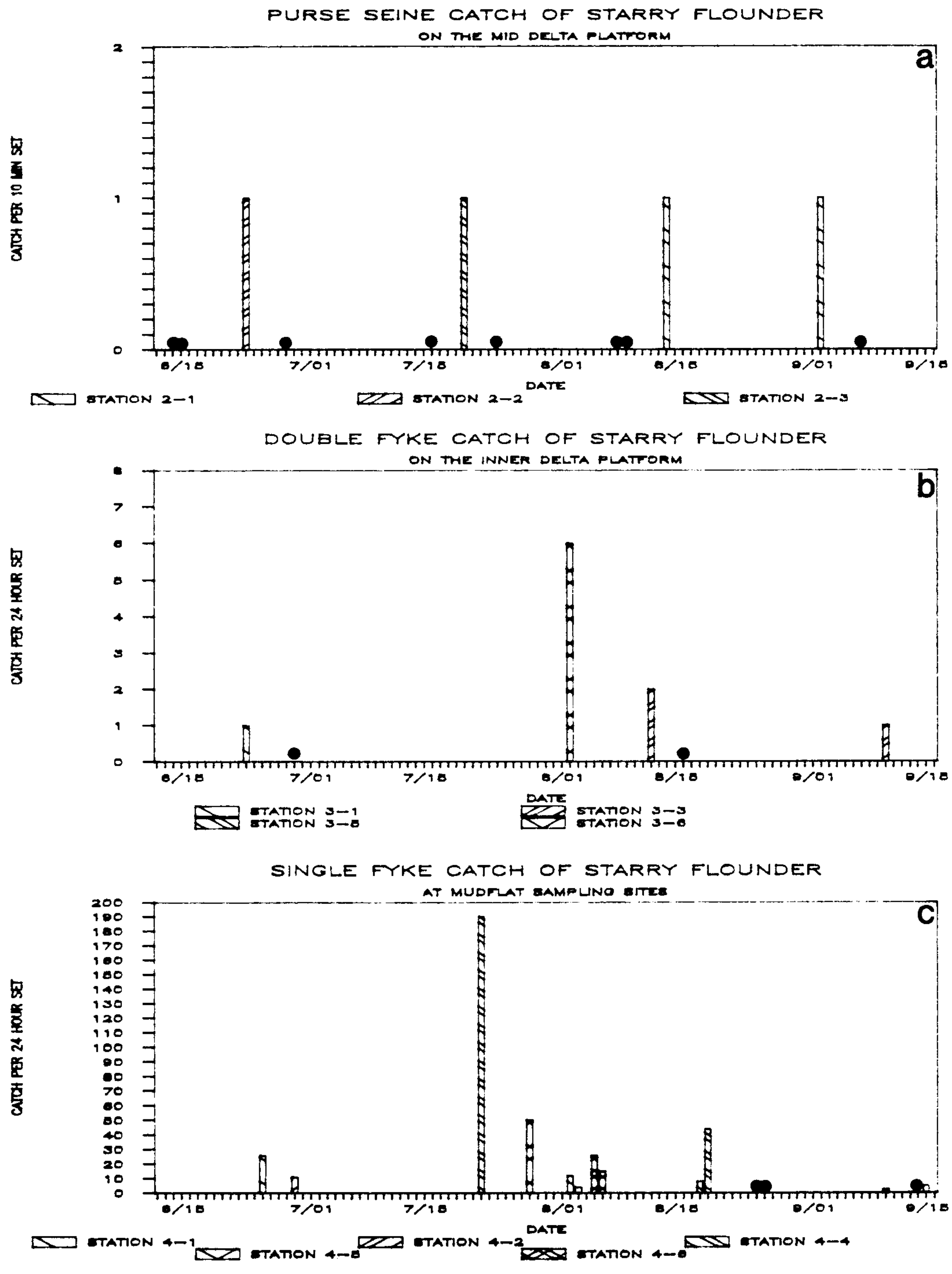


Figure 4-18. Catch Per Unit Effort of Starry Flounder in (a) Mid Delta Platform, (b) Inner Delta Platform, and (c) Mudflat Sampling Sites.

(●) = Effort but no catch.

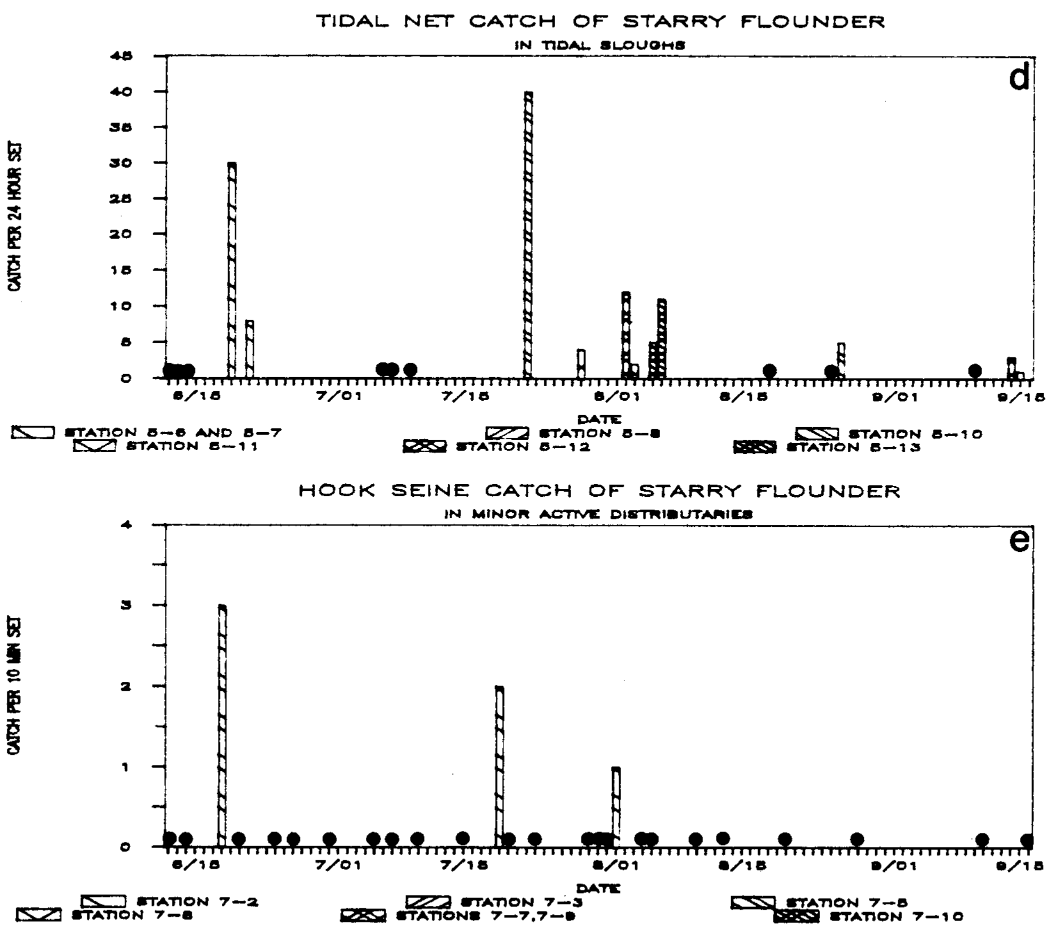


Figure 4-18. Catch Per Unit Effort of Starry Flounder in (d) Tidal Sloughs, and (e) Minor Active Distributaries.

(●) = Effort but no catch.

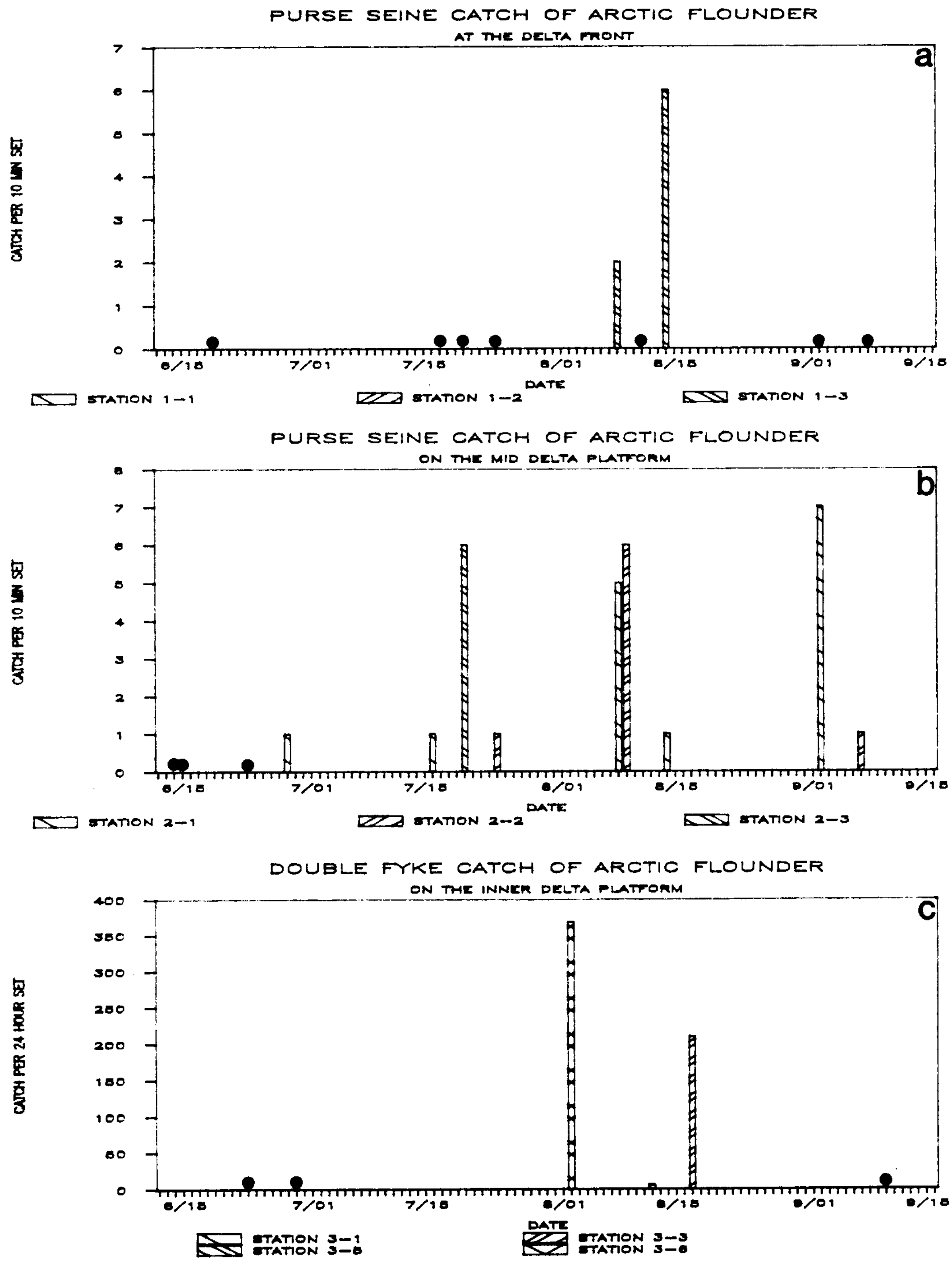


Figure 4-19. Catch Per Unit Effort of Arctic Flounder in (a) Delta Front, (b) Mid Delta Platform, and (c) Inner Delta Platform.

(●) = Effort but no catch.

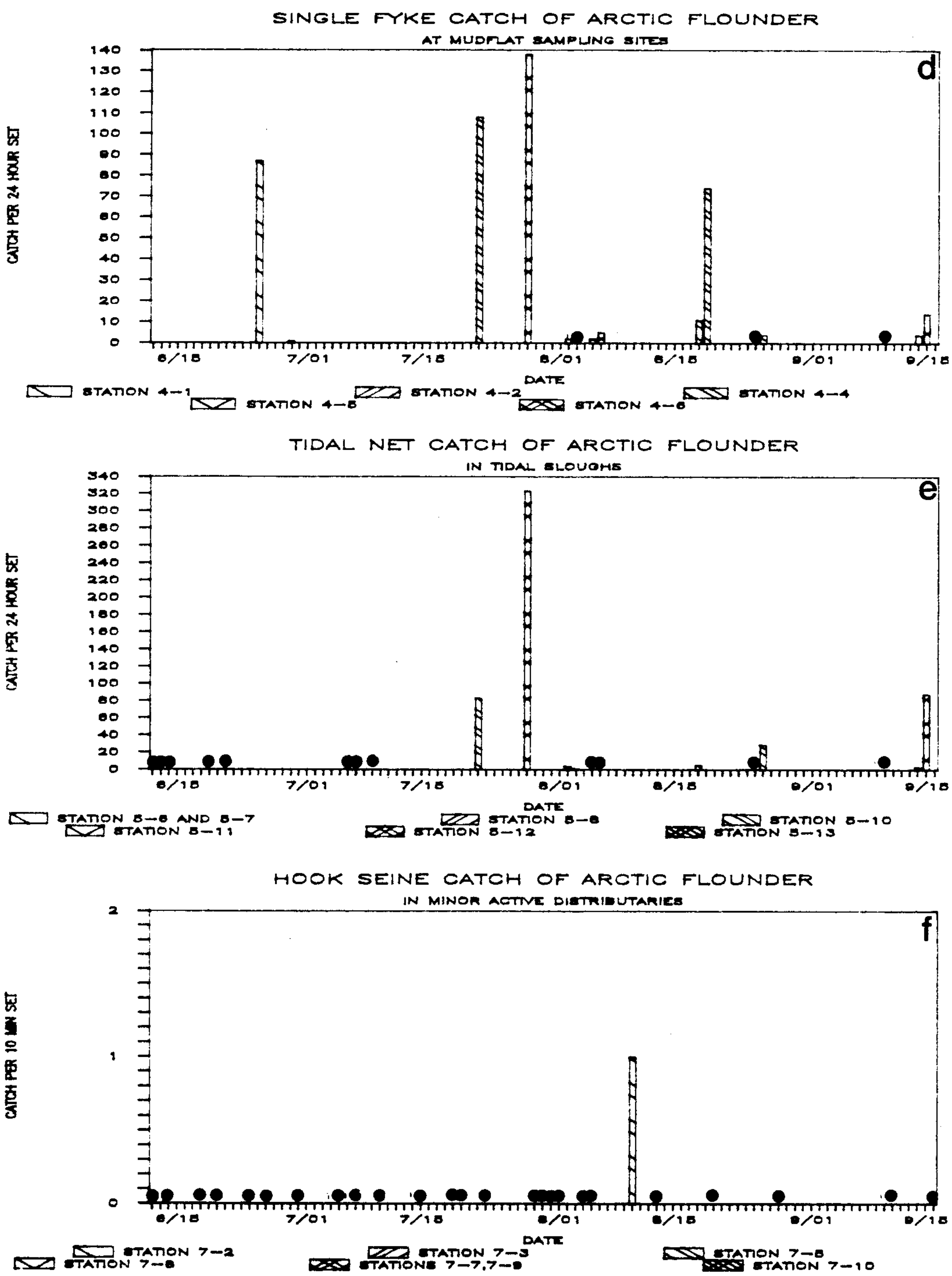


Figure 4-19. Catch Per Unit Effort of Arctic Flounder in (d) Mudflat Sampling Sites, (e) Tidal Sloughs, and (f) Minor Active Distributaries.

(●) = Effort but no catch.

Saffron Cod

Saffron cod were taken from coastal and offshore habitats (Table 4-10). The majority were caught in August and September, and a small number were caught during June and July.

Purse seine samples from the delta front produced the most saffron cod, as CPUE on five different occasions ranged from 33 to 167 fish (Figure 4-20). The largest single fyke net catches in the mudflats habitats produced catches of 71 and 219 fish per 24-hour set, and five separate 24-hour tidal net sets produced CPUE's from 25 to 121 fish. The CPUE in the mid delta platform was only one fish.

Fourhorn Sculpin

Fourhorn sculpin were caught primarily in the delta platform and a small number were also caught in the delta front, coastal and active distributary habitats (Table 4-10). None were caught in July while the majority were taken in August.

Pacific Herring

Pacific herring were only caught in the delta front. The majority were caught during the latter part of July (Table 4-10). The CPUE of three separate 10-minute purse seine sets yielded 19 to 100 fish, and other sets had scattered catches (Figure 4-21).

4.4.3.2 Size Composition

Boreal Smelt

The cumulative size distribution of boreal smelt for the entire summer exhibited a single mode between 70 and 80 mm FL (Appendix C Table 2). Fish caught with all gear types and in all habitats ranged from a minimum of 40 to a maximum of 260 mm; however, only five fish exceeded 200 mm.

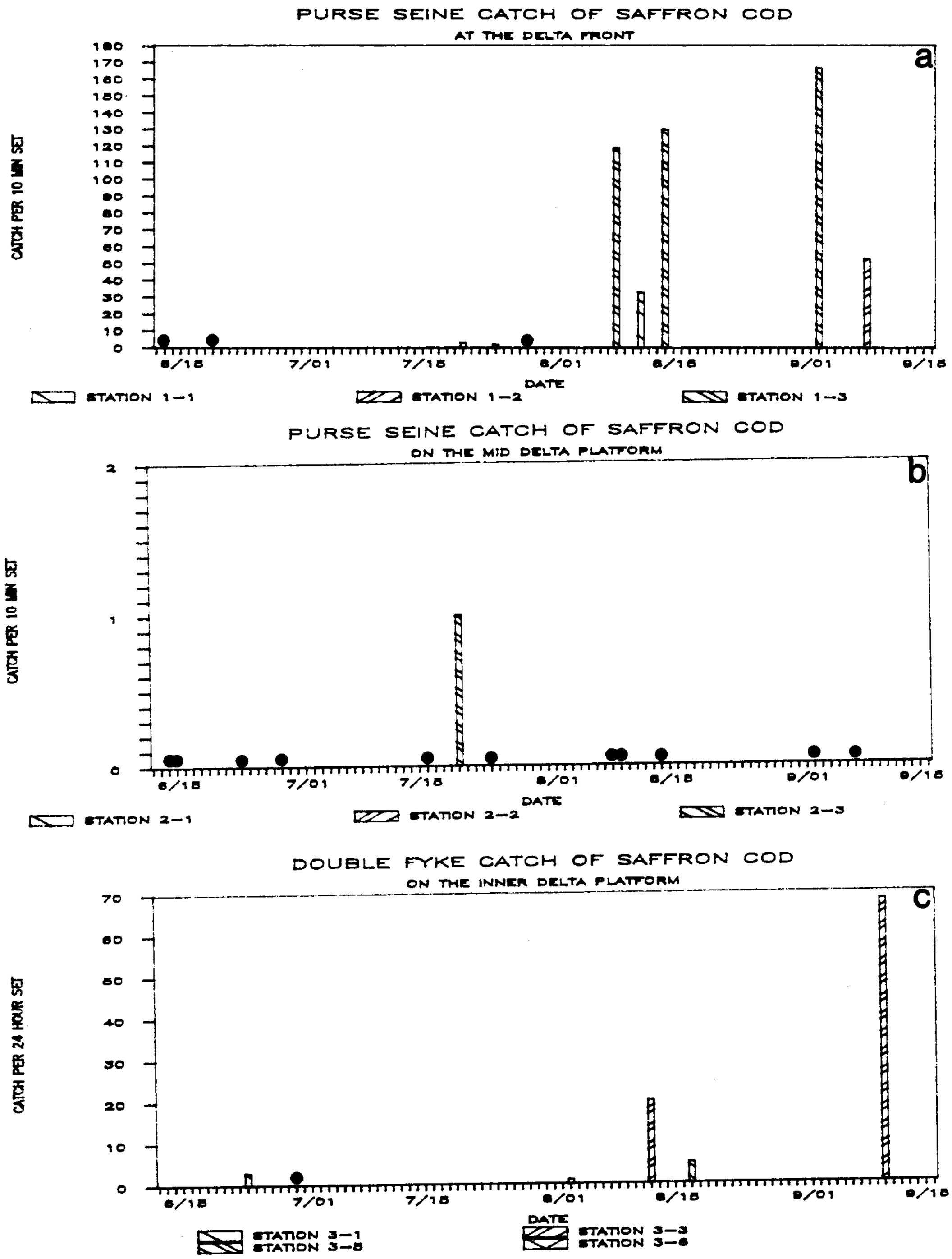
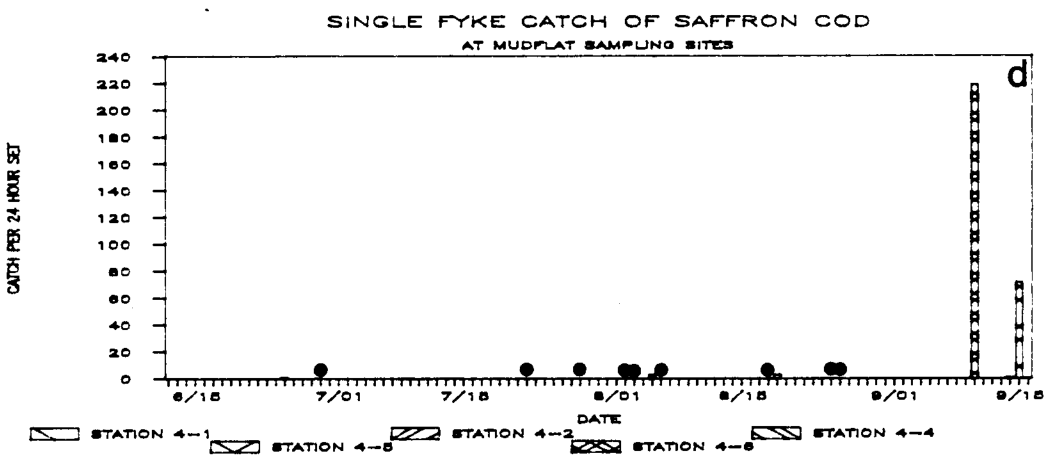


Figure 4-20. Catch Per Unit Effort of Saffron Cod in (a) Delta Front, (b) Mid Delta Platform, and (c) Inner Delta Platform.

(●) = Effort but no catch.



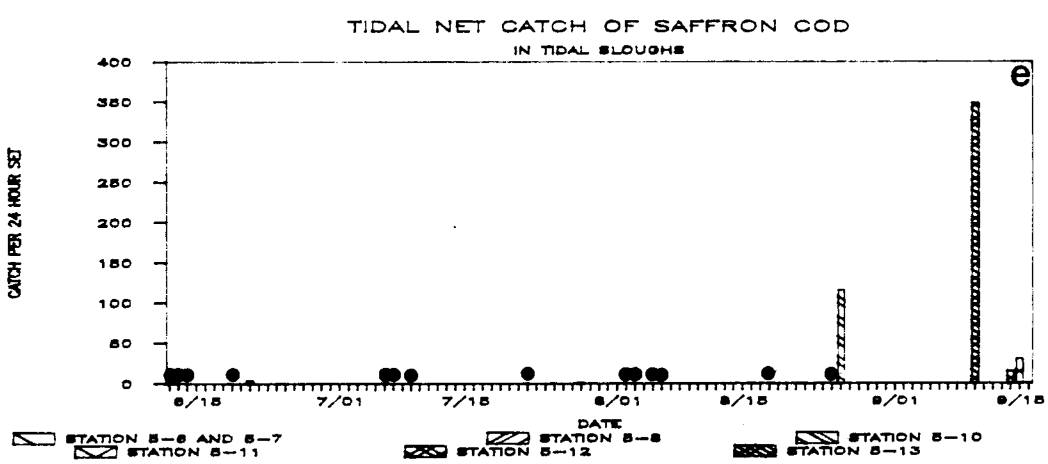


Figure 4-20. Catch Per Unit Effort of Saffron Cod in (d) Mudflat Sampling Sites and (e) Tidal Sloughs.

(●) = Effort but no catch.

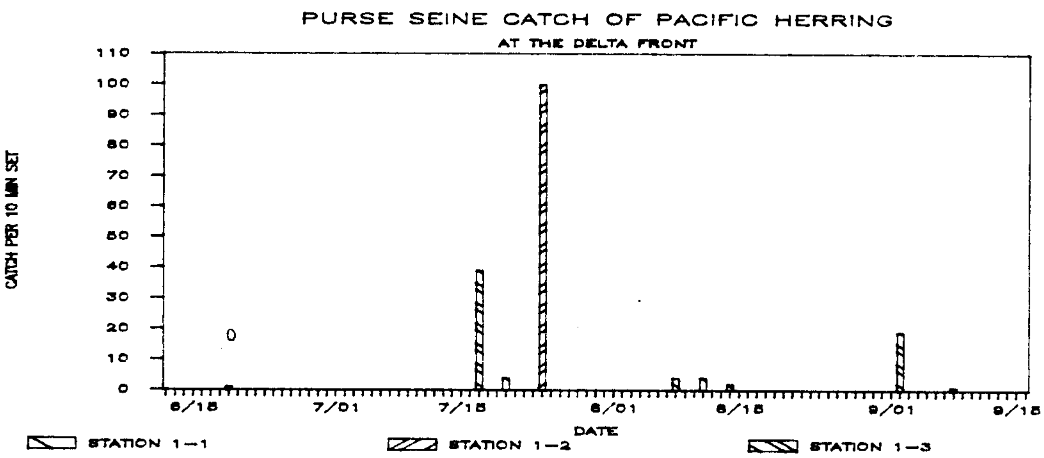


Figure 4-21. Catch Per Unit Effort of Pacific Herring in Delta Front

(●) = Effort but no catch.

Although only a single mode was discernible from the cumulative length-frequency distributions, several size classes were typically evident when data were grouped by habitat and time. In late June, at least two size classes were present in the study area. The smallest of the two ranged from 40 to 60 mm with a mode at 50 mm. The larger size class ranged from 140 to 180 mm with a mode at 160 mm. The smaller size class occurred primarily in the minor active distributaries and to a lesser degree in the coastal slough and mudflat habitats. The larger size class was found predominantly in the minor active distributary, the major active distributaries and the inner delta platform. During July two size classes were again present. The smallest group ranged from 70 to 90 mm and was found mostly within the inner delta. The largest size class was smaller than encountered in June with an overall range of 90 to 140 mm. In early August size classes of small individuals (60-80 mm) were still being collected in the inner delta platform and delta front habitats. Length-frequency histograms also suggested the presence of a second size class in the area of the delta front comparable in size to the smelt captured the previous month (90 to 120 mm) in this habitat.

All of the boreal smelt caught from 1-18 September came from the delta front. Their length-frequency distribution contained only a single discernible mode with most fish 70 to 100 mm in length.

Pond Smelt

Two probable size classes of pond smelt occurred in the study area (Appendix C, Table 13). The smaller and more numerous size class ranged from about 30 to 60 mm FL and the larger smelt ranged mostly from 60 to 90 mm with a few as large as 130 mm. These larger individuals may have been part of a third or fourth size class but numerical abundances were too low to make this determination.

Unidentified Smelt

The length-frequency distribution for unidentified smelt had a single mode at 30 mm FL and a range of 20-70 mm (Appendix C, Table 14). Most fish were less than 50 mm and most were caught in August. These fish represent more than a single species since juvenile and larval forms of both pond and boreal smelt were noted to co-occur at other times and locations.

Ninespine Stickleback

The length-frequency distribution for ninespine stickleback was monomodal at 30-50 mm FL with an overall range of 20-70 mm (Appendix C, Table 15). Similar size composition was noted throughout the summer at all locations.

Arctic Lamprey

Arctic lamprey ranged in size from 50 to 180 mm FL with a modal size of 120 mm (Appendix C, Table 16). Although catches were small, their overall size composition did not appear to change over the brief period (i.e., June and July) that they were present in the delta.

Unidentified lamprey (ammocoetes) which were captured in the delta were very likely this species since no other species of lamprey were present in the region.

Longnose Sucker

Longnose sucker ranged in size from a minimum of 20 mm to a maximum of 230 mm FL (Appendix C, Table 17). The largest proportion of the catch measured between 100 and 160 mm in length.

Northern Pike

Northern pike ranged in size from 20 to 670 mm FL with very little evidence of strong size class structure (Appendix C, Table 18).

Burbot

Burbot ranged in size from 20-790 mm FL (Appendix C, Table 19). They were present in the delta over a large size range but were largely dominated by smaller individuals. The overall modal size of burbot collected from delta habitats was 30 to 40 mm.

Notable differences in size composition of burbot existed among several of the eight different habitats in which they were collected. Smaller fish were caught in the active distributaries, lake outlets, and inner delta habitats. Larger fish were most commonly encountered in the coastal sloughs, minor active distributaries and the lake outlets. Burbot collected from the inner delta and coastal mudflats were similar in size composition with small individuals (50 - 80 mm) dominating the catch and a few larger individuals ranging up to 330 mm. Individuals collected in the coastal sloughs ranged from 50 to 440 mm and were not strongly dominated by any one size class. Burbot collected in the active distributaries, both minor and major, were strongly dominated by a small size class ranging 20-80 mm. Burbot from a lake outlet ranged from 40-790 mm with a mode at 60 mm. The majority were less than 100 mm.

Burbot caught from 14-30 June were broadly distributed over a range from 70 - 780 mm. One size class was evident between 70 and 130 mm but all other fish were somewhat uniformly distributed between 230 and 780 mm. Most of the burbot came from coastal sloughs and minor active distributaries. The smaller fish (70 to 130 mm) were present only in the coastal sloughs.

Burbot sampled in July were mostly captured in the minor active distributaries and were typically less than 50 mm in length. The predominance of smaller burbot in the minor active distributaries continued through early August. By late August and early September the proportion of small burbot in our samples had declined substantially. The fish captured towards the end of the summer ranged from 50 - 670 mm with individuals of 60 to 80 mm still being most numerous.

Alaska Blackfish

Blackfish ranged in size from 50-160 mm FL (Appendix C, Table 20). Size composition was notably different within the two habitats in which this species was most abundant. Blackfish in the lake outlet channels were mostly 90 mm or less, whereas blackfish collected in the landlocked lake were primarily 90 mm or greater in length.

Trout Perch

Trout perch ranged in size from 30-40 mm FL (Appendix C, Table 21). The sole trout perch caught in a minor active distributary in late June measured 40 mm.

Starry Flounder

Only a single size class was discernible in their cumulative length-frequency distribution for starry flounder. Their modal size was between 140-150 mm FL with an overall range of 30-250 mm (Appendix C, Table 22).

Although starry flounder were present in five different habitats, they were abundant in only two -- the coastal mudflats and sloughs. Fish occupying these two habitats were similar in size composition. Most individuals ranged from 100 - 180 mm.

The modal size of starry flounder increased slightly over the course of the summer. In late June a single, although small, mode occurred at 120 mm. By late July the mode had increased to between 140 and 150 mm and one month later was between 160 and 170 mm.

Arctic Flounder

The overall length-frequency distribution for arctic flounder was monomodal at 80 mm FL with a size range of 20-200 mm (Appendix C, Table 23).

A distinct spatial gradient in size composition was evident for this species. Larger fish were captured offshore in the vicinity of the delta front while smaller individuals were more common in the coastal habitats. Flounder collected from the mid delta platform were primarily from a larger size class (130 to 200 mm; mode = 140 mm). Fish captured in the inner delta and on the mudflats were similar in size composition and consisted of at least two size classes. The smaller size class collected in the mudflat habitat was notably smaller than its counterpart in the inner delta. At least two size classes were captured in the coastal sloughs. The most numerous size class consisted of the smallest fish collected in the study area. This group ranged from 20 to 50 mm with a mode of 30 mm. The second size class occurred between 50 and 90 mm with a mode of 80 mm. A possible third size class measured 90 to 110 mm with a mode of 100 mm.

Substantial temporal changes in size composition of Arctic flounder occurred over the course of the summer. In June, the largest percentage of flounders ranged from 50 to 60 mm were caught almost exclusively in the mudflat habitat. During the last two weeks of July, flounders were found in both the mudflat and coastal slough habitats. Those collected in the mudflat were all greater than 100 mm while fish captured in the slough were dominated by individuals that were less than 100 mm. Within the coastal sloughs, two size classes were present that were under 100 mm. The larger of the two ranged from 60 to 90 mm with a mode of 70 mm. This group was believed to correspond with the

50 to 60 mm size class found over the mudflats in June. The presence of the smaller size class (20 to 30 mm) in the sloughs marked the first occurrence of this size class in the study area. At the end of the summer larger size classes were not distinct due to decreases in overall catch. Fish collected in the coastal slough habitat, however, were notably smaller than fish from either of the other two habitats (mid delta platform and coastal mudflats) from which flounder were collected.

Saffron Cod

The cumulative length-frequency distribution was monomodal at 60 mm FL with a range of 50-390 mm (Appendix C, Table 24).

Between June and July few cod were present in the the delta study area but those captured during were relatively large individuals. Cod caught during 14-30 June came from the inner delta, mudflats, and a coastal slough habitat and ranged from 190-300 mm. Those from 16-31 July were from the delta front, mid-delta, and a coastal slough habitat and had a range of 110-260 mm. Cod caught from 1-15 August came mostly from the delta front, ranging in size from 50-260 mm. The majority of these fish measured 60 mm. Fewer fish were caught in the inner delta and ranged in size from 60-240 mm with only two greater than 100 mm. The fewest numbers of fish caught during this period were from the mudflats and ranged in size from 120-300 mm.

During late August larger saffron cod were found in the coastal sloughs and mudflats. Smaller, although fewer, individuals were captured further offshore on the delta platform. Most of the cod caught during 16-31 August came from coastal sloughs and ranged from 210-320 mm with the majority measuring 260-280 mm. Cod from the mudflats ranged from 240-280 mm. Fewer fish were caught in the delta front and ranged from 60-270 mm with a single mode at 70 mm. Mid-delta cod measured 60-70 mm.

By September when saffron cod were most abundant strong spatial differences became evident in the size structure within the study area. The cumulative length-frequency distribution from 1 to 18 September was monomodal at 80 mm, but ranged from 70-390 mm. Cod collected in the coastal sloughs were distinctly larger than those collected in other habitats. They ranged in size from 130-380 mm with only two individuals less than 200 mm. Most of the fish measured 250-280 mm. Cod collected from the mudflats were similar in size and ranged from 140-390 mm with the majority between 260 and 280 mm. Fish captured in the delta front were markedly smaller with a mode of 80 mm and range of 70 to 110 mm.

Fourhorn Sculpin

Fourhorn sculpin ranged in size from 40 - 200 mm FL with a distinct mode between 90 and 110 mm (Appendix C, Table 25). Fish collected in the region of the mid delta platform were generally larger than fish from the inner delta platform; however, this is more likely a reflection of sampling gear than actual size differences.

Pacific Herring

Pacific herring ranged in size from 50-200 mm FL (Appendix C, Table 26). Fish caught in July ranged 80-110 mm and by September fish ranged 110-120 mm.

4.5 FOOD HABITS

4.5.1 Samples Collected and Analyzed

Fish stomach contents samples were collected from approximately half of the 54 locations sampled across the delta. Most of the samples originated from minor active distributaries (21%), coastal sloughs

(18%), major active distributaries (17%), and delta front (17%) habitats (Table 4-13); no samples were obtained from minor inactive distributaries, lakes, or lake outlets.

Of the 456 total stomach samples analyzed, approximately 41 percent originated from fyke net collections, 40% from purse seine collections, and the remainder from beach seine collections (Table 4-14).

Of the total stomach sample size, 116 (21.2%) of the stomachs were empty. In all further discussion of diet composition, quantification of prey taxa as a frequency or proportion of the total sample refers to only those stomachs containing food items.

4.5.2 Composite Diet Descriptions

Summary tabulation of the composite (for the species overall) diet composition of the eleven selected fish species, as discussed in the following section, is included in Appendix D. These tables describe the stomach contents at the finest level of taxonomic, life history, and organism parts identified. Diet composition, based on the %SIRI irrespective of prey organism part or life history stage, is summarized for the eleven species in Table 4-15.

Bering Cisco

Calanoid copepods (74.5%SIRI) and the mysid *Neomysis* sp. (23.3%SIRI) dominated the IRI prey spectrum of Bering cisco (Figure 4-22). Calanoids, which occurred most frequently (73.7%) and accounted for almost all the prey abundance (92.0%), although not specifically identifiable, appear to be marine and estuarine pelagic types. Although not as frequently consumed (26.2%) or as numerically prominent (5.9%), the epibenthic estuarine mysid, *Neomysis* sp., provided most

TABLE 4-13

HABITAT ORIGINS (NUMBER OF COLLECTIONS) OF JUVENILE SALMONIDS AND NON-SALMONIDS CAPTURED ON YUKON RIVER DELTA, JUNE-SEPTEMBER 1985, WHICH WERE UTILIZED FOR STOMACH CONTENTS ANALYSES

	Fish Taxa a/											
Habitat	BRC	LSC	HBW	PKS	CHS	COS	CNS	SHE	PSM	BSM	BUR	Total
delta front	3	1		2	2				3	6		17
mid-delta platform	1			2			3		1			7
inner delta platform		1	1			1	1	2	1	2	1	10
mudflat	1	3	5					3				12
coastal slough		4	6	1	1			3	1		2	18
major active distributary		2	4	2	5	1		2			1	17
minor active distributary		2	2	3	5	1	1	3	2		2	21
minor inactive distributary												
lake												
lake outlet												
Totals	5	13	18	8	15	3	2	16	7	9	6	102

a/ BRC = Bering cisco; LSC = least cisco; HBW = humpback whitefish group; PKS = pink salmon; CHS = chum salmon; COS = coho salmon; CNS = chinook salmon; SHE = sheefish; PSM = pond smelt; BSM = boreal smelt; BUR = burbot

TABLE 4-14

SUMMARY OF FISH SAMPLES ANALYZED FOR DIET COMPOSITION OF YUKON RIVER DELTA FISHES, JUNE-SEPTEMBER 1985

Species-Common Name	Collection Gear			Total Sample Size	Number Empty	Percent Empty (%)
	Fyke Net	Purse Seine	Beach Seine			
Bering cisco	5	15	0	20	1	5.0
Least cisco	48	22	10	80	15	18.8
Humpback whitefish	66	23	10	99	31	31.3
Pink salmon	2	12	19	33	7	21.1
Chum salmon	5	47	30	82	13	15.9
Coho salmon	1	1	3	5	1	20.0
Chinook salmon	3	0	6	9	3	33.3
Sheefish	54	24	16	94	28	29.8
Pond smelt	10	27	0	37	3	8.1
Boreal smelt	16	42	0	58	10	17.2
Burbot	14	5	10	29	4	13.8
Total	224	218	104	546	116	21.1

TABLE 4-15

OVERALL IMPORTANCE (%SIRI) OF PREY TAXA (IRRESPECTIVE OF LIFE HISTORY STAGE) OF ELEVEN SPECIES OF JUVENILE SALMONIDS AND NON-SALMONID FISHES CAPTURED ON YUKON RIVER DELTA, JUNE-SEPTEMBER 1985

Prey Taxa	Fish Taxa a/										
	BRC	LSC	HBW	PKS	CHS	COS	CNS	SHE	PSM	BSM	BUR
Rotifera			0.3								
Nematoda			-								
Annelida											
Polychaeta									+	+	
Oligochaeta			-								
Mollusca											
Bivalvia	+b/										
Arachnida											
Araneae		-c/	-		-						
Acarina			-		-			-			
Crustacea			-		-						
Notostraca									0.5		
Cladocera		-	-						-		
Daphnidae			-								
Daphnia sp.		-	-		0.1			0.8			
Bosminidae											
Bosmina sp.		0.1	0.4		-			-	0.1		
Polyphemidae											
Podon sp.	+								-	0.2	
Chydoridae		-	-								
Ostracoda		-	0.8		-			-		-	5.4
Calanoida	74.5	24.9	7.5	16.8	1.3			1.8	88.9	50.9	0.1
Temoridae											
Epischura sp.				0.9	0.8	1.7		0.2			
Eurytemora sp.		11.8	2.9						+	-	1.2
Pontellidae											
Epilabidocera longipedata		-							0.1	0.1	

TABLE 4-15 (Continued)

OVERALL IMPORTANCE (%SIRI) OF PREY TAXA (IRRESPECTIVE OF LIFE HISTORY STAGE) OF ELEVEN SPECIES OF JUVENILE SALMONIDS AND NON-SALMONID FISHES CAPTURED ON YUKON RIVER DELTA, JUNE-SEPTEMBER 1985

Prey Taxa	Fish Taxa [a/]										
	BRC	LSC	HBW	PKS	CHS	COS	CNS	SHE	PSM	BSM	BUR
Harpacticoida	0.1	3.0	20.7	0.8	0.2				4.6	0.1	-
Tachidiidae											
Tachidius sp.		35.0	10.3								
Canthocamptidae				0.1							
Cyclopoida		4.7	8.4	13.0	5.4			3.5	1.3	6.6	-
Monstrilloida											
Monstrillidae									-		
Balanomorpha	+								+	0.1	
Mysidacea											
Mysidae	+	0.1	0.5					3.3	0.6	25.4	3.9
Neomysis sp.	23.3	2.5	0.5					67.4	0.2	0.7	61.5
Isopoda											
Valifera											
Odoteidae											
Saduria entomon					0.3	27.4	88.1			-	0.2
Bopyridae	+										
Amphipoda											
Gammaridea		1.0	0.2		+				-	0.2	-
Gammaridae					+						
Atylidae											
Atylus sp.										-	
Haustoriidae	1.8	6.3	42.5					14.2	2.6	0.1	0.4
Hyperiidea										+	
Decapoda											
Penaeidea		0.1	0.2								
Caridea										0.2	
Crangonidae	0.1							0.2	0.8		-
Brachyura										-	
Insecta		0.7			0.4			-	+		
Collembola		-	0.3	0.1	0.3				-		-
Ephemeroptera		-	-		-			-			-
Heptagenioidea											
Heptageniidae					-			0.1			
Plecoptera					1.2	1.9	2.9	-			
Psocoptera		-									

TABLE 4-15 (Continued)

OVERALL IMPORTANCE (%SIRI) OF PREY TAXA (IRRESPECTIVE OF LIFE HISTORY STAGE) OF ELEVEN SPECIES OF JUVENILE SALMONIDS AND NON-SALMONID FISHES CAPTURED ON YUKON RIVER DELTA, JUNE-SEPTEMBER 1985

Prey Taxa	Fish Taxa [a/]										
	BRC	LSC	HBW	PKS	CHS	COS	CNS	SHE	PSM	BSM	BUR
Insecta (Continued)											
Thysanoptera		-									
Hemiptera								-			
Homoptera		0.1									
Cercopidea											
Cercopidae				-							
Psylloidea											
Psyllidae					-						
Aphidoidea											
Aphididae		-	-					-			
Coleoptera			-		-						
Staphylinoidea											
Staphylinidae					0.1						
Tricoptera		-	0.1		-						
Diptera		0.1	-		0.2						
Tipulidae		0.2			0.1			-			
Ceratopogonidae		1.4			0.5			-			-
Chironomidae	+	6.3	3.1	63.3	89.0		3.1	7.6	0.3		11.1
Chaoboridae		-									
Blephericeridae								-			
Simulidae					-						
Nematocera		-			0.1			-			
Brachycera		0.3	-		-						
Sciomyzoidea											
Dryomyzidae					-						
Drosophiloidea											
Ephydridae		-			-			-			
Muscoidea											
Muscidae		-									
Hymenoptera		0.3			-						
Tenthredinoidea											
Tenthredinidae					-			-			
Apocrita		-									
Chalcidoidea											
Mymaridae		-									
Proctotrupoidea											
Platygasteridae		-			-						

TABLE 4-15 (Continued)

OVERALL IMPORTANCE (%SIRI) OF PREY TAXA (IRRESPECTIVE OF LIFE HISTORY STAGE) OF ELEVEN SPECIES OF JUVENILE SALMONIDS AND NON-SALMONID FISHES CAPTURED ON YUKON RIVER DELTA, JUNE-SEPTEMBER 1985

Prey Taxa	Fish Taxa a/										
	BRC	LSC	HBW	PKS	CHS	COS	CNS	SHE	PSM	BSM	BUR
Vertebrata											
Teleostei	0.2				-			0.72	21.5	0.7	
Clupeiformes											
Clupeidae											
Clupea harengus pallasi									0.4		
Salmoniformes											
Salmonidae											
Coregonus sp.											6.6
Oncorhynchus sp.						36.5					
Stenodus leucichthys											1.0
Gasterosteoidea											
Gasterosteidae											
Pungitis pungitius								0.1			1.2
Plants and Plant Parts				-	-	32.6	5.9				
Adjusted Sample Size(n)	19	65	68	26	69	4	6	66	34	48	25
Percent Dominance	0.61	0.21	0.25	0.51	0.80	0.31	0.78	0.48	0.79	0.37	0.40
Shannon-Weiner Diversity (H')	0.95	2.81	2.57	1.32	0.79	1.78	0.71	1.69	0.78	1.66	2.06
Evenness Index	0.27	0.53	0.52	0.42	0.15	0.77	0.35	0.36	0.18	0.38	0.49

a/ BRC = Bering cisco; LSC = least cisco; HBW = humpback whitefish group; PKS = pink salmon; CHS = chum salmon; COS = coho salmon; CNS = chinook salmon; SHE = sheefish; PSM = pond smelt; BSM = boreal smelt; BUR = burbot

b/ + = less than 0.1 %SIRI

c/ - = frequency of occurrence less than 5%, numerical and gravimetric composition less than 1%

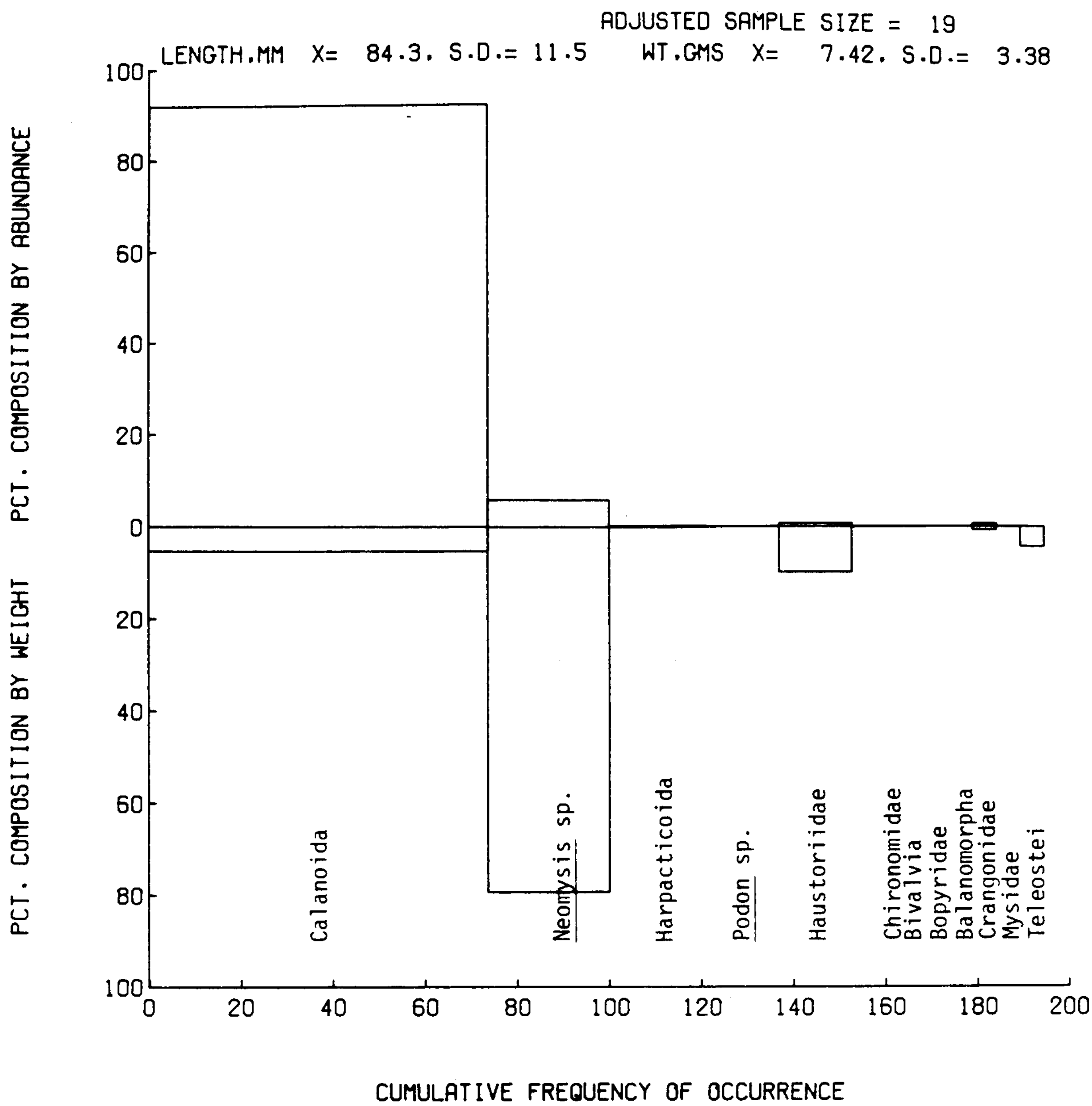


Fig. 4-22 Index of Relative Importance (IRI) prey spectrum of Bering cisco, *Coregonus laurettae*, captured in the Yukon River delta, June-September 1985.

(79.3%) of the prey biomass. The only other significant (1.7%SIRI) contribution to the diet spectrum was by haustoriid amphipods, also an epibenthic marine-estuarine taxa.

Least Cisco

Unlike the Bering cisco, the prey spectrum of least cisco (Figure 4-23) was much more diverse (H' = 2.81) and even (evenness index = 0.53), probably the consequence of the greater sample size and diversity of sample sources. The principal prey were epibenthic harpacticoid copepods (primarily the estuarine form Tachidius sp.), which accounted for 37.9%SIRI, and calanoid copepods (primarily the estuarine form, Eurytemora sp.; 36.8%SIRI). Other, less prominent prey taxa included: (1) drift insects such as adult dipteran flies (chironomids, certopogonids), 10.1%SIRI; (2) haustoriid amphipods, 6.3%SIRI; (3) cyclopoid copepods, 4.7%SIRI; and, (4) Neomysis sp., 2.5%SIRI.

Humpback Whitefish

The prey spectrum of humpback whitefish (Figure 4-24) is based on a relatively large sample size, and indicates rather diverse (H' = 2.57) prey resources. Numerically, epibenthic harpacticoid copepods (primarily Tachidius sp., 31.0%SIRI), and planktonic cyclopoid (8.4%) and calanoid (Eurytemora sp., 10.3%) were the more prevalent prey. But, due to its gravimetric importance (66.2% of total prey biomass), haustoriid amphipods were the singularly most important prey taxon (42.5%SIRI). Insects (both epibenthic chironomid larvae and drift adults) and other epibenthic crustaceans (e.g., mysids, ostracods) contributed less than 1%SIRI.

Pink Salmon

Chironomids, including both epibenthic larvae and drift adults, dominated (68.3%SIRI) the prey spectrum of juvenile pink salmon (Figure 4-25) due to their high frequency of occurrence (84.6%),

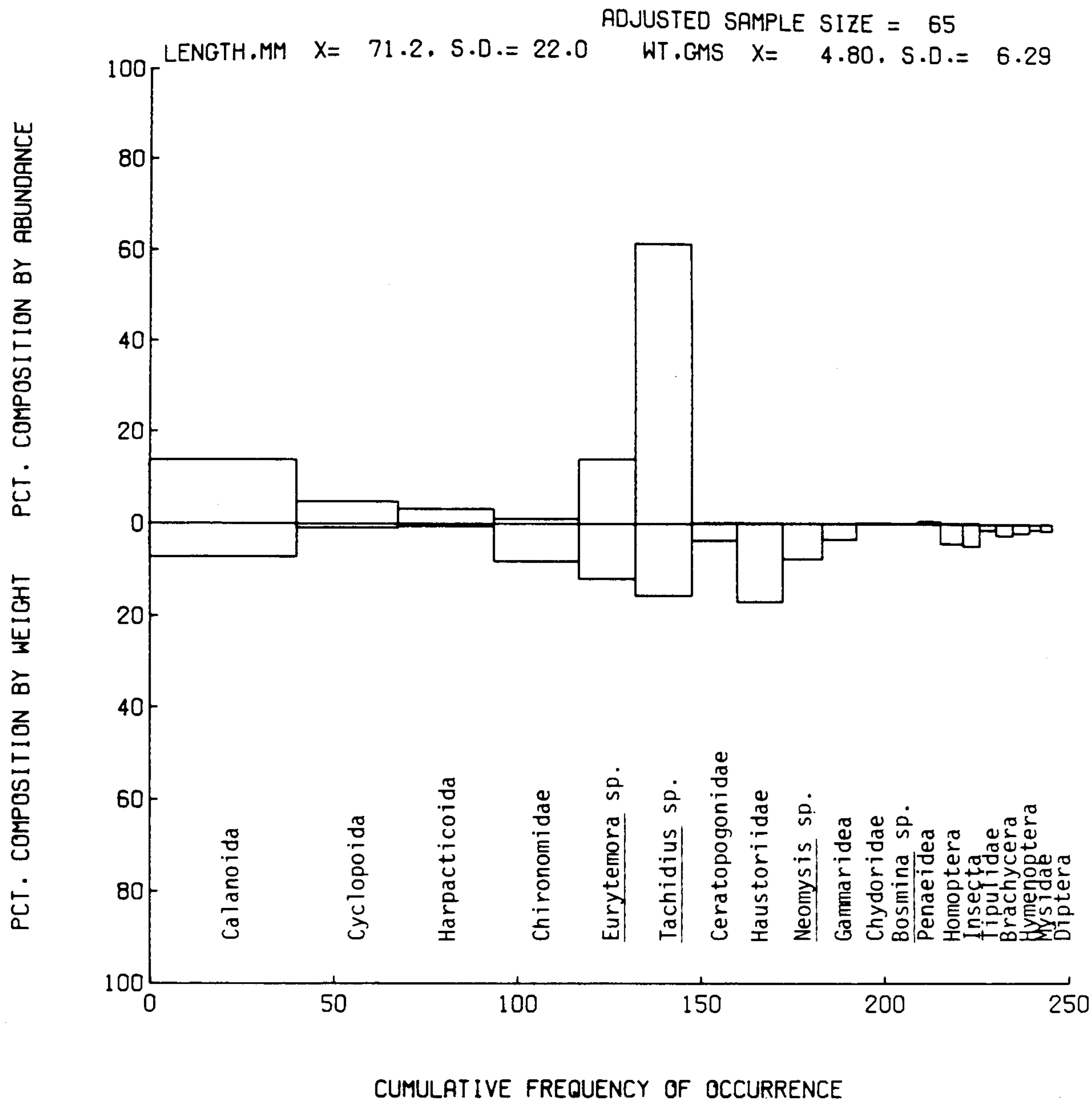


Fig. 4-23 Index of Relative Importance (IRI) prey spectrum of least cisco, *Coregonus sardinella*, captured in the Yukon River delta, June-September 1985.

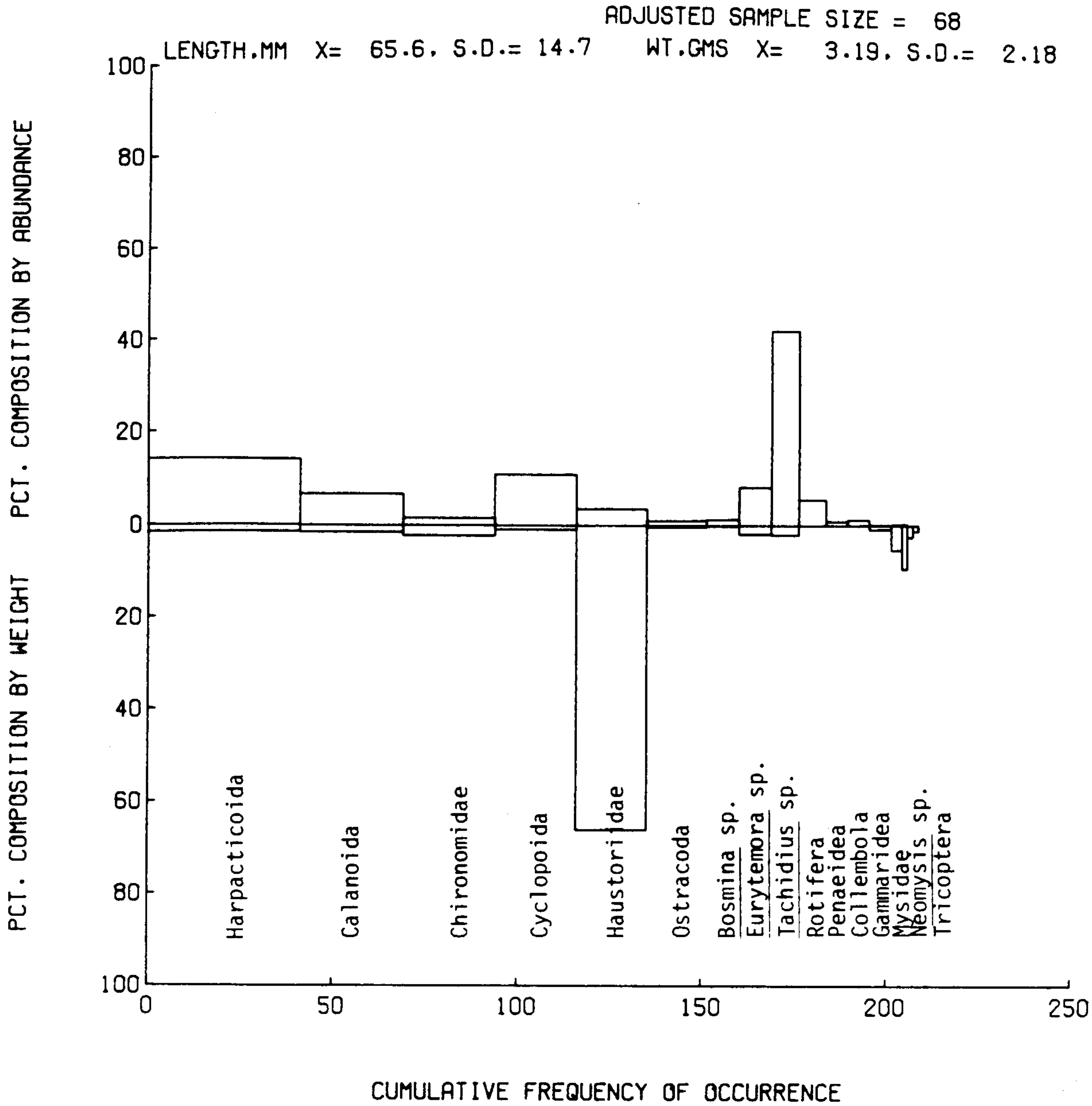


Fig. 4-24 Index of Relative Importance (IRI) prey spectrum of humpback whitefish, Coregonus cf pidschian, captured in the Yukon River delta, June-September 1985.

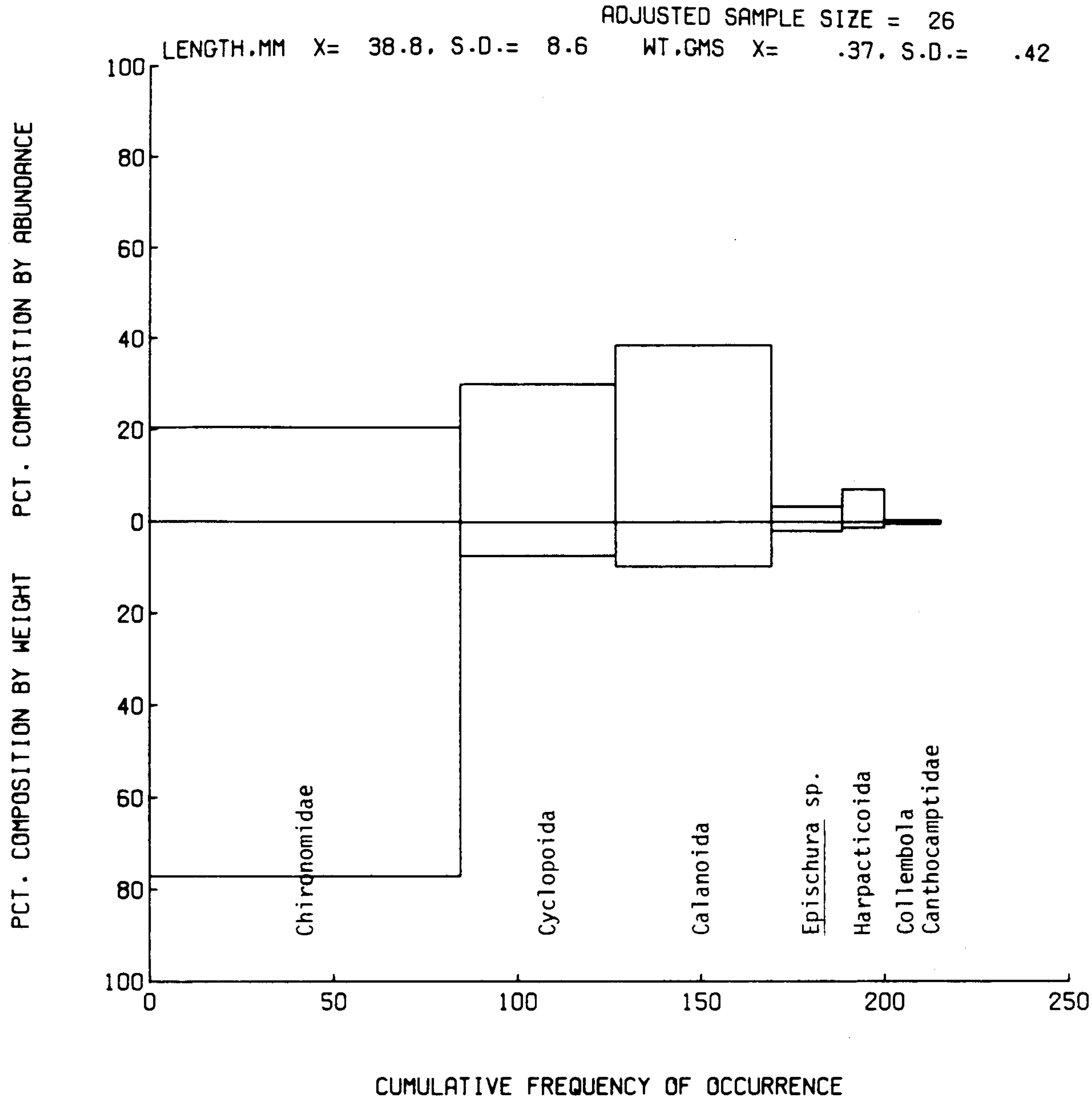


Fig. 4-25 Index of Relative Importance (IRI) prey spectrum of juvenile pink salmon, *Oncorhynchus gorbuscha*, captured in the Yukon River delta, June-September 1985.

gravimetric composition (77.2% of total prey biomass), and measurable (20.4% of total prey abundance) numerical contribution. Planktonic calanoid (17.7%SIRI) and cyclopoid (13.0%SIRI) copepods occurred frequently in the stomachs but were comparatively less important.

Chum Salmon

Despite being based on a large sample size, the prey spectrum of juvenile chum salmon (Figure 4-26) is noteworthy for its low diversity (H' = 0.79) and overwhelming dominance (89.0%SIRI, percent dominance = 80%) by one prey taxon, chironomid insects. Although epibenthic larvae were included in this category, the vast majority of these prey were adults (Appendix D) which presumably were consumed as drift organisms. Other common prey taxa included planktonic cyclopoid (5.4%SIRI) and calanoid (2.1%SIRI) copepods and other drift insects (2.7%SIRI in aggregate).

Coho Salmon

Among the stomach contents of four juvenile coho salmon examined, three had plant material and one each contained valiferan isopods (*Saduria entomon*), plecopterans (stoneflies), other juvenile salmon, and freshwater planktonic calanoid copepods (*Epischura* sp.). As a consequence, due to their respective frequency of occurrence, numerical contribution, and gravimetric contribution to the diet, plants, *Saduria*, and juvenile salmon comprised approximate equal proportions of the prey spectrum (Figure 4-27).

Chinook Salmon

Saduria entomon were also prominent (88.1%SIRI) in the prey spectrum of the six juvenile chinook salmon examined (Figure 4-28), while chironomids (both larvae and adults), plant material, and plecopterans were minor components of the overall diet.

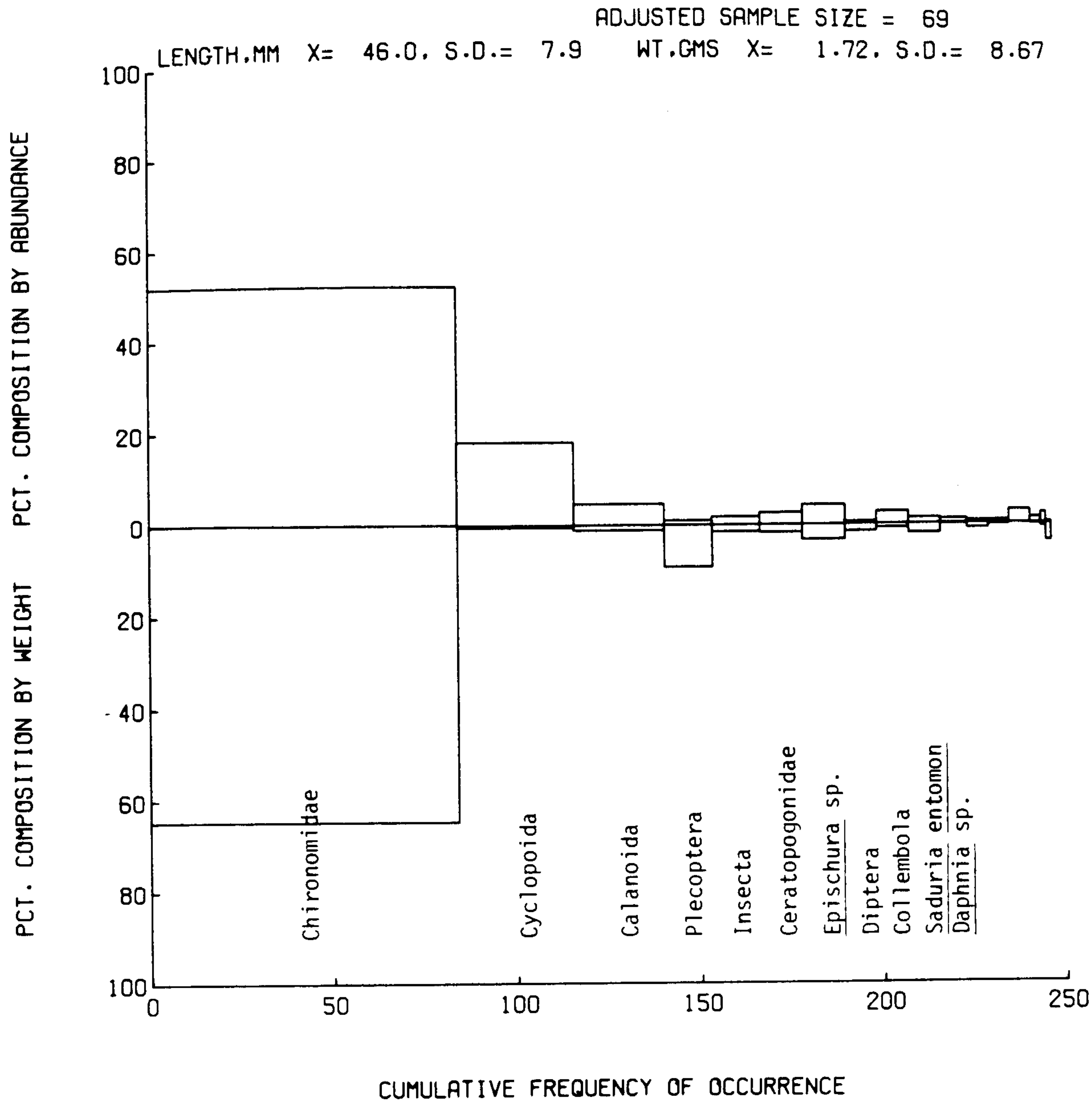


Fig. 4-26 Index of Relative Importance (IRI) prey spectrum of juvenile chum salmon, _Oncorhynchus keta_, captured in the Yukon River delta, June-September 1985.

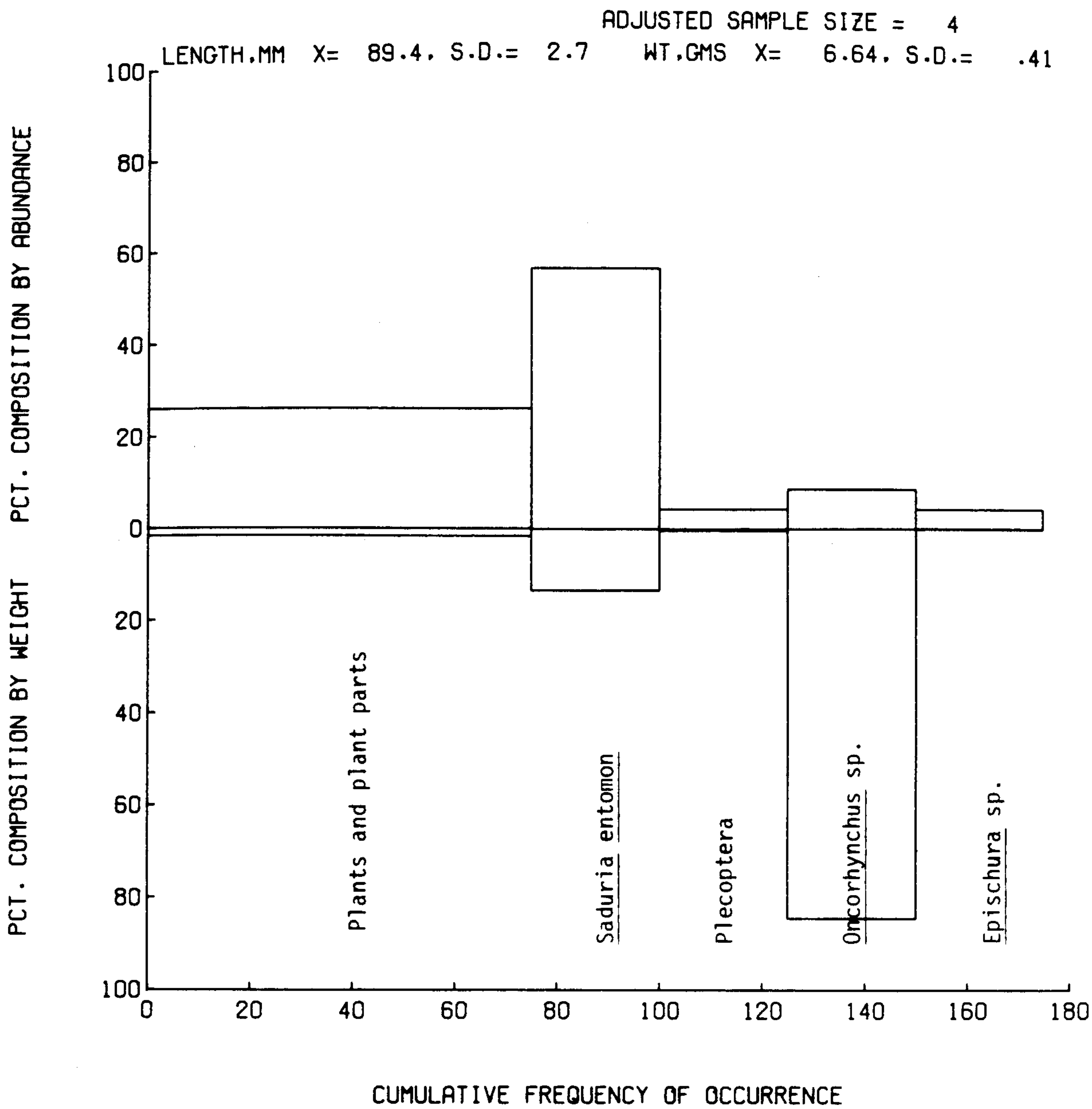


Fig. 4-27 Index of Relative Importance (IRI) prey spectrum of juvenile coho salmon, Oncorhynchus kisutch, captured in the Yukon River delta, June-September 1985.

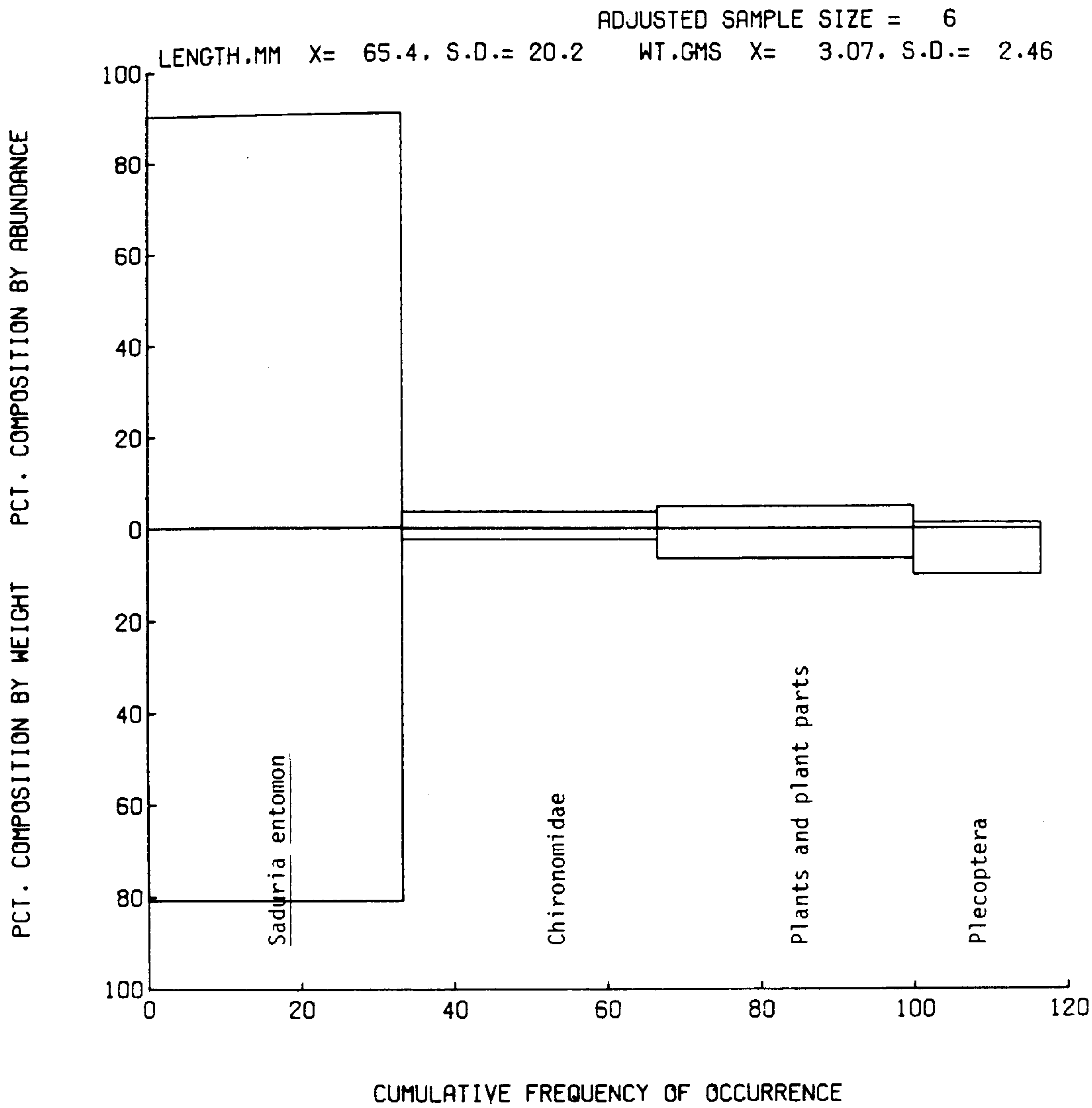


Fig. 4-28 Index of Relative Importance (IRI) prey spectrum of juvenile chinook salmon, *Oncorhynchus tshawytscha*, captured in the Yukon River delta, June-September 1985.

Sheefish

The prey spectrum of sheefish (Figure 4-29) was dominated by estuarine-marine epibenthos, including mysids (Neomysis sp., 70.7%SIRI) and haustoriid amphipods (14.2%SIRI); freshwater-estuarine chironomids (7.6%SIRI) and cyclopoid (3.5%SIRI) and calanoid copepods (2.0%SIRI) were the only other prey taxa of significance. In comparison to the other prey spectra from equivalent sample sizes, the overall sheefish diet was intermediate in terms of feeding specificity (e.g., dominance, diversity, and evenness).

Pond Smelt

With a prey spectrum similar in composition to the Bering cisco, the overall diet of pond smelt (Figure 4-30) included predominantly estuarine and marine organisms. Calanoid copepods, which included both the neustonic-surface layer marine form, Epilabidocera longipedata, and the archtypical estuarine taxa, Eurytemora sp., accounted for almost 90%SIRI. Harpacticoid (4.6%SIRI) and cyclopoid copepods (1.3%SIRI) and haustoriid amphipods (2.6%SIRI) were also common in the diet (the copepods) or contributed a significant portion of the total prey biomass (the amphipods). Although crangonid shrimp and mysids (Neomysis sp.) each provided between 10% and 13% of the total prey biomass, they were neither common nor numerous in the pond smelt diet. In terms of feeding habits, pond smelt appeared to be one of the more specialized, similar to juvenile chum salmon in the dominance of their prey spectrum by few prey taxa (i.e., high dominance, low diversity).

Boreal Smelt

Boreal smelt also preyed predominantly upon estuarine-marine organisms (Figure 4-31), although the diet was more diversely (H' = 1.66) distributed among calanoid copepods (51.0%SIRI, including Epilabidocera longipedata), mysids (26.2%SIRI, including Neomysis sp.), and fish (21.9%SIRI, predominantly larvae and including Clupea harengus pallasi).

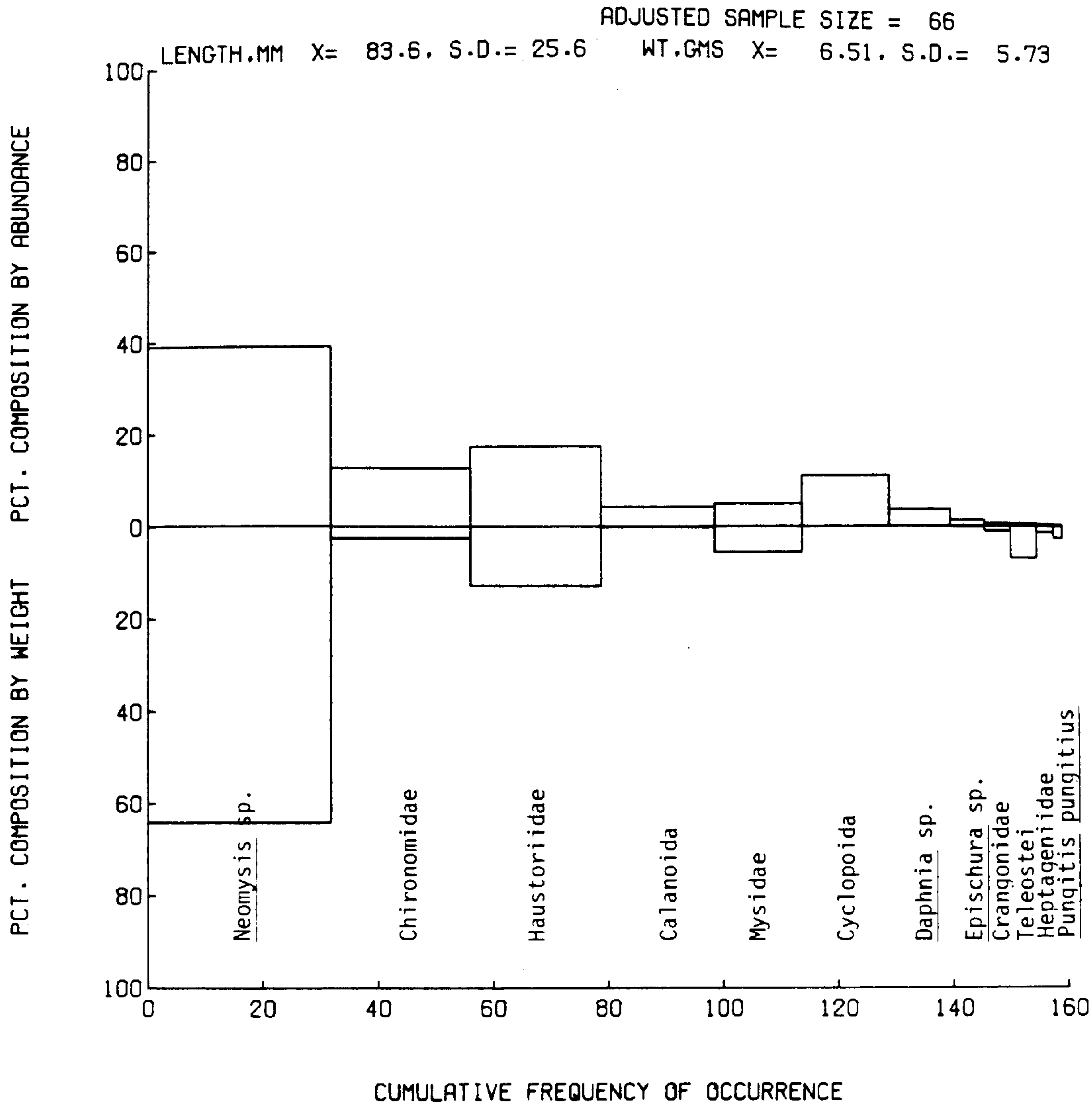


Fig. 4-29 Index of Relative Importance (IRI) prey spectrum of sheefish, Stenodus leucichthys, captured in the Yukon River delta, June-September 1985.

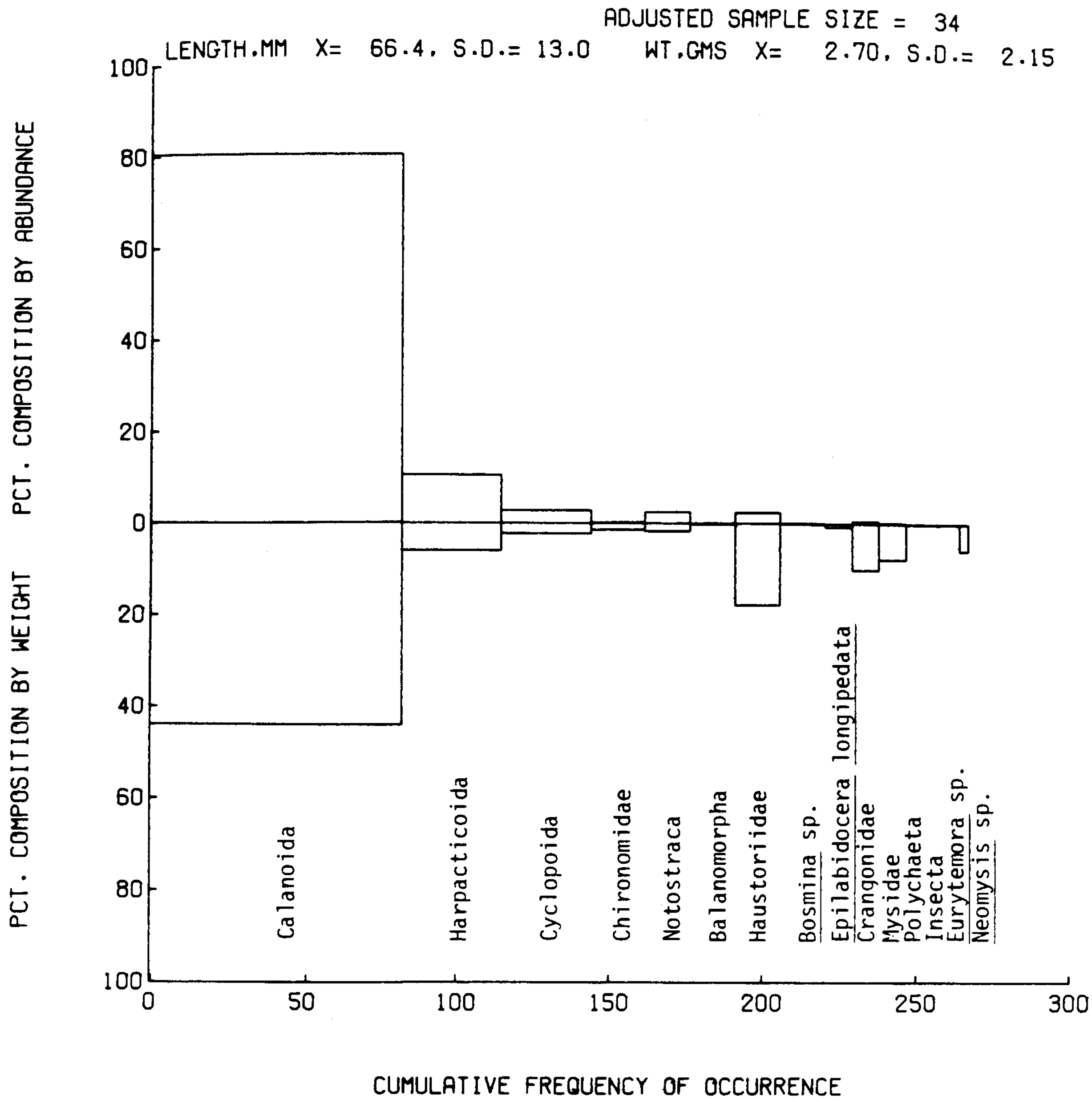


Fig. 4-30 Index of Relative Importance (IRI) prey spectrum of pond smelt, Hypomesus olidus, captured in the Yukon River delta, June-September 1985.

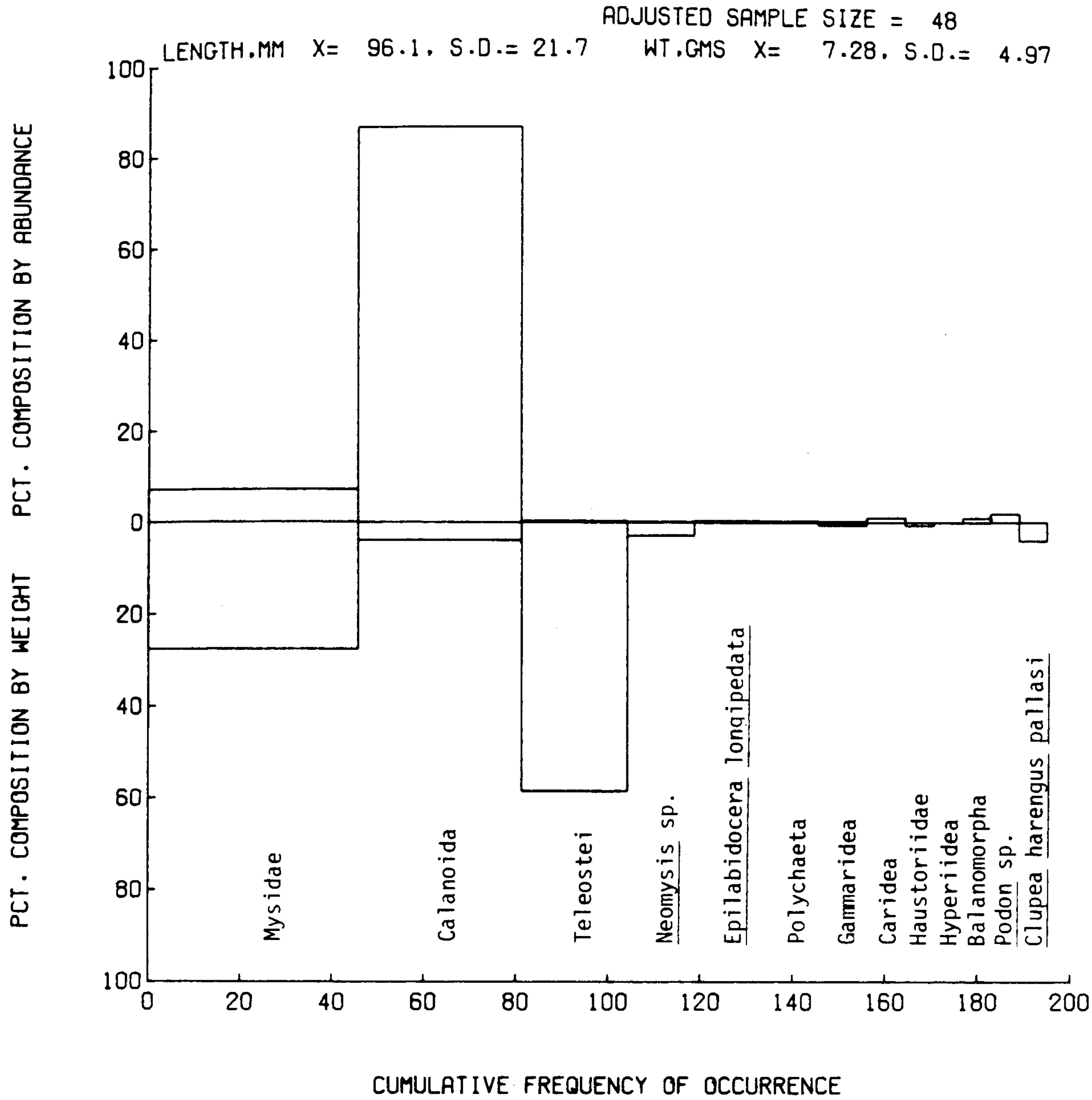


Fig. 4-31 Index of Relative Importance (IRI) prey spectrum of Boreal smelt, *Osmerus eperlanus*, captured in the Yukon River delta, June-September 1985.

Burbot

Probably due to the broad range of sizes (39-141 mm) of burbot sampled, their prey spectrum (Figure 4-32) included a variety of epibenthic, planktonic, and drift prey organisms. Epibenthic estuarine mysids (Neomysis sp.) were prevalent (65.4%SIRI) in all aspects. Chironomid larvae (11.1%SIRI), cyclopoid copepods (6.6%SIRI), and ostracods (5.4%SIRI) were also common and abundant in the diet. Approximately half of the total prey biomass, however, was composed of fish (particularly juvenile Coregonus sp., but also Stenodus leucichthys and Pungitis pungitius), but their low occurrence and abundance in the diet resulted in an overall contribution of only 9.4%SIRI.

4.5.3 Diet Variation

Bering Cisco

Purse seine samples from three delta front sites sampled between early August and early September indicated uniform feeding upon calanoid (Eurytemora sp.) copepods (Table 4-16); PSI (overlap) among the diet composition in these samples was high, between 72.1% and 93.2%. In contrast, the diet from the one mudflat sample in mid-September was dominated by epibenthic mysids (Neomysis sp.), which resulted in essentially no (0 to 0.2%) overlap with the other samples.

Least Cisco

Least cisco appeared to prey predominantly upon planktonic copepods and drift insects in most distributary and offshore habitats; mudflat and coastal slough habitats provided a complex of pelagic and epibenthic copepods and gammarid amphipods (Table 4-17). PSI overlap was highest (66.0-79.0%) among the minor active distributary (beach seine) samples and the mid-delta platform (purse seine) sample, and (up to 84.5%) among many of the coastal slough, mudflat, and inner delta platform fyke net samples. In the latter, coastal habitats, epibenthic

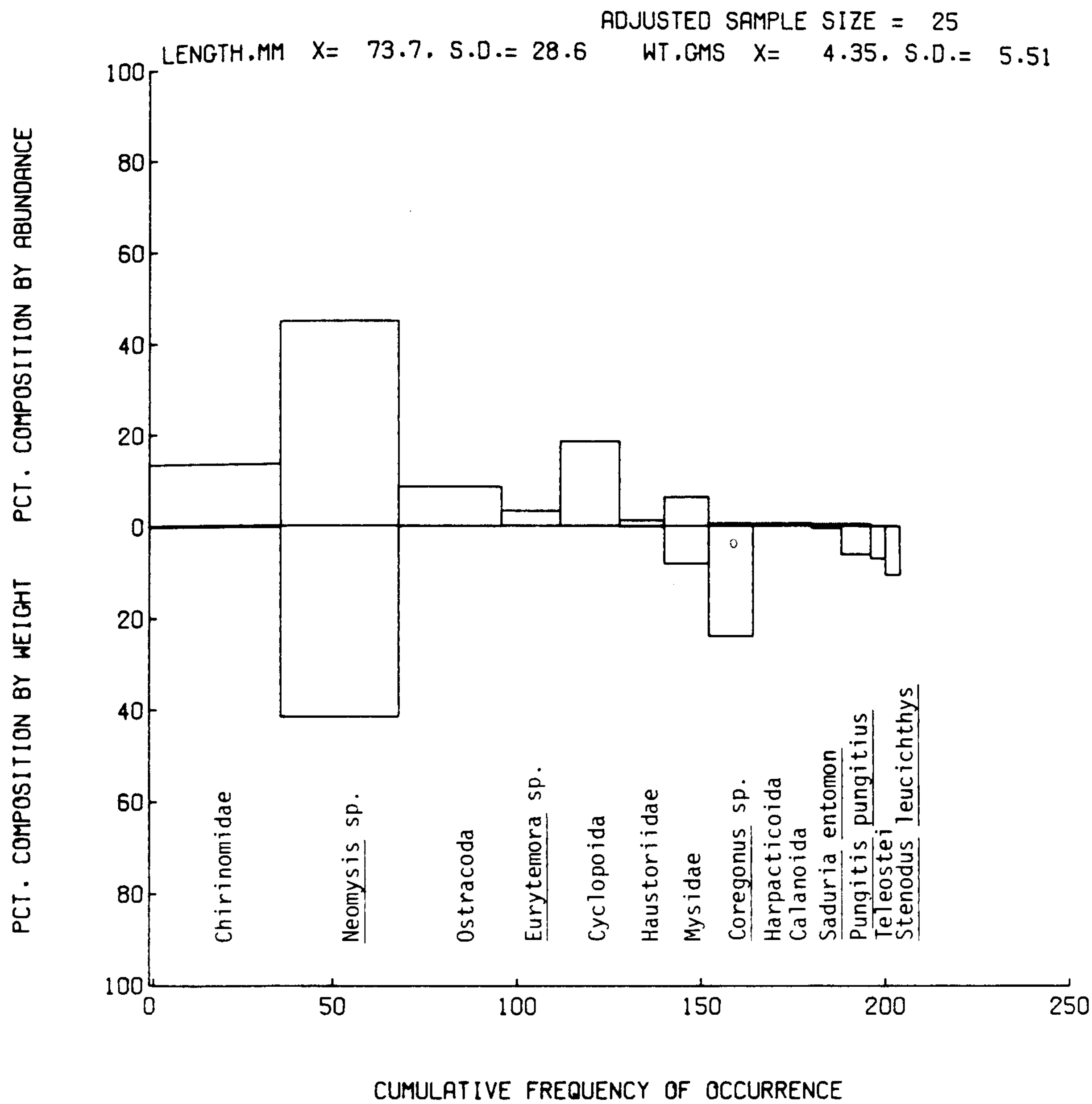


Fig. 4-32 Index of Relative Importance (IRI) prey spectrum of burbot, Lota lota, captured in the Yukon River delta, June-September 1985.

TABLE 4-16

DIET COMPOSITION (%SIRI) OF BERING CISCO
OVER SAMPLING HABITAT, STATION, AND DATE IN THE YUKON RIVER DELTA,
JUNE-SEPTEMBER 1985.

Gear:	Purse Seine			Fyke Net
Habitat:	Delta Front			Mudflat
Station:	1-3	1-1	1-2	4-1
Date:	8/10	8/13	9/10	9/16
n:	5	5	4	5
Bivalvia		+ a/		
Cladocera	6.1	+	1.8	
Calanoida	93.2	99.4	72.0	
Harpacticoida		0.4		
Balanomorpha		+		
Epicaridea		+		
Gammaridea				7.3
Mysidae	0.2			92.7
Caridea	6.6			
Diptera		+	2.3	
Teleostei			23.9	

a/ + = less than 0.1 %SIRI.

TABLE 4-17

DIET COMPOSITION (%SIRI) OF LEAST CISCO
OVER SAMPLING HABITAT,
STATION, AND DATE IN THE YUKON RIVER DELTA,
JUNE-SEPTEMBER 1985.

Gear:	Hook Seine		Purse Seine				Double Fyke	Single Fyke			Tidal Net			
Habitat:	Minor Active Dist.		Delta Front	Mid-Delta Plat.	Major Active Dist.		Inner Delta Plat.	Mudflat			Coastal Slough			
Station:	7-8	7-8	1-2	2-1	6-2	6-2	3-3	4-4	4-4	4-6	5-10	5-10	5-13	5-12
Date:	7/12	8/30	7/26	7/18	8/14	9/13	9/12	7/24	8/27	9/12	7/24	8/27	9/12	9/16
n:	5	5	5	5	1	2	9	2	5	5	5	4	8	5
Araneae		1.2												
Cladocera	0.7					26.3				1.0	0.2		0.4	1.9
Ostracoda														1.1
Calanoida	1.3	0.2	57.1	1.0			20.1	23.6	30.4	95.9	48.1	6.9	61.6	1.4
Harpacticoida							15.2		25.1	2.5	0.7	93.1	11.7	83.1
Cyclopoida	17.6	1.1	6.7	10.1				23.6			46.0		0.1	
Mysida							5.8		3.4	0.6			14.8	6.2
Gammaridea							58.5	52.9	41.1				11.4	6.2
Penaeidea											5.1			
Insecta		7.0			100		0.2							
Collembola				0.2										
Ephemeroptera		0.3				73.7								
Psocoptera		1.1												
Thysanoptera	0.7													
Homoptera			34.4											
Aphidoidea		2.8												
Tricoptera				0.4										
Diptera	63.7	77.2	0.2	77.9			0.2							0.2
Nematocera				1.7										
Brachycera		0.5		8.6										
Drosophiloidea		0.4												
Muscoidea			1.5											
Hymenoptera	1.0	8.0												
Apocrita	5.6													
Chalcidoidea		0.1												
Proctotrupoidea	9.5		0.2											

harpacticoid copepods and gammarid amphipods and planktonic calanoid and cyclopoid copepods appeared to be relatively "interchangable" in the diet spectra.

Humpback Whitefish

Diet composition of humpback whitefish was highly variable among sites within habitats, but relatively consistent over time within sites (Table 4-18). The highest consistency occurred in fish captured in coastal sloughs, which preyed on either calanoid (Eurytemora sp.) or harpacticoid (Tachidius sp.) copepods; highest overlap (PSI = 79.1% to 95.5%) was between samples from two different sampling dates (July-August) at station 5-10, and between these samples and one from mid-September at station 5-11. Overlap among the mudflat samples was marginal except between two samples from station 4-4 taken a week apart in late August (PSI = 92.8%), which had included both gammarid amphipods (haustoriids) as dominant prey items. Samples from minor active distributary station 7-8 and major active distributary station 6-2 in mid-August were also quite similar (PSI = 81.0%) due to the common occurrence of both cyclopoid copepods and dipterans.

Pink Salmon

Prey spectra of juvenile pink salmon displayed uniform utilization of dipterans in minor and major active distributaries and coastal sloughs, as opposed to predation on calanoid copepods (Epischura sp.?) in the replicated samples from delta front stations 1-1 and 1-2 (Table 4-19). Prey overlaps (PSI) were between 54.0% and 83.7% among the distributary and slough samples. As might be expected, the two replicated purse seine samples were quite consistent, with 95.4% PSI overlap.

Chum Salmon

In general, the diet compositions from samples of juvenile chum salmon across the delta were uniformly focused upon dipteran (primarily adult) insects (Table 4-20). The occurrence of calanoid and cyclopoid

TABLE 4-18

DIET COMPOSITION (%SIRI) OF HUMPBACK WHITEFISH
OVER SAMPLING HABITAT, STATION,
AND DATE IN THE YUKON RIVER DELTA,
JUNE-SEPTEMBER 1985.

Gear:	Hook Seine		Purse Seine		Double Fyke	Single Fyke					Tidal Net					
Habitat:	Minor Active Dist.		Major Active Dist.		Inner Delta Plat.	Mudflat					Coastal Slough					
Station:	7-8	7-2	6-2	6-2	3-3	4-4	4-6	4-4	4-4	4-6	5-10	5-10	5-10	5-13	5-12	5-11
Date:	7/12	8/12	7/21	9/13	9/12	7/24	8/7	8/20	8/27	9/12	7/24	8/27	9/12	9/16	9/16	9/17
n:	5	5	5	1	5	3	4	5	3	4	5	3	5	5	5	5
Rotifera											19.8					
Nematoda											0.6					
Oligochaeta																0.9
Araneae	4.1															
Acarina														0.1		
Crustacea											0.2					
Cladocera		1.9								0.5	10.0			0.2		
Ostracoda					4.3	8.2				2.0	0.2		0.1		27.1	3.6
Calanoida	1.0					6.8	43.7			78.4	6.7	19.0	2.3	63.9		18.8
Harpacticoida		68.1	13.7		62.7	6.8	0.9			19.2	0.6	81.0	92.8	23.5	37.1	76.7
Cyclopoida	33.2	1.9	38.5			78.3					37.1					
Mysida					30.8			0.2	7.4							
Gammaridea					2.3		28.4	99.8	92.6				4.7	10.7	14.1	
Penaeidea											3.8					
Collembola											5.0					
Ephemeroptera				100												
Aphidoidea											0.6					
Coleoptera														0.9		
Tricoptera							27.1									
Diptera	61.7	28.0	47.8								15.5	0.1	0.8			
Brachycera															8.6	

TABLE 4-19

DIET COMPOSITION (%SIRI) OF JUVENILE PINK SALMON
OVER SAMPLING HABITAT,
STATION, AND DATE IN THE YUKON RIVER DELTA,
JUNE-SEPTEMBER 1985

Gear:	Hook Seine		Purse Seine			Single Fyke
Habitat:	Minor Active Dist.		Delta Front		Major Active Dist.	Coastal Slough
Station:	7-3	7-4	1-1	1-2	3	5-6
Date:	6/20	6/22	6/21	6/21	6/20	6/23
n:	8	5	5	3	2	2
Calanoida	1.1	2.3	80.2	76.7	18.4	
Harpacticoida		0.2		4.6	1.1	3.1
Cyclopoida	19.1	34.0			29.3	1.7
Collembola	0.2					1.7
Diptera	79.2	63.5	19.8	18.7	51.2	66.5

TABLE 4-20

DIET COMPOSITION (%SIRI) OF JUVENILE CHUM SALMON
OVER SAMPLING HABITAT, STATION,
AND DATE IN THE YUKON RIVER DELTA,
JUNE-SEPTEMBER 1985.

Gear:	Hook Seine					Purse Seine		Double Fyke		Purse Seine					Fyke Net
Habitat:	Minor Active Dist.					Delta Front		Mid-Delta Plat.		Major Active Distributary					Coastal Slough
Station:	7-3	7-4	7-8	7-8	7-8	1/1	1/2	2-2	2-1	6-1	6-2	6-3	6-1	6-2	4-6
Date:	6/20	6/22	6/28	7/7	8/15	6/21	6/21	6/25	6/30	6/17	6/19	6/25	7/17	7/21	6/23
n:	5	9	5	3	1	3	2	5	10	5	6	5	3	2	5
Acarina									+						
Araneae														3.8	
Crustacea													1.3		
Cladocera			0.3	14.5					0.1						
Ostracoda	2.2												2.2		
Calanoida			9.8	2.5		35.5	54.7	30.8	6.0	0.8		2.5			1.2
Harpacticoida							4.8								14.9
Cyclopoida	1.5		4.6	54.3		2.0		5.6	0.6	0.8	13.9	26.0	3.3		2.3
Vavifera								17.4							33.6
Gammaridea				0.5				18.0							3.6
Insecta	1.6	0.8						0.8		1.7	1.4	42.7		3.9	
Collembola		0.9									4.4			2.9	4.5
Heptagenoidea								7.8							
Ephemeroptera										2.3					
Plecoptera			2.1	18.9					0.8	3.1			17.8	7.8	
Psylloidea		0.5													
Coleoptera			9.8									6.4	4.1		
Tricoptera														7.2	
Diptera	92.6	95.6	69.8	9.3	100	47.2	40.6	19.6	92.2	93.6	78.0	22.4	68.0	62.3	39.9
Nematocera	1.4		1.0						+					6.9	
Brachycera									0.2						
Sciomyzoidea			0.4											5.4	
Drosophiloidea									0.1						
Hymenoptera													3.3		
Tenthredinoidea			2.3												
Proctotrupoidea	0.7														
Teleostei						15.3									

copepods (the replicated delta front samples from station 1-1, one minor active distributary, and one mid-delta platform sample) and the occurrence of valviferan isopods (Saduria; coastal slough fyke net sample) were the only significant divergences from diet dominated by drift insects.

Coho Salmon

Sample sizes were generally insufficient to make comparisons of juvenile coho salmon diet composition. One sample of two fish was dominated by inorganic debris, one stomach from another sample was filled entirely with juvenile salmon, and another stomach (inner delta platform fyke net sample) was full of the valviferan isopod Saduria entomon.

Chinook Salmon

Only two samples were available for comparison of juvenile chinook salmon diets. One sample (n = 4) from a minor active distributary (station 7-1) beach seine collection was dominated by inorganic matter, with the remainder of the stomach contents being plecopteran and dipteran insects. The other sample (n = 2), from an inner delta platform (station 3-1) fyke net collection, was dominated by Saduria entomon.

Sheefish

Sheefish diets were relatively uniform within, but not between, two habitat groups: (1) minor and active distributaries and mid-delta platform habitats, where the fish fed predominantly upon dipteran insects; and, (2) inner delta platform, mudflat, and coastal slough habitats where epibenthic mysids (Neomysis sp.) and gammarid amphipods (Haustoriid) were the more important prey items (Table 4-21). Except for one sample, an early July beach seine sample in minor active distributary station 7-8, where planktonic copepods were consumed,

TABLE 4-21

DIET COMPOSITION (%SIRI) OF SHEEFISH OVER SAMPLING HABITAT, STATION, AND DATE IN THE YUKON RIVER DELTA, JUNE-SEPTEMBER 1985.

Gear:	Hook Seine			Purse Seine			Double Fyke		Single Fyke					
Habitat:	Minor Active Dist.			Mid-Delta Plat.	Major Active Dist.		Inner Delta Plat.		Mudflat			Coastal Slough		
Station:	7-8	7-8	7-8	2-1	6-1	6-2	3-5	3-3	4-4	4-1	4-5	5-10	5-10	5-12
Date:	7/7	7/12	8/1	7/18	7/17	7/21	8/19	9/12	7/24	9/16	9/16	7/24	8/28	9/16
n:	5	5	4	5	5	5	5	5	5	5	5	3	4	5
Acarina		1.5												
Cladocera	19.0	14.3		2.3	0.9									
Ostracoda	2.6													
Calanoida	34.3	6.2	1.8	2.6	31.7	3.7						9.6		
Cyclopoida	41.9	17.9	8.1	2.3	0.8									
Mysida							54.9	98.0	0.5	89.4	83.7	90.4	95.0	99.7
Gammaridea							43.1	1.0	99.2	10.6	1.1		5.0	0.3
Caridea								1.0			3.6			
Insecta						1.2								
Ephemeroptera			2.3											
Heptagenoidea						9.0	2.0							
Plecoptera		27.3												
Hemiptera		17.0												
Aphidoidea		3.0												
Diptera	2.2	30.6	67.9	82.2	62.9	78.1								
Nematocera					1.6									
Drosophiloidea		2.3			2.2									
Tenthredinoidea				10.6										
Teleostei						8.1			0.3		7.9			
Gasterosteiodei											3.7			

overlap among the first habitat group was always greater than 35-40% , and often greater than 65%. In the case of the second habitat group, only one sample had a majority of the %SIRI contributed by gammarid amphipods; as a result, diet overlap was high (PSI = greater than 80%) in all but a few cases. One of the few long term sample series was also available for the beach seine collections at minor active distributary station 7-8, which indicated a gradual shift from planktonic calanoids and cyclopoids in early July to adult dipteran (drift) insects by early August.

Pond Smelt

Pond smelt diets overlapped extensively among samples from purse seine collections in delta front and major active distributary habitats, but differed somewhat among these samples and fyke net samples from inner delta platform and coastal slough habitats (Table 4-22). Overlap among the samples sampled by the purse seine, which were predominantly fish that had fed upon planktonic calanoid copepods, was very high (PSI = greater than 85%) except in comparison with one sample from the major active distributary station 6-2 (which had fed more on planktonic cyclopoids). Fish from the fyke net samples had also fed on planktonic copepods, but epibenthic mysids and gammarid amphipods were also prominent in their diets, reducing the diet overlap between them (PSI = 19.6%) and among the samples.

Boreal Smelt

The differential utilization of two discrete prey taxa--planktonic calanoid copepods (*Epilabidocera longipedata* and *Eurytemora* sp.) and epibenthic mysids (*Neomysis* sp.)--resulted in generally modest (PSI = 30% to 50%) diet overlap in boreal smelt diet composition (Table 4-23). Significant overlaps were evident, however, among purse seine samples from the delta front (Station 1-2 on 7/26 and station 1-1 on 8-13 = 87.5%) and between delta front and mid-delta platform fyke

TABLE 4-22

DIET COMPOSITION (%SIRI) OF POND SMELT
OVER SAMPLING HABITAT, STATION,
AND DATE IN THE YUKON RIVER DELTA,
JUNE-SEPTEMBER 1985.

Gear:	Purse Seine					Fyke Net	
Habitat:	Delta Front			Major Active Dist.		Inner Delta Platform	Coastal Slough
Station:	1-3	1-1	1-3	6-1	6-2	3-6	5-5
Date:	8/10	8/13	9/4	8/10	8/12	8/4	6/23
n:	5	5	8	2	5	4	5
Polychaeta	0.1		0.3				
Notostraca							4.5
Cladocera	+			2.1	0.4		0.4
Calanoida	87.4	95.7	97.0	85.0	8.4	19.6	46.5
Harpacticoida		0.4	0.3	8.2	0.3		16.4
Cyclopoida				2.6	87.6		1.9
Monstrilloida	0.1						
Balanomorpha		0.6	0.3				
Mysidae	0.1	3.4				80.4	
Gammaridea			2.0				28.4
Caridea	12.4						
Insecta					2.8		
Collembola							0.1
Diptera				2.1	0.6		1.7

TABLE 4-23

DIET COMPOSITION (%SIRI) OF BOREAL SMELT
OVER SAMPLING HABITAT, STATION,
AND DATE IN THE YUKON RIVER DELTA,
JUNE-SEPTEMBER 1985.

Gear:	Purse Seine							Double Fyke	
Habitat:	Delta Front					Mid-Delta Plat.	Delta Front	Inner Delta Platform	
Station:	1-2	1-3	1-1	1-3	1-2	2-3	1-1	3-1	3-6
Date:	7/26	8/10	8/13	9/4	9/10	7/22	7/22	6/23	8/4
n:	5	10	5	5	6	5	5	5	2
Polychaeta		0.4					+		
Cladocera							1.6		
Ostracoda							+		
Calanoida	1.2	56.9	0.4	4.9	4.7	23.3	76.2		
Harpacticoida		+					+		
Cyclopoida						0.7	0.9		
Balanomorpha							1.0		
Mysidae	87.1	42.7	95.9	38.2	21.0	70.3	19.4		100
Valvifera						1.1	0.7		
Gammaridea	1.2		0.1	9.0	48.0	4.7		4.6	
Hyperiidea							0.7		
Caridea	0.2						1.2		
Brachyura				24.9					
Teleostei	10.5		0.5	2.9	26.3			94.7	
Clupeiformes			3.0	20.0					

net samples (stations 1-1 & 2-3 on 6/23 & 7/22, respectively) and delta front purse seine samples (station 1-3,8/10 and station 1-1,8/13, respectively).

Burbot

The rather eclectic foraging behavior, as well as the broad size range, of burbot resulted in rather minimal overlap among the various stomach samples (Table 4-24). In actuality, the only major overlap (PSI = 98.8%) occurred between samples originating from fyke net collections in two different habitats (coastal slough station 5-13, 8/8:inner delta platform station 3-5) due to the mutual dominance of juvenile mysids in the diet. Otherwise, burbot displayed opportunistic foraging upon planktonic copepods, epibenthic mysids, amphipods, and isopods, drift insects, and fishes.

4.6 POTENTIAL IMPACTS OF OIL AND GAS DEVELOPMENT

4.6.1 Indices of Habitat Utilization and Species Importance

Monthly duration of occurrence values and species abundance by month are reported in Tables 4-25 and 4-26. Chum salmon utilized the Yukon Delta during the entire sampling period, appearing in the highest abundance in June. The other salmon species occurred predominantly early in the season in all habitats except the tidal sloughs and mudflat. Sheefish, ciscoes, and whitefish occurred in riverine habitats all season and moved into offshore locations in July. Sheefish began to move back inshore beginning in August while ciscoes remained offshore for the duration of the sampling season. Whitefish were never found as far offshore as ciscoes and sheefish. Northern pike and burbot utilized predominantly the inshore and coastal habitats, saffron cod were found in all locations but riverine habitats and herring occurred only on the delta front. Blackfish were found in the minor active distributaries, lakes, and inactive channels. Of these habitats, only the minor active distributaries were sampled

TABLE 4-24

DIET COMPOSITION (%SIRI) OF BURBOT
OVER SAMPLING HABITAT, STATION,
AND DATE IN THE YUKON RIVER DELTA,
JUNE-SEPTEMBER 1985.

Gear:	Hook Seine		Purse Seine	Double Fyke	Single Fyke	
Habitat:	Minor Active Dist.		Major Active Dist.	Inner Delta Plat.	Coastal Slough	
Station:	7-8	7-2	6-2	3-5	5-10	5-13
Date:	8/1	8/3	9/13	8/19	7/24	8/8
n:	3	5	3	5	4	5
Ostracoda	14.5	39.1	5.6			
Calanoida	0.6	21.4		0.1		
Harpacticoida		0.7				0.1
Cyclopoida	12.6	14.6				
Mysidae				98.6	4.2	99.3
Valvifera		5.1			2.3	
Gammaridea		6.6		0.2		0.6
Caridea				0.1		
Collembola		0.7				
Ephemeroptera			47.1			
Diptera	72.4	11.9	47.3			
Teleostei					5.6	
Salmoniformes					82.8	
Gasterosteoidea				1.1	5.1	

TABLE 4-25

MONTHLY DURATION OF OCCURRENCE VALUES
BY SPECIES AND HABITAT

Species	Habitat	Month			
		June	July	Aug.	Sept.
Chum Salmon	Delta front	1.0	1.0	1.0	0.5
	Mid delta platform	1.0	1.0	1.0	0.5
	Inner delta platform	1.0	1.0	1.0	0.5
	Mudflat	1.0	1.0	0.0	0.0
	Tidal Slough	1.0	1.0	0.5	0.0
	Major active distributary	1.0	1.0	1.0	0.5
	Minor active distributary	1.0	1.0	1.0	0.5
Chinook Salmon	Delta front	0.0	0.0	0.0	0.0
	Mid delta platform	1.0	1.0	0.0	0.0
	Inner delta platform	1.0	1.0	0.0	0.0
	Mudflat	0.0	0.0	0.5	0.0
	Tidal Slough	0.0	0.0	1.0	0.0
	Major active distributary	1.0	1.0	0.0	0.0
	Minor active distributary	1.0	1.0	0.0	0.0
Coho Salmon	Delta front	0.0	0.0	0.0	0.0
	Mid delta platform	0.0	0.0	0.0	0.0
	Inner delta platform	0.0	0.0	0.0	0.0
	Mudflat	0.0	0.0	0.0	0.0
	Tidal Slough	0.0	0.0	0.0	0.0
	Major active distributary	0.0	0.0	0.5	0.0
	Minor active distributary	0.0	0.0	0.0	0.0

TABLE 4-25 (Continued)

MONTHLY DURATION OF OCCURRENCE VALUES
BY SPECIES AND HABITAT

Species	Habitat	Month June	July	Aug.	Sept.
Pink Salmon	Delta front	1.0	1.0	0.0	0.0
	Mid delta platform	1.0	1.0	0.0	0.0
	Inner delta platform	1.0	1.0	0.0	0.0
	Mudflat	0.0	0.0	0.0	0.0
	Tidal Slough	1.0	0.0	0.0	0.0
	Major active distributary	1.0	1.0	0.0	0.0
	Minor active distributary	1.0	1.0	0.25	0.6
Sheefish	Delta front	0.0	0.4	0.0	0.0
	Mid delta platform	0.0	0.8	1.0	0.0
	Inner delta platform	0.0	0.6	1.0	1.0
	Mudflat	0.0	1.0	1.0	1.0
	Tidal Slough	1.0	1.0	1.0	1.0
	Major active distributary	1.0	1.0	1.0	1.0
	Minor active distributary	1.0	1.0	1.0	1.0
Ciscoes	Delta front	0.0	0.3	0.75	0.67
	Mid delta platform	0.0	0.2	0.5	1.0
	Inner delta platform	1.0	1.0	1.0	1.0
	Mudflat	1.0	1.0	1.0	1.0
	Tidal Slough	1.0	1.0	1.0	1.0
	Major active distributary	1.0	1.0	1.0	1.0
	Minor active distributary	1.0	1.0	1.0	1.0

TABLE 4-25 (Continued)

MONTHLY DURATION OF OCCURRENCE VALUES
BY SPECIES AND HABITAT

Species	Habitat	Month			
		June	July	Aug.	Sept.
Whitefish	Delta front	0.0	0.0	0.0	0.0
	Mid delta platform	0.0	0.0	1.0	0.0
	Inner delta platform	1.0	1.0	1.0	1.0
	Mudflat	1.0	1.0	1.0	1.0
	Tidal Slough	1.0	1.0	1.0	1.0
	Major active distributary	1.0	1.0	1.0	1.0
	Minor active distributary	1.0	1.0	0.5	1.0
Northern Pike	Delta front	0.0	0.0	0.0	0.0
	Mid delta platform	0.0	0.0	0.0	0.0
	Inner delta platform	0.0	0.0	0.0	0.0
	Mudflat	0.0	1.0	0.0	0.0
	Tidal Slough	0.5	1.0	0.5	0.0
	Major active distributary	1.0	1.0	1.0	1.0
	Minor active distributary	1.0	1.0	1.0	1.0
Burbot	Delta front	0.0	0.0	0.0	0.0
	Mid delta platform	0.0	0.0	0.0	0.0
	Inner delta platform	0.0	0.0	1.0	1.0
	Mudflat	0.0	0.0	0.75	0.33
	Tidal Slough	1.0	1.0	1.0	1.0
	Major active distributary	1.0	0.6	1.0	1.0
	Minor active distributary	1.0	1.0	1.0	1.0

TABLE 4-25 (Continued)

MONTHLY DURATION OF OCCURRENCE VALUES
BY SPECIES AND HABITAT

Species	Habitat	Month June	July	Aug.	Sept.
Saffron Cod	Delta front	0.0	1.0	1.0	1.0
	Mid delta platform	0.0	1.0	1.0	1.0
	Inner delta platform	1.0	1.0	1.0	1.0
	Mudflat	1.0	0.0	1.0	1.0
	Tidal Slough	0.5	1.0	1.0	1.0
	Major active distributary	0.0	0.0	0.0	0.0
	Minor active distributary	0.0	0.0	0.0	0.0
Herring	Delta front	1.0	1.0	1.0	1.0
	Mid delta platform	0.0	0.0	0.0	0.0
	Inner delta platform	0.0	0.0	0.0	0.0
	Mudflat	0.0	0.0	0.0	0.0
	Tidal Slough	0.0	0.0	0.0	0.0
	Major active distributary	0.0	0.0	0.0	0.0
	Minor active distributary	0.0	0.0	0.0	0.0
Blackfish	Delta front	0.0	0.0	0.0	0.0
	Mid delta platform	0.0	0.0	0.0	0.0
	Inner delta platform	0.0	0.0	0.0	0.0
	Mudflat	0.0	0.0	0.0	0.0
	Tidal Slough	0.0	0.0	0.0	0.0
	Major active distributary	0.0	0.0	0.0	0.0
	Minor active distributary	0.5	0.0	0.0	0.0

TABLE 4-25 (Continued)

MONTHLY DURATION OF OCCURRENCE VALUES
BY SPECIES AND HABITAT

Species	Habitat	Month			
		June	July	Aug.	Sept.
Smelt	Delta front	1.0	1.0	1.0	1.0
	Mid delta platform	0.5	1.0	1.0	0.0
	Inner delta platform	1.0	1.0	1.0	1.0
	Mudflat	1.0	0.8	1.0	0.5
	Tidal Slough	1.0	0.0	0.5	0.67
	Major active distributary	1.0	0.0	1.0	1.0
	Minor active distributary	1.0	1.0	1.0	1.0
Starry Flounder	Delta front	0.0	0.0	0.0	0.0
	Mid delta platform	0.5	1.0	0.5	1.0
	Inner delta platform	1.0	1.0	0.5	1.0
	Mudflat	1.0	1.0	1.0	1.0
	Tidal Slough	1.0	1.0	1.0	1.0
	Major active distributary	0.0	0.0	0.0	0.0
	Minor active distributary	1.0	0.4	0.25	0.0

TABLE 4-26

MONTHLY ABUNDANCE VALUES BY SPECIES AND HABITAT

Species	Habitat	Month June	July	Aug.	Sept.
Chum Salmon	Delta front	1	1	1	1
	Mid delta platform	2	1	1	1
	Inner delta platform	3	1	1	1
	Mudflat	1	1	0	0
	Tidal Slough	1	1	1	0
	Major active distributary	3	1	1	1
	Minor active distributary	3	1	1	1
Chinook Salmon	Delta front	0	0	0	0
	Mid delta platform	1	1	0	0
	Inner delta platform	1	1	0	0
	Mudflat	0	0	1	0
	Tidal Slough	0	0	1	0
	Major active distributary	1	1	0	0
	Minor active distributary	1	1	0	0
Coho Salmon	Delta front	0	0	0	0
	Mid delta platform	0	0	0	0
	Inner delta platform	0	0	0	0
	Mudflat	0	0	0	0
	Tidal Slough	0	0	0	0
	Major active distributary	0	0	1	0
	Minor active distributary	0	0	0	0

TABLE 4-26 (Continued)

MONTHLY ABUNDANCE VALUES BY SPECIES
AND HABITAT

Species	Habitat	Month			
		June	July	Aug.	Sept.
Pink Salmon	Delta front	1	1	0	0
	Mid delta platform	1	1	0	0
	Inner delta platform	1	1	0	0
	Mudflat	0	0	0	0
	Tidal Slough	1	0	0	0
	Major active distributary	1	1	0	0
	Minor active distributary	1	1	1	1
Sheefish	Delta front	0	1	0	0
	Mid delta platform	0	1	1	0
	Inner delta platform	0	1	2	2
	Mudflat	0	3	2	2
	Tidal Slough	2	3	1	2
	Major active distributary	1	2	1	1
	Minor active distributary	1	2	1	1
Ciscoes	Delta front	0	2	1	1
	Mid delta platform	0	3	1	1
	Inner delta platform	1	1	1	1
	Mudflat	1	2	3	3
	Tidal Slough	3	3	2	1
	Major active distributary	1	2	1	1
	Minor active distributary	1	2	1	1

TABLE 4-26 (Continued)

MONTHLY ABUNDANCE VALUES BY SPECIES AND HABITAT

Species	Habitat	Month			
		June	July	Aug.	Sept.
Whitefish	Delta front	0	0	0	0
	Mid delta platform	0	0	1	0
	Inner delta platform	1	1	1	1
	Mudflat	2	3	3	1
	Tidal Slough	3	3	3	2
	Major active distributary	1	2	3	1
	Minor active distributary	1	2	1	1
Northern Pike	Delta front	0	0	0	0
	Mid delta platform	0	0	0	0
	Inner delta platform	0	0	0	0
	Mudflat	0	1	0	0
	Tidal Slough	1	1	1	0
	Major active distributary	1	1	1	1
	Minor active distributary	1	1	1	1
Burbot	Delta front	0	0	0	0
	Mid delta platform	0	0	0	0
	Inner delta platform	0	0	2	1
	Mudflat	0	0	1	1
	Tidal Slough	1	1	1	1
	Major active distributary	1	1	1	1
	Minor active distributary	1	2	1	1

TABLE 4-26 (Continued)

MONTHLY ABUNDANCE VALUES BY SPECIES AND HABITAT

Species	Habitat	Month June	July	Aug.	Sept.
Saffron Cod	Delta front	0	1	3	3
	Mid delta platform	0	1	1	1
	Inner delta platform	1	1	2	3
	Mudflat	1	0	1	2
	Tidal Slough	1	0	1	2
	Major active distributary	0	0	0	0
	Minor active distributary	0	0	0	0
Herring	Delta front	1	2	1	1
	Mid delta platform	0	0	0	0
	Inner delta platform	0	0	0	0
	Mudflat	0	0	0	0
	Tidal Slough	0	0	0	0
	Major active distributary	0	0	0	0
	Minor active distributary	0	0	0	0
Blackfish	Delta front	0	0	0	0
	Mid delta platform	0	0	0	0
	Inner delta platform	0	0	0	0
	Mudflat	0	0	0	0
	Tidal Slough	0	0	0	0
	Major active distributary	0	0	0	0
	Minor active distributary	1	0	0	0

TABLE 4-26 (Continued)

MONTHLY ABUNDANCE VALUES BY SPECIES AND HABITAT

Species	Habitat	Month June	July	Aug.	Sept.
Smelt	Delta front	3	3	3	1
	Mid delta platform	1	0	1	3
	Inner delta platform	3	1	2	1
	Mudflat	1	1	1	1
	Tidal Slough	1	1	2	0
	Major active distributary	1	1	1	0
	Minor active distributary	3	2	1	1
Starry Flounder	Delta front	0	0	0	0
	Mid delta platform	1	1	1	1
	Inner delta platform	1	1	1	1
	Mudflat	1	2	1	1
	Tidal Slough	1	1	1	1
	Major active distributary	0	0	0	0
	Minor active distributary	1	1	1	0

frequently enough to determine relative species abundance and occurrence. For a detailed description of distribution and abundance, see Sections 4.3 and 5.2.

The contribution of each species to the local commercial and subsistence fisheries (Table 4-27) was determined relative to the catch of chum which represented the species which contributed the most to the total local catches. The catch of chum overwhelmed the catches of most other species. Chinook salmon had the second largest catch (approximately 0.143 as high as chum) and the catch of coho salmon was third (0.028 the size of the chum catch). The catch of all other species are less than one hundredth the size of the chum catch.

4.6.2 Indices of Species Sensitivity to Oil

The exposure of fish to spilled petroleum and its water soluble aromatic hydrocarbons could produce a variety of lethal and sub-lethal effects. The acute effects of hydrocarbon exposure have been extensively studied. However, interpretation and comparison of these results are often difficult due to the general lack of standardization of methods, the frequent lack of monitoring of hydrocarbon concentrations during the bioassay, (Patten 1977) and the differing levels of highly toxic aromatic hydrocarbons found in oil from different sources. Prudhoe Bay crude contains approximately 25% aromatic hydrocarbons which is quite high (Nelson-Smith, 1982). A further complication is the interpretation of laboratory studies in terms of responses that would occur under natural environmental conditions. Reviews of test results including discussions of comparative methods can be found in Rice (1976), Craddock (1977), Patten (1977), NAS (1975, 1983) and Bax (1985).

Possible sub-lethal responses include a variety of physiological and behavioral changes, many of which can lead to the death of the animal or impact the population levels of a species over a long period. Possible physiological changes include changes in the fecundity, survival, growth rates, and formation of metabolites (Patten 1977).

TABLE 4-27

RELATIVE CONTRIBUTION OF EACH SPECIES TO THE LOCAL COMMERCIAL AND SUBSISTENCE FISHERIES ESTIMATED FROM 10-YEAR AVERAGE CATCH OF SALTWATER AND ANADROMOUS SPECIES AND 5-YEAR AVERAGE CATCH OF FRESHWATER SPECIES

Species	Relative Contribution
Chum salmon	1.000
Chinook salmon	0.143
Coho salmon	0.028
Pink salmon	0.001
Sheefish	0.002
Ciscoes	0.002
Whitefish	0.002
Northern pike	0.001[a/]
Burbot	0.001[a/]
Saffron cod	0.001[a/]
Herring	0.002
Blackfish	0.006[a/]
Smelt	0.000
Starry Flounder	0.000

a/ Estimated from household harvest rates reported by Wolfe (1981).

Most of these physiological responses are poorly studied and understood. Changes in growth and survival of eggs and larvae of a number of species including herring (Struhsaker et al. 1974; Kuhnhold 1969; Rice et al. 1975; Moles et al. 1979; Smith and Cameron 1979), flounder (Sprague and Carson 1970; Vaughn 1973), cod (Kuhnhold 1969) and pink salmon (Rice et al. 1975) have been studied. Generally, pelagic eggs and larvae have been found to be highly susceptible to damage as a result of contact with oil and oil extracts.

Possible behavioral responses to exposure to hydrocarbons include avoidance reactions which have been demonstrated in several species (Rice 1973; Weber et al. 1981; Maynard and Weber 1981; Anonymous 1978), Cough response (Rice et al. 1977) and interference with migration, changes in locomotor and activity patterns, and reduced feeding (Patten 1977). Exposure of a habitat to oil may also have substantial impacts on fish growth and reproduction through changes in availability of prey items and other perturbations of the aquatic ecology (Simenstadt et al. 1979; Budosh and Atlas 1977; Moore and Dwyer 1973; Shaw et al. 1981; Anderson et al. 1974).

Possible responses to exposure to oil which were considered in assigning susceptibility levels include the results of acute toxicity tests, impact on food availability, avoidance reactions, survival of eggs and larvae, and the ability of a species to relocate to other less affected habitats. Little, if any, information was available on other factors which may affect the impact of exposure to oil.

Description of factors considered for each species in determining potential vulnerability levels follow and are summarized in Table 4-28.

Salmon

Many experiments designed to measure the acute toxic effects of exposure to oil on various salmon species have been reported (Rice et al. 1975a; Rice et al. 1975b; Rice et al. 1976; Rice et al. 1977; Moles et al. 1979; Moles 1980; Moles et al. 1981; Moles et al. 1983; Cardwell

TABLE 4-28

SUSCEPTIBILITY LEVELS OF SPECIES
FOUND IN THE YUKON RIVER DELTA

Species	Susceptibility Rating	Numerical Rating	Type of Potential Impact
Chum Salmon	Medium	3	Reduction of food availability Possible interference in migration patterns
Chinook Salmon	Medium	3	Reduction of food availability Possible interference in migration patterns
Coho Salmon	Medium	3	Reduction of food availability Possible interference in migration patterns
Pink Salmon	High	4	High sensitivity to aromatics Reduction of food availability Possible interference in migration patterns
Whitefish, Sheefish & Ciscoes	Low	2	Reduction in food availability Ability to relocate to lesser impacted habitats
Herring	Negligible	1	Negligible
Saffron Cod	Medium	3	Toxic to eggs and larvae Reduction in food availability
Starry Flounder	Medium	3	Toxic to eggs and larvae Reduction in food availability
Smelt	Low	2	Interference in migration patterns
Northern Pike	Low	2	Highly tolerant eggs and larvae
Blackfish	Low	2	Demersal habit Reduction in food availability
Burbot	Low	2	Reduction in food availability

1973; Wolf and Strand 1973; Bean et al. 1974; Rice 1973; Morrow 1973), however, the results of few of these experiments are comparable due to variation in methods and experimental design (including differences in salinity of test water, differences in sources of oil, differences in methods used to prepare the oil and water mixture, and differences in methods of measuring concentrations of oil in solution). Different salmon species were seldom tested using similar methods. Moles et al. (1979) tested three species of salmon fry in freshwater and reported 96 hr LC_{50} values of 4.0 ppm, 3.6 ppm, and 3.7 ppm for sockeye, chinook, and coho, respectively. In a later study using similar methods, Moles et al. (1983) reported an LC_{50} values for pink salmon of 1.2 ppm. Cardwell tested chinook salmon in a freshwater and oil emulsion and chum and pink salmon in a saltwater emulsion. The 96 hr LC_{50} calculated in that experiment was reported to be 0.349 ml/l for chinook, 0.312 ml/l for chum, and 0.184 ml/l for pink salmon. The results of these studies suggest that coho, chinook and sockeye experience similar reactions to oil exposure and that pink are more susceptible to adverse affects of oil than are the other salmon species.

Moles et al. (1979) reported that outmigrants of the salmonid species tested were more sensitive to exposure to benzene or Prudhoe Bay crude oil in saltwater as outmigrants in freshwater, which concurs with results found by Rice et al. (1975). This suggests that the point of transition from fresh to saltwater environments may be a critical point for salmonids exposed to oil contamination.

Upon entry into saltwater salmonid smolts begin to switch their prey from a diet of freshwater dipterans to a diet of neritic zooplankton such as harpacticoid copepods and gammarid amphipods (Simenstad et al. 1979). Information regarding toxicity of oil to harpacticoids is limited. However, studies of toxicity to gammarid amphipods indicate that oil spills in the Arctic may cause large scale mortality of these species (Busdosh and Atlas 1977; Percy and Mullen 1975), thereby reducing the quantity of available food to these outmigrants.

The avoidance of oil and oil extracts by juvenile salmonids is not well documented, but studies indicate that some level of avoidance may be expected. Pink salmon fry were found to avoid the water soluble fraction of Prudhoe Bay crude oil in laboratory experiments using both salt and freshwater (Rice 1973). The avoidance reaction reported was greater in fry adapted to seawater, and appeared to increase with age. The avoidance response to dissolved hydrocarbons has also been reported by Maynard and Weber (1981) and Shaw et al. (1981) in laboratory tests. The threshold concentration at which avoidance reactions were demonstrated was highly variable, ranging from 497 ppm for pink salmon in freshwater in early summer to 1.6 ppm for pink salmon in saltwater in late summer. All these tests were conducted in laboratory situations. The avoidance reactions in a natural situation have not been documented, but these studies suggest that some level of avoidance to oil extracts can be expected in juvenile salmonids. This may help to reduce the amount of dissolved hydrocarbons encountered by outmigrants, but may also result in disruption of migration paths.

Given the above factors, vulnerability to the toxic effects of oil for all salmon species except pinks was rated medium relative to other fish species found on the Yukon delta. Due to the extreme sensitivity to aromatic hydrocarbons demonstrated in pink salmon, this species has been given a relative susceptibility rating of high.

The ratings given the salmon species consider only the lethal and sublethal effects of exposure to petroleum hydrocarbons and speculation on how the exposure may affect their food supply. Factors which were not considered due to the lack of available information include the vertical distribution of the species in the water column, size of the fish, age of the fish, and detailed information regarding diet and dependence on specific food items.

Whitefish, Sheefish, and Ciscoes

The effects of exposure to oil or oil extracts on whitefish, sheefish, and ciscoes has largely been ignored despite their abundance in arctic and subarctic habitats and their importance to subsistence fisheries. Because of similarities in life history and phylogeny, the vulnerability of these species to the effects of oil is probably similar to that found in salmon fry, arctic char, or dolly varden. Moles et al. (1979) found the median tolerance limits (TLm's) to the water soluble portion of Prudhoe Bay crude oil to range from 1.25 mg/L (dolly varden) to 2.17 mg/l (arctic char) with the salmon species and arctic grayling tolerance limits falling somewhere between. Where coregonids fall in this range (or outside of it) is unknown. It is possible, given the wide range of those species tested, that any or all of the coregonids may be highly susceptible or, conversely, relatively tolerant to exposure to hydrocarbons. It is assumed here that the effect of direct exposure to these species is similar to that of chum, chinook, or coho.

Sheefish, ciscoes, and whitefish all spawn predominantly upriver from the delta, removing any danger of exposure to spawning beds. The greatest potential sub-lethal effect which these species may encounter is the probable reduction in food availability, particularly on the tidal flats and delta platform. Concentrations of prey items may also be reduced within river channels, but this reduction is expected to be less severe due to extensive flushing of the river. Most adult forms of fish have been shown to exhibit some sort of avoidance reaction to concentrations of hydrocarbons. Because these coregonid species are not dependent on migration routes to complete their life history, it is possible that they will move to less impacted areas, avoiding lethal contact. Therefore these species have been given a relative susceptibility rating of low.

Herring

Adult herring were captured only on the delta front. They apparently do not spawn along the delta, nor does the delta appear to be used as a nursery ground. Therefore, the fact the herring eggs and larval have been found to be extremely sensitive to contact with hydrocarbons (Smith and Cameron 1979; Vaughn 1973; Rice et al. 1975) has no bearing on the presence of the species in the study area. Herring in the Yukon Delta area were given a susceptibility rating of negligible.

Saffron Cod

Saffron cod is a demersal species which spawns in the shallows, and has pelagic eggs and larvae. The eggs of cod species have been found to be less sensitive to exposure to hydrocarbons than herring eggs, but the larvae are very sensitive to exposure, the actual results varying with the origin of the crude oil used in testing (Kunhold 1969; Kunhold 1979). Given this sensitivity in combination with a probable reduction in available food, a serious impact to Yukon delta stocks is possible for one or more year classes depending on the duration of toxic levels of hydrocarbons in the area. Saffron cod are, however, quite ubiquitous in the subarctic and numbers in the area would probably recover rapidly; therefore,cod were given a susceptibility rating of medium.

Starry Flounder

Starry Flounder also have pelagic eggs and larvae. No tests of acute toxicity of starry flounder have been conducted, however the rates of mortality and disformity of larvae due to exposure to a variety of types of oil have been studied (Craddock 1977). The result of these studies are variable, but most suggest that low levels of oil may be quite toxic to the eggs and larvae. The effects of oil on this species were considered to be similar to the effects on arctic cod and the species was given a susceptibility rating of medium.

Smelt

No studies are available on the toxic effects of oil on smelt. Assuming this species exhibits some sort of avoidance reaction, the freshwater runs may encounter some interference in migration routes. Due to lack of information, the susceptibility was assigned a low level.

Northern Pike

Pike were found distributed throughout the inland channels of the Yukon delta, particularly in backwater channels and lakes where currents are low. No information was found pertaining to the toxic effects of contact with oil and oil extracts on adult northern pike. However, the eggs and larvae were found to be highly tolerant of exposure (Craddock 1977). For lack of any further information on northern pike, they were assigned a susceptibility level of low.

Blackfish

No literature was found on the vulnerability of blackfish to exposure to oil. The species is a demersal freshwater fish which has evolved an ability to endure stress resulting from the exposure to extreme cold. Because they inhabit the marshes and backwaters of the tidal plane, they would undoubtedly encounter considerable amounts of dissolved extracts in the water and sunken residue on the bottom. The actual impact of the presence on oil is unknown, but is assumed to be low based on their known tolerance of stress stemming from other sources.

Burbot

No information could be found on this species with respect to oil exposure. Given their broad distribution and their tendency to spawn upriver, their susceptibility level was assumed to be low.

4.6.3 Indices of Relative Impact

Indices of relative impact for each habitat were determined monthly and for the entire sampling season (Tables 4-29 and 4-30). The community importance value for chum salmon so overwhelmed the values for other species that the habitat impact indices which included these values were predominantly an index with respect to chum. Therefore, indices were also calculated without consideration to community importance values (Table 4-29 and 4-30). The indices which included the community importance values indicated that the inriver and delta platform habitats were the most vulnerable to the impacts of oil in June, August, September, and for the season as a whole. All habitats were rated nearly equal in July.

Habitat impact ratings calculated without the community importance values were very different. In June and for the entire sampling season, the inner delta platform, tidal sloughs, and minor active distributaries received the highest potential impact ratings. In July, all habitats except the delta front received similar ratings, with the minor active distributions ranking the highest in vulnerability. The inner delta platform, mudflat, and tidal sloughs were rated the most vulnerable in August and September, though the values in September were generally much reduced. September was, overall, the least vulnerable month to the effects of oil, reflecting the reduced numbers of all species in the catches of that month.

TABLE 4-29

RELATIVE IMPACT (SCALE 0 TO 10) OF AN OIL SPILL ON THE FISH COMMUNITY IN HABITATS OF THE YUKON RIVER DELTA DURING SUMMER

	Month			
Habitat	June	July	Aug.	Sept.
Community importance values included:				
Delta front	3.2	3.2	3.2	0.1
Mid delta platform	10.0	3.6	3.2	1.6
Inner delta platform	10.0	3.6	3.2	1.6
Mudflat	3.2	3.2	0.3	0.1
Tidal Slough	3.2	3.2	1.7	0.1
Major active distributary	10.0	3.7	3.2	1.6
Minor active distributary	10.0	3.7	3.2	1.6
Community importance values excluded:				
Delta front	4.4	5.2	6.7	5.1
Mid delta platform	5.7	8.4	4.8	2.7
Inner delta platform	9.2	7.0	9.5	7.8
Mudflat	5.1	8.4	8.3	6.9
Tidal Slough	10.0	8.3	8.3	6.8
Major active distributary	7.0	8.0	6.7	3.0
Minor active distributary	9.8	9.1	6.7	5.6

TABLE 4-30

OVERALL RELATIVE IMPACT (SCALE 0 TO 10) OF AN OIL SPILL ON THE FISH COMMUNITY IN HABITATS OF THE YUKON RIVER DELTA DURING SUMMER (i.e., JUNE-SEPTEMBER)

Habitat	Impact Rating: Community Importance Values Included	Impact Rating: Community Importance Values Excluded
Community importance values included:		
Delta front	5.2	6.4
Mid delta platform	10.0	6.4
Inner delta platform	10.0	10.0
Mudflat	3.6	8.6
Tidal Slough	4.4	9.7
Major active distributary	10.0	7.4
Minor active distributary	10.0	9.3

5.0 DISCUSSION

5.1 PHYSICAL ENVIRONMENT

5.1.1 Characterization of Habitats Based on Physical Factors - Summer Discrete Measurements.

Delta Front

The delta front habitat is defined as the depositional area seaward of the delta platform. This zone extends from the edge of the delta platform to the prodelta. The seaward edge of the delta platform is typically located 20 to 30 km offshore and at a depth of approximately 3 m. The delta front meets the prodelta at a distance of 25 to 35 km offshore, where depths average 14 m. Stations sampled in this zone ranged from 6 to 9 m and averaged 7 m in depth.

The delta front was the most variable habitat studied and was the only habitat where truly estuarine conditions were encountered. A high degree of stratification was often evident in both temperature and salinity. Surface waters averaged 12.4°C and 6.5 parts per thousand (ppt) salinity while bottom waters averaged 10.6°C and 13.2 ppt salinity.

Water column salinity stratification generally intensified over the course of the summer survey (Appendix A). In June and July differences in salinity between surface and bottom waters were generally 4 to 7 ppt. By August and September salinity differences between surface and bottom waters were often up to 23 ppt with bottom waters ranging from 23 to 26 ppt.

Temperature differences between surface and bottom waters tended to be most extreme in June and July when 4 to 5 degree variations were common. Surface waters ranged from 10 to 15°C and bottom temperatures varied between 4 to 15°C. By August and September temperatures were typically uniform throughout the water column. As water column temperatures became more uniform in August they also started a gradual decline. Temperatures dropped from 13°C in mid August to 9°C in mid September when the final sampling was conducted.

Secchi depths for these delta front habitats ranged from 20-120 cm with a mean of 70 cm. Water clarity at the delta front was thus greater than in active distributaries and channels, and equal to or somewhat less than in lakes and minor inactive distributaries (Table 4-2).

Mid Delta Platform

The delta platform consists of the area from the outer edge of the coastal mudflats to the approximate outer limit of shorefast ice in the winter. This zone may extend 20-30 km seaward from the coast. The delta platform slopes very gradually (1:1000 or less) until reaching the delta front. With the exception of the sub-ice channels which cross the platform, depths in this habitat are less than 3 m. Sampling in this habitat was limited to the sub-ice channels in the southern portions of this habitat but was over the shallow waters off the north mouth area. Sampling depths in this habitat averaged 8 m with an overall range of 4 to 10 m.

This region was predominantly a fresh water habitat. Salinities averaged only 0.3 ppt at the surface and 0.4 ppt at the bottom. Over the entire summer season the highest salinity recorded in this area was 1.9 ppt. This measurement was recorded in mid September during the last sampling of this habitat. Water temperatures in this habitat were relatively warm and constant throughout the water column. The average temperature of surface water was 14.8°C while bottom water averaged 14.7°C. During the first sampling of this habitat in mid June, temperatures had already reached 12°C. By late July temperatures had peaked at 19°C. Temperatures then started to decline at a rate of 4-5 degrees per month reaching 10°C in early September.

Secchi disc depth readings were low (10-20 cm) with a mean of 14 cm, reflecting the flowing turbid river water character of these sub-ice channels during the summer time period.

Inner Delta Platform

The inner delta platform was defined as the habitat located just seaward of the intertidal zone (coastal mudflats). Mean water depth at stations monitored within this habitat was 2 m.

As a result of the shallow nature of this habitat, water quality conditions tended to be highly variable. Temperature averaged 14.8°C at the surface and 12.8°C near the bottom. These data, however, are somewhat misleading since measurements could be taken at both the surface and bottom only during high tides when colder offshore waters had moved inshore. During these times temperatures were nearly identical throughout the water column. Later in the summer season several measurements within this habitat suggested that water temperatures were two to three degrees warmer than in the main channels of the distributaries. Salinities in this habitat reached a maximum of 2.0 ppt in mid August but averaged only 0.4 ppt.

Secchi disc readings in this shallow, active habitat were again low (10-20 cm) with a mean of 13 cm, essentially identical with those of the outer delta platform and very similar to those in the active distributaries further back in the delta.

Coastal Mudflat

The coastal mudflat habitat consists of the intertidal zone extending from the edge of the emergent delta to the delta platform. In some areas of the delta the coastal mudflats extend as much as 1.5 km offshore (Truett et al., 1985). Measurements of water quality within this habitat were not always possible since the tide was occasionally out when sampling gear was deployed. Water quality over the coastal mudflats was even more variable then in the inner delta platform habitat. Water temperature averaged 11.7°C but was recorded over the range from 5° to 21°C. Temperatures within this habitat were occasionally found to be far higher than those measured in other areas. As early as July 24, a temperature of 21°C was recorded over the mudflats. In September a temperature of 14°C was measured in this habitat while temperatures within the main distributaries of the river were 5 degrees lower. Due to the very shallow water depths, this area seemed to respond much more rapidly to air temperature and insolation (incoming solar radiation).

Salinities were typically less than 1 ppt (mean=0.9 ppt) but occasionally exceeded 2 ppt. The highest salinity encountered in this habitat was 3.6 ppt. These salinities are higher than those found at either the mid or inner delta platform habitats located further from shore. Since sampling was temporally sparse, this apparent anomaly was probably just a result of the timing of individual measurements. Secchi disc readings were again low (15 cm mean), essentially identical to the readings further offshore.

Coastal Slough

The coastal sloughs examined in this study consisted of relatively narrow dead end channels that opened to the coast. These sloughs were often dendritic, forming small drainages in the grass and sedge meadows found along the seaward edge of the emergent delta. Sediments in these sloughs were typically composed of soft muds (silt/clay). Water depths in the sloughs were tidally influenced. Water depths in this habitat averaged only 1 m. During low tide some coastal sloughs were often drained of water. At high tide, water depths reached a maximum of 2 m in these habitats.

Water quality in the coastal sloughs was generally similar to that of the coastal mudflats. Temperatures averaged 10.5°C and salinity averaged 1.0 ppt. From June through July temperatures gradually increased from 8° to 18°C. Salinities during this same time period were normally 0 to 0.1 ppt. By early August temperatures were already starting to decline. Water salinity increased only slightly during the latter part of the summer when most measurements ranged between 0.6 and 2.1 ppt.

Water quality measurements taken in association with a 24-hour study on August 27 indicated that both temperature and salinity did not fluctuate substantially on a diurnal basis. Temperatures measured during this study ranged from 9° to 10°C while salinities were between 1.1 and 2.1 ppt.

Secchi disc depths were somewhat higher than the delta front, platform, or distributary readings,being 10-60 cm with a mean of 27 cm. This coastal slough habitat is apparently a less turbulent flow regime than the offshore habitats or active tributaries, but with considerably more water movement than quiet water habitats of minor inactive tributaries or lakes.

Major Active Distributary

The major active distributaries are the large river channels ranging from 0.5 to 3 km wide that flow year round and extend seaward as subsea (summer) or sub-ice (winter) channels (Truett et al. 1985). Water velocities in these channels are extremely high in early summer but decline rapidly later in the open water season. Water depths in this habitat were often quite deep due to scouring. Areas sampled during the summer study averaged 9 m with some sites attaining depths of up to 15 m.

The high flows in the major distributaries maintained low salinities/conductivities throughout most of the summer. Salinities, both at the surface and near the bottom, were 0.1 ppt or less through the middle of August. During this time period conductivities increased steadily from .059 to .300 mmhos/cm. As flows declined in the latter portion of the survey (i.e. early September) small increases in salinity occurred in all three major distributaries. Salinities measured during the final synoptic survey (i.e., September 4-14) ranged from 0.4 to 0.6 ppt. No salinity intrusions occurred during any of the positive storm surge events. This probably resulted from the relatively fresh water which was present on the delta platform also.

Water temperatures in this habitat averaged 14.6°C. Water temperatures ranged from 9° to 19°C with temperatures increasing through June and July, reaching a maximum in late July and then declining to a minimum in September at the end of the sampling. Due to the high current the water in the major distributaries was found to be well mixed from top to bottom. The largest measured vertical difference was only one degree centigrade for temperature and 0.2 ppt for salinity. Secchi disc depths were again low (10-20 cm), characteristic of turbulent flowing river waters.

Minor Active Distributary

Minor active distributaries are defined as the relatively narrow distributaries that branch off the lower portion of the major distributaries. Water velocities are lower in this habitat in comparison to those in the major distributaries. Water depths are correspondingly less. Sites sampled during the summer survey averaged only three meters and ranged from one to six meters in depth.

This can be characterized as a freshwater habitat with a thermal regime similar to that found in the major distributaries. Both salinities and conductivities were among the lowest recorded during this study. The average salinity was 0.0 ppt and conductivities averaged 0.1 mmhos/cm. Temperatures averaged 15.8°C over the season. This average is slightly higher than reported in the major active distributaries but temperatures were similar when measurements were compared for similar time periods. Secchi disc depths were shallow (10-20 cm), characteristic of flowing river water.

Minor Inactive Distributary

Minor inactive distributaries are those smaller distributaries that no longer connect to the ocean except perhaps during flood conditions. These older distributaries typically form dead end channels that open into either minor or major active channels. These shallow channels form a depositional environment where water velocities are low and depths are shallow. Water depth at both stations sampled within this habitat was 2 m.

The physical characteristics of this habitat were not well documented since measurements were taken on only two occasions. Both sets of measurements were taken in late June. During the first sampling of this habitat (18 June) water temperature was 15°C. This was two to three degrees warmer than in the adjoining active distributary. On the second sampling of this habitat (21 June) temperatures were comparable to those recorded in the major distributaries. Conductivities in this habitat averaged 0.1 mmhos/cm reflecting those measured in the major distributaries in late June.

Secchi disc depths were much higher than those for the habitats discussed above (60-90 cm; mean 75 cm), reflecting the more quiescent water of these inactive tributaries.

Lake

This habitat consisted of lentic environments which were surrounded by delta marsh but were connected to other delta channels by small outlet streams. Two different sites were sampled within this habitat type. Both were quite shallow with depths of 1 m or less.

Salinity/conductivity measurements varied slightly among the two sites. Salinities at station 9-1 never exceeded 0.0 ppt and conductivities were always .130 mmhos/cm or less. Salinities at station 9-2 reached 0.2 ppt with conductivities from .367 to .422 mmhos/cm. Temperatures in this habitat were generally consistent with those measured during the same time period at other locations in the delta. During the first week in July temperatures averaged 15°C. By the end of August temperatures in this habitat had dropped to an average of 10°C. Secchi disc readings were again high (90-120 cm; mean 92 cm), reflecting clearer water in a quiesent environment.

Lake Outlet

The lake outlet habitat type consists of small drainage channels that connect the shallow delta lakes either directly with major or minor active distributaries or with other habitats that are confluent with major or minor distributaries. This was a very shallow water environment with depths ranging from one to two meters.

Near continuous sampling within this habitat provided a good physical characterization of this environment. Temperatures averaged 14.1°C over the summer survey. On a daily basis temperatures measured within this habitat were similar to water temperatures in the major distributaries but exhibited more variability. Temperatures were occasionally a degree cooler in the lake outlets but were never warmer than waters in the active distributaries. Conductivities in this environment were typically very low but tended to increase over the course of the summer study. In mid June conductivities were as low as 0.05 mmhos/cm and by late August and September conductivities of 0.15 to 0.34 mmhos/cm were common. Secchi disc readings were again high, 50-220 cm, reflecting the quiet lake source water.

Major Inactive Distributary

This habitat is simply a former major distributary that no longer connects with the ocean. It differs from the minor inactive distributaries only in width. Like the minor inactive distributaries, this is a shallow water environment with low current velocities. Depths measured at sampling stations in this habitat were only 1 m on the two days that this habitat was sampled.

Water quality conditions did not vary from those of the major distributaries, however, measurements in this habitat were too minimal to characterize this environment. Sampling within this habitat occurred on June 16 and July 1. Temperatures measured on these dates ranged from 13° to 15°C. Conductivities were recorded at 0.1 mmhos/cm. Secchi disc readings were somewhat higher (20-30 cm; mean 27) than in the more active areas.

Inter Island Channels

This habitat type represents only a small portion of the Yukon Delta study area. The inter island channels consist of very narrow channels that cross the low relief islands that form near the mouths of the major distributaries. Water velocities in these channels appear to be relatively low and are driven primarily by the tides. Sediments in these channels consisted of extremely soft silts and clays. These channels are very shallow and rarely exceed 1 m.

Sampling of this habitat took place on the 25th and 26th of August at only one location. The vertical water structure was isothermal, with temperatures being 12°C and salinities being 0.0 ppt. Conductivities measured 0.1 mmhos/cm. Water in this habitat was slightly more turbid than at other habitats, with secchi disk depths of 10 cm.

Land-Locked Lake

This habitat consisted of lentic environments which were surrounded by delta marsh and had no apparent outlet. Water exchange in this habitat would be expected to occur only during flooding associated with breakup or during storm surges which commonly occur in the fall. Only a single station (Figure 3-3) was sampled in this habitat. Water depths at this station were only 1 m.

Water quality measurements were only taken at this location during the 29th and 30th of August. During this time water conductivities (.048 to .059 mmhos/cm) were among the lowest recorded in the study area but water temperatures (10° to 11°C) were comparable to those recorded within other delta habitats. Secchi disc readings (120-130 cm; mean 125 cm) were the highest clarity water encountered for any habitat in the study.

5.1.2 Winter Habitat Conditions - Discrete Physical Measurements

Water quality measurements which were conducted during December 6 through December 13, 1984 included sampling of six sites and included a variety of habitat types. These habitat types included freshwater and brackish water areas, major distributaries, and sloughs.

Temperature ranged from 0.0°C in areas of freshwater down to -1.5°C in areas of brackish water as can be seen in Table 4-1. Water depths at the stations ranged from 2 to 4 meters.

Brackish water was found at three of the coastal sites and at one inland location along the Black River, Figure 3-2. Salinity values ranged from freshwater at most locations to 19.3 ppt at the bottom in Elongozhik Slough. At the two coastal stations near North Mouth (Okshokwewhik Slough and Okwega Pass) water was found to be fresh (0.0 ppt) and 0.0°C. Progressing west and south along the coast, brackish water of 13.8 to 19.3 ppt was found at Elongozhik Slough, 0.7 - 14.4 ppt salinity at Nunaktuk Island in the Middle Mouth, 15.0 - 16.7 ppt salinity in Bugomowik Slough, and fresh water at both stations near the South Mouth (Caseys Channel and Kwemeluk Junction). At the Black River site salinities ranged from 0.0 ppt at the surface to 14.1 ppt at the bottom. Of the four stations where brackish water was measured, Middle Mouth and Black River stations were found to have a 1 m thick fresh water lenses over the saline water. In the case of the Black River site, the saline intrusion extended at least 35 km up the river to the sampling location.

Qualitative estimates of turbidity were made by visually observing and noting the water clarity. The water was clear at all stations where freshwater was found. At Bugomowik Slough and Elongozhik Slough where brackish water was measured at the surface the water was found to be slightly turbid. Dissolved oxygen during the sampling ranged from 10.5 to 14.2 parts per million (ppm). The highest values were found at the Black River site. No correlation was found between dissolved oxygen and other water quality parameters.

5.1.3 Dynamics of Physical Processes

Prior to the start of the field program, the study area was stratified into thirteen potentially different habitats based on river flow, water depth, location, and expected water quality conditions. After analysis of the physical characteristics of the Yukon Delta study area, it became evident that there wasn't always a clear distinction between the thirteen habitat types.

Salinity was found to be 0.0 ppt in almost all of the habitats between June and August with a maximum reading of 3.5 ppt in the nearshore zone. Higher salinities were recorded at station 4-4 which was located in the nearshore area approximately mid-way between the south and middle mouths of the Yukon River. As river discharge decreased during the latter part of summer, marine waters penetrated to the coast resulting in a low but significant increase in salinity. An examination of a false color-infrared Landsat image of the delta that was taken in late July 1975, indicates the presence of two less turbid coastal zones located in the region surrounding Station 4-4 and in the northern region in between the middle and north mouths of the Yukon River. This suggests the presence of a marine water return zone which would influence the salinity and water quality of the nearshore waters located in between the major distributary mouths.

The only habitat where marine conditions were measured was the delta front. The delta front is a depositional zone seaward of the delta platform and the furthest habitat offshore where sampling could be accomplished safely from a small boat. Temperature and salinity were highly stratified at this location throughout the whole summer with stratification intensifying in August and September. The increase in stratification probably resulted from decreased river discharge, which would mean less freshwater was available to the delta area,allowing marine water to intrude further onto the delta platform. River discharge would be expected to decline through fall and early winter allowing marine water to intrude further onto the delta platform eventually reaching the coastline,and then migrating up the deeper river channels. Winter sampling during December 1984 confirms these marine intrusions; salt water was found as far as 35 km inland along the Black River.

The large freshwater discharge of the Yukon River controls the water quality of the major and minor active distributaries, sloughs, and nearshore areas extending out past the delta platform. The river's huge sediment load reduces water clarity to a minimum in most areas. The only areas of relatively clear water were in the brackish water on the delta platform, in lakes, or in the inactive distributaries where the suspended sediment had a chance to settle out. The deepest Sechi disk reading was 220 cm at a lake outlet,with the most shallow being 10 cm, which was measured at a number of habitats with high currents or intense wind mixing on the delta platform.

Jones and Kirchoff (1978) indicated the presence of clear-water zones in the mudflats located between major river distributaries. A close examination of these sites indicated the presence of highly turbid waters (i.e., Secchi disk readings of 10 to 20 cm at Stations 4-1 and 4-4) during high tide and relatively clear waters in the broad shallow tidal pools (i.e., 5-10 cm deep) during low tide. During the high tide, waves and coastal currents stir up the fine sediments in the mudflats reducing water clarity to levels similar to the active distributaries. These were the conditions which were measured during the sample program. However, during low tide the mudflats in the intertidal zone become exposed and suspended sediment in the shallow tidal pools settles out enough for the bottom to be clearly visible.

Temperature was found to have a very high spatial correlation throughout the delta. The only temperature differences noted between continuous recording instrumentation locations were in the strength of the diurnal temperature fluctuation. Areas of shallow water responded much more readily to fluctuations in either air temperature or insolation. It is difficult to compare the discrete temperature sampling between habitats since large temporal differences are known to exist from the continuous measurements. Temperature varied over 1.0°C diurnally and up to 5°C over a week period at the same location. In general, water temperatures were around 10°C in early June at the beginning of the sampling. Temperatures gradually increased through June and July,reaching a maximum of 20°C in early August, after which point they began a steady decline. A minimum temperature of 5°C was reached at the end of September. It seems that seasonal and short term temporal temperature changes, which could be large,are much more important than spatial differences, which were small. The only temperature fronts that were measured were on the delta platform in conjuction with the marine bottom layer, which was found at distances of 20-30 km from shore.

Water level in the river was fairly constant through most of the summer, although there was a slow decline in August and an increase during September. The difference between highest high water and lowest low water measured in the river was 1.0 m at Naringolapak Slough. This was the only site representing river conditions since the other recording gauges were located at the coast. No tidal oscillations could be discerned in the record at this site. A couple of small storm surges did occur, however, which were reflected by water level increases at the coastal sites. The largest of these occurred September 1 and 2 when the river level increased 0.2 m, then declined 48 hours later. Other than these few events, little correlation was observed between this inland site at Naringolapak Slough and the coastal sites at the heads of the three main distributaries.

Water levels at the three coastal sites were influenced mainly by astronomical tides and surge events associated with local wind speed and direction, storm events, and barometric pressure forcing. A number of surge events were found to correlate very well between all three of the coastal sites, with the highest correlation occurring between the North Mouth and the South Mouth. The Middle Mouth site seems to have been sheltered from both storm surges and tides as a result of shoals extending across the distributary mouth, which caused wind waves to break. The tidal range at this site was less than half of that predicted for the area by the 1985 NOAA/NOS Tide Tables (1984). The highest positive storm surge occurred September 1 and 2 with a range of 1.5 m at North Mouth, 0.8 m at Middle Mouth, and 1.2 m at South Mouth. Winds during this period were 10-23 knots from the southwest at Emmonak. Positive storm surges also occurred between August 6 and 15 during wind periods of 10-18 knots from the southwest. A meteorological time series would have been very useful for cross correlating with storm surge events, but only the surface weather observations at Emmonak were available. These observations were taken only for a 12-hour period each day.

Tides at the coastal sites were mixed at the South Mouth, which gradually changed to diurnal at the North Mouth bordering Norton Sound. Tides approach the area from the south with approximately 2 hours lag between the South and North Mouths. A large diurnal inequality (i.e., the difference in height between successive high or low waters) can be seen in the tidal plot for the South Mouth. This inequality increases at the Middle Mouth and at the North Mouth the tide has become almost entirely diurnal. As a result of the configuration and depth of Norton Sound, the bay resonates at diurnal frequencies and increases the influence of diurnal constituents for the region. Semidiurnal constituents still have similiar magnitudes at both the North and South Mouth sites, which results in an increase in tidal range for the North Mouth site. The extent that tides travel up the river distributaries was not determined since the recording gauge deployed a short distance upstream from the South Mouth was lost, and the other meter at Naringolapak Slough showed no tidal influence.

5.2 POPULATION STRUCTURE DISTRIBUTION AND HABITAT ASSOCIATIONS

5.2.1 Juvenile Salmon

Chinook Salmon

The small catch of juvenile chinook salmon suggests that either the fishing gear was ineffective, effort was insufficient, or fish were not very abundant in the delta habitats during the period of sampling. It was unlikely that chinook were escaping the fishing gear, since a variety of gears were deployed and all gear had mesh small enough (i.e. 6.35 mm) to retain juvenile fish. Also, it is unlikely that juvenile chinook, which are strong swimmers, could have consistently avoided the active gear (i.e. purse seine or hooks seine) because hundreds of similar size fish and similar species of fish (i.e. sheefish, whitefish, and cisco) were caught during the survey.

Fishing effort was intermittent and was partitioned among many habitats and locations. Only several stations were sampled repeatedly throughout the summer. Therefore, the frequency of sampling may not have been enough to detect changes in the spatial and temporal distribution of juvenile chinook. Catches of juvenile chum, sheefish, whitefish, and cisco, however, were sufficient to identify temporal trends (Figures 4-4, 4-7, 4-10, 4-13). Additional fishing effort for these species would have better defined their temporal distribution within specific habitats, but would not have improved understanding of their general timing in delta habitats. This suggests the low catch of juvenile chinook was primarily a result of their low abundance during the sample period.

The majority of the juvenile chinook salmon outmigration probably occurred prior to the sample period (i.e. before June 14). Barton's (1983) survey of the Yukon River during June 7 through July 7, 1977 recorded 14 juveniles, of which most were caught during early June. This low catch concurs with the results of this study and suggests the peak of the outmigration may occur during or shortly after ice breakup.

Juvenile chinook were primarily associated with active distributary habitats. All fish, except one caught at the mudflat station 4-4, were caught in active distributaries or at stations located in close proximity to an active distributary (Figure 4-3). Other than the one fish caught in the mudflats there is no indication that juvenile chinook utilize the nearshore waters of the Yukon delta. However, this observation could be a function of the low sampling effort in coastal habitats during June and early July rather than lack of habitat utilization. These habitats were not sampled very often during the early summer period (i.e. before July 15) because of problems with access which prohibited travel to the coastal stations. Juvenile chinook are known to temporarily utilize the estuarine habitats of other major river deltas including: the Fraser River (Levy and Northcote, 1982), the Columbia River (Johnson and Sims 1973) and the Sacramento River (Kjelson et al. 1981). Therefore, it is likely that juvenile chinook utilize the Yukon Delta as well. Sampling immediately after ice breakup in the river and during early summer in coastal habitats would be needed to test this hypothesis.

Chum Salmon

Temporal trends in the catch of juvenile chum salmon indicates that peak catches occurred between June 25 - June 30 in the active distributaries. Catches declined to a low level by mid-July after which a few fish occurred intermittently throughout the rest of the summer (Fig. 4-4). The low catches observed at the beginning of sampling which were followed by large catches in late June suggests the peak of the outmigration occurred during the latter period. It is possible, however, that this apparent peak in abundance was a smaller mode in the outmigration pattern and a larger mode could have occurred prior to the sample period. During 1977 Barton (1983) found the peak outmigration occurred between June 13 and June 15. This difference in timing may also be due to natural variability in run timing and annual variations in weather. During 1985 ice breakup did not occur until June 7, whereas in 1977, breakup occurred at least one week earlier.

The results indicate that juvenile chum utilize the coastal habitats and the delta front during June through early August (Figure 4-4). Catches were low in these habitats compared to the active distributaries. But this may have been a result of limited sampling effort during June when abundance would likely be greater. No juvenile chum were found in these habitats after August 5 which suggests juveniles probably moved seaward of the delta front by this time. A similar pattern in habitat utilization was observed by Barton (1983) in Norton Sound during spring 1977. He found juvenile chum present in the nearshore waters of Golovin Bay with the onset of ice breakup and they remained in this habitat until about the second week of July. Juvenile chum from the Noatak River, which is just north of Seward Peninsula, enter Kotzebue Sound during mid to late-June and utilize the nearshore waters until mid-July (Merritt and Raymond 1983). Studies conducted in coastal waters of Southeast Alaska, British Columbia, and Puget Sound also show a similar orientation of juvenile chum toward shallow inshore areas (Lagler and Wright 1962; Mason 1974; Healey 1979; Levy and Levings 1978; Bax 1983; and Meyer et al. 1980).

Catches of juvenile chum salmon were more associated with temporal differences than spatial differences in water quality. Chum were most abundant in all habitats during late June when river discharge was high, temperature ranged 12-14°C, and salinity was low (1.0 ppt). The high, discharge and numerous distributary channels facilitates the dispersal of millions of juvenile chum along the extensive coastal habitats (i.e., tidal slough, mudflats and delta platform) that surround the Yukon River Delta. Water temperatures during this period were near the optimum for growth when fish are feeding at repletion levels (Brett et al. 1969). Since most chum stomachs were full of food (i.e., 85 percent of fish examined) the results suggest that food was not limiting at this time. As temperatures increased to 18-21°C by mid-July, the catches of juvenile chum declined. These higher temperatures are suboptimal for growth which suggests one reason why juvenile chum would move to the cooler waters offshore. Catches of juvenile chum were not associated with any spatial differences in habitat because water quality was similar among all habitats except the delta front. The cool waters in the delta front may have been more favorable for rearing during late July and early August when temperatures in the coastal habitats were high. However, the limited number of samples collected from the delta front during the summer was probably not sufficient to detect any transition in habitat preference. Juvenile chum could also have moved into the marine-water-return-areas that were identified from landsat imagery and were located in between the major distributaries. The catch of one juvenile chum in what appears to be a marine-water-return-area on the north coast (i.e., Station 5-12, Figure 3-2) during August suggests this hypothesis may be true. Unfortunately, a sufficient number of samples were not taken to confirm either the physical conditions or the habitat preference by juvenile chum.

The change in size of juvenile chum from a modal length of 40 mm during late June to a modal length of 50mm during late July and August (Appendix C Table 2) suggests temporary residency of juveniles could be occurring in the delta. Results of the otolith increment analysis suggests further that chum may be residing for periods of 13-29 days (Figure 4-6) and that fish may spend more time in some habitats than others (Table 4-12); although interpretation of the latter results must be viewed with some caution. The assumption that otolith increments produced in the edge zone were produced on a daily basis has not been validated for these fish. Laboratory studies under optimal conditions showed that 17 species out of 20 species deposit daily increments. However, in studies that examined increment deposition under suboptimal or extreme conditions, deposition was not daily in over half of the species (Jones 1986). Neilsen and Geen (1982 and 1985) found that changes in environmental variables (e.g., feeding frequency and diel temperature fluctuations) can increase the rate of increment formation in juvenile chinook salmon resulting in one or more growth increments per day. In the Yukon Delta, environmental conditions were probably not suboptimal for juvenile chum salmon. Maximum daily fluctuation of water temperature did not exceed 1.5°C and only 16 percent of the stomachs examined for food habits were empty (Table 4-14). This suggests that deposition of increments was daily and that the period of residence probably ranged from 13-29 days. This estimate agrees with the estimates for chum residency times in the Nanaimo Estuary (Vancouver Island, B.C.) which varied between 0 and 18 days during two field seasons of mark and recapture studies (Healey 1979).

The second assumption,that the otolith edge zone corresponds to the period of delta/estuarine residency,is also unknown. Without comparisons of otoliths between upriver and delta fish it is impossible to know what ecological or physiological significance is attached to the edge zone examined. Similar otolith transitions observed in juvenile chum salmon corresponded to their release from a hatchery environment into Hood Canal (Volk et al MS). Neilson et al. (1985) have recognized a correspondence between changes in otolith microstructure and migration into an estuary for juvenile chinook salmon. It was suggested that the step-wise increase in increment width and intensity expressed at the transition reflects an improved feeding environment in the estuary resulting in increased growth rates. It is possible that a similar interpretation may hold true for chum migrating seaward through the Yukon Delta.

Pink Salmon

Juvenile pink salmon were caught from the beginning of sampling until August 2, but the majority of fish were caught during June (Figure 4-5). Low numbers of fish prohibited the detection of an outmigration pattern other than the identification of the end of the outmigration. The rapid decline in catch shortly after sampling began suggests the peak of the outmigration probably occurred prior to June 14. The result of Barton's (1983) survey of the Yukon River concur with these findings, since he only caught 6 juvenile pink salmon and all were taken before June 21. In the Susitna River, Alaska the pink salmon outmigration begins immediately after ice breakup and the peak of the migration occured from early to mid-June during two years of study (ADF&G 1983a, 1984).

Pink salmon in the Yukon River Delta were not found in coastal nearshore habitats. Although effort was low in these habitats during June. Therefore it is possible that juveniles utilized these habitats but were not detected at this time. Juvenile pink salmon were found in the nearshore waters of Golovin Bay, Norton Sound, primarily during June and no fish were taken after July 7 (Barton 1983). Increased sampling effort in the coastal habitats of the Yukon Delta during late July and early August indicates that juveniles did not utilize these habitats at this time.

The results indicate that juvenile pink salmon migrated directly through the delta platform and out to the delta front. Most fish ranged in size from 30-40 m which suggests that residence time in the delta was minimal. Pink salmon in the Fraser River spend little time in the delta and move offshore into the river plume (Barraclough and Phillips 1978). Residence time for pink salmon in the Fraser River Delta was found to be no more than a day or two (Levy et al. 1979).

5.2.2 Other Salmonids

Sheefish, Whitefish, and Cisco

Sheefish, whitefish, and cisco accounted for 65 percent of the total catch during the summer survey and were the most widely distributed of all species in the Yukon River Delta. Juveniles of all three groups passed through the active distributaries during their downstream migration, moved into and out of lakes adjacent to the river, and were most concentrated in the coastal mudflats and sloughs. All three groups were found in low numbers on the delta platform and only cisco were caught in significant numbers in the delta front.

These results indicate the coastal habitats were of primary importance as rearing areas for juvenile fish. Juveniles entered these habitats in early to mid-July and remained past the end of sampling in September. Juveniles would have to move out of shallow water habitats by winter since these areas become frozen to the bottom. Small sheefish, whitefish, and cisco were not caught in the deeper coastal habitats during December 1984, but large adult fish were present. The absence of the small fish may be more a result of size selectivity of the gill nets rather than an indication of no utilization at this time. The shallow coastal waters of the outer Mackenzie Delta were the most important habitats for juvenile rearing during the summer and the delta lakes and channels were used extensively for overwintering (Percy 1975).

Timing of the downstream migration of juvenile sheefish, whitefish, and cisco was readily identified in the catches from minor active distributary habitats (Figs. 4-7g, 4-10f, and 4-13g). Sheefish moved through the delta during the first two weeks of July. Juvenile whitefish began significant movements during the third week of July with peak catches occurring during the last week of July. Cisco migration patterns were similar to the migration timing of whitefish. Barton (1979) observed a similar trend in the timing of the sheefish, whitefish, and cisco outmigration during his study of the Yukon River in 1977.

During the juvenile outmigration period all three groups of coregonids were observed moving into and immediately out of the lake outlet channel. Samples from the lake indicated that no juvenile whitefish or juvenile cisco utilized the lake habitat, and only a small number of juvenile sheefish were caught. Therefore, these data suggest that juvenile fish were probably not actively seeking the outlet channel or lake habitats. Rather, these fish may have been temporarily entrained in inactive sloughs or channels during the incoming tide, but rapidly found their way out of these habitats during the ebb tide. Turbid river water was observed moving into and out of inactive distributary channels with the fluctuating tides.

Sheefish, whitefish, and cisco were mostly found in areas of freshwater or areas of low salinity (i.e., less than 3 ppt). Juvenile cisco was the only coregonid species that occurred in the delta front where salinities ranged up to 19.9 ppt. In Norton Sound, Barton (1979) found the greatest abundance of cisco and whitefish in brackish water areas and sheefish were only captured in the Yukon River.

5.2.3 Non-salmonids

Nonsalmonid species that utilized the Yukon River delta can be placed into three general categories based upon their life history strategies (Table 4-8). These included marine, anadromous and freshwater species. A total of ten marine species were collected in the region of the Yukon Delta but the majority were not abundant in the collections nor directly dependent upon delta habitats for completion of a phase of their life history. The four most significant marine species were arctic flounder, saffron cod, starry flounder and Pacific herring. The first three species are demersal while the fourth, Pacific herring, is pelagic. Among the four anadromous species collected in the delta only two, boreal smelt and ninespine stickleback, were present in substantial abundances in delta habitats. Six freshwater species were collected in the study area but only two, burbot and pond smelt, were abundant.

The following discussion focuses on those marine, anadromous or freshwater nonsalmonid species that were abundant, important to either subsistence or commercial fisheries, or of ecological significance in the region.

Arctic Flounder

The arctic flounder was the numerically dominant marine species collected in the Yukon Delta during the summer. This relatively small, slow-growing species is known to inhabit shallow littoral and strongly freshened coastal waters during the summer and has a preference for muddy bottoms (Andriyashev 1954). Flounder were strictly limited in their distribution to coastal and offshore habitats (Table 4-10). The majority were caught in the inner delta platform, coastal mudflats and sloughs. It is probable that arctic flounder were also abundant over much of the shallow water habitat of the delta platform and delta front but sampling gear used in these areas was not designed to sample demersal species.

Within the mudflat habitat, occurrences and abundances of arctic flounder were associated with those of a similar species, the starry flounder (Table 4-10). This association may be a reflection of their comparable feeding habits (Fechhelm, 1985; Orcutt 1950).

Arctic flounder have been reported to reach maturity at lengths greater than 150 mm (Fechhelm, et al. 1985). Very few of the arctic flounder caught in the Yukon River delta area were that large, suggesting that the majority of the fish which utilized the study area were juveniles.

The mudflat and coastal slough habitats served as nursery areas for the arctic flounder during the summer months. A large proportion of the catch within these habitats were within two size classes, one from 20 to 30 mm and a second from 70 to 80 mm.

Saffron Cod

Saffron cod are usually found in relatively cold water areas to depths of less than 60 m. Within Norton Sound, this species has been estimated to represent nearly 50% of the total biomass of demersal fish (Wolotira et al. 1977). In this study, the majority of saffron cod were taken from the delta front in August and September, and from the mudflats and coastal sloughs in September (Table 4-10).

Saffron cod became common in the delta front, mudflats and coastal slough catches late in the survey. The larger cod (modal length = 250 to 280 mm FL) were found in the nonsaline waters of the sloughs and mudflats while smaller cod with a range of 70 to 110 mm in length were found only in the brackish delta front habitats.

The late season movement of large saffron cod into the coastal region of the delta is consistent with the inshore spawning migration noted in other studies (Svetovidov, 1948; Andriyashov 1954; Barton, 1979; Wolotira, 1985). The juveniles were restricted to far offshore. They did not enter the study area in abundance until August when bottom salinities at the delta front increased to 16 ppt or greater. Since our surveys did not extend out past the delta front, it is not possible to assess the importance of the delta front habitat to juvenile saffron cod.

Starry Flounder

The starry flounder is one of the most widely distributed flounders and is the most abundant flatfish in Norton Sound (Wolotira et al. 1980). The majority of the starry flounder caught in this study were taken from the mudflats and coastal sloughs in July and August (Figure 4-18). However, selectivity of the purse seine gear could have attributed to low delta front and mid-delta catches.

During our summer survey, small young-of-the-year individuals were uncommon in the entire survey area. Most starry flounder collected in the coastal habitats ranged from 120 to 170 mm, a size range generally associated with age 1+ fish (Orcutt 1950). Neither spawning habitats nor location of young-of-the-year flounder were identified in this study. It is suspected that spawning and early development occurs further offshore as a result of the seaward extent of freshwater during the late spring and early summer.

Pacific Herring

The only herring caught in this study were taken in the deeper waters of the delta front. No larval or young-of-the-year herring were found in the nearshore habitat which suggests that the Yukon delta does not represent an important spawning and rearing area for the species.

Boreal Smelt

Throughout the summer months, boreal smelt were most common in habitats seaward of the emergent delta with the highest numbers collected in the region of the delta front. Smelt captured in the study area tended to be small but varied in size composition, both temporally and spatially. The overall size composition was similar to that reported for smelt collected with beach seines in Norton Sound during the summer (Barton 1977). A similar predominance of smaller size classes has been observed in summer fyke net collections near Pt. Lay in the Chukchi Sea (Fechhelm et al. 1985) and near the Colville River in the Beaufort Sea (Craig and Haldorson 1981).

Based upon age, length and size at maturity relationships for fish collected in the Beaufort Sea (Haldorson and Craig 1984), it would be expected that most fish captured in our study area were less than four to five years old and still sexually immature. Age, length and size at maturity relationships, however, can vary substantially among populations.

Spawning of boreal smelt is reported to occur in fresh water (Musienko, 1970). After hatching the young drift downstream into lakes or estuaries. In our survey of the Yukon River delta there was little evidence of a pulse of young boreal smelt. The smallest size class of boreal smelt captured during the summer (40 to 60 mm FL) was collected in June in a minor active distributary but abundances were relatively low. A large, brief pulse of small smelt passing through the minor active distributaries in August may have been boreal smelt but species identification of these small smelt was not made.

Ninespine Stickleback

In the 1985 Yukon delta survey the ninespine stickleback was found in ten habitats and was present throughout the duration of the survey (Table 4-10). The majority were caught in coastal slough habitats, although they were also common in the brackish waters (up to 19.9 ppt) of the delta front.

Because of their small size, ninespine sticklebacks were not well sampled by any of our sampling gear. In the coastal slough, where abundances were the highest, sticklebacks were observed to move freely through the webbing of the tidal nets. Nevertheless, this habitat was clearly favored by sticklebacks.

Burbot

Burbot were caught in eight different habitats during the summer of 1985 in the Yukon delta project. However, they were not seen in the delta front or mid-delta platform. The majority of burbot were caught in July (Table 4-10) in the minor active distributary habitats. The species apparently avoids marine or brackish waters in the delta, which concurs with the findings of Andriyashev (1954).

From June 14 - 30 most of the burbot were caught in the coastal slough and minor active distributaries. During this time the smaller fish (70 - 130 mm) were present only in the sloughs. In July most of the burbot were caught in the minor active distributaries and most were less than 50 mm long, suggesting that a younger age class had moved into the sampling area.

Pond Smelt

Pond smelt are normally considered a freshwater species in Arctic regions but have been known to venture out into brackish waters further to the south (McPhail and Lindsey 1970). The largest catches of these fish in this study occurred in the delta front in August and September (Table 4-15). Salinities in these habitats never exceeded brackish levels.

The only pond smelt caught in June in this study were from the coastal slough habitats (Table 4-15) and were from 90 to 100 mm FL. It is possible that the coastal sloughs are utilized by these larger, presumably mature, fish for spawning areas.

5.3 FOOD HABITS

5.3.1 Principal Diet Components and Feeding Dependency

The general trend in prey resource utilization across the delta habitats includes utilization of: (1) drift and epibenthic (aquatic larvae) insects in distributary habitats; (2) epibenthic organisms (mysids, copepods, amphipods) in coastal slough, mudflat, and inner delta platform habitats; and, (3) planktonic copepods in mid-delta platform and delta front habitats (Table 5-1). These generalities, however, would hold only for the more opportunistic fishes. Some species appeared to have rather specialized feeding behaviors in these habitat "regions." For instance, both boreal smelt and sheefish fed upon epibenthic mysids from the delta front to coastal slough habitats, and juvenile pink salmon foraged on epibenthic insect larvae in all habitats in which they occurred except the delta front.

In the absence of any indication of the prey resources available to the fish within each habitat stratum, and within microhabitat "intrastrata" (e.g., neustonic layer, water column, epibenthic boundary layer, benthic substrate, etc.), it is nearly impossible to ascribe dependency of any of these fishes to particularly prominent components of their diets. The alternative sources of prey cannot be identified without this information. Despite this major data gap, it is evident

TABLE 5-1

PRINCIPAL DIET COMPONENTS[a/] OF ELEVEN TAXA OF JUVENILE SALMON AND NON-SALMONID FISHES IN MARINE, ESTUARINE, AND FRESHWATER HABITATS OF THE YUKON RIVER DELTA, JUNE-SEPTEMBER 1985

Delta Habitat	Fish Taxa[b/]										
	BRC	LSC	HBW	PKS	CHS	COS	CNS	SHE	PSM	BSM	BUR
delta front	Pc	Pc, Di		Pc	Pc, Di				Pc	Em, Pc	
mid-delta platform		Di			Di, Pc					Em	
inner delta platform		Ea, Pc	Ec, Em			Es	Es	Em, Ea	Em	Em, Fs	Em
mudflat	Em	Pc, Ea	Ea, Pc					Em, Ea			
coastal slough		Pc, Ea	Ec, Pc	Ei	Di, Es			Em	Pc, Ea		Em, Fs
major active distributary		Di	Di, Pc	Ei, Pc	Di			Di, Pc	Pc		Ei, Di
minor active distributary		Di	Di, Ec	Ei, Pc	Di		Di	Di, Pc			Ei, Eo

a/ Di = drift insects; Ea = epibenthic amphipods; Ec = epibenthic copepods; Ei = epibenthic insects (larvae); Em = epibenthic mysids; Eo = epibenthic ostracods; Es = epibenthic isopods; Fs = fish; Pc = pelagic copepods

b/ BRC = Bering cisco; LSC = least cisco; HBW = humpback whitefish group; PKS = pink salmon; CHS = chum salmon; COS = coho salmon; CNS = chinook salmon; SHE = sheefish; PSM = pond smelt; BSM = boreal smelt; BUR = burbot.

that a restricted number of prey species appear prominently across most of the diets and, as such, may constitute "requisite" prey for these fishes during their residency or migration through the delta. These would include:

Insects;

drift adults - Chironomidae

epibenthic larvae - Chironomidae

Planktonic cladocerans;

Bosmina

Daphnia

Podon

Planktonic copepods;

Eurytemora

Epischura

Epilabidocera longipedata

Epibenthic copepods;

Tachidius

Epibenthic mysids;

Neomysis

Epibenthic amphipods;

Haustoriidae

Epibenthic isopods;

Saduria entomon

Fish;

Pungitis pungitius

The reader should be aware of some tentative assumptions in several of these classifications, however. The ubiquitous estuarine calanoid copepod, _Eurytemora_ sp., although commonly classified as a planktonic organism, is often found to be epibenthic in behavior and may be available in the same microhabitat as Neomysis and Tachidius. Similarly, we might presume that chironomid larvae are epibenthic on the substrate and vegetation surfaces but, in fact, they may be captured by the fish at the water surface. Microhabitat distribution studies of these particular prey assemblages will be required before the location of the actual foraging events can be established.

Nested within the fish sampling design deployed in 1985 is also a potential bias affecting the interpretation of the diet compositions for these fishes. Any collection method which results in prolonged retention (e.g., greater than 10-15 min.) of the fish specimens introduces the probability of effects upon prey digestion (especially in the case of fish which have died at the time of sampling) and upon prey consumption within the confines of the sampling gear (so-called "net-feeding") which would not be representative of the fishes' diets in situ. In particular, there is some suggestion that the fyke nets set in coastal sloughs and on the mudflat, which are passive samplers compared to the beach and purse seines, may have caused higher than normal consumption of some epibenthic crustaceans which were entrained and concentrated (i.e., became "abnormally" available) within the net with live fish specimens. The representation of gammarid amphipods, Neomysis sp., and Saduria entomon almost exclusively in the diets of fish from fyke net samples is suspected in the cases of humpack whitefish, sheefish, and burbot. Burbot had also consumed fish (so prominent in their diet) only in cases of fyke net-derived collections.

One of the more notable gaps in the food web linkages to these fishes is the absence of benthic infauna which is, perhaps, primarily an indication of the lack of sampling emphasis on demersal fishes per se. It is interesting, however, that none of the eleven species of concern in this study utilized benthic organisms to any extent.

5.3.2 Seasonal Shifts in Diets

Knowledge of seasonal shifts in the diets of juvenile fishes is desired to determine how spilled petroleum might affect food availability at crucial periods of migration. Attempts were made to ascertain differences in food composition of juvenile fish species as their migration periods passed from summer to autumn. Statistical resolutions of these differences were not possible since seasons could not be replicated with only one year of sampling. Alternatively, diet compositions of juvenile fishes were examined informally (without statistical rigor) to detect apparent trends developing over July, August, and September of 1985.

Most attempts at identifying dietary shifts did not reveal temporal patterns that would provide reasonable indicators of change. While a few dietary shifts over time appeared to be evident, most stomach analyses showed varities of food items that were too diverse to suggest temporal feeding patterns. Evidence of dietary seasonal shifts was suggested only by humpback whitefish, sheefish, and boreal smelt. In each of these cases the evidence appeared only for single habitat types; such dietary shifts throughout deltaic habitats for any juvenile species were not apparent.

Juvenile humpback whitefish feeding in deltaic distributaries appeared to shift from harpacticoids and cyclopoids in the summer to exclusively ephemeropterans in the fall (Table 4-18). In the same habitat, juvenile sheefish appeared to feed mostly on calanoid and cyclopoid copepods in early July but were more heavily dependent on dipterans in August (Table 4-21). They also fed heavily on gammarids in the mudflats during July but appeared to shift to mysids by September. Juvenile boreal smelt appeared to feed heavily on small teleosts in the delta platform habitat during June, but by August they fed exclusively on mysids in the same habitat (Table 4-23).

Further attempts at interpreting these diet composition data would be unwise. Variations of diet compositions within sampling times, and variations of same within habitats sampled, seem to be too great to permit definitive conclusions about seasonal variations. Therefore, implications derived from a non-statistical examination of these data are that reliable interpretations of seasonal shifts will require additional seasons of replication and the application of appropriate statistical analyses. Until this is accomplished, attempts to associate food availability with potential consequences of spilled petroleum would not be profitable.

5.3.3 Comparisons With Previous Studies

To our knowledge, this is the first study of food web relationships of fishes in this region of Alaska. As a result, comparisons can only be drawn from adjacent nearshore and estuarine regions, essentially all of which derive from prior OCSEAP studies.

Earlier investigations in Norton Sound (Barton 1979, Wolotira et al. 1979; see Drury and Ramsdell 1985 for synthesis) were concentrated on fish stocks available for human consumption and, as such, did not assess nearshore and estuarine habitat utilization by juvenile salmon and non-salmonid fishes and, more relevantly, did not include food habits data.

The OCSEAP (1978) synthesis of ecosystems in the Beaufort/Chukchi seas describes key fish species in this region as feeding extensively upon epibenthic invertebrates and zooplankton, including amphipods, mysids, isopods and copepods. In particular, in the intensively studied area of Simpson Lagoon, the mysids *Mysis litoralis* and *M. relicta* and amphipods *Onisimus glacialis* and *Apherusa glacialis* were considered to be important food items for both anadromous and marine fishes.

Fechhelm et al. (1985) included some of the most recent results on nearshore fishes in the northeastern Chukchi Sea. In general, anadromous fishes such as ciscoes, whitefishes, and juvenile salmonids were relatively uncommon in their collections and typically restricted to adults, rather than juvenile life history stages. As a result, comparable diet information was available only for rainbow smelt. In addition, their sampling methods (fyke net and gill net collections over long durations) were not appropriate for quantitative comparisons, although the qualitative data on overlapping species is relevant. Boreal smelt were considered to be "strongly piscivorous," feeding upon Arctic cod; Mysis littoralis was the only other prominent prey.

The recent synthesis of the Beaufort Sea ecosystem (Barnes et al. 1984) provided further evidence that epibenthic mysids (Mysis littoralis and M. relicta) and amphipods (Onisimus glacialis, Pontoporeia affinis, P. femorata) constitute important prey resources for least cisco and boreal smelt. None of these studies, however, provided any data on the composition and relative availability of prey resources at the time of their fish food habits studies.

5.3.4 Sources of Principal Food Web Linkages

Food web linkages leading to the eleven principal salmon and non-salmonid fishes in the Yukon River delta would appear to be rather direct and uncomplex, often involving but one or two important prey resources. These particular prey resources, in turn, derive their trophic support from three basic sources and pathways of organic carbon:

1. Terrestrial wetland plant production, which is utilized directly by herbivorous insects and indirectly by detritivorous insects; ultimately, the detritus is exported from the emergent vegetation zone and deposited in channels and, potentially, washed out into major active distributaries and into the coastal environs where it becomes available (as fine particulate organic carbon or FPOC) as a food source for detritivorous organisms such as mysids, gammarid amphipods, and harpacticoid copepods;

2. Benthic microphyte (diatom) production, which is utilized directly by epibenthic crustaceans in the coastal slough, mudflat, and inner delta platform habitats which are shallow enough to permit light penetration to the sediment through the turbid coastal waters; and

3. Water column (phytoplankton) production, which is the primary food source of herbivorous planktonic copepods.

On the surface, given the potential for depressed phytoplankton production in the turbid, turbulent distributary and coastal waters of the delta, the delta's extensive emergent marsh seems responsible for significant export of detrimental matter into the adjacent aquatic ecosystem, where it could be the dominant source of organic carbon to the estuarine-coastal food web explored in this study.

Considerably more elaborate studies would have to be implemented if this hypothesis were to be tested. In many instances, the food sources overlap or are indistinguishable, as in benthic diatoms and detritus particles in the surface sediment. Only laborious microscopic or biochemical tracer (e.g., stable carbon isotopes, 13C) techniques will provide more accurate definition of the actual food sources.

5.4 POTENTIAL IMPACTS OF OIL AND GAS DEVELOPMENT

The methodology used to determine the potential impacts of petroleum on fish involved numerous assumptions as a result of inadequacy of available data. Sampling in habitats in 1985 was patchy and each period/habitat combination was inadequately represented. Assumptions made about the distribution and abundance of species in the Yukon delta area attempted to simulate known and apparent patterns in distribution and life history. Critical periods in the life history may have been missed, which could affect the vulnerability ratings of the habitats. The assumptions made about the equivalence of relative abundances by gear type probably introduced some bias in the habitat ratings. Each habitat was sampled predominantly by one gear type. Ratings could be affected if the relative catches between gear types did not represent the same densities of fish in each habitat. This is not unlikely. Gear standardization is necessary if catches of each gear type are to be compared accurately. Unfortunately, there was an insufficient amount of overlap in the types of gear fished in any given habitat and period to permit gear standardization. The extent of the bias resulting from this assumption is unknown.

The available literature on the sensitivity of arctic species to petroleum does not adequately describe the effects of oil on species found on the Yukon delta. What is required is a measure of the acute and sublethal effects of oil on all Yukon delta species using standardized methods. Until such a study is done, the effects or presence of oil can only be estimated from known life history patterns and from oil impacts on similar species. The variability of reactions to petroleum and petroleum components within groups of similar species is considerable, and estimates of sensitivity of a species may be misleading.

Despite the numerous assumptions made, the relative impact ratings for each habitat are not unrealistic. The major and minor active distributaries were expected to have ratings more nearly equal, given the similarity of these two habitats. Both are of similar depth and velocity, and have similar availability of fish habitats. The difference in the overall ratings of these two habitats is likely due to the difference in gear efficiency between the purse seine and the hook net. The inner delta platform and tidal sloughs received the highest impact ratings, which was not unexpected. These areas represent typical highly productive estuarine areas, often used as feeding and nursery areas. The minor active distributaries also received high ratings. These ratings reflect the use of these areas for migration by anadromous species. The delta front and mid-delta platform received the lowest ratings, which may be artificially depressed due to bias of gear type and reduced amount of sampling. These offshore habitats generally represent areas of reduced species diversification, and are less important as feeding and nursery grounds. Therefore, it is not unexpected that these habitats were found to have the lowest impact rating.

Improved regularity of sampling, standardization of gear types, and better knowledge of species sensitivity would greatly improve the estimates of habitat vulnerability. Other factors not included in the ratings which potentially could affect the magnitude of an impact include the likelihood of oil reaching a habitat, consideration of the cultural value of fish species to the local economy and the potential impacts of oil on lower trophic levels as they affect the availability of prey items for fish.

The likelihood of oil reaching a specific habitat would be dependent upon physical processes (e.g., wind, waves and currents) for oil transport and the elevation and/or location of each habitat. Information on the former was not available but is currently being developed by an OCSEAP physical processes study (i.e., PU4110). Based on location and elevation however, each habitat can be ranked in order of their relative vulnerability to oil as follows:

1) Delta front and delta platform
2) Intertidal mudflats and tidal sloughs
3) Active distributaries
4) Inactive distributaries and connected lakes
5) Tundra lakes

Species of fish that occur in the delta front and delta platform would most likely be impacted by oil because these habitats are adjacent to the oil and gas lease areas (Figure 2-1). Since the inner delta platforms received the highest overall impact rating, as well, this habitat would have the greatest vulnerability to an oil spill. Active distributaries also received a high potential impact rating but would be less likely to receive an impact because marine waters do not penetrate into the delta during much of the open water period (i.e., during peak runoff, June through August). Inactive distributaties and tundra lakes would be the least likely to be impacted because oil could only reach these habitats by a large storm surge event.

The measurement of sociological and cultural importance of a fish species is difficult. The local economy depends primarily on the catch of chum salmon, but other species are very important on a seasonal basis (Wolfe, 1981). The measurement of a rating of community value is at best highly subjective and no attempt was made to include it.

The feeding study did not include an assessment of the composition and standing stocks of the prey assemblages potentially available to foraging fish in the delta habitats. Knowledge of prey resources would make possible an estimate of habitat dependency based on the sources of the principal prey in the diet. The sensitivity of prey to oil and abundance of prey items is expected to have a significant effect on the impact analysis. For example, juvenile pink salmon and juvenile chum salmon were found to have highly specific diets that consisted primarily of larval and adult dipteran insects. Dipteran (i.e., mostly chironomidae) are mostly likely produced in the tidal sloughs and distributary channels. Juvenile chum feed on dipteran within these habitats and on insects that drift from these habitats to the delta platform. Therefore, oil contamination of the food producing areas could also have a significant effect on food resources for juvenile salmon in the coastal areas as well.

6.0 SUMMARY AND RECOMMENDATIONS

It is evident from the results that the primary period of delta habitat utilization by juvenile salmon occurs during the period from ice breakup to mid-July. However, the run timing for each species and their distribution among the delta habitats needs to be better defined. The duration of residency within the delta varies by species but the magnitude of residency is not known for any species. The diet of juvenile salmon was extremely specific and limited to a narrow spectrum of drift, plankton, and epibenthic prey taxa. However, more data will be needed to confirm these results. Assessing feeding dependency on delta habitats will require information on the composition and standing stocks of the prey assemblages potentially available to the foraging fish community. At a minimum, a second field season in the Yukon River Delta will be required in order to fill data gaps identified from this investigation. The experimental design for a second year study should include the following recommendations:

- Fish sampling should be conducted for a period of 5 weeks, beginning immediately after ice-breakup and for a period of 2 weeks during early August. This timing of the sample program would coincide with the period of maximum habitat utilization and would provide the data needed to assess the relative importance of delta habitats to juvenile salmon.

- Fish sampling should be concentrated in coastal, delta platform, and delta front habitats that are representative of physical conditions within and outside of distributary plume areas.

- Samples should be taken frequently (i.e., every 2-3 days) at a selected set of representative stations, including one station in a major active distributary, in order to define the temporal trends in habitat utilization.

- Fish should be collected with a few types of active fishing gears which are comparable. This will enable: (1) comparisons of catch among all habitats, (2) quantitative correlation with physical conditions, and (3) minimal bias of the stomach contents analysis.

- Salmon otoliths should be collected from upriver of the delta and from delta habitats in order to test the transition zone hypothesis. Furthermore, holding pen experiments should be conducted in order to determine otolith increment periodicity.

- Periodic fish stomach contents samples should be collected from all habitats where juvenile salmon occur.

- Composition and standing stock of prey resources in all habitats should be determined from samples of: surface drift and neuston, water column zooplankton, epibenthos, and, near surface benthos.

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APPENDIX A

WATER QUALITY DATA

APPENDIX A

Table 1. Surface Water Quality Data

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)	
01	1	6/21	1309	1	0.4	1000	0.5	10.0	1.2	
01	3	7/19	1645	1	7.6	12300	7.7	15.0	0.7	
01	1	7/22	1053	1	6.6	10800	6.7	14.0	1.2	
01	1	7/22	1145	1	6.5	10600	6.5	14.0	1.1	
01	2	7/26	1415	1	6.1	10000	6.1	15.0	1.0	
01	2	7/26	1525	1	6.1	10000	6.1	15.0	1.0	
01	3	8/10	1703	1	18.9	23900	15.8	13.0	0.7	
01	1	8/13	1334	1	11.1	14500	9.2	13.0	0.5	
01	3	8/16	1514	1	5.5	7400	4.4	12.0	0.3	
01	3	9/04	1623	1	12.5	15500	9.8	10.0	0.3	
01	2	9/10	1231	1	3.5	4400	2.5	9.0	0.2	
01	2	9/10	1445	1	3.5	4400	2.5	9.0	0.2	
					7.4	10400	6.5	12.4	.70	Ave
					4.9	6019	4.0	2.4	.39	Sdv
					0.4	1000	0.5	9.0	.2	Min
					18.9	23900	15.8	15.0	1.2	Max

Number of Observations: 12

02	1	6/16	1749	1						
02	1	6/17	1221	1		60	0.0	12.0	0.2	
02	2	6/25	1612	1		50	0.0	13.0	0.2	
02	1	6/30	1707	1	0.4	920	0.4	14.0	0.2	
02	1	7/18	1300	1		160	0.0	18.0	0.1	
02	1	7/18	1515	1		170	0.0	17.0	0.1	
02	3	7/22	1315	1	0.4	880	0.4	19.0	0.2	
02	3	7/22	1410	1	0.7	1400	0.7	19.0	0.2	
02	2	7/26	1140	1		300	0.1	18.0	0.1	
02	2	7/26	1230	1		300	0.1	18.0	0.1	
02	1	8/10	1503	1		148	0.0	16.0	0.1	
02	2	8/11	1846	1	0.1	300	0.1	16.0	0.1	
02	2	8/11	1935	1	0.1	300	0.1	16.0	0.1	
02	1	8/16	1216	1		200	0.0	14.0	0.1	
02	1	8/16	1306	1		200	0.0	14.0	0.1	
02	1	9/04	1232	1	0.9	1200	0.6	11.0	0.1	
02	1	9/04	1335	1	0.9	1200	0.6	11.0	0.1	
02	2	9/09	1533	1	0.9	1500	0.8	10.0	0.2	
02	2	9/09	1620	1	0.9	1500	0.8	10.0	0.2	
					0.6	599	0.3	14.8	.14	Ave
					0.3	543	0.3	3.1	.05	Sdv
					0.1	50	0.0	10.0	.1	Min
					0.9	1500	0.8	19.0	.2	Max

Number of Observations: 19

Table 1. Surface Water Quality Data (Continued)

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)
03	1	6/24	1815	1		49		13.0	0.2
03	2	6/30	1327	1		84	0.0	13.0	0.1
03	6	8/04	1200	1	0.1	500	0.2	18.0	0.2
03	6	8/04	1200	1	0.1	500	0.2	18.0	0.2
03	3	8/13	1748	1		200	0.0	13.0	0.1
03	3	8/13	1800	1		200	0.0	13.0	0.1
03	3	8/13	1800	1		200	0.0	13.0	0.1
03	3	8/14	920	1	1.2	1900	1.0	12.0	0.1
03	5	8/18	943	1	0.1	435	0.2	16.0	0.1
03	5	8/19	805	1	1.9	3450	2.0	17.0	0.1
03	3	9/11	1330	1					
03	3	9/12	1025	1					
					0.7	751	0.4	14.6	.13 Ave
					0.8	1089	0.6	2.4	.05 Sav
					0.1	49	0.0	12.0	.1 Min
					1.9	3450	2.0	18.0	.2 Max

Number of Observations: 12

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)
04	1	6/27	1140	1				14.0	0.2
04	2	6/30	1430	1	0.4	900	0.4	12.0	0.1
04	4	7/24	1845	1	2.2	4000	2.3	21.0	0.2
04	5	7/30	1136	1	0.8	1550	0.8	13.0	
04	1	8/05	1115	1	0.2	580	0.2	18.0	0.2
04	6	8/07	1825	1		300	0.1	16.0	0.1
04	6	8/07	1850	1		300	0.1	16.0	0.1
04	6	8/08	2100	1		177	0.0	13.0	0.1
04	4	8/19	1220	1	0.5	1120	0.6		0.2
04	4	8/20	1605	1	0.3	680	0.3	16.0	0.1
04	4	8/20	1720	1	0.3	680	0.3	16.0	0.1
04	4	8/21	1605	1	0.7	1390	0.7		0.1
04	4	8/27	900	1	0.4	980	0.5	10.0	0.2
04	4	8/27	1100	1	0.5	1075	0.5	10.0	0.1
04	4	8/27	1100	1	0.5	1075	0.5	10.0	0.1
04	4	8/27	1300	1	0.8	1575	0.8	10.0	0.1
04	4	8/27	1302	1	0.8	1575	0.8	10.0	0.1
04	4	8/27	1456	1	0.7	1420	0.7	10.0	0.1
04	4	8/27	1510	1	0.7	1420	0.7	10.0	0.1
04	4	8/27	1805	1	0.9	1725	0.9	10.0	0.2
04	4	8/27	1820	1	0.9	1725	0.9	10.0	0.2
04	4	8/27	2005	1	2.1	3850	2.2	10.0	0.2
04	4	8/27	2014	1	2.1	3850	2.2	10.0	0.2
04	4	8/28	1150	1	0.1	480	0.2	9.0	0.2
04	6	9/11	2002	1					
04	6	9/12	1815	1	0.7	1500	0.8	9.0	0.1

Table 1. Surface Water Quality Data (Continued)

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)	
04	1	9/15	1210	1	0.2	510	0.2	6.0	0.2	
04	1	9/16	1008	1	0.2	550	0.2	5.0	0.3	
04	5	9/16	1655	1	2.7	4700	2.7	9.0	0.1	
04	5	9/17	1641	1	3.5	6100	3.6	14.0	0.1	
					0.9	1635	0.9	11.7	.15	Ave
					0.9	1480	0.9	3.6	.06	Sdv
					0.1	177	0.0	5.0	.1	Min
					3.5	6100	3.6	21.0	.3	Max

Number of Observations: 30

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)
05	1	6/13	1300	1				8.0	
05	14	6/15	1545	1		62		9.0	0.1
05	14	6/15	1615	1		62		9.0	0.1
05	7	6/21	1130	1				14.0	0.4
05	4	6/23	1600	1		155	0.0	14.0	0.2
05	5	6/23	1745	1		330	0.1	14.0	0.3
05	6	6/23	1210	1				10.0	0.2
05	6	6/23	1820	1				13.0	0.3
05	6	6/23	915	1				10.0	0.2
05	8	7/08	1945	1		275	0.1	11.0	0.5
05	8	7/08	1945	1		275	0.1	11.0	0.5
05	9	7/08	1710	1		275	0.1	11.0	0.5
05	8	7/09	1145	1		155	0.0	14.0	0.2
05	8	7/09	1115	1		155	0.0	14.0	0.2
05	8	7/09	1115	1		155	0.0	14.0	0.2
05	8	7/09	1145	1		155	0.0	14.0	0.2
05	8	7/11	1205	1		210	0.0	14.0	0.2
05	8	7/11	1205	1		210	0.0	14.0	0.2
05	10	7/24	2200	1	0.4	900	0.4		0.2
05	12	8/05	1410	1	0.5	1150	0.6	18.0	0.6
05	12	8/05	1420	1	0.5	1150	0.6	18.0	0.6
05	13	8/07	2100	1	0.6	1220	0.6	14.0	0.3
05	13	8/07	2105	1	0.6	1220	0.6	14.0	0.3
05	13	8/07	2145	1	0.6	1220	0.6	14.0	0.3
05	13	8/07	2150	1	0.6	1220	0.6	14.0	0.3
05	13	8/08	1840	1		190	0.0	13.0	0.2
05	13	8/08	1930	1		190	0.0	13.0	0.2
05	10	8/19	1045	1	1.7	3175	1.8		0.2
05	10	8/19	1045	1	1.7	3175	1.8		0.2
05	10	8/20	1650	1					
05	10	8/20	1810	1					
05	10	8/27	935	1	1.7	3050	1.7	10.0	0.2
05	10	8/27	1130	1	1.9	3450	2.0	9.0	0.2
05	10	8/27	947	1	1.7	3050	1.7	10.0	0.2

Table 1. Surface Water Quality Data (Continued)

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)
05	10	8/27	1140	1	1.9	3450	2.0	9.0	0.2
05	10	8/27	1135	1	1.9	3450	2.0	9.0	0.2
05	10	8/27	1330	1	1.1	2075	1.1	10.0	0.2
05	10	8/27	1148	1	1.9	3450	2.0	9.0	0.2
05	10	8/27	1338	1	1.1	2075	1.1	10.0	0.2
05	10	8/27	1334	1	1.1	2075	1.1	10.0	0.2
05	10	8/27	1539	1	1.1	2085	1.1	10.0	0.2
05	10	8/27	1344	1	1.1	2075	1.1	10.0	0.2
05	10	8/27	1549	1	1.1	2085	1.1	10.0	0.2
05	10	8/27	1543	1	1.1	2085	1.1	10.0	0.2
05	10	8/27	1838	1	2.0	3650	2.1	10.0	0.2
05	10	8/27	1558	1	1.1	2085	1.1	10.0	0.4
05	10	8/27	1852	1	2.0	3650	2.1	10.0	0.4
05	10	8/27	1848	1	2.0	3650	2.1	10.0	0.4
05	10	8/27	2030	1	2.0	3675	2.1	10.0	0.4
05	10	8/27	1859	1	2.0	3650	2.1	10.0	0.3
05	10	8/27	2041	1	2.0	3675	2.1	10.0	0.3
05	10	8/27	2034	1	2.0	3675	2.1	10.0	0.3
05	10	8/27	2048	1	2.0	3675	2.1	10.0	0.3
05	10	8/28	1243	1	1.1	2075	1.1	9.0	0.3
05	13	9/11	1905	1	0.6	1300	0.7	7.0	0.2
05	13	9/11	1905	1	0.6	1300	0.7	7.0	0.2
05	13	9/12	1610	1	0.6	1200	0.6	8.0	0.3
05	13	9/12	1610	1	0.6	1200	0.6	8.0	0.3
05	12	9/15	1254	1	0.3	720	0.3	6.0	0.3
05	12	9/15	1254	1	0.3	720	0.3	6.0	0.3
05	11	9/16	1650	1	1.6	3000	1.7	7.0	0.3
05	11	9/16	1700	1	1.6	3000	1.7	7.0	0.3
05	12	9/16	1202	1	0.5	1100	0.5	6.0	0.3
05	12	9/16	1225	1	0.5	1100	0.5	6.0	0.3
05	11	9/17	1610	1	1.6	3000	1.7	7.0	0.3
05	11	9/17	1610	1	1.6	3000	1.7	7.0	0.3
					1.2	1793	1.0	10.5	.27 Ave
					0.6	1303	0.8	2.8	.11 Sdv
					0.3	62	0.0	6.0	.1 Min
					2.0	3675	2.1	18.0	.6 Max

Number of Observations: 66

06	1	6/17	1851	1		59		12.0	0.1
06	2	6/19	1944	1		59		13.0	0.2
06	3	6/25	1212	1		43		13.0	0.2
06	3	6/25	1316	1		43		13.0	0.2
06	1	7/04	1345	1		100	0.0	14.0	0.2
06	1	7/15	1400	1		150	0.0	16.0	0.2

Table 1. Surface Water Quality Data (Continued)

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)
06	1	7/15	1530	1		155	0.0	16.0	0.2
06	1	7/17	1315	1		155	0.0	17.0	0.2
06	1	7/17	1635	1		155	0.0	17.0	0.1
06	2	7/21	1615	1		160	0.0	18.0	0.2
06	2	7/21	1712	1		170	0.0	18.0	0.2
06	3	7/25	1430	1		190	0.0	18.0	0.2
06	3	7/25	1650	1		190	0.0	19.0	0.1
06	1	8/10	1118	1		200	0.0	16.0	0.2
06	1	8/10	1223	1		200	0.0	16.0	0.2
06	3	8/11	1535	1		200	0.0	16.0	0.1
06	3	8/11	1624	1		200	0.0	16.0	0.1
06	2	8/12	1506	1		300	0.1	16.0	0.1
06	2	8/12	1720	1		300	0.1	16.0	0.1
06	2	8/12	1601	1		300	0.1	16.0	0.1
06	2	8/12	1720	1		300	0.1	16.0	0.1
06	3	8/12	1224	1		200	0.0	16.0	0.1
06	3	8/12	1224	1		200	0.0	16.0	0.1
06	2	8/14	1128	1		300	0.1	15.0	0.2
06	3	8/14	1600	1		300	0.1	15.0	0.1
06	1	8/15	1156	1	0.1	300	0.1	14.0	0.1
06	1	8/15	1243	1	0.1	300	0.1	14.0	0.1
06	1	8/30	1353	1		1775		11.8	0.2
06	1	9/05	1543	1	0.6	900	0.4	11.0	0.2
06	3	9/10	1735	1	0.7	1200	0.6	10.0	0.2
06	3	9/10	1815	1	0.7	1200	0.6	10.0	0.2
06	2	9/13	1254	1	0.8	790	0.5	9.0	0.2
06	2	9/13	1346	1	0.8	790	0.5	9.0	0.2
					0.5	726	0.3	14.6	.16 Ave
					0.3	1841	1.1	2.7	.05 Sav
					0.1	43	0.0	9.0	.1 Min
					0.8	7900	0.5	19.0	.2 Max

Number of Observations: 34

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)
07	1	6/15	1935	1		56		10.0	0.1
07	2	6/20	1522	1		44		14.0	0.2
07	2	6/20	1553	1		44		14.0	0.2
07	3	6/20	1808	1		39		13.0	0.1
07	3	6/20	1834	1		39		13.0	0.1
07	4	6/22	1554	1		50		13.0	0.2
07	5	6/26	1417	1		159	0.0	11.0	0.2
07	5	6/26	1445	1		159	0.0	11.0	0.2
07	7	6/28	1421	1		42		14.0	0.1
07	8	6/28	1902	1		64		14.0	0.2
07	8	6/28	1929	1		64		14.0	0.2
07	8	7/02	1947	1		100	0.0	14.0	0.2

Table 1. Surface Water Quality Data (Continued)

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)
07	8	7/02	2010	1		100	0.0	14.0	0.2
07	8	7/07	1030	1		105	0.0	15.0	0.2
07	8	7/07	1055	1		105	0.0	15.0	0.2
07	8	7/09	1315	1		150	0.0	14.0	0.2
07	8	7/09	1340	1		150	0.0	14.0	0.2
07	8	7/09	1340	1		150	0.0	14.0	0.2
07	8	7/09	1335	1		150	0.0	14.0	0.2
07	8	7/12	1605	1		155	0.0	15.0	0.1
07	8	7/12	1315	1		155	0.0	15.0	0.1
07	8	7/12	1315	1		155	0.0	15.0	0.1
07	8	7/12	1635	1		155	0.0	15.0	0.1
07	9	7/12	2040	1		160	0.0	17.0	0.2
07	9	7/12	2115	1		160	0.0	17.0	0.2
07	8	7/17	1930	1		160	0.0	17.0	0.1
07	8	7/17	2003	1		160	0.0	17.0	0.1
07	2	7/21	1246	1		140	0.0	18.0	0.2
07	2	7/21	1305	1		140	0.0	18.0	0.2
07	3	7/22	1635	1		170	0.0	19.0	0.2
07	3	7/22	1700	1		170	0.0	19.0	0.2
07	10	7/25	1902	1		200	0.0	19.0	0.2
07	10	7/25	1920	1		200	0.0	19.0	0.2
07	8	8/01	1537	1		146	0.0	19.0	0.1
07	8	8/01	1555	1		146	0.0	19.0	0.1
07	3	8/02	1947	1		144	0.0	19.0	0.2
07	3	8/02	2050	1		144	0.0	19.0	0.2
07	3	8/02	2020	1		144	0.0	19.0	0.2
07	3	8/02	2050	1		144	0.0	19.0	0.2
07	8	8/02	1300	1		148	0.0	19.0	0.1
07	8	8/02	1300	1		148	0.0	19.0	0.1
07	10	8/02	1621	1		146	0.0	20.0	0.2
07	10	8/02	1722	1		146	0.0	20.0	0.2
07	10	8/02	1645	1		146	0.0	20.0	0.2
07	10	8/02	1722	1		146	0.0	20.0	0.2
07	2	8/03	1535	1		160	0.0	20.0	0.1
07	2	8/03	1645	1		160	0.0	20.0	0.1
07	2	8/03	1618	1		160	0.0	20.0	0.1
07	2	8/03	1645	1		160	0.0	20.0	0.1
07	9	8/06	1237	1		172	0.0	18.0	0.2
07	9	8/06	1337	1		172	0.0	18.0	0.2
07	9	8/06	1302	1		172	0.0	18.0	0.2
07	9	8/06	1337	1		172	0.0	18.0	0.2
07	8	8/07	1035	1		148	0.0	18.0	0.2
07	8	8/07	1200	1		148	0.0	18.0	0.2
07	8	8/07	1105	1		148	0.0	18.0	0.2

Table 1. Surface Water Quality Data (Continued)

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)	
07	8	8/07	1200	1		148	0.0	18.0	0.2	
07	2	8/12	1820	1		200	0.0	15.0	0.1	
07	8	8/15	1357	1	0.1	300	0.1	15.0	0.1	
07	8	8/15	1418	1	0.1	300	0.1	15.0	0.1	
07	8	8/22	945	1		175	0.0	13.0	0.1	
07	8	8/22	1110	1		175	0.0	13.0	0.1	
07	8	8/22	1004	1		175	0.0	13.0	0.1	
07	8	8/22	1110	1		175	0.0	13.0	0.1	
07	8	8/30	1157	1		162	0.0	13.0	0.2	
07	8	8/30	1316	1		162	0.0	13.0	0.2	
07	8	8/30	1225	1		162	0.0	13.0	0.2	
07	8	8/30	1316	1		162	0.0	13.0	0.2	
07	2	9/13	1038	1		210	0.0	9.0	0.2	
07	2	9/13	1131	1		210	0.0	9.0	0.2	
07	8	9/18	1038	1		190	0.0	8.0	0.2	
07	8	9/18	1107	1		190	0.0	8.0	0.2	
					0.1	148	0.0	15.8	.17	Ave
					0.0	49	0.0	3.2	.05	Sdv
					0.1	39	0.0	8.0	.1	Min
					0.1	300	0.1	20.0	.2	Max

Number of Observations: 72

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)	
08	1	6/18	1305	1		66		15.0	0.6	
08	1	6/18	1411	1		66		15.0	0.6	
08	2	6/21	2015	1		57		12.0	0.9	
08	2	6/21	2020	1		57		12.0	0.9	
						61	0.0	13.5	.75	Ave
						4	0.0	1.7	.17	Sdv
						57	0.0	12.0	.6	Min
						66	0.0	15.0	.9	Max

Number of Observations: 4

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)
09	1	7/05	1545	1		75	0.0	15.0	1.2
09	1	7/05	1400	1		75	0.0	15.0	1.2
09	1	7/05	1645	1		75	0.0	15.0	1.2
09	1	7/05	1700	1		75	0.0	15.0	1.2
09	1	7/06	1130	1		79	0.0	16.0	
09	1	7/06	1115	1		79	0.0	16.0	
09	1	7/06	1135	1		79	0.0	16.0	
09	1	8/22	1545	1				10.0	

Table 1. Surface Water Qualitv Data (Continued)

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)	
09	1	8/23	1025	1		130	0.0	9.0	0.4	
09	2	8/23	1345	1	0.1	422	0.2	10.0	0.6	
09	2	8/23	1430	1	0.1	422	0.2	10.0	0.6	
09	2	8/24	2015	1	0.1	390	0.1	10.0	0.7	
09	2	8/24	2040	1	0.1	390	0.1	10.0	0.7	
09	2	8/24	2049	1	0.1	390	0.1	10.0	0.7	
09	2	8/25	1340	1	0.1	367	0.1	10.0	0.5	
					0.1	217	0.0	12.5	.82	Ave
					0.0	162	0.1	2.9	.32	Sdv
					0.1	75	0.0	9.0	.4	Min
					0.1	422	0.2	16.0	1.2	Max

Number of Observations: 15

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)
10	3	6/18	1625	1		47		13.0	1.0
10	3	6/18	1635	1		47		13.0	1.0
10	1	6/29	1428	1				12.0	
10	1	6/29	1428	1				12.0	
10	1	6/30	1100	1				12.0	
10	1	6/30	1101	1				12.0	
10	1	6/30	1100	1				12.0	
10	1	6/30	1101	1				12.0	
10	1	7/03	1100	1		90	0.0	12.0	2.1
10	1	7/03	1130	1		90	0.0	12.0	2.1
10	1	7/03	1100	1		90	0.0	12.0	2.1
10	1	7/03	1130	1		90	0.0	12.0	2.1
10	1	7/05	1320	1		90	0.0	13.0	2.1
10	1	7/05	1400	1		90	0.0	13.0	2.1
10	1	7/05	1320	1		90	0.0	13.0	2.1
10	1	7/05	1400	1		90	0.0	13.0	2.1
10	1	7/06	1215	1		82	0.0	15.0	
10	1	7/06	1315	1		82	0.0	15.0	
10	1	7/06	1305	1		82	0.0	15.0	
10	1	7/06	1315	1		82	0.0	15.0	
10	1	7/09	1815	1		115	0.0	12.0	2.2
10	1	7/09	1800	1		115	0.0	12.0	2.2
10	1	7/09	1800	1		115	0.0	12.0	2.2
10	1	7/09	1815	1		115	0.0	12.0	2.2
10	1	7/14	1100	1		117	0.0	14.0	2.1
10	1	7/14	1210	1		117	0.0	14.0	2.1
10	1	7/14	1100	1		117	0.0	14.0	2.1
10	1	7/14	1210	1		117	0.0	14.0	2.1
10	1	7/16	1620	1		120	0.0	19.0	1.5

Table 1. Surface Water Quality Data (Continued)

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)
10	1	7/16	1720	1		120	0.0	19.0	1.5
10	1	7/16	1620	1		120	0.0	19.0	1.5
10	1	7/16	1720	1		120	0.0	19.0	1.5
10	1	7/23	1200	1		150	0.0	19.0	0.8
10	1	7/23	1315	1		150	0.0	19.0	0.8
10	1	7/23	1200	1		150	0.0	19.0	0.8
10	1	7/23	1315	1		150	0.0	19.0	0.8
10	1	7/29	1215	1		150	0.0	17.0	0.8
10	1	7/29	1345	1		150	0.0	17.0	0.8
10	1	7/29	1315	1		150	0.0	17.0	0.8
10	1	7/29	1345	1		150	0.0	17.0	0.8
10	1	8/01	1158	1		146	0.0	17.0	0.5
10	1	8/01	1330	1		146	0.0	17.0	0.5
10	1	8/01	1243	1		146	0.0	17.0	0.5
10	1	8/01	1330	1		146	0.0	17.0	0.5
10	1	8/07	1555	1		148	0.0	17.0	0.7
10	1	8/07	1645	1		148	0.0	17.0	0.7
10	1	8/07	1615	1		148	0.0	17.0	0.7
10	1	8/07	1645	1		148	0.0	17.0	0.7
10	1	8/12	1955	1		170	0.0	15.0	0.6
10	1	8/12	2020	1		170	0.0	15.0	0.6
10	1	8/12	1955	1		170	0.0	15.0	0.6
10	1	8/12	2020	1		170	0.0	15.0	0.6
10	1	8/18	1800	1		142	0.0	17.0	0.8
10	1	8/18	1810	1		142	0.0	17.0	0.8
10	1	8/18	1800	1		142	0.0	17.0	0.8
10	1	8/18	1810	1		142	0.0	17.0	0.8
10	1	8/22	1650	1		149	0.0	12.0	
10	1	8/22	1725	1		149	0.0	12.0	
10	1	8/22	1710	1		149	0.0	12.0	
10	1	8/22	1725	1		149	0.0	12.0	
10	2	8/23	1303	1	0.1	340	0.1	12.0	1.1
10	2	8/23	1303	1	0.1	340	0.1	12.0	1.1
10	2	8/25	1203	1		275	0.1	11.0	0.5
10	2	8/25	1208	1		275	0.1	11.0	0.5
10	2	8/25	1142	1		275	0.1	11.0	0.5
10	2	8/25	1148	1		275	0.1	11.0	0.5
10	2	8/26	1325	1		315	0.1	11.0	0.8
10	2	8/26	1437	1		315	0.1	11.0	0.8
10	2	8/26	1325	1		315	0.1	11.0	0.8
10	2	8/26	1437	1		315	0.1	11.0	0.8
10	1	8/29	1404	1		155	0.0	11.0	1.0
10	1	8/29	1430	1		155	0.0	11.0	1.0
10	1	8/29	1423	1		155	0.0	11.0	1.0
10	1	8/29	1430	1		155	0.0	11.0	1.0
10	1	9/08	1958	1		100	0.0	10.0	2.0
10	1	9/08	2025	1		100	0.0	10.0	2.0

Table 1. Surface Water Quality Data (Continued)

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)	
					0.1	151	0.0	14.1	1.20	Ave
					0.0	69	0.0	2.8	.63	Sdv
					0.1	47	0.0	10.0	.5	Min
					0.1	340	0.1	19.0	2.2	Max

Number of Observations: 76

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)	
11	1	6/16	2110	1				15.0	0.2	
11	2	7/01	2005	1		115	0.0	13.0	0.3	
11	2	7/01	2030	1		115	0.0	13.0	0.3	
						76	0.0	13.7	.27	Ave
						66	0.0	1.2	.06	Sdv
								13.0	.2	Min
						115	0.0	15.0	.3	Max

Number of Observations: 3

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)	
12	1	8/25	1702	1		140	0.0	12.0	0.1	
12	1	8/25	1735	1		140	0.0	12.0	0.1	
12	1	8/26	1116	1		146	0.0	12.0	0.1	
12	1	8/26	1151	1		146	0.0	12.0	0.1	
12	1	8/26	1100	1		146	0.0	12.0	0.1	
12	1	8/26	1151	1		146	0.0	12.0	0.1	
						144	0.0	12.0	0.1	Ave
						3	0.0	0.0	0	Sdv
						140	0.0	12.0	0.1	Min
						146	0.0	12.0	0.1	Max

Number of Observations: 6

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)	
13	1	8/29	1642	1		48		10.0	1.2	
13	1	8/29	1714	1		48		10.0	1.2	
13	1	8/30	1700	1		59		11.0	1.3	
13	1	8/30	1645	1		59	0.0	11.0	1.3	
						53	0.0	10.5	1.25	Ave
						6	0.0	0.6	.06	Sdv
						48		10.0	1.2	Min
						59	0.0	11.0	1.3	Max

Number of Observations: 4

Table 1. Surface Water Quality Data (Continued)

HAB	LOC DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP (°C)	SECCHI DEPTH (x 0.1 m)	
				1.6	1037	0.5	13.5	3	Ave
				2.6	2406	1.5	3.4	0	Sdv
				0.1	39	0.0	5.0	3	Min
				18.9	23900	15.8	21.0	4	Max

Number of Observations: 353

APPENDIX A

Table 2. Bottom Water Quality Data

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP °C	
01	1	6/21	1309	2	0.4	1000	0.5	4.0	
01	3	7/19	1645	2	14.0	21500	14.1	15.0	
01	1	7/22	1053	2	10.1	16000	10.2	8.0	
01	1	7/22	1145	2	9.3	14800	9.4	10.0	
01	2	7/26	1415	2	10.1	16000	10.2	13.0	
01	2	7/26	1525	2	10.1	16000	10.2	13.0	
01	3	8/10	1703	2	22.8	27700	18.6	12.0	
01	1	8/13	1334	2	11.4	14900	9.4	13.0	
01	3	8/16	1514	2	20.9	25200	16.8	11.0	
01	3	9/04	1623	2	26.4	29500	19.9	10.0	
01	2	9/10	1231	2	26.0	28900	19.5	9.0	
01	2	9/10	1445	2	26.0	28900	19.5	9.0	
					15.6	20033	13.2	10.6	Ave
					8.5	8524	5.9	2.9	Sdv
					0.4	1000	0.5	4.0	Min
					26.4	29500	19.9	15.0	Max

Number of Observations: 12

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP °C	
02	1	6/17	1221	2		65	0.0	12.0	
02	2	6/25	1612	2		48	0.0	13.0	
02	1	6/30	1707	2		100	0.0	14.0	
02	1	7/18	1300	2		165	0.0	18.0	
02	1	7/18	1515	2		180	0.0	18.0	
02	3	7/22	1315	2	0.8	1600	0.8	19.0	
02	3	7/22	1410	2	1.0	1900	1.0	19.0	
02	2	7/26	1140	2		300	0.1	18.0	
02	2	7/26	1230	2		300	0.1	18.0	
02	1	8/10	1503	2		200	0.0	15.0	
02	2	8/11	1846	2	0.2	400	0.1	16.0	
02	2	8/11	1935	2	0.2	400	0.1	16.0	
02	1	8/16	1216	2		300	0.1	14.0	
02	1	8/16	1306	2		300	0.1	14.0	
02	1	9/04	1232	2	0.9	1200	0.6	11.0	
02	1	9/04	1335	2	0.9	1200	0.6	11.0	
02	2	9/09	1533	2	2.5	3400	1.9	9.0	
02	2	9/09	1620	2	2.5	3400	1.9	9.0	
					1.1	858	0.4	14.7	Ave
					0.9	1076	0.6	3.3	Sdv
					0.2	48	0.0	9.0	Min
					2.5	3400	1.9	19.0	Max

Number of Observations: 18

Table 2. Bottom Water Quality Data (Continued)

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP °C	
03	2	6/30	1327	2		85	0.0	13.0	
03	3	8/13	1748	2		200	0.0	13.0	
03	3	8/13	1800	2		200	0.0	13.0	
03	3	8/13	1800	2		200	0.0	13.0	
03	3	8/14	920	2	1.3	1900	1.0	12.0	
					1.3	517	0.2	12.8	Ave
					0.0	774	0.5	0.4	Sdv
					1.3	85	0.0	12.0	Min
					1.3	1900	1.0	13.0	Max

Number of Observations: 5

06	1	6/17	1851	2		62	0.0	12.0
06	2	6/19	1944	2		58	0.0	13.0
06	3	6/25	1212	2		47	0.0	13.0
06	3	6/25	1316	2		47	0.0	13.0
06	1	7/04	1345	2		100	0.0	14.0
06	1	7/15	1400	2		150	0.0	17.0
06	1	7/15	1530	2		150	0.0	17.0
06	1	7/17	1315	2		160	0.0	17.0
06	1	7/17	1635	2		160	0.0	17.0
06	2	7/21	1615	2		170	0.0	18.0
06	2	7/21	1712	2		280	0.1	19.0
06	3	7/25	1430	2		185	0.0	19.0
06	3	7/25	1650	2		185	0.0	19.0
06	1	8/10	1118	2		200	0.0	16.0
06	1	8/10	1223	2		200	0.0	16.0
06	3	8/11	1535	2		200	0.0	16.0
06	3	8/11	1624	2		200	0.0	16.0
06	2	8/12	1506	2		300	0.1	16.0
06	2	8/12	1720	2		300	0.1	16.0
06	2	8/12	1601	2		300	0.1	16.0
06	2	8/12	1720	2		300	0.1	16.0
06	3	8/12	1224	2		300	0.1	16.0
06	3	8/12	1224	2		300	0.1	16.0
06	2	8/14	1128	2	0.1	300	0.1	15.0
06	3	8/14	1600	2	0.1	300	0.1	15.0
06	1	8/15	1156	2	0.1	300	0.1	14.0
06	1	8/15	1243	2	0.1	300	0.1	14.0
06	1	8/30	1353	2		180	0.0	12.0
06	1	8/30	1353	2		180	0.0	12.0
06	1	9/05	1543	2	0.8	1100	0.5	11.0
06	3	9/10	1735	2	0.8	1200	0.6	10.0
06	3	9/10	1815	2	0.8	1200	0.6	10.0
06	2	9/13	1254	2	0.9	1300	0.7	9.0
06	2	9/13	1346	2	0.9	1300	0.7	9.0

Table 2. Bottom Water Quality Data (Continued)

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP °C	
07	8	8/15	1357	2	0.1	300	0.1	14.0	
07	8	8/15	1418	2	0.1	300	0.1	14.0	
07	8	8/22	945	2		172	0.0	13.0	
07	8	8/22	1110	2		172	0.0	13.0	
07	8	8/22	1004	2		172	0.0	13.0	
07	8	8/22	1110	2		172	0.0	13.0	
07	8	8/30	1157	2		180	0.0	12.0	
07	8	8/30	1316	2		180	0.0	12.0	
07	8	8/30	1225	2		180	0.0	12.0	
07	8	8/30	1316	2		180	0.0	12.0	
					0.1	157	0.0	16.0	Ave
					0.0	46	0.0	2.7	Sdv
					0.1	41	0.0	11.0	Min
					0.1	300	0.1	20.0	Max

Number of Observations: 51

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP °C	
08	2	6/21	2015	2		58	0.0	11.0	
08	2	6/21	2020	2		58	0.0	11.0	
						58	0.0	11.0	Ave
						0	0.0	0.0	Sdv
						58	0.0	11.0	Min
						58	0.0	11.0	Max

Number of Observations: 2

6.1	2283	1.4	14.7	Ave
8.8	6445	4.3	3.2	Sdv
0.1	41	0.0	4.0	Min
26.4	29500	19.9	20.0	Max

Number of Observations: 122

Table 2. Bottom Water Quality Data (Continued)

HAB	LOC	DATE	TIME	S/B	INSITU SALINITY (ppt)	COND (umhos/cm)	CALC. SALINITY (ppt)	TEMP °C	
					0.5	353	0.1	14.7	Ave
					0.4	375	0.2	2.8	Sdv
					0.1	47	0.0	9.0	Min
					0.9	1300	0.7	19.0	Max

Number of Observations: 34

07	5	6/26	1417	2		150	0.0	11.0
07	5	6/26	1445	2		150	0.0	11.0
07	8	6/28	1902	2		41	0.0	14.0
07	8	6/28	1929	2		41	0.0	14.0
07	8	7/02	1947	2		100	0.0	14.0
07	8	7/02	2010	2		100	0.0	14.0
07	8	7/07	1030	2		105	0.0	15.0
07	8	7/07	1055	2		105	0.0	15.0
07	8	7/09	1315	2		150	0.0	14.0
07	8	7/09	1340	2		150	0.0	14.0
07	8	7/09	1340	2		150	0.0	14.0
07	8	7/09	1335	2		150	0.0	14.0
07	8	7/12	1605	2		160	0.0	16.0
07	8	7/12	1315	2		160	0.0	16.0
07	8	7/12	1315	2		160	0.0	16.0
07	8	7/12	1635	2		160	0.0	16.0
07	9	7/12	2040	2		160	0.0	17.0
07	9	7/12	2115	2		160	0.0	17.0
07	8	7/17	1930	2		165	0.0	17.0
07	8	7/17	2003	2		165	0.0	17.0
07	2	7/21	1246	2		150	0.0	19.0
07	2	7/21	1305	2		150	0.0	19.0
07	3	7/22	1635	2		180	0.0	19.0
07	3	7/22	1700	2		180	0.0	19.0
07	8	8/01	1537	2		155	0.0	19.0
07	8	8/01	1555	2		155	0.0	19.0
07	3	8/02	1947	2		146	0.0	20.0
07	3	8/02	2050	2		146	0.0	20.0
07	3	8/02	2020	2		146	0.0	20.0
07	3	8/02	2050	2		146	0.0	20.0
07	8	8/02	1300	2		144	0.0	19.0
07	8	8/02	1300	2		144	0.0	19.0
07	10	8/02	1621	2		148	0.0	19.0
07	10	8/02	1722	2		148	0.0	19.0
07	10	8/02	1645	2		148	0.0	19.0
07	10	8/02	1722	2		148	0.0	19.0
07	8	8/07	1035	2		150	0.0	17.0
07	8	8/07	1200	2		150	0.0	17.0
07	8	8/07	1105	2		150	0.0	17.0
07	8	8/07	1200	2		150	0.0	17.0
07	2	8/12	1820	2	0.1	300	0.1	16.0

APPENDIX B

CATCH PER UNIT EFFORT

APPENDIX B

Table 1. Catch Per 24-Hour Gill Net Set

	STATION											
DATE	5-2	5-3	5-6	8-1	8-2	9-1	9-2	10-3	11-1	11-2	12-1	13-1
JUVENILE CHUM SALMON												
06/16/85	.	3	.	.	.	.	.	.	.	.	.	.
07/02/85	.	.	.	.	.	.	.	.	.	0	.	.
ADULT CHUM SALMON												
06/16/85	.	3	.	.	.	.	.	.	.	.	.	.
07/02/85	.	.	.	.	.	.	.	.	.	1	.	.
SHEEFISH												
06/14/85	56	.	.	.	.	.	.	.	.	.	.	.
06/17/85	.	.	.	.	.	.	.	.	24	.	.	.
06/19/85	.	.	.	0	.	.	.	1	.	.	.	.
06/22/85	.	.	.	.	1	.	.	.	.	.	.	.
07/02/85	.	.	.	.	.	.	.	.	.	1	.	.
HUMPBACK WHITEFISH												
06/14/85	72	.	.	.	.	.	.	.	.	.	.	.
06/17/85	.	.	.	.	.	.	.	.	20	.	.	.
06/19/85	.	.	.	32	.	.	.	13	.	.	.	.
06/22/85	.	.	.	.	8	.	.	.	.	.	.	.
07/02/85	.	.	.	.	.	.	.	.	.	14	.	.
08/24/85	.	.	.	.	.	.	4	.	.	.	.	.
BROAD WHITEFISH												
06/14/85	24	.	.	.	.	.	.	.	.	.	.	.
06/17/85	.	.	.	.	.	.	.	.	4	.	.	.
06/19/85	.	.	.	7	.	.	.	1	.	.	.	.
07/02/85	.	.	.	.	.	.	.	.	.	4	.	.
ARCTIC CISCO												
06/14/85	4	.	.	.	.	.	.	.	.	.	.	.
LEAST CISCO												
06/14/85	52	.	.	.	.	.	.	.	.	.	.	.
06/17/85	.	.	.	.	.	.	.	.	4	.	.	.
06/19/85	.	.	.	14	.	.	.	4	.	.	.	.
06/22/85	.	.	.	.	1	.	.	.	.	.	.	.
07/02/85	.	.	.	.	.	.	.	.	.	11	.	.
08/24/85	.	.	.	.	.	.	1	.	.	.	.	.
UNIDENTIFIED CISCO												
06/19/85	.	.	.	1	.	.	.	1	.	.	.	.
06/23/85	.	.	0	.	.	.	.	.	.	.	.	.
08/26/85	.	.	.	.	.	.	.	.	.	.	0	.
LONGNOSE SUCKER												
06/19/85	.	.	.	1	.	.	.	0	.	.	.	.
07/02/85	.	.	.	.	.	.	.	.	.	1	.	.
NORTHERN PIKE												
06/14/85	8	.	.	.	.	.	.	.	.	.	.	.
06/17/85	.	.	.	.	.	.	.	.	4	.	.	.
06/19/85	.	.	.	8	.	.	.	12	.	.	.	.
06/22/85	.	.	.	.	3	.	.	.	.	.	.	.
07/05/85	.	.	.	.	.	9	.	.	.	.	.	.
07/06/85	.	.	.	.	.	18	.	.	.	.	.	.
08/24/85	.	.	.	.	.	.	2	.	.	.	.	.
BURBOT												
06/14/85	4	.	.	.	.	.	.	.	.	.	.	.
06/17/85	.	.	.	.	.	.	.	.	4	.	.	.
BLACKFISH												
08/30/85	.	.	.	.	.	.	.	.	.	.	.	12

APPENDIX B
Table 2. Catch Per 24-Hour Single Fyke Net Set

	STATION														
DATE	4-1	4-2	4-4	4-5	4-6	7-1	7-6	8-1	8-2	9-1	9-2	10-3	11-2	12-1	13-1
CHINOOK SALMON															
06/16/85	.	.	.	.	.	13	.	.	.	.	.	.	.	.	.
08/21/85	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
JUVENILE CHUM SALMON															
06/16/85	.	.	.	.	.	8	.	.	.	.	.	.	.	.	.
07/30/85	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.
ADULT CHUM SALMON															
06/16/85	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
07/30/85	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.
PINK SALMON															
06/16/85	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.
UNIDENTIFIED DOLLY VARDEN/ARCTIC CHAR															
07/30/85	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
SHEEFISH															
07/01/85	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.
07/06/85	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
07/09/85	.	.	.	.	.	.	.	.	.	15	.	.	.	.	.
07/24/85	.	.	587	.	.	.	.	.	.	.	.	.	.	.	.
07/30/85	.	.	.	175	.	.	.	.	.	.	.	.	.	.	.
08/04/85	26	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/05/85	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	11	.	.	.	.	.	.	.	.	.	.
08/08/85	.	.	.	.	40	.	.	.	.	.	.	.	.	.	.
08/20/85	.	.	37	.	.	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	246	.	.	.	.	.	.	.	.	.	.	.	.
08/28/85	.	.	113	.	.	.	.	.	.	.	.	.	.	.	.
09/12/85	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.
09/16/85	101	.	.	.	.	.	.	.	.	.	.	.	.	.	.
09/17/85	.	.	.	81	.	.	.	.	.	.	.	.	.	.	.
HUMPBACK WHITEFISH															
06/14/85	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.
06/16/85	.	.	.	.	.	36	.	.	.	.	.	.	.	.	.
06/22/85	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
06/27/85	23	.	.	.	.	.	.	.	.	.	.	.	.	.	.
07/24/85	.	.	13	.	.	.	.	.	.	.	.	.	.	.	.
08/04/85	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/05/85	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.
08/08/85	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.
08/20/85	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	75	.	.	.	.	.	.	.	.	.	.	.	.
08/24/85	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
08/25/85	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
08/28/85	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.
09/12/85	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
09/16/85	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.

APPENDIX B
Table 2. Catch Per 24-Hour Single Fyke Net Set

	STATION														
DATE	4-1	4-2	4-4	4-5	4-6	7-1	7-6	8-1	8-2	9-1	9-2	10-3	11-2	12-1	13-1
BROAD WHITEFISH															
06/27/85	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
07/01/85	.	15	.	.	.	.	.	.	.	.	.	.	.	.	.
07/02/85	.	.	.	.	.	.	.	.	.	.	.	.	10	.	.
07/24/85	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
08/04/85	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/28/85	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.
09/12/85	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
09/17/85	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.
UNIDENTIFIED WHITEFISH															
07/24/85	.	.	3813	.	.	.	.	.	.	.	.	.	.	.	.
07/30/85	.	.	.	449	.	.	.	.	.	.	.	.	.	.	.
08/04/85	483	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/05/85	1962	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	2807	.	.	.	.	.	.	.	.	.	.
08/08/85	.	.	.	.	836	.	.	.	.	.	.	.	.	.	.
08/20/85	.	.	13	.	.	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	82	.	.	.	.	.	.	.	.	.	.	.	.
08/25/85	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
08/26/85	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.
08/28/85	.	.	140	.	.	.	.	.	.	.	.	.	.	.	.
09/12/85	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.
09/16/85	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
09/17/85	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.
BERING CISCO															
07/01/85	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.
07/24/85	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.
07/30/85	.	.	.	61	.	.	.	.	.	.	.	.	.	.	.
08/04/85	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/05/85	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	7	.	.	.	.	.	.	.	.	.	.
08/08/85	.	.	.	.	12	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	6	.	.	.	.	.	.	.	.	.	.	.	.
08/28/85	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.
09/12/85	.	.	.	.	14	.	.	.	.	.	.	.	.	.	.
09/16/85	16	.	.	.	.	.	.	.	.	.	.	.	.	.	.
09/17/85	.	.	.	94	.	.	.	.	.	.	.	.	.	.	.
LEAST CISCO															
06/14/85	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.
06/16/85	.	.	.	.	.	38	.	.	.	.	.	.	.	.	.
06/19/85	.	.	.	.	.	.	.	1	.	.	.	0	.	.	.
06/20/85	.	.	.	.	.	.	.	2	.	.	.	0	.	.	.
06/22/85	.	.	.	.	.	.	.	.	25	.	.	.	.	.	.
06/27/85	55	.	.	.	.	.	.	.	.	.	.	.	.	.	.
07/01/85	.	35	.	.	.	.	.	.	.	.	.	.	.	.	.

APPENDIX B
Table 2. Catch Per 24-Hour Single Fyke Net Set

							STATION								
DATE	4-1	4-2	4-4	4-5	4-6	7-1	7-6	8-1	8-2	9-1	9-2	10-3	11-2	12-1	13-1
LEAST CISCO CONT.															
07/02/85	.	.	.	.	.	.	.	.	.	.	.	.	29	.	.
07/24/85	.	.	64	.	.	.	.	.	.	.	.	.	.	.	.
07/30/85	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
08/04/85	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/05/85	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	25	.	.	.	.	.	.	.	.	.	.
08/08/85	.	.	.	.	13	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
08/25/85	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
08/28/85	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.
09/12/85	.	.	.	.	10	.	.	.	.	.	.	.	.	.	.
09/17/85	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
UNIDENTIFIED CISCO															
07/24/85	.	.	146	.	.	.	.	.	.	.	.	.	.	.	.
07/30/85	.	.	.	94	.	.	.	.	.	.	.	.	.	.	.
08/04/85	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/05/85	140	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	87	.	.	.	.	.	.	.	.	.	.
08/08/85	.	.	.	.	77	.	.	.	.	.	.	.	.	.	.
08/20/85	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	42	.	.	.	.	.	.	.	.	.	.	.	.
08/28/85	.	.	359	.	.	.	.	.	.	.	.	.	.	.	.
09/12/85	.	.	.	.	12	.	.	.	.	.	.	.	.	.	.
09/16/85	21	.	.	.	.	.	.	.	.	.	.	.	.	.	.
09/17/85	.	.	.	234	.	.	.	.	.	.	.	.	.	.	.
UNIDENTIFIED CISCO AND WHITEFISH															
07/02/85	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.
07/06/85	.	.	.	.	.	.	.	.	.	11	.	.	.	.	.
07/09/85	.	.	.	.	.	.	.	.	.	12	.	.	.	.	.
07/30/85	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
BOREAL SMELT															
06/14/85	.	.	.	.	.	.	19	.	.	.	.	.	.	.	.
06/16/85	.	.	.	.	.	6	.	.	.	.	.	.	.	.	.
06/27/85	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.
07/01/85	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.
07/24/85	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
08/08/85	.	.	.	.	7	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
POND SMELT															
08/07/85	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.
08/20/85	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
08/28/85	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
09/16/85	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
09/17/85	.	.	.	9	.	.	.	.	.	.	.	.	.	.	.

APPENDIX B

Table 2. Catch Per 24-Hour Single Fyke Net Set

DATE	4-1	4-2	4-4	4-5	4-6	7-1	7-6	8-1	8-2	9-1	9-2	10-3	11-2	12-1	13-1
							STATION								
THREESPINE STICKLEBACK															
07/01/85	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
NINESPINE STICKLEBACK															
06/14/85	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
06/16/85	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
06/22/85	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.
07/01/85	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.
07/06/85	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
08/04/85	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/05/85	10	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/20/85	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.
09/16/85	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
09/17/85	.	.	.	191	.	.	.	.	.	.	.	.	.	.	.
LONGNOSE SUCKER															
06/16/85	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
06/19/85	.	.	.	.	.	.	.	1	.	.	.	0	.	.	.
07/02/85	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.
07/24/85	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.
08/08/85	.	.	.	.	5	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
08/25/85	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
NORTHERN PIKE															
06/19/85	.	.	.	.	.	.	.	0	.	.	.	1	.	.	.
06/20/85	.	.	.	.	.	.	.	0	.	.	.	1	.	.	.
07/06/85	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
07/30/85	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
08/23/85	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.
08/24/85	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.
08/25/85	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.
BURBOT															
06/14/85	.	.	.	.	.	.	26	.	.	.	.	.	.	.	.
06/19/85	.	.	.	.	.	.	.	0	.	.	.	1	.	.	.
07/02/85	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
08/04/85	27	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	10	.	.	.	.	.	.	.	.	.	.
08/08/85	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.
08/20/85	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	7	.	.	.	.	.	.	.	.	.	.	.	.
08/24/85	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.
08/25/85	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.
09/12/85	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.
BLACKFISH															
08/24/85	.	.	.	.	.	.	.	.	.	.	7	.	.	.	.
08/30/85	.	.	.	.	.	.	.	.	.	.	.	.	.	.	27

APPENDIX B

Table 2. Catch Per 24-Hour Single Fyke Net Set

							STATION								
DATE	4-1	4-2	4-4	4-5	4-6	7-1	7-6	8-1	8-2	9-1	9-2	10-3	11-2	12-1	13-1
STARRY FLOUNDER															
06/27/85	26	.	.	.	.	.	.	.	.	.	.	.	.	.	.
07/01/85	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.
07/24/85	.	.	190	.	.	.	.	.	.	.	.	.	.	.	.
07/30/85	.	.	.	50	.	.	.	.	.	.	.	.	.	.	.
08/04/85	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/05/85	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	26	.	.	.	.	.	.	.	.	.	.
08/08/85	.	.	.	.	15	.	.	.	.	.	.	.	.	.	.
08/20/85	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	44	.	.	.	.	.	.	.	.	.	.	.	.
08/28/85	.	.	21	.	.	.	.	.	.	.	.	.	.	.	.
09/12/85	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.
09/17/85	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.
ARCTIC FLOUNDER															
06/27/85	87	.	.	.	.	.	.	.	.	.	.	.	.	.	.
07/01/85	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
07/24/85	.	.	108	.	.	.	.	.	.	.	.	.	.	.	.
07/30/85	.	.	.	138	.	.	.	.	.	.	.	.	.	.	.
08/04/85	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.
08/08/85	.	.	.	.	5	.	.	.	.	.	.	.	.	.	.
08/20/85	.	.	11	.	.	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	74	.	.	.	.	.	.	.	.	.	.	.	.
08/28/85	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.
09/16/85	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.
09/17/85	.	.	.	14	.	.	.	.	.	.	.	.	.	.	.
SAFFRON COD															
06/27/85	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.
08/21/85	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.
09/12/85	.	.	.	.	219	.	.	.	.	.	.	.	.	.	.
09/16/85	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
09/17/85	.	.	.	71	.	.	.	.	.	.	.	.	.	.	.
FOURHORN SCULPIN															
09/12/85	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.

APPENDIX B

Table 3. Catch Per 24-Hour Double Fyke Net Set

DATE	3-1	3-2	3-3	3-5	3-6
		STATION			
CHINOOK SALMON					
06/25/85	4	.	.	.	.
JUVENILE CHUM SALMON					
06/25/85	128	.	.	.	.
PINK SALMON					
06/25/85	16	.	.	.	.
SHEEFISH					
08/04/85	.	.	.	.	21
08/14/85	.	.	32	.	.
08/19/85	.	.	.	70	.
09/12/85	.	.	30	.	.
HUMPBACK WHITEFISH					
06/25/85	11	.	.	.	.
09/12/85	.	.	3	.	.
UNIDENTIFIED WHITEFISH					
08/04/85	.	.	.	.	1
08/14/85	.	.	17	.	.
08/19/85	.	.	.	2	.
09/12/85	.	.	15	.	.
BERING CISCO					
08/04/85	.	.	.	.	3
09/12/85	.	.	1	.	.
LEAST CISCO					
06/25/85	7	.	.	.	.
08/14/85	.	.	3	.	.
09/12/85	.	.	3	.	.
UNIDENTIFIED CISCO					
08/04/85	.	.	.	.	10
08/14/85	.	.	26	.	.
08/19/85	.	.	.	3	.
09/12/85	.	.	14	.	.
BOREAL SMELT					
06/25/85	49	.	.	.	.
08/04/85	.	.	.	.	273
08/14/85	.	.	3	.	.
08/19/85	.	.	.	2	.

APPENDIX B

Table 3. Catch Per 24-Hour Double Fyke Net Set

DATE	STATION 3-1	3-2	3-3	3-5	3-6
POND SMELT					
08/04/85	.	.	.	.	18
08/14/85	.	.	3	.	.
08/19/85	.	.	.	5	.
09/12/85	.	.	3	.	.
UNIDENTIFIED SMELT					
08/04/85	.	.	.	.	103
08/14/85	.	.	74	.	.
NINESPINE STICKLEBACK					
08/04/85	.	.	.	.	2
08/14/85	.	.	36	.	.
08/19/85	.	.	.	1	.
09/12/85	.	.	2	.	.
ARCTIC LAMPREY					
06/25/85	2	.	.	.	.
BURBOT					
08/04/85	.	.	.	.	1
08/14/85	.	.	53	.	.
08/19/85	.	.	.	9	.
09/12/85	.	.	9	.	.
STARRY FLOUNDER					
06/25/85	1	.	.	.	.
08/04/85	.	.	.	.	6
08/14/85	.	.	2	.	.
09/12/85	.	.	1	.	.
ARCTIC FLOUNDER					
08/04/85	.	.	.	.	369
08/14/85	.	.	6	.	.
08/19/85	.	.	.	210	.
SAFFRON COD					
06/25/85	3	.	.	.	.
08/04/85	.	.	.	.	1
08/14/85	.	.	20	.	.
08/19/85	.	.	.	4	.
09/12/85	.	.	68	.	.
FOURHORN SCULPIN					
08/04/85	.	.	.	.	25
08/14/85	.	.	12	.	.
08/19/85	.	.	.	60	.
UNIDENTIFIED SCULPIN					
07/01/85	.	0	.	.	.
08/04/85	.	.	.	.	7

APPENDIX B

Table 4. Catch Per 10-Minute Purse Seine Set

DATE	STATION 1-1	1-2	1-3	2-1	2-2	2-3	6-1	6-2	6-3
CHINOOK SALMON									
06/14/85	.	.	.	.	.	.	1	.	.
06/16/85	.	.	.	1	.	.	.	.	.
06/17/85	.	.	.	1	.	.	0	.	.
06/25/85	.	.	.	.	2	.	.	.	2
06/30/85	.	.	.	1	.	.	.	.	.
07/18/85	.	.	.	1	.	.	.	.	.
07/25/85	.	.	.	.	.	.	.	.	1
JUVENILE CHUM SALMON									
06/17/85	.	.	.	3	.	.	5	.	.
06/19/85	.	.	.	.	.	.	.	12	.
06/21/85	1	.	.	.	.	.	.	.	.
06/25/85	.	.	.	.	19	.	.	.	46
06/30/85	.	.	.	136	.	.	.	.	.
07/04/85	.	.	.	.	.	.	3	.	.
07/15/85	.	.	.	.	.	.	1	.	.
07/17/85	.	.	.	.	.	.	2	.	.
07/21/85	.	.	.	.	.	.	.	1	.
07/25/85	.	.	.	.	.	.	.	.	1
07/26/85	.	1	.	.	1	.	.	.	.
08/10/85	.	.	0	0	.	.	1	.	.
08/12/85	.	.	.	.	.	.	.	1	.
09/10/85	.	0	.	.	.	.	.	.	1
ADULT CHUM SALMON									
06/17/85	.	.	.	1	.	.	0	.	.
07/21/85	.	.	.	.	.	.	.	1	.
ADULT COHO SALMON									
08/12/85	.	.	.	.	.	.	.	1	.
PINK SALMON									
06/14/85	.	.	.	.	.	.	2	.	.
06/16/85	.	.	.	1	.	.	.	.	.
06/17/85	.	.	.	1	.	.	5	.	.
06/19/85	.	.	.	.	.	.	.	2	.
06/21/85	6	.	.	.	.	.	.	.	.
07/18/85	.	.	.	1	.	.	.	.	.
07/21/85	.	.	.	.	.	.	.	2	.
07/26/85	.	1	.	.	0	.	.	.	.
UNIDENTIFIED DOLLY VARDEN/ARCTIC CHAR									
07/22/85	0	.	.	.	.	1	.	.	.
SHEEFISH									
07/15/85	.	.	.	.	.	.	4	.	.
07/17/85	.	.	.	.	.	.	19	.	.
07/18/85	.	.	.	49	.	.	.	.	.
07/21/85	.	.	.	.	.	.	.	27	.
07/22/85	0	.	.	.	.	3	.	.	.

APPENDIX B

Table 4. Catch Per 10-Minute Purse Seine Set

DATE	STATION 1-1	1-2	1-3	2-1	2-2	2-3	6-1	6-2	6-3
SHEEFISH									
07/25/85	.	.	.	.	.	.	.	.	27
07/26/85	.	1	.	.	1	.	.	.	.
08/10/85	.	.	0	1	.	.	3	.	.
08/11/85	.	.	.	.	2	.	.	.	5
08/12/85	.	.	.	.	.	.	.	10	.
08/14/85	.	.	.	.	.	.	.	4	0
08/15/85	.	.	.	.	.	.	2	.	.
08/16/85	.	.	0	2	.	.	.	.	.
HUMPBACK WHITEFISH									
08/12/85	.	.	.	.	.	.	.	1	.
09/13/85	.	.	.	.	.	.	.	1	.
BROAD WHITEFISH									
08/12/85	.	.	.	.	.	.	.	1	.
UNIDENTIFIED WHITEFISH									
07/04/85	.	.	.	.	.	.	2	.	.
07/21/85	.	.	.	.	.	.	.	1	.
07/25/85	.	.	.	.	.	.	.	.	31
08/10/85	.	.	0	0	.	.	1	.	.
08/11/85	.	.	.	.	1	.	.	.	0
08/12/85	.	.	.	.	.	.	.	55	.
08/14/85	.	.	.	.	.	.	.	28	0
08/16/85	.	.	0	1	.	.	.	.	.
09/13/85	.	.	.	.	.	.	.	7	.
LEAST CISCO									
07/21/85	.	.	.	.	.	.	.	1	.
08/16/85	.	.	0	1	.	.	.	.	.
09/13/85	.	.	.	.	.	.	.	1	.
UNIDENTIFIED CISCO									
07/25/85	.	.	.	.	.	.	.	.	17
07/26/85	.	34	.	.	2	.	.	.	.
08/10/85	.	.	36	1	.	.	2	.	.
08/11/85	.	.	.	.	1	.	.	.	1
08/12/85	.	.	.	.	.	.	.	9	.
08/13/85	10	.	.	.	.	.	.	.	.
08/14/85	.	.	.	.	.	.	.	12	0
09/04/85	.	.	0	1	.	.	.	.	.
09/05/85	.	.	.	.	.	.	3	.	.
09/10/85	.	3	.	.	.	.	.	.	0
09/13/85	.	.	.	.	.	.	.	6	.
UNIDENTIFIED CISCO AND WHITEFISH									
07/15/85	.	.	.	.	.	.	35	.	.
07/17/85	.	.	.	.	.	.	76	.	.
07/18/85	.	.	.	77	.	.	.	.	.
07/21/85	.	.	.	.	.	.	.	102	.
07/22/85	1	.	.	.	.	60	.	.	.

APPENDIX B

Table 4. Catch Per 10-Minute Purse Seine Set

				STATION					
DATE	1-1	1-2	1-3	2-1	2-2	2-3	6-1	6-2	6-3
BOREAL SMELT									
06/14/85	.	.	.	.	.	.	7	.	.
06/16/85	.	.	.	4	.	.	.	.	.
06/17/85	.	.	.	2	.	.	0	.	.
06/21/85	930	.	.	.	.	.	.	.	.
06/25/85	.	.	.	.	0	.	.	.	1
07/19/85	.	.	50	.	.	.	.	.	.
07/22/85	8	.	.	.	.	243	.	.	.
07/26/85	.	4	.	.	0	.	.	.	.
08/10/85	.	.	380	0	.	.	0	.	.
08/11/85	.	.	.	.	1	.	.	.	2
08/13/85	54	.	.	.	.	.	.	.	.
08/16/85	.	.	361	0	.	.	.	.	.
09/04/85	.	.	61	0	.	.	.	.	.
09/10/85	.	84	.	.	.	.	.	.	0
POND SMELT									
08/10/85	.	.	116	0	.	.	4	.	.
08/12/85	.	.	.	.	.	.	.	11	.
08/13/85	13	.	.	.	.	.	.	.	.
08/14/85	.	.	.	.	.	.	.	3	0
08/16/85	.	.	6	2	.	.	.	.	.
09/04/85	.	.	51	0	.	.	.	.	.
09/10/85	.	97	.	.	.	.	.	.	0
09/13/85	.	.	.	.	.	.	.	1	.
UNIDENTIFIED SMELT									
07/22/85	0	.	.	.	.	91	.	.	.
08/10/85	.	.	0	1	.	.	2	.	.
08/11/85	.	.	.	.	0	.	.	.	1
08/15/85	.	.	.	.	.	.	1	.	.
08/16/85	.	.	0	1	.	.	.	.	.
NINESPINE STICKLEBACK									
06/30/85	.	.	.	1	.	.	.	.	.
07/18/85	.	.	.	1	.	.	.	.	.
07/22/85	120	.	.	.	.	8	.	.	.
07/26/85	.	6	.	.	0	.	.	.	.
08/10/85	.	.	66	2	.	.	0	.	.
08/12/85	.	.	.	.	.	.	.	2	.
08/13/85	1	.	.	.	.	.	.	.	.
08/16/85	.	.	5	7	.	.	.	.	.
09/04/85	.	.	5	76	.	.	.	.	.
09/10/85	.	25	.	.	.	.	.	.	0
09/13/85	.	.	.	.	.	.	.	1	.

APPENDIX B

Table 4. Catch Per 10-Minute Purse Seine Set

DATE	STATION 1-1	1-2	1-3	2-1	2-2	2-3	6-1	6-2	6-3
ARCTIC LAMPREY									
06/14/85	.	.	.	.	.	.	1	.	.
06/17/85	.	.	.	1	.	.	0	.	.
06/25/85	.	.	.	.	0	.	.	.	1
07/04/85	.	.	.	.	.	.	1	.	.
07/22/85	1	.	.	.	.	0	.	.	.
LONGNOSE SUCKER									
08/12/85	.	.	.	.	.	.	.	1	.
NORTHERN PIKE									
08/12/85	.	.	.	.	.	.	.	1	.
BURBOT									
07/15/85	.	.	.	.	.	.	2	.	.
07/17/85	.	.	.	.	.	.	2	.	.
07/21/85	.	.	.	.	.	.	.	2	.
08/11/85	.	.	.	.	0	.	.	.	1
08/12/85	.	.	.	.	.	.	.	1	.
08/14/85	.	.	.	.	.	.	.	1	0
09/05/85	.	.	.	.	.	.	1	.	.
09/13/85	.	.	.	.	.	.	.	5	.
STARRY FLOUNDER									
06/25/85	.	.	.	.	1	.	.	.	0
07/22/85	0	.	.	.	.	1	.	.	.
08/16/85	.	.	0	1	.	.	.	.	.
09/04/85	.	.	0	1	.	.	.	.	.
ARCTIC FLOUNDER									
06/30/85	.	.	.	1	.	.	.	.	.
07/18/85	.	.	.	1	.	.	.	.	.
07/22/85	0	.	.	.	.	6	.	.	.
07/26/85	.	0	.	.	1	.	.	.	.
08/10/85	.	.	2	5	.	.	0	.	.
08/11/85	.	.	.	.	6	.	.	.	0
08/16/85	.	.	6	1	.	.	.	.	.
09/04/85	.	.	0	7	.	.	.	.	.
09/09/85	.	.	.	.	1	.	.	.	.
SAFFRON COD									
07/22/85	3	.	.	.	.	1	.	.	.
07/26/85	.	2	.	.	0	.	.	.	.
08/10/85	.	.	119	0	.	.	0	.	.
08/13/85	33	.	.	.	.	.	.	.	.
08/16/85	.	.	130	0	.	.	.	.	.
09/04/85	.	.	167	0	.	.	.	.	.
09/10/85	.	53	.	.	.	.	.	.	0

APPENDIX B

Table 4. Catch Per 10-Minute Purse Seine Set

				STATION					
DATE	1-1	1-2	1-3	2-1	2-2	2-3	6-1	6-2	6-3
ARCTIC COD									
08/14/85	.	.	.	.	.	.	.	0	0
09/10/85	.	1	.	.	.	.	.	.	0
FOURHORN SCULPIN									
06/25/85	.	.	.	.	1	.	.	.	0
08/10/85	.	.	1	0	.	.	0	.	.
08/11/85	.	.	.	.	2	.	.	.	0
08/16/85	.	.	1	1	.	.	.	.	.
09/04/85	.	.	0	8	.	.	.	.	.
09/09/85	.	.	.	.	2	.	.	.	.
PACIFIC HERRING									
06/21/85	1	.	.	.	.	.	.	.	.
07/19/85	.	.	39	.	.	.	.	.	.
07/22/85	4	.	.	.	.	0	.	.	.
07/26/85	.	100	.	.	0	.	.	.	.
08/10/85	.	.	4	0	.	.	0	.	.
08/13/85	4	.	.	.	.	.	.	.	.
08/16/85	.	.	2	0	.	.	.	.	.
09/04/85	.	.	19	0	.	.	.	.	.
09/10/85	.	1	.	.	.	.	.	.	0
CAPELIN									
07/19/85	.	.	3	.	.	.	.	.	.
BERING POACHERS									
08/16/85	.	.	1	0	.	.	.	.	.
PRICKLEBACKS									
08/10/85	.	.	1	0	.	.	0	.	.
08/16/85	.	.	2	0	.	.	.	.	.
WHITESPOTTED GREENLING									
08/10/85	.	.	3	0	.	.	0	.	.

APPENDIX B

Table 5. Catch Per 10-Minute Hook Seine Set

	STATION							
DATE	7-2	7-3	7-4	7-5	7-7	7-8	7-9	7-10
CHINOOK SALMON								
06/28/85	.	.	.	.	0	1	.	.
JUVENILE CHUM SALMON								
06/20/85	0	13	.	.	.	.	.	.
06/22/85	.	.	31	.	.	.	.	.
06/26/85	.	.	.	3	.	.	.	.
06/28/85	.	.	.	.	1	125	.	.
07/02/85	.	.	.	.	.	16	.	.
07/07/85	.	.	.	.	.	10	.	.
07/09/85	.	.	.	.	.	6	.	.
07/12/85	.	.	.	.	.	5	1	.
07/22/85	.	1	.	.	.	.	.	.
08/02/85	.	1	.	.	.	.	.	0
08/15/85	.	.	.	.	.	1	.	.
08/30/85	.	.	.	.	.	1	.	.
09/13/85	1	.	.	.	.	.	.	.
JUVENILE COHO SALMON								
07/25/85	.	.	.	.	.	.	.	1
PINK SALMON								
06/20/85	1	14	.	.	.	.	.	.
06/22/85	.	.	8	.	.	.	.	.
06/26/85	.	.	.	1	.	.	.	.
06/28/85	.	.	.	.	0	4	.	.
08/02/85	.	1	.	.	.	.	.	0
08/03/85	0	.	.	.	.	.	.	.
UNIDENTIFIED MIXED PINK AND CHUM								
06/20/85	0	128	.	.	.	.	.	.
06/26/85	.	.	.	1	.	.	.	.
SHEEFISH								
06/20/85	2	0	.	.	.	.	.	.
06/26/85	.	.	.	1	.	.	.	.
06/28/85	.	.	.	.	0	2	.	.
07/02/85	.	.	.	.	.	1	.	.
07/07/85	.	.	.	.	.	17	.	.
07/09/85	.	.	.	.	.	27	.	.
07/12/85	.	.	.	.	.	28	16	.
07/17/85	.	.	.	.	.	17	.	.
07/21/85	2	.	0	.	.	.	.	.
08/01/85	.	.	.	.	.	4	.	.
08/07/85	.	.	.	.	.	1	.	.
08/12/85	1	.	.	.	.	.	.	.
08/15/85	.	.	.	.	.	2	.	.
08/30/85	.	.	.	.	.	1	.	.
09/13/85	2	.	.	.	.	.	.	.

APPENDIX B

Table 5. Catch Per 10-Minute Hook Seine Set

DATE	STATION 7-2	7-3	7-4	7-5	7-7	7-8	7-9	7-10
HUMPBACK WHITEFISH								
06/20/85	4	1	.	.	.	.	.	.
06/26/85	.	.	.	2	.	.	.	.
07/21/85	2	.	0	.	.	.	.	.
07/25/85	.	.	.	.	.	.	.	3
08/01/85	.	.	.	.	.	1	.	.
08/02/85	.	1	.	.	.	.	.	2
08/03/85	0	.	.	.	.	.	.	.
08/06/85	.	.	.	.	.	.	2	.
08/12/85	2	.	.	.	.	.	.	.
BROAD WHITEFISH								
06/20/85	0	1	.	.	.	.	.	.
06/26/85	.	.	.	1	.	.	.	.
06/28/85	.	.	.	.	0	1	.	.
07/02/85	.	.	.	.	.	1	.	.
07/22/85	.	1	.	.	.	.	.	.
UNIDENTIFIED WHITEFISH								
06/28/85	.	.	.	.	0	5	.	.
07/02/85	.	.	.	.	.	29	.	.
07/21/85	2	.	0	.	.	.	.	.
07/22/85	.	1	.	.	.	.	.	.
07/25/85	.	.	.	.	.	.	.	24
08/01/85	.	.	.	.	.	51	.	.
08/02/85	.	37	.	.	.	.	.	11
08/03/85	6	.	.	.	.	.	.	.
08/06/85	.	.	.	.	.	.	22	.
08/07/85	.	.	.	.	.	1	.	.
08/12/85	9	.	.	.	.	.	.	.
08/15/85	.	.	.	.	.	2	.	.
08/30/85	.	.	.	.	.	2	.	.
BERING CISCO								
06/26/85	.	.	.	1	.	.	.	.
LEAST CISCO								
06/20/85	1	0	.	.	.	.	.	.
06/26/85	.	.	.	2	.	.	.	.
06/28/85	.	.	.	.	1	1	.	.
07/09/85	.	.	.	.	.	4	.	.
07/12/85	.	.	.	.	.	0	1	.
07/21/85	4	.	0	.	.	.	.	.
08/03/85	1	.	.	.	.	.	.	.
09/13/85	4	.	.	.	.	.	.	.

APPENDIX B

Table 5. Catch Per 10-Minute Hook Seine Set

DATE	7-2	7-3	7-4	STATION 7-5	7-7	7-8	7-9	7-10
UNIDENTIFIED CISCO								
07/25/85	.	.	.	.	.	.	.	15
08/01/85	.	.	.	.	.	2	.	.
08/02/85	.	9	.	.	.	.	.	2
08/03/85	3	.	.	.	.	.	.	.
08/06/85	.	.	.	.	.	.	2	.
08/07/85	.	.	.	.	.	1	.	.
08/15/85	.	.	.	.	.	1	.	.
08/22/85	.	.	.	.	.	2	.	.
08/30/85	.	.	.	.	.	12	.	.
09/13/85	14	.	.	.	.	.	.	.
UNIDENTIFIED CISCO AND WHITEFISH								
06/28/85	.	.	.	.	1	0	.	.
07/07/85	.	.	.	.	.	148	.	.
07/09/85	.	.	.	.	.	73	.	.
07/12/85	.	.	.	.	.	136	199	.
07/17/85	.	.	.	.	.	121	.	.
07/21/85	192	.	0	.	.	.	.	.
07/22/85	.	49	.	.	.	.	.	.
BOREAL SMELT								
06/20/85	1	0	.	.	.	.	.	.
06/26/85	.	.	.	15	.	.	.	.
08/02/85	.	1	.	.	.	.	.	0
08/06/85	.	.	.	.	.	.	1	.
POND SMELT								
07/02/85	.	.	.	.	.	1	.	.
07/21/85	0	.	0	.	.	.	.	.
07/25/85	.	.	.	.	.	.	.	1
08/01/85	.	.	.	.	.	1	.	.
08/15/85	.	.	.	.	.	1	.	.
08/30/85	.	.	.	.	.	3	.	.
09/13/85	32	.	.	.	.	.	.	.
UNIDENTIFIED SMELT								
07/21/85	0	.	0	.	.	.	.	.
07/31/85	.	.	.	.	.	0	.	.
08/02/85	.	70	.	.	.	.	.	0
08/03/85	582	.	.	.	.	.	.	.
08/06/85	.	.	.	.	.	.	1	.
08/07/85	.	.	.	.	.	1	.	.
08/12/85	272	.	.	.	.	.	.	.
08/15/85	.	.	.	.	.	6	.	.
08/22/85	.	.	.	.	.	1	.	.
08/30/85	.	.	.	.	.	13	.	.

APPENDIX B
Table 5. Catch Per 10-Minute Hook Seine Set

	STATION							
DATE	7-2	7-3	7-4	7-5	7-7	7-8	7-9	7-10
NINESPINE STICKLEBACK								
06/20/85	7	0	.	.	.	.	.	.
07/21/85	7	.	0	.	.	.	.	.
08/02/85	.	1	.	.	.	.	.	1
08/03/85	14	.	.	.	.	.	.	.
08/06/85	.	.	.	.	.	.	1	.
08/07/85	.	.	.	.	.	1	.	.
08/12/85	10	.	.	.	.	.	.	.
08/15/85	.	.	.	.	.	1	.	.
08/30/85	.	.	.	.	.	1	.	.
09/13/85	14	.	.	.	.	.	.	.
ARCTIC LAMPREY								
06/20/85	2	3	.	.	.	.	.	.
06/22/85	.	.	2	.	.	.	.	.
06/28/85	.	.	.	.	0	2	.	.
07/02/85	.	.	.	.	.	4	.	.
UNIDENTIFIED LAMPREY								
07/09/85	.	.	.	.	.	3	.	.
07/12/85	.	.	.	.	.	5	1	.
07/17/85	.	.	.	.	.	1	.	.
08/01/85	.	.	.	.	.	1	.	.
08/06/85	.	.	.	.	.	.	9	.
08/15/85	.	.	.	.	.	1	.	.
08/30/85	.	.	.	.	.	1	.	.
09/18/85	.	.	.	.	.	1	.	.
LONGNOSE SUCKER								
06/28/85	.	.	.	.	1	0	.	.
07/07/85	.	.	.	.	.	1	.	.
07/12/85	.	.	.	.	.	0	1	.
07/22/85	.	1	.	.	.	.	.	.
08/02/85	.	1	.	.	.	.	.	1
08/06/85	.	.	.	.	.	.	3	.
08/07/85	.	.	.	.	.	1	.	.
08/12/85	2	.	.	.	.	.	.	.
NORTHERN PIKE								
06/28/85	.	.	.	.	1	0	.	.
07/12/85	.	.	.	.	.	0	1	.
07/25/85	.	.	.	.	.	.	.	2
08/06/85	.	.	.	.	.	.	1	.
08/07/85	.	.	.	.	.	3	.	.
08/15/85	.	.	.	.	.	1	.	.

APPENDIX B

Table 5. Catch Per 10-Minute Hook Seine Set

				STATION				
DATE	7-2	7-3	7-4	7-5	7-7	7-8	7-9	7-10
BURBOT								
06/20/85	1	0	.	.	.	.	.	.
06/28/85	.	.	.	.	1	0	.	.
07/07/85	.	.	.	.	.	16	.	.
07/09/85	.	.	.	.	.	2	.	.
07/12/85	.	.	.	.	.	42	146	.
07/17/85	.	.	.	.	.	94	.	.
07/21/85	12	.	0	.	.	.	.	.
07/22/85	.	54	.	.	.	.	.	.
07/25/85	.	.	.	.	.	.	.	22
08/01/85	.	.	.	.	.	9	.	.
08/02/85	.	30	.	.	.	.	.	25
08/03/85	3	.	.	.	.	.	.	.
08/06/85	.	.	.	.	.	.	16	.
08/07/85	.	.	.	.	.	3	.	.
08/12/85	1	.	.	.	.	.	.	.
08/15/85	.	.	.	.	.	2	.	.
08/22/85	.	.	.	.	.	1	.	.
09/13/85	2	.	.	.	.	.	.	.
09/18/85	.	.	.	.	.	1	.	.
BLACKFISH								
06/20/85	1	0	.	.	.	.	.	.
TROUT-PERCH								
06/28/85	.	.	.	.	0	1	.	.
STARRY FLOUNDER								
06/20/85	3	0	.	.	.	.	.	.
07/21/85	2	.	0	.	.	.	.	.
08/03/85	1	.	.	.	.	.	.	.
ARCTIC FLOUNDER								
08/12/85	1	.	.	.	.	.	.	.
FOURHORN SCULPIN								
08/02/85	.	0	.	.	.	.	.	1

APPENDIX B

Table 6. Catch Per 24-Hour Lake Outlet Trap Set

			STATION			
DATE	10-1 DOWN	10-1 UP	10-2 DOWN	10-2 UP	10-3 DOWN	10-3 UP
CHUM SALMON						
06/27/85	.	.	.	.	35	1
07/03/85	0	0	.	.	.	.
07/05/85	0	0	.	.	.	.
07/06/85	1	0	.	.	.	.
SHEEFISH						
07/03/85	1	2	.	.	.	.
07/05/85	47	22	.	.	.	.
07/06/85	12	19	.	.	.	.
07/09/85	37	41	.	.	.	.
07/14/85	13	14	.	.	.	.
07/16/85	11	11	.	.	.	.
07/23/85	3	1	.	.	.	.
07/29/85	1	1	.	.	.	.
08/01/85	1	1	.	.	.	.
BROAD WHITEFISH						
08/26/85	.	.	0	1	.	.
UNIDENTIFIED WHITEFISH						
06/30/85	0	0	.	.	.	.
07/23/85	46	33	.	.	.	.
07/29/85	64	8	.	.	.	.
08/01/85	76	13	.	.	.	.
08/07/85	13	2	.	.	.	.
08/18/85	2	0	.	.	.	.
08/22/85	0	0	.	.	.	.
08/25/85	.	.	13	8	.	.
08/26/85	.	.	12	15	.	.
08/29/85	2	1	.	.	.	.
09/08/85	0	0	.	.	.	.
LEAST CISCO						
06/27/85	.	.	.	.	15	1
08/26/85	.	.	0	1	.	.
UNIDENTIFIED CISCO						
07/23/85	0	1	.	.	.	.
07/29/85	1	10	.	.	.	.
08/01/85	12	5	.	.	.	.
08/07/85	1	0	.	.	.	.
08/18/85	0	0	.	.	.	.
08/22/85	1	0	.	.	.	.
08/25/85	.	.	13	4	.	.
08/26/85	.	.	36	6	.	.
08/29/85	1	0	.	.	.	.
09/08/85	0	0	.	.	.	.

APPENDIX B
Table 6. Catch Per 24-Hour Lake Outlet Trap Set

DATE	STATION 10-1 DOWN	10-1 UP	10-2 DOWN	10-2 UP	10-3 DOWN	10-3 UP
UNIDENTIFIED CISCO AND WHITEFISH						
07/03/85	2	4	.	.	.	.
07/05/85	331	29	.	.	.	.
07/06/85	111	20	.	.	.	.
07/09/85	54	35	.	.	.	.
07/14/85	116	46	.	.	.	.
07/16/85	157	105	.	.	.	.
NINESPINE STICKLEBACK						
07/23/85	0	0	.	.	.	.
08/22/85	1	0	.	.	.	.
08/25/85	.	.	2	0	.	.
08/26/85	.	.	105	39	.	.
09/08/85	0	0	.	.	.	.
LONGNOSE SUCKER						
06/27/85	.	.	.	.	0	1
07/14/85	0	0	.	.	.	.
08/18/85	0	0	.	.	.	.
08/25/85	.	.	1	1	.	.
NORTHERN PIKE						
07/05/85	0	0	.	.	.	.
07/06/85	3	0	.	.	.	.
07/09/85	1	0	.	.	.	.
07/23/85	0	0	.	.	.	.
08/01/85	4	1	.	.	.	.
08/07/85	0	0	.	.	.	.
08/12/85	1	0	.	.	.	.
08/18/85	0	0	.	.	.	.
08/22/85	1	1	.	.	.	.
BURBOT						
07/14/85	0	0	.	.	.	.
07/16/85	1	0	.	.	.	.
07/23/85	0	0	.	.	.	.
07/29/85	0	1	.	.	.	.
08/01/85	0	1	.	.	.	.
08/07/85	0	0	.	.	.	.
08/12/85	0	2	.	.	.	.
08/18/85	0	2	.	.	.	.
08/22/85	3	0	.	.	.	.
08/25/85	.	.	1	5	.	.
08/26/85	.	.	3	1	.	.
08/29/85	1	0	.	.	.	.
BLACKFISH						
06/27/85	.	.	.	.	0	3
07/03/85	0	0	.	.	.	.
07/29/85	0	0	.	.	.	.
08/07/85	0	0	.	.	.	.
08/12/85	1	4	.	.	.	.
08/18/85	1	3	.	.	.	.
08/22/85	1	1	.	.	.	.
08/29/85	0	0	.	.	.	.
09/08/85	0	0	.	.	.	.
TROUT-PERCH						
07/06/85	9	0	.	.	.	.

APPENDIX B

Table 7. Catch Per 50-Meter Beach Seine Haul

	STATION				
DATE	5-1	5-4	5-5	5-9	5-14
JUVENILE CHUM SALMON					
06/23/85	.	0	1	.	.
PINK SALMON					
06/14/85	2	.	.	.	.
06/15/85	.	.	.	.	0
06/23/85	.	0	1	.	.
SHEEFISH					
06/14/85	5	.	.	.	.
HUMPBACK WHITEFISH					
06/14/85	34	.	.	.	.
06/23/85	.	37	7	.	.
07/08/85	.	.	.	1	.
BROAD WHITEFISH					
06/14/85	6	.	.	.	.
07/08/85	.	.	.	1	.
BERING CISCO					
06/14/85	1	.	.	.	.
LEAST CISCO					
06/14/85	4	.	.	.	.
06/23/85	.	3	3	.	.
07/08/85	.	.	.	1	.
UNIDENTIFIED CISCO AND WHITEFISH					
07/08/85	.	.	.	141	.
NINESPINE STICKLEBACK					
06/14/85	1	.	.	.	.
06/15/85	.	.	.	.	0
06/23/85	.	0	1	.	.
ARCTIC LAMPREY					
06/15/85	.	.	.	.	1
LONGNOSE SUCKER					
06/14/85	1	.	.	.	.
07/08/85	.	.	.	1	.
BURBOT					
06/15/85	.	.	.	.	1
06/23/85	.	4	0	.	.
07/08/85	.	.	.	8	.
STARRY FLOUNDER					
06/23/85	.	0	2	.	.

APPENDIX B

Table 8. Catch Per 24-Hour Tidal Net Set

	STATION												
DATE	5-1 DOWN	5-6 DOWN	5-7 DOWN	5-8 DOWN	5-8 UP	5-10 DOWN	5-10 UP	5-11 DOWN	5-11 UP	5-12 DOWN	5-12 UP	5-13 DOWN	5-13 UP
JUVENILE CHUM SALMON													
07/09/85	.	.	.	0	2	.	.	.	.	.	.	.	.
07/11/85	.	.	.	0	0	.	.	.	.	.	.	.	.
08/05/85	.	.	.	.	.	.	.	.	.	0	1	.	.
ADULT CHUM SALMON													
07/11/85	.	.	.	0	1	.	.	.	.	.	.	.	.
UNIDENTIFIED MIXED PINK AND CHUM													
06/23/85	.	51	.	.	.	.	.	.	.	.	.	.	.
SHEEFISH													
06/14/85	4	.	.	.	.	.	.	.	.	.	.	.	.
07/09/85	.	.	.	15	3	.	.	.	.	.	.	.	.
07/11/85	.	.	.	7	5	.	.	.	.	.	.	.	.
07/24/85	.	.	.	.	.	36	4	.	.	.	.	.	.
07/30/85	.	.	.	.	.	.	.	97	9	.	.	.	.
08/04/85	.	.	.	.	.	.	.	.	.	4	5	.	.
08/05/85	.	.	.	.	.	.	.	.	.	1	7	.	.
08/07/85	.	.	.	.	.	.	.	.	.	.	.	2	0
08/08/85	.	.	.	.	.	.	.	.	.	.	.	2	0
08/28/85	.	.	.	.	.	58	8	.	.	.	.	.	.
09/12/85	.	.	.	.	.	.	.	.	.	.	.	1	0
09/16/85	.	.	.	.	.	.	.	.	.	112	70	.	.
HUMPBACK WHITEFISH													
06/14/85	16	.	.	.	.	.	.	.	.	.	.	.	.
06/21/85	.	.	629	.	.	.	.	.	.	.	.	.	.
06/23/85	.	191	.	.	.	.	.	.	.	.	.	.	.
07/09/85	.	.	.	9	2	.	.	.	.	.	.	.	.
07/11/85	.	.	.	1	0	.	.	.	.	.	.	.	.
07/24/85	.	.	.	.	.	3	0	.	.	.	.	.	.
07/30/85	.	.	.	.	.	.	.	1	0	.	.	.	.
08/04/85	.	.	.	.	.	.	.	.	.	1	3	.	.
08/05/85	.	.	.	.	.	.	.	.	.	7	4	.	.
08/07/85	.	.	.	.	.	.	.	.	.	.	.	8	4
08/08/85	.	.	.	.	.	.	.	.	.	.	.	14	6
08/28/85	.	.	.	.	.	82	13	.	.	.	.	.	.
09/12/85	.	.	.	.	.	.	.	.	.	.	.	1	1
09/16/85	.	.	.	.	.	.	.	.	.	10	16	.	.
BROAD WHITEFISH													
06/21/85	.	.	20	.	.	.	.	.	.	.	.	.	.
07/09/85	.	.	.	0	2	.	.	.	.	.	.	.	.
08/04/85	.	.	.	.	.	.	.	.	.	1	0	.	.
08/05/85	.	.	.	.	.	.	.	.	.	0	1	.	.
08/08/85	.	.	.	.	.	.	.	.	.	.	.	1	2
09/12/85	.	.	.	.	.	.	.	.	.	.	.	0	2
09/17/85	.	.	.	.	.	.	.	0	30	.	.	.	.

APPENDIX B
Table 8. Catch Per 24-Hour Tidal Net Set

	STATION												
DATE	5-1 DOWN	5-6 DOWN	5-7 DOWN	5-8 DOWN	5-8 UP	5-10 DOWN	5-10 UP	5-11 DOWN	5-11 UP	5-12 DOWN	5-12 UP	5-13 DOWN	5-13 UP
ROUND WHITEFISH													
06/23/85	.	4	.	.	.	.	.	.	.	.	.	.	.
UNIDENTIFIED WHITEFISH													
07/24/85	.	.	.	.	.	212	497	.	.	.	.	.	.
07/30/85	.	.	.	.	.	.	.	1050	102	.	.	.	.
08/04/85	.	.	.	.	.	.	.	.	.	94	132	.	.
08/05/85	.	.	.	.	.	.	.	.	.	100	243	.	.
08/07/85	.	.	.	.	.	.	.	.	.	.	.	81	36
08/08/85	.	.	.	.	.	.	.	.	.	.	.	41	112
08/20/85	.	.	.	.	.	108	24	.	.	.	.	.	.
08/28/85	.	.	.	.	.	109	43	.	.	.	.	.	.
09/12/85	.	.	.	.	.	.	.	.	.	.	.	1	28
09/16/85	.	.	.	.	.	.	.	.	.	31	101	.	.
09/17/85	.	.	.	.	.	.	.	0	13	.	.	.	.
ARCTIC CISCO													
06/21/85	.	.	3	.	.	.	.	.	.	.	.	.	.
BERING CISCO													
06/14/85	1	.	.	.	.	.	.	.	.	.	.	.	.
07/30/85	.	.	.	.	.	.	.	1	0	.	.	.	.
08/04/85	.	.	.	.	.	.	.	.	.	0	1	.	.
08/05/85	.	.	.	.	.	.	.	.	.	0	1	.	.
08/07/85	.	.	.	.	.	.	.	.	.	.	.	3	0
08/28/85	.	.	.	.	.	5	0	.	.	.	.	.	.
09/12/85	.	.	.	.	.	.	.	.	.	.	.	3	1
LEAST CISCO													
06/14/85	18	.	.	.	.	.	.	.	.	.	.	.	.
06/21/85	.	.	444	.	.	.	.	.	.	.	.	.	.
06/23/85	.	136	.	.	.	.	.	.	.	.	.	.	.
07/09/85	.	.	.	8	3	.	.	.	.	.	.	.	.
07/11/85	.	.	.	1	1	.	.	.	.	.	.	.	.
07/24/85	.	.	.	.	.	9	9	.	.	.	.	.	.
07/30/85	.	.	.	.	.	.	.	3	0	.	.	.	.
08/04/85	.	.	.	.	.	.	.	.	.	1	1	.	.
08/05/85	.	.	.	.	.	.	.	.	.	1	10	.	.
08/07/85	.	.	.	.	.	.	.	.	.	.	.	6	2
08/08/85	.	.	.	.	.	.	.	.	.	.	.	3	2
08/20/85	.	.	.	.	.	2	0	.	.	.	.	.	.
08/28/85	.	.	.	.	.	11	3	.	.	.	.	.	.
09/12/85	.	.	.	.	.	.	.	.	.	.	.	13	1
09/16/85	.	.	.	.	.	.	.	.	.	4	1	.	.
09/17/85	.	.	.	.	.	.	.	0	1	.	.	.	.

APPENDIX B

Table 8. Catch Per 24-Hour Tidal Net Set

	STATION												
DATE	5-1 DOWN	5-6 DOWN	5-7 DOWN	5-8 DOWN	5-8 UP	5-10 DOWN	5-10 UP	5-11 DOWN	5-11 UP	5-12 DOWN	5-12 UP	5-13 DOWN	5-13 UP
UNIDENTIFIED CISCO													
07/24/85	.	.	.	.	.	45	48	.	.	.	.	.	.
07/30/85	.	.	.	.	.	.	.	798	112	.	.	.	.
08/04/85	.	.	.	.	.	.	.	.	.	41	4	.	.
08/05/85	.	.	.	.	.	.	.	.	.	7	48	.	.
08/07/85	.	.	.	.	.	.	.	.	.	.	.	2	6
08/08/85	.	.	.	.	.	.	.	.	.	.	.	2	3
08/20/85	.	.	.	.	.	12	8	.	.	.	.	.	.
08/28/85	.	.	.	.	.	98	130	.	.	.	.	.	.
09/12/85	.	.	.	.	.	.	.	.	.	.	.	8	1
09/16/85	.	.	.	.	.	.	.	.	.	38	75	.	.
09/17/85	.	.	.	.	.	.	.	0	4	.	.	.	.
UNIDENTIFIED CISCO AND WHITEFISH													
07/09/85	.	.	.	94	251	.	.	.	.	.	.	.	.
07/11/85	.	.	.	37	107	.	.	.	.	.	.	.	.
BOREAL SMELT													
06/21/85	.	.	26	.	.	.	.	.	.	.	.	.	.
06/23/85	.	4	.	.	.	.	.	.	.	.	.	.	.
08/04/85	.	.	.	.	.	.	.	.	.	2	0	.	.
POND SMELT													
06/21/85	.	.	53	.	.	.	.	.	.	.	.	.	.
09/17/85	.	.	.	.	.	.	.	0	1	.	.	.	.
THREESPINE STICKLEBACK													
07/24/85	.	.	.	.	.	1	0	.	.	.	.	.	.
NINESPINE STICKLEBACK													
06/21/85	.	.	579	.	.	.	.	.	.	.	.	.	.
06/23/85	.	23	.	.	.	.	.	.	.	.	.	.	.
07/24/85	.	.	.	.	.	10	0	.	.	.	.	.	.
07/30/85	.	.	.	.	.	.	.	244	7	.	.	.	.
08/05/85	.	.	.	.	.	.	.	.	.	0	4	.	.
08/08/85	.	.	.	.	.	.	.	.	.	.	.	1	0
08/20/85	.	.	.	.	.	5	0	.	.	.	.	.	.
08/28/85	.	.	.	.	.	213	17	.	.	.	.	.	.
09/12/85	.	.	.	.	.	.	.	.	.	.	.	38	47
09/16/85	.	.	.	.	.	.	.	.	.	13	1	.	.
09/17/85	.	.	.	.	.	.	.	1054	92	.	.	.	.
LONGNOSE SUCKER													
06/21/85	.	.	579	.	.	.	.	.	.	.	.	.	.
06/23/85	.	23	.	.	.	.	.	.	.	.	.	.	.
07/24/85	.	.	.	.	.	10	0	.	.	.	.	.	.
07/30/85	.	.	.	.	.	.	.	244	7	.	.	.	.
08/05/85	.	.	.	.	.	.	.	.	.	0	4	.	.
08/08/85	.	.	.	.	.	.	.	.	.	.	.	1	0
08/20/85	.	.	.	.	.	5	0	.	.	.	.	.	.
08/28/85	.	.	.	.	.	213	17	.	.	.	.	.	.
09/12/85	.	.	.	.	.	.	.	.	.	.	.	38	47
09/16/85	.	.	.	.	.	.	.	.	.	13	1	.	.
09/17/85	.	.	.	.	.	.	.	1054	92	.	.	.	.
LONGNOSE SUCKER													
06/21/85	.	.	17	.	.	.	.	.	.	.	.	.	.
06/23/85	.	23	.	.	.	.	.	.	.	.	.	.	.
07/09/85	.	.	.	0	2	.	.	.	.	.	.	.	.
07/11/85	.	.	.	1	1	.	.	.	.	.	.	.	.
07/24/85	.	.	.	.	.	2	0	.	.	.	.	.	.
08/07/85	.	.	.	.	.	.	.	.	.	.	.	10	5
08/08/85	.	.	.	.	.	.	.	.	.	.	.	12	13

APPENDIX B

Table 8. Catch Per 24-Hour Tidal Net Set

	STATION												
DATE	5-1 DOWN	5-6 DOWN	5-7 DOWN	5-8 DOWN	5-8 UP	5-10 DOWN	5-10 UP	5-11 DOWN	5-11 UP	5-12 DOWN	5-12 UP	5-13 DOWN	5-13 UP
08/20/85	.	.	.	.	.	1	0	.	.	.	.	.	.
NORTHERN PIKE													
07/09/85	.	.	.	2	0	.	.	.	.	.	.	.	.
08/07/85	.	.	.	.	.	.	.	.	.	.	.	0	1
08/08/85	.	.	.	.	.	.	.	.	.	.	.	1	0
BURBOT													
06/14/85	13	.	.	.	.	.	.	.	.	.	.	.	.
06/21/85	.	.	3	.	.	.	.	.	.	.	.	.	.
07/09/85	.	.	.	2	3	.	.	.	.	.	.	.	.
07/11/85	.	.	.	1	0	.	.	.	.	.	.	.	.
07/24/85	.	.	.	.	.	2	0	.	.	.	.	.	.
08/05/85	.	.	.	.	.	.	.	.	.	0	1	.	.
08/07/85	.	.	.	.	.	.	.	.	.	.	.	5	1
08/08/85	.	.	.	.	.	.	.	.	.	.	.	9	7
08/20/85	.	.	.	.	.	2	2	.	.	.	.	.	.
08/28/85	.	.	.	.	.	6	2	.	.	.	.	.	.
09/12/85	.	.	.	.	.	.	.	.	.	.	.	2	0
09/16/85	.	.	.	.	.	.	.	.	.	4	6	.	.
STARRY FLOUNDER													
06/21/85	.	.	30	.	.	.	.	.	.	.	.	.	.
06/23/85	.	8	.	.	.	.	.	.	.	.	.	.	.
07/24/85	.	.	.	.	.	33	7	.	.	.	.	.	.
07/30/85	.	.	.	.	.	.	.	4	0	.	.	.	.
08/04/85	.	.	.	.	.	.	.	.	.	10	2	.	.
08/05/85	.	.	.	.	.	.	.	.	.	0	2	.	.
08/07/85	.	.	.	.	.	.	.	.	.	.	.	1	4
08/08/85	.	.	.	.	.	.	.	.	.	.	.	7	4
08/28/85	.	.	.	.	.	2	3	.	.	.	.	.	.
09/16/85	.	.	.	.	.	.	.	.	.	3	0	.	.
09/17/85	.	.	.	.	.	.	.	1	0	.	.	.	.
ARCTIC FLOUNDER													
07/24/85	.	.	.	.	.	74	9	.	.	.	.	.	.
07/30/85	.	.	.	.	.	.	.	317	6	.	.	.	.
08/04/85	.	.	.	.	.	.	.	.	.	4	0	.	.
08/05/85	.	.	.	.	.	.	.	.	.	0	1	.	.
08/20/85	.	.	.	.	.	5	0	.	.	.	.	.	.
08/28/85	.	.	.	.	.	26	3	.	.	.	.	.	.
09/16/85	.	.	.	.	.	.	.	.	.	2	1	.	.
09/17/85	.	.	.	.	.	.	.	83	5	.	.	.	.
SAFFRON COD													
06/23/85	.	4	.	.	.	.	.	.	.	.	.	.	.
07/30/85	.	.	.	.	.	.	.	1	0	.	.	.	.
08/28/85	.	.	.	.	.	25	91	.	.	.	.	.	.
09/12/85	.	.	.	.	.	.	.	.	.	.	.	121	227
09/16/85	.	.	.	.	.	.	.	.	.	6	9	.	.
09/17/85	.	.	.	.	.	.	.	0	30	.	.	.	.
FOURHORN SCULPIN													
06/23/85	.	4	.	.	.	.	.	.	.	.	.	.	.
08/08/85	.	.	.	.	.	.	.	.	.	.	.	1	0
09/17/85	.	.	.	.	.	.	.	0	1	.	.	.	.

APPENDIX C

LENGTH-FREQUENCY OF CATCH

APPENDIX C

Table 1. Length Frequency of Catch by Habitat and Time Period for Chinook Salmon

LENGTH FREQUENCIES OF CATCH
(IN 10MM INTERVALS)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
CHINOOK SALMON													
6/14/85 TO 6/30/85													
70	.	1	.	.	.	.	.	.	.	.	.	.	1
80	.	.	.	.	.	2	6	.	.	.	.	.	8
90	.	1	.	.	.	.	3	.	.	.	.	.	4
100	.	5	.	.	.	1	.	.	.	.	.	.	6
7/16/85 TO 7/31/85													
90	.	1	.	.	.	.	.	.	.	.	.	.	1
110	.	1	.	.	.	1	.	.	.	.	.	.	2
8/16/85 TO 8/31/85													
60	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 CHINOOK SALMON													
60	.	.	.	1	.	.	.	.	.	.	.	.	1
70	.	1	.	.	.	.	.	.	.	.	.	.	1
80	.	.	.	.	.	2	6	.	.	.	.	.	8
90	.	2	.	.	.	.	3	.	.	.	.	.	5
100	.	5	.	.	.	1	.	.	.	.	.	.	6
110	.	1	.	.	.	1	.	.	.	.	.	.	2

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 2. Length Frequency of Catch by Habitat and Time Period for Chum Salmon

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
CHUM SALMON													
6/14/85 TO 6/30/85													
30	.	2	.	.	.	6	27	.	.	.	.	.	35
40	2	102	47	.	1	70	216	.	.	12	.	.	450
50	.	39	10	.	.	12	49	.	.	14	.	.	124
60	.	.	.	.	.	.	3	.	.	.	.	.	3
70	.	1	.	.	.	.	.	.	.	.	.	.	1
100	.	1	.	.	.	.	.	.	.	.	.	.	1
590	.	.	.	.	1	.	.	.	.	.	.	.	1
620	.	.	.	.	.	.	1	.	.	.	.	.	1
640	.	.	.	.	1	.	.	.	.	.	.	.	1
660	.	.	.	.	1	.	.	.	.	.	.	.	1
7/01/85 TO 7/15/85													
30	.	.	.	.	.	.	6	.	.	.	.	.	6
40	.	.	.	.	.	2	44	.	.	2	.	.	48
50	.	.	.	.	.	1	11	.	.	1	.	.	13
60	.	.	.	.	1	.	.	.	.	.	.	.	1
590	.	.	.	.	1	.	.	.	.	.	.	.	1
660	.	.	.	.	.	.	.	.	.	.	1	.	1
7/16/85 TO 7/31/85													
40	.	.	.	.	.	.	1	.	.	.	.	.	1
50	1	.	.	.	.	1	1	.	.	.	.	.	3
60	.	1	.	.	.	1	.	.	.	.	.	.	2
70	.	.	.	.	.	2	.	.	.	.	.	.	2
80	.	.	.	.	.	1	.	.	.	.	.	.	1
560	.	.	.	.	.	1	.	.	.	.	.	.	1
600	.	.	.	1	.	.	.	.	.	.	.	.	1
650	.	.	.	1	.	.	.	.	.	.	.	.	1
670	.	.	.	1	.	.	.	.	.	.	.	.	1
810	.	.	.	1	.	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
40	.	.	.	.	.	.	2	.	.	.	.	.	2
50	.	.	.	.	1	2	1	.	.	.	.	.	4
70	.	.	.	.	.	.	1	.	.	.	.	.	1
8/16/85 TO 8/31/85													
50	.	.	.	.	.	.	1	.	.	.	.	.	1
9/01/85 TO 9/18/85													
50	.	.	.	.	.	1	.	.	.	.	.	.	1
60	.	.	.	.	.	.	1	.	.	.	.	.	1

APPENDIX C

Table 2. Chum Salmon (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 CHUM SALMON													
30	.	2	.	.	.	6	33	.	.	.	.	.	41
40	2	102	47	.	1	72	263	.	.	14	.	.	501
50	1	39	10	.	1	17	63	.	.	15	.	.	146
60	.	1	.	.	1	1	4	.	.	.	.	.	7
70	.	1	.	.	.	2	1	.	.	.	.	.	4
80	.	.	.	.	.	1	.	.	.	.	.	.	1
100	.	1	.	.	.	.	.	.	.	.	.	.	1
560	.	.	.	.	.	1	.	.	.	.	.	.	1
590	.	.	.	.	2	.	.	.	.	.	.	.	2
600	.	.	.	1	.	.	.	.	.	.	.	.	1
620	.	.	.	.	.	.	1	.	.	.	.	.	1
640	.	.	.	.	1	.	.	.	.	.	.	.	1
650	.	.	.	1	.	.	.	.	.	.	.	.	1
660	.	.	.	.	1	.	.	.	.	.	1	.	2
670	.	.	.	1	.	.	.	.	.	.	.	.	1
810	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 3. Length Frequency of Catch by Habitat and Time Period for Pink Salmon

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
PINK SALMON													
6/14/85 TO 6/30/85													
30	10	1	.	.	5	1	34	.	.	.	.	.	51
40	1	1	.	.	.	7	9	.	.	.	.	.	18
50	.	.	.	.	1	2	3	.	.	.	.	.	6
7/16/85 TO 7/31/85													
40	1	.	.	.	.	.	.	.	.	.	.	.	1
60	.	2	.	.	.	1	.	.	.	.	.	.	3
8/01/85 TO 8/15/85													
30	.	.	.	.	.	.	1	.	.	.	.	.	1
40	.	.	.	.	.	.	1	.	.	.	.	.	1

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85													
PINK SALMON													
30	10	1	.	.	5	1	35	.	.	.	.	.	52
40	2	1	.	.	.	7	10	.	.	.	.	.	20
50	.	.	.	.	1	2	3	.	.	.	.	.	6
60	.	2	.	.	.	1	.	.	.	.	.	.	3

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 4. Length Frequency of Catch by Habitat and Time Period for Sheefish

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
SHEEFISH													
6/14/85 TO 6/30/85													
30	.	.	.	.	.	.	2	.	.	.	.	.	2
40	.	.	.	.	.	.	1	.	.	.	.	.	1
250	.	.	.	.	1	.	.	.	.	.	.	.	1
310	.	.	.	.	.	.	1	.	.	.	.	.	1
320	.	.	.	.	.	.	1	.	.	.	.	.	1
330	.	.	.	.	.	.	1	.	.	.	.	.	1
350	.	.	.	.	.	.	1	.	.	.	2	.	3
360	.	.	.	.	2	.	.	.	.	.	.	.	2
370	.	.	.	.	1	.	.	.	.	.	2	.	3
380	.	.	.	.	1	.	.	.	.	.	.	.	1
390	.	.	.	.	2	.	1	.	.	.	.	.	3
400	.	.	.	.	5	.	.	.	.	.	.	.	5
410	.	.	.	.	1	.	.	.	.	.	.	.	1
420	.	.	.	.	1	.	.	.	.	.	.	.	1
430	.	.	.	.	1	.	.	.	.	.	.	.	1
440	.	.	.	.	1	.	.	.	.	.	.	.	1
450	.	.	.	.	1	.	.	.	.	.	.	.	1
460	.	.	.	.	2	.	.	.	.	.	.	.	2
470	.	.	.	.	3	.	.	.	.	.	2	.	5
480	.	.	.	.	.	.	.	.	.	1	2	.	3
510	.	.	.	.	.	.	.	.	.	.	2	.	2
610	.	.	.	.	.	.	.	.	.	.	2	.	2
620	.	.	.	.	2	.	.	.	.	.	.	.	2
630	.	.	.	.	.	.	.	1	.	.	.	.	1
660	.	.	.	.	1	.	.	.	.	.	.	.	1
720	.	.	.	.	1	.	.	.	.	.	.	.	1
7/01/85 TO 7/15/85													
10	.	.	.	.	1	.	.	.	.	1	.	.	2
30	.	.	.	.	1	.	3	.	.	3	.	.	7
40	.	.	.	.	6	.	45	.	20	85	.	.	156
50	.	.	.	.	11	2	77	.	31	223	.	.	344
60	.	.	.	.	12	.	31	.	.	25	.	.	68
70	.	.	.	.	1	.	3	.	.	1	.	.	5
140	.	.	.	2	.	.	.	.	.	.	.	.	2
150	.	.	.	3	.	.	.	.	.	.	.	.	3
180	.	.	.	1	.	.	.	.	.	.	.	.	1
190	.	.	.	.	1	.	.	.	.	.	.	.	1
250	.	.	.	.	1	.	.	.	.	.	.	.	1
260	.	.	.	2	.	.	.	.	.	.	.	.	2
330	.	.	.	.	1	.	.	.	.	.	.	.	1
360	.	.	.	.	1	.	.	.	.	.	.	.	1
380	.	.	.	.	.	.	.	.	.	.	1	.	1
420	.	.	.	.	1	.	.	.	.	.	.	.	1
500	.	.	.	.	1	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

Table 4. Sheefish (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
SHEEFISH CONT. 7/16/85 TO 7/31/85													
40	.	.	.	1	.	.	1	.	.	5	.	.	7
50	.	17	.	4	9	11	9	.	.	31	.	.	81
60	1	50	.	20	28	31	9	.	.	19	.	.	158
70	.	21	.	49	30	37	5	.	.	5	.	.	147
80	.	5	.	35	10	26	.	.	.	1	.	.	77
90	.	.	.	25	3	9	1	.	.	.	.	.	38
100	.	.	.	6	.	1	.	.	.	.	.	.	7
110	.	.	.	1	.	.	.	.	.	.	.	.	1
150	.	.	.	1	.	.	.	.	.	.	.	.	1
170	.	.	.	1	.	.	.	.	.	.	.	.	1
180	.	.	.	1	.	.	.	.	.	.	.	.	1
190	.	.	.	2	.	.	1	.	.	.	.	.	3
200	.	.	.	1	.	.	.	.	.	.	.	.	1
210	.	.	.	1	.	.	.	.	.	.	.	.	1
250	.	.	.	1	.	.	.	.	.	.	.	.	1
260	.	.	.	1	.	.	.	.	.	.	.	.	1
290	.	.	.	2	.	.	.	.	.	.	.	.	2
300	.	.	.	2	.	.	.	.	.	.	.	.	2
320	.	.	.	2	.	.	1	.	.	.	.	.	3
360	.	.	.	1	.	.	.	.	.	.	.	.	1
370	.	.	.	1	.	.	.	.	.	.	.	.	1
410	.	.	.	1	.	.	.	.	.	.	.	.	1
420	.	.	.	1	.	.	.	.	.	.	.	.	1
480	.	.	.	1	.	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
50	.	.	.	.	3	.	.	.	.	.	.	.	3
60	.	.	1	3	3	.	.	.	.	1	.	.	8
70	.	1	8	23	1	5	.	.	.	1	.	.	39
80	.	.	12	34	3	6	1	.	.	.	.	.	56
90	.	.	11	24	3	11	2	.	.	.	.	.	51
100	.	2	4	4	4	14	3	.	.	.	.	.	31
110	.	2	2	2	.	5	.	.	.	.	.	.	11
130	.	.	.	.	.	1	.	.	.	.	.	.	1
200	.	.	.	1	.	.	.	.	.	.	.	.	1
220	.	.	.	1	.	.	.	.	.	.	.	.	1
290	.	.	.	.	.	.	1	.	.	.	.	.	1
330	.	.	.	1	.	.	.	.	.	.	.	.	1
550	.	.	.	.	.	1	.	.	.	.	.	.	1
8/16/85 TO 8/31/85													
70	.	.	3	.	.	.	.	.	.	.	.	.	3
80	.	.	12	14	.	.	.	.	.	.	.	.	26
90	.	.	19	23	5	.	.	.	.	.	.	.	47
100	.	2	21	66	12	.	1	.	.	.	.	.	102
110	.	2	7	53	16	.	1	.	.	.	.	.	79
120	.	.	3	30	14	.	.	.	.	.	.	.	47
130	.	.	.	9	3	.	.	.	.	.	.	.	12
140	.	.	.	1	2	.	.	.	.	.	.	.	3

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 4. Sheefish (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
SHEEFISH CONT. 9/01/85 TO 9/18/85													
70	.	.	.	.	1	.	.	.	.	.	.	.	1
80	.	.	1	1	2	.	.	.	.	.	.	.	4
90	.	.	2	5	1	.	.	.	.	.	.	.	8
100	.	.	4	12	4	.	.	.	.	.	.	.	20
110	.	.	5	31	23	.	.	.	.	.	.	.	59
120	.	.	4	30	24	.	1	.	.	.	.	.	59
130	.	.	6	29	27	.	1	.	.	.	.	.	63
140	.	.	2	15	17	.	.	.	.	.	.	.	34
150	.	.	2	8	10	.	1	.	.	.	.	.	21
160	.	.	.	3	.	.	.	.	.	.	.	.	3
210	.	.	.	.	.	.	1	.	.	.	.	.	1
400	.	.	.	.	2	.	.	.	.	.	.	.	2

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 4. Sheefish (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 SHEEFISH													
10	.	.	.	.	1	.	.	.	.	1	.	.	2
30	.	.	.	.	1	.	5	.	.	3	.	.	9
40	.	.	.	1	6	.	47	.	20	90	.	.	164
50	.	17	.	4	23	13	86	.	31	254	.	.	428
60	1	50	1	23	43	31	40	.	.	45	.	.	234
70	.	22	11	72	33	42	8	.	.	7	.	.	195
80	.	5	25	84	15	32	1	.	.	1	.	.	163
90	.	.	32	77	12	20	3	.	.	.	.	.	144
100	.	4	29	88	20	15	4	.	.	.	.	.	160
110	.	4	14	87	39	5	1	.	.	.	.	.	150
120	.	.	7	60	38	.	1	.	.	.	.	.	106
130	.	.	6	38	30	1	1	.	.	.	.	.	76
140	.	.	2	18	19	.	.	.	.	.	.	.	39
150	.	.	2	12	10	.	1	.	.	.	.	.	25
160	.	.	.	3	.	.	.	.	.	.	.	.	3
170	.	.	.	1	.	.	.	.	.	.	.	.	1
180	.	.	.	2	.	.	.	.	.	.	.	.	2
190	.	.	.	2	1	.	1	.	.	.	.	.	4
200	.	.	.	2	.	.	.	.	.	.	.	.	2
210	.	.	.	1	.	.	1	.	.	.	.	.	2
220	.	.	.	1	.	.	.	.	.	.	.	.	1
250	.	.	.	1	2	.	.	.	.	.	.	.	3
260	.	.	.	3	.	.	.	.	.	.	.	.	3
290	.	.	.	2	.	.	1	.	.	.	.	.	3
300	.	.	.	2	.	.	.	.	.	.	.	.	2
310	.	.	.	.	.	.	1	.	.	.	.	.	1
320	.	.	.	2	.	.	2	.	.	.	.	.	4
330	.	.	.	1	1	.	1	.	.	.	.	.	3
350	.	.	.	.	.	.	1	.	.	.	2	.	3
360	.	.	.	1	3	.	.	.	.	.	.	.	4
370	.	.	.	1	1	.	.	.	.	.	2	.	4
380	.	.	.	.	1	.	.	.	.	.	1	.	2
390	.	.	.	.	2	.	1	.	.	.	.	.	3
400	.	.	.	.	7	.	.	.	.	.	.	.	7
410	.	.	.	1	1	.	.	.	.	.	.	.	2
420	.	.	.	1	2	.	.	.	.	.	.	.	3
430	.	.	.	.	1	.	.	.	.	.	.	.	1
440	.	.	.	.	1	.	.	.	.	.	.	.	1
450	.	.	.	.	1	.	.	.	.	.	.	.	1
460	.	.	.	.	2	.	.	.	.	.	.	.	2
470	.	.	.	.	3	.	.	.	.	.	2	.	5
480	.	.	.	1	.	.	.	.	.	1	2	.	4
500	.	.	.	.	1	.	.	.	.	.	.	.	1
510	.	.	.	.	.	.	.	.	.	.	2	.	2
550	.	.	.	.	.	1	.	.	.	.	.	.	1
610	.	.	.	.	.	.	.	.	.	.	2	.	2
620	.	.	.	.	2	.	.	.	.	.	.	.	2
630	.	.	.	.	.	.	.	1	.	.	.	.	1
660	.	.	.	.	1	.	.	.	.	.	.	.	1
720	.	.	.	.	1	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 5. Length Frequency of Catch by Habitat and Time Period for Humpback Whitefish

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
HUMPBACK WHITEFISH													
6/14/85 TO 6/30/85													
10	.	.	1	.	.	.	.	.	.	.	.	.	1
30	.	.	.	.	1	.	.	.	.	.	.	.	1
60	.	.	.	.	1	.	.	.	.	.	.	.	1
70	.	.	.	1	14	.	2	.	.	.	.	.	17
80	.	.	2	.	68	.	7	.	.	.	.	.	77
90	.	.	3	2	99	.	10	.	.	.	.	.	114
100	.	.	.	3	59	.	4	1	.	.	.	.	67
110	.	.	2	2	29	.	1	.	.	.	.	.	34
120	.	.	.	.	9	.	.	.	.	.	.	.	9
130	.	.	.	2	6	.	.	.	.	.	.	.	8
140	.	.	.	3	5	.	.	.	.	.	.	.	8
150	.	.	.	2	7	.	2	.	.	.	.	.	11
160	.	.	.	1	10	.	.	.	.	.	.	.	11
170	.	.	1	2	3	.	.	.	.	.	.	.	6
180	.	.	1	.	4	.	1	.	.	.	.	.	6
190	.	.	1	.	2	.	.	.	.	.	.	.	3
200	.	.	.	.	7	.	.	1	.	.	.	.	8
210	.	.	.	1	6	.	.	.	.	1	.	.	8
220	.	.	.	.	5	.	1	2	.	1	.	.	9
230	.	.	.	.	10	.	.	1	.	.	.	.	11
240	.	.	.	.	10	.	.	3	.	.	.	.	13
250	.	.	.	1	4	.	3	.	.	1	2	.	11
260	.	.	.	.	6	.	.	1	.	1	.	.	8
270	.	.	.	.	1	.	2	1	.	1	.	.	5
280	.	.	.	.	3	.	.	1	.	.	.	.	4
290	.	.	.	.	4	.	1	2	.	.	.	.	7
300	.	.	.	.	3	.	1	.	.	.	.	.	4
310	.	.	.	.	1	.	.	.	.	1	2	.	4
320	.	.	.	.	2	.	1	2	.	.	.	.	5
330	.	.	.	.	4	.	1	.	.	1	2	.	8
340	.	.	.	.	1	.	1	1	.	1	.	.	4
350	.	.	.	.	1	.	.	1	.	.	.	.	2
360	.	.	.	.	1	.	.	1	.	.	.	.	2
370	.	.	.	.	2	.	.	2	.	.	.	.	4
380	.	.	.	.	2	.	.	3	.	.	.	.	5
390	.	.	.	.	.	.	.	1	.	1	2	.	4
400	.	.	.	.	.	.	.	1	.	.	.	.	1
410	.	.	.	.	.	.	.	.	.	1	.	.	1
420	.	.	.	.	.	.	.	1	.	.	.	.	1
430	.	.	.	.	.	.	.	4	.	1	.	.	5
440	.	.	.	.	.	.	.	3	.	.	.	.	3
450	.	.	.	.	.	.	.	2	.	.	.	.	2
460	.	.	.	.	.	.	.	1	.	.	2	.	3

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 5. Humpback Whitefish (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
HUMPBACK WHITEFISH CONT.													
7/01/85 TO 7/15/85													
160	.	.	.	.	1	.	.	.	.	.	.	.	1
170	.	.	.	.	1	.	.	.	.	.	.	.	1
190	.	.	.	.	1	.	.	.	.	.	.	.	1
210	.	.	.	.	1	.	.	.	.	.	.	.	1
230	.	.	.	.	.	.	.	.	.	.	1	.	1
250	.	.	.	.	1	.	.	.	.	.	.	.	1
260	.	.	.	.	.	.	.	.	.	.	1	.	1
280	.	.	.	.	1	.	.	.	.	.	.	.	1
320	.	.	.	.	2	.	.	.	.	.	3	.	5
330	.	.	.	.	.	.	.	.	.	.	1	.	1
340	.	.	.	.	.	.	.	.	.	.	1	.	1
360	.	.	.	.	.	.	.	.	.	.	1	.	1
390	.	.	.	.	1	.	.	.	.	.	.	.	1
410	.	.	.	.	.	.	.	.	.	.	1	.	1
430	.	.	.	.	.	.	.	.	.	.	1	.	1
7/16/85 TO 7/31/85													
130	.	.	.	.	1	.	.	.	.	.	.	.	1
160	.	.	.	.	1	.	1	.	.	.	.	.	2
170	.	.	.	.	.	.	1	.	.	.	.	.	1
190	.	.	.	.	1	.	.	.	.	.	.	.	1
200	.	.	.	.	.	.	2	.	.	.	.	.	2
210	.	.	.	.	.	.	1	.	.	.	.	.	1
240	.	.	.	1	.	.	.	.	.	.	.	.	1
250	.	.	.	1	.	.	.	.	.	.	.	.	1
260	.	.	.	.	1	.	.	.	.	.	.	.	1
270	.	.	.	4	.	.	.	.	.	.	.	.	4
280	.	.	.	.	.	.	1	.	.	.	.	.	1
320	.	.	.	.	.	.	1	.	.	.	.	.	1
340	.	.	.	1	.	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
120	.	.	.	.	1	.	.	.	.	.	.	.	1
130	.	.	.	.	1	.	.	.	.	.	.	.	1
140	.	.	.	.	2	1	.	.	.	.	.	.	3
150	.	.	.	1	1	.	.	.	.	.	.	.	2
160	.	.	.	.	2	.	.	.	.	.	.	.	2
170	.	.	.	1	3	.	.	.	.	.	.	.	4
180	.	.	.	.	6	.	2	.	.	.	.	.	8
190	.	.	.	.	5	.	.	.	.	.	.	.	5
200	.	.	.	1	4	.	.	.	.	.	.	.	5
210	.	.	.	1	2	.	.	.	.	.	.	.	3
220	.	.	.	1	2	.	.	.	.	.	.	.	3
230	.	.	.	.	.	.	1	.	.	.	.	.	1
240	.	.	.	.	1	.	1	.	.	.	.	.	2
250	.	.	.	1	.	.	1	.	.	.	.	.	2
260	.	.	.	1	2	.	.	.	.	.	.	.	3
270	.	.	.	5	5	.	.	.	.	.	.	.	10
280	.	.	.	1	1	.	.	.	.	.	.	.	2
290	.	.	.	2	2	.	2	.	.	.	.	.	6
310	.	.	.	.	.	.	1	.	.	.	.	.	1
330	.	.	.	1	3	.	2	.	.	.	.	.	6
390	.	.	.	.	.	.	1	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 5. Humpback Whitefish (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
HUMPBACK WHITEFISH CONT. 8/16/85 TO 8/31/85													
120	.	.	.	9	7	.	.	.	.	.	.	.	16
130	.	.	.	24	21	.	.	.	.	.	.	.	45
140	.	.	.	22	13	.	.	.	.	.	.	.	35
150	.	.	.	5	5	.	.	.	.	.	.	.	10
160	.	.	.	2	2	.	.	.	.	.	.	.	4
170	.	.	.	1	3	.	.	.	.	.	.	.	4
180	.	.	.	3	8	.	.	.	.	.	.	.	11
190	.	.	.	8	15	.	.	.	.	.	.	.	23
200	.	.	.	7	13	.	.	.	.	.	.	.	20
210	.	.	.	1	6	.	.	.	.	.	.	.	7
220	.	.	.	.	3	.	.	.	2	.	.	.	5
230	.	.	.	2	2	.	.	.	1	.	.	.	5
250	.	.	.	.	4	.	.	.	.	.	.	.	4
260	.	.	.	1	.	.	.	.	.	.	.	.	1
270	.	.	.	.	1	.	.	.	.	.	.	.	1
280	.	.	.	.	2	.	.	.	.	.	.	.	2
290	.	.	.	.	.	.	.	.	1	.	.	.	1
300	.	.	.	.	1	.	.	.	.	.	.	.	1
310	.	.	.	.	.	.	.	.	2	.	.	.	2
330	.	.	.	.	.	.	.	.	1	.	.	.	1
9/01/85 TO 9/18/85													
100	.	.	.	.	1	.	.	.	.	.	.	.	1
110	.	.	1	.	.	.	.	.	.	.	.	.	1
130	.	.	.	.	3	1	.	.	.	.	.	.	4
140	.	.	.	1	3	.	.	.	.	.	.	.	4
150	.	.	.	.	6	1	.	.	.	.	.	.	7
160	.	.	.	1	.	.	.	.	.	.	.	.	1
190	.	.	.	2	3	.	.	.	.	.	.	.	5
200	.	.	.	.	5	.	.	.	.	.	.	.	5
210	.	.	.	.	2	.	.	.	.	.	.	.	2
230	.	.	1	.	1	.	.	.	.	.	.	.	2
240	.	.	.	.	1	.	.	.	.	.	.	.	1
260	.	.	1	.	1	.	.	.	.	.	.	.	2
270	.	.	.	.	1	.	.	.	.	.	.	.	1
320	.	.	.	.	1	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 5. Humpback Whitefish (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 HUMPBACK WHITEFISH													
10	.	.	1	.	.	.	.	.	.	.	.	.	1
30	.	.	.	.	1	.	.	.	.	.	.	.	1
60	.	.	.	.	1	.	.	.	.	.	.	.	1
70	.	.	.	1	14	.	2	.	.	.	.	.	17
80	.	.	2	.	68	.	7	.	.	.	.	.	77
90	.	.	3	2	99	.	10	.	.	.	.	.	114
100	.	.	.	3	60	.	4	1	.	.	.	.	68
110	.	.	3	2	29	.	1	.	.	.	.	.	35
120	.	.	.	9	17	.	.	.	.	.	.	.	26
130	.	.	.	26	32	1	.	.	.	.	.	.	59
140	.	.	.	26	23	1	.	.	.	.	.	.	50
150	.	.	.	8	19	1	2	.	.	.	.	.	30
160	.	.	.	4	16	.	1	.	.	.	.	.	21
170	.	.	1	4	10	.	1	.	.	.	.	.	16
180	.	.	1	3	18	.	3	.	.	.	.	.	25
190	.	.	1	10	27	.	.	.	.	.	.	.	38
200	.	.	.	8	29	.	2	1	.	.	.	.	40
210	.	.	.	3	17	.	1	.	.	1	.	.	22
220	.	.	.	1	10	.	1	2	2	1	.	.	17
230	.	.	1	2	13	.	1	1	1	.	1	.	20
240	.	.	.	1	12	.	1	3	.	.	.	.	17
250	.	.	.	3	9	.	4	.	.	1	2	.	19
260	.	.	1	2	10	.	.	1	.	1	1	.	16
270	.	.	.	9	8	.	2	1	.	1	.	.	21
280	.	.	.	1	7	.	1	1	.	.	.	.	10
290	.	.	.	2	6	.	3	2	1	.	.	.	14
300	.	.	.	.	4	.	1	.	.	.	.	.	5
310	.	.	.	.	1	.	1	.	2	1	2	.	7
320	.	.	.	.	5	.	2	2	.	.	3	.	12
330	.	.	.	1	7	.	3	.	1	1	3	.	16
340	.	.	.	1	1	.	1	1	.	1	1	.	6
350	.	.	.	.	1	.	.	1	.	.	.	.	2
360	.	.	.	.	1	.	.	1	.	.	1	.	3
370	.	.	.	.	2	.	.	2	.	.	.	.	4
380	.	.	.	.	2	.	.	3	.	.	.	.	5
390	.	.	.	.	1	.	1	1	.	1	2	.	6
400	.	.	.	.	.	.	.	1	.	.	.	.	1
410	.	.	.	.	.	.	.	.	.	1	1	.	2
420	.	.	.	.	.	.	.	1	.	.	.	.	1
430	.	.	.	.	.	.	.	4	.	1	1	.	6
440	.	.	.	.	.	.	.	3	.	.	.	.	3
450	.	.	.	.	.	.	.	2	.	.	.	.	2
460	.	.	.	.	.	.	.	1	.	.	2	.	3

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 6. Length Frequency of Catch by Habitat and Time Period for Broad Whitefish

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
BROAD WHITEFISH													
6/14/85 TO 6/30/85													
80	.	.	.	.	3	.	.	.	.	.	.	.	3
90	.	.	.	.	1	.	.	.	.	.	.	.	1
100	.	.	.	1	3	.	1	.	.	.	.	.	5
110	.	.	.	.	1	.	.	.	.	.	.	.	1
120	.	.	.	1	2	.	.	.	.	.	.	.	3
150	.	.	.	.	1	.	1	.	.	.	.	.	2
160	.	.	.	.	1	.	.	.	.	.	.	.	1
200	.	.	.	.	2	.	.	.	.	.	.	.	2
210	.	.	.	.	1	.	.	.	.	1	.	.	2
220	.	.	.	.	2	.	.	.	.	.	.	.	2
230	.	.	.	.	1	.	.	.	.	.	.	.	1
270	.	.	.	.	1	.	.	1	.	.	.	.	2
280	.	.	.	.	.	.	.	1	.	.	.	.	1
290	.	.	.	.	1	.	.	1	.	.	2	.	4
300	.	.	.	.	1	.	.	.	.	.	.	.	1
320	.	.	.	.	.	.	.	1	.	.	.	.	1
340	.	.	.	.	.	.	.	1	.	.	.	.	1
360	.	.	.	.	.	.	1	.	.	.	.	.	1
400	.	.	.	.	.	.	.	1	.	.	.	.	1
7/01/85 TO 7/15/85													
80	.	.	.	1	.	.	.	.	.	.	1	.	2
90	.	.	.	2	.	.	.	.	.	.	1	.	3
100	.	.	.	1	.	.	.	.	.	.	2	.	3
110	.	.	.	4	2	.	1	.	.	.	2	.	9
120	.	.	.	2	.	.	.	.	.	.	1	.	3
130	.	.	.	1	.	.	.	.	.	.	.	.	1
140	.	.	.	1	.	.	.	.	.	.	.	.	1
170	.	.	.	1	.	.	.	.	.	.	.	.	1
210	.	.	.	.	.	.	.	.	.	.	1	.	1
240	.	.	.	1	.	.	.	.	.	.	.	.	1
260	.	.	.	.	.	.	.	.	.	.	1	.	1
310	.	.	.	.	.	.	.	.	.	.	1	.	1
320	.	.	.	1	.	.	.	.	.	.	.	.	1
7/16/85 TO 7/31/85													
170	.	.	.	.	.	.	1	.	.	.	.	.	1
190	.	.	.	1	.	.	.	.	.	.	.	.	1
240	.	.	.	1	.	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
100	.	.	.	.	.	1	.	.	.	.	.	.	1
120	.	.	.	.	1	.	.	.	.	.	.	.	1
130	.	.	.	.	2	.	.	.	.	.	.	.	2
140	.	.	.	.	1	.	.	.	.	.	.	.	1
210	.	.	.	.	1	.	.	.	.	.	.	.	1
280	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 6. Broad Whitefish (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
BROAD WHITEFISH CONT. 8/16/85 TO 8/31/85													
110	.	.	.	1	.	.	.	.	.	.	.	.	1
130	.	.	.	2	.	.	.	.	.	1	.	.	3
9/01/85 TO 9/18/85													
100	.	.	.	.	5	.	.	.	.	.	.	.	5
110	.	.	.	1	2	.	.	.	.	.	.	.	3
120	.	.	.	.	4	.	.	.	.	.	.	.	4
130	.	.	.	.	9	.	.	.	.	.	.	.	9
140	.	.	.	.	7	.	.	.	.	.	.	.	7
150	.	.	.	.	3	.	.	.	.	.	.	.	3
170	.	.	.	.	1	.	.	.	.	.	.	.	1

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 BROAD WHITEFISH													
80	.	.	.	1	3	.	.	.	.	.	1	.	5
90	.	.	.	2	1	.	.	.	.	.	1	.	4
100	.	.	.	2	8	1	1	.	.	.	2	.	14
110	.	.	.	6	5	.	1	.	.	.	2	.	14
120	.	.	.	3	7	.	.	.	.	.	1	.	11
130	.	.	.	3	11	.	.	.	.	1	.	.	15
140	.	.	.	1	8	.	.	.	.	.	.	.	9
150	.	.	.	.	4	.	1	.	.	.	.	.	5
160	.	.	.	.	1	.	.	.	.	.	.	.	1
170	.	.	.	1	1	.	1	.	.	.	.	.	3
190	.	.	.	1	.	.	.	.	.	.	.	.	1
200	.	.	.	.	2	.	.	.	.	.	.	.	2
210	.	.	.	.	2	.	.	.	.	1	1	.	4
220	.	.	.	.	2	.	.	.	.	.	.	.	2
230	.	.	.	.	1	.	.	.	.	.	.	.	1
240	.	.	.	2	.	.	.	.	.	.	.	.	2
260	.	.	.	.	.	.	.	.	.	.	1	.	1
270	.	.	.	.	1	.	.	1	.	.	.	.	2
280	.	.	.	1	.	.	.	1	.	.	.	.	2
290	.	.	.	.	1	.	.	1	.	.	2	.	4
300	.	.	.	.	1	.	.	.	.	.	.	.	1
310	.	.	.	.	.	.	.	.	.	.	1	.	1
320	.	.	.	1	.	.	.	1	.	.	.	.	2
340	.	.	.	.	.	.	.	1	.	.	.	.	1
360	.	.	.	.	.	.	1	.	.	.	.	.	1
400	.	.	.	.	.	.	.	1	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 7. Length Frequency of Catch by Habitat and Time Period for Unidentified Whitefish

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
UNIDENTIFIED WHITEFISH													
6/14/85 TO 6/30/85													
20	.	.	.	.	.	.	4	.	.	.	.	.	4
30	.	.	.	.	.	.	5	.	.	.	.	.	5
7/01/85 TO 7/15/85													
20	.	.	.	.	.	.	5	.	.	.	.	.	5
30	.	.	.	.	.	2	35	.	.	.	.	.	37
40	.	.	.	.	.	.	18	.	.	.	.	.	18
7/16/85 TO 7/31/85													
30	.	.	.	.	1	.	.	.	.	2	.	.	3
40	.	.	.	1	31	.	15	.	.	54	.	.	101
50	.	.	.	21	91	11	19	.	.	88	.	.	230
60	.	.	.	27	37	12	7	.	.	10	.	.	93
70	.	.	.	14	7	15	2	.	.	1	.	.	39
80	.	.	.	11	1	15	.	.	.	.	.	.	27
90	.	.	.	5	.	2	.	.	.	.	.	.	7
100	.	.	.	2	.	.	1	.	.	.	.	.	3
110	.	.	.	13	3	1	2	.	.	.	.	.	19
120	.	.	.	13	3	1	1	.	.	.	.	.	18
130	.	.	.	6	.	.	.	.	.	.	.	.	6
140	.	.	.	4	1	.	.	.	.	.	.	.	5
160	.	.	.	3	.	.	.	.	.	.	.	.	3
170	.	.	.	5	.	.	.	.	.	.	.	.	5
180	.	.	.	4	.	.	.	.	.	.	.	.	4
190	.	.	.	3	.	.	.	.	.	.	.	.	3
200	.	.	.	1	.	.	.	.	.	.	.	.	1
210	.	.	.	1	.	.	.	.	.	.	.	.	1
230	.	.	.	2	.	.	.	.	.	.	.	.	2
8/01/85 TO 8/15/85													
30	.	.	.	.	.	.	1	.	.	.	.	.	1
40	.	.	.	4	9	.	20	.	.	13	.	.	46
50	.	.	3	55	132	2	58	.	.	110	.	.	360
60	.	.	8	68	123	38	42	.	.	38	.	.	317
70	.	1	.	25	35	53	23	.	.	4	.	.	141
80	.	.	.	8	13	23	10	.	.	1	.	.	55
90	.	.	1	.	4	8	3	.	.	.	.	.	16
100	.	.	.	1	.	.	.	.	.	.	.	.	1
110	.	.	.	1	4	.	1	.	.	.	.	.	6
120	.	.	.	.	7	.	.	.	.	.	.	.	7
130	.	.	.	4	2	.	1	.	.	.	.	.	7
140	.	.	.	1	1	.	.	.	.	.	.	.	2
160	.	.	.	1	.	.	.	.	.	.	.	.	1
180	.	.	.	2	.	.	.	.	.	.	.	.	2
190	.	.	.	1	.	.	.	.	.	.	.	.	1
220	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 7. Unidentified Whitefish (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
UNIDENTIFIED WHITEFISH CONT.													
8/16/85 TO 8/31/85													
40	.	.	.	.	3	.	.	.	.	.	.	.	3
50	.	.	.	12	35	.	.	.	.	13	.	.	60
60	.	.	2	44	54	.	1	.	.	30	.	1	132
70	.	1	.	96	46	.	2	.	1	32	.	.	178
80	.	.	.	31	28	.	.	.	.	19	.	.	78
90	.	.	.	2	4	.	.	.	.	5	.	.	11
100	.	.	.	2	1	.	.	.	.	.	.	.	3
110	.	.	.	6	4	.	.	.	.	.	.	.	10
120	.	.	.	2	3	.	.	.	.	1	.	.	6
130	.	.	.	.	.	.	.	.	.	1	.	.	1
140	.	.	.	1	.	.	.	.	.	.	.	.	1
170	.	.	.	.	.	.	.	.	.	1	.	.	1
9/01/85 TO 9/18/85													
60	.	.	.	.	4	.	.	.	.	.	.	.	4
70	.	.	3	2	43	.	.	.	.	2	.	.	50
80	.	.	7	3	50	2	.	.	.	.	.	.	62
90	.	.	2	.	7	9	.	.	.	.	.	.	18
100	.	.	1	.	4	1	.	.	.	.	.	.	6
110	.	.	.	.	1	1	.	.	.	.	.	.	2
120	.	.	.	.	2	.	.	.	.	.	.	.	2
130	.	.	.	.	2	.	.	.	.	.	.	.	2
150	.	.	.	.	1	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

LENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85													
UNIDENTIFIED WHITEFISH													
20	.	.	.	.	.	.	9	.	.	.	.	.	9
30	.	.	.	.	1	2	41	.	.	2	.	.	46
40	.	.	.	5	43	.	53	.	.	67	.	.	168
50	.	.	3	88	258	13	77	.	.	211	.	.	650
60	.	.	10	139	218	50	50	.	.	78	.	1	546
70	.	2	3	137	131	68	27	.	1	39	.	.	408
80	.	.	7	53	92	40	10	.	.	20	.	.	222
90	.	.	3	7	15	19	3	.	.	5	.	.	52
100	.	.	1	5	5	1	1	.	.	.	.	.	13
110	.	.	.	20	12	2	3	.	.	.	.	.	37
120	.	.	.	15	15	1	1	.	.	1	.	.	33
130	.	.	.	10	4	.	1	.	.	1	.	.	16
140	.	.	.	6	2	.	.	.	.	.	.	.	8
150	.	.	.	.	1	.	.	.	.	.	.	.	1
160	.	.	.	4	.	.	.	.	.	.	.	.	4
170	.	.	.	5	.	.	.	.	.	1	.	.	6
180	.	.	.	6	.	.	.	.	.	.	.	.	6
190	.	.	.	4	.	.	.	.	.	.	.	.	4
200	.	.	.	1	.	.	.	.	.	.	.	.	1
210	.	.	.	1	.	.	.	.	.	.	.	.	1
220	.	.	.	1	.	.	.	.	.	.	.	.	1
230	.	.	.	2	.	.	.	.	.	.	.	.	2

' FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 8. Length Frequency of Catch by Habitat and Time Period for Bering Cisco

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
BERING CISCO													
6/14/85 TO 6/30/85													
80	.	.	.	.	.	.	1	.	.	.	.	.	1
140	.	.	.	.	.	.	1	.	.	.	.	.	1
170	.	.	.	.	1	.	.	.	.	.	.	.	1
290	.	.	.	.	1	.	.	.	.	.	.	.	1
7/01/85 TO 7/15/85													
260	.	.	.	1	.	.	.	.	.	.	.	.	1
270	.	.	.	1	.	.	.	.	.	.	.	.	1
300	.	.	.	1	.	.	.	.	.	.	.	.	1
310	.	.	.	1	.	.	.	.	.	.	.	.	1
330	.	.	.	1	.	.	.	.	.	.	.	.	1
340	.	.	.	1	.	.	.	.	.	.	.	.	1
360	.	.	.	2	.	.	.	.	.	.	.	.	2
440	.	.	.	1	.	.	.	.	.	.	.	.	1
7/16/85 TO 7/31/85													
150	.	.	.	1	.	.	.	.	.	.	.	.	1
240	.	.	.	1	1	.	.	.	.	.	.	.	2
280	.	.	.	1	.	.	.	.	.	.	.	.	1
290	.	.	.	6	.	.	.	.	.	.	.	.	6
300	.	.	.	2	.	.	.	.	.	.	.	.	2
310	.	.	.	1	.	.	.	.	.	.	.	.	1
320	.	.	.	1	.	.	.	.	.	.	.	.	1
330	.	.	.	9	.	.	.	.	.	.	.	.	9
340	.	.	.	2	.	.	.	.	.	.	.	.	2
350	.	.	.	1	.	.	.	.	.	.	.	.	1
360	.	.	.	3	.	.	.	.	.	.	.	.	3
370	.	.	.	1	.	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
70	.	.	1	.	.	.	.	.	.	.	.	.	1
110	.	.	.	4	.	.	.	.	.	.	.	.	4
120	.	.	.	1	.	.	.	.	.	.	.	.	1
130	.	.	1	4	.	.	.	.	.	.	.	.	5
140	.	.	.	2	.	.	.	.	.	.	.	.	2
150	.	.	1	.	.	.	.	.	.	.	.	.	1
160	.	.	.	.	1	.	.	.	.	.	.	.	1
170	.	.	.	.	1	.	.	.	.	.	.	.	1
270	.	.	.	1	1	.	.	.	.	.	.	.	2
280	.	.	.	1	.	.	.	.	.	.	.	.	1
290	.	.	.	6	.	.	.	.	.	.	.	.	6
300	.	.	.	4	.	.	.	.	.	.	.	.	4
320	.	.	.	1	.	.	.	.	.	.	.	.	1
330	.	.	.	1	1	.	.	.	.	.	.	.	2
340	.	.	.	4	.	.	.	.	.	.	.	.	4
350	.	.	.	.	1	.	.	.	.	.	.	.	1
360	.	.	.	1	.	.	.	.	.	.	.	.	1
370	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 8. Bering Cisco (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
BERING CISCO CONT. 8/16/85 TO 8/31/85													
100	.	.	.	.	1	.	.	.	.	.	.	.	1
150	.	.	.	1	.	.	.	.	.	.	.	.	1
160	.	.	.	1	.	.	.	.	.	.	.	.	1
170	.	.	.	1	.	.	.	.	.	.	.	.	1
180	.	.	.	1	.	.	.	.	.	.	.	.	1
190	.	.	.	2	.	.	.	.	.	.	.	.	2
210	.	.	.	.	1	.	.	.	.	.	.	.	1
240	.	.	.	.	1	.	.	.	.	.	.	.	1
260	.	.	.	2	1	.	.	.	.	.	.	.	3
270	.	.	.	.	1	.	.	.	.	.	.	.	1
320	.	.	.	2	.	.	.	.	.	.	.	.	2
350	.	.	.	.	1	.	.	.	.	.	.	.	1
9/01/85 TO 9/18/85													
90	.	.	.	2	.	.	.	.	.	.	.	.	2
100	.	.	.	1	.	.	.	.	.	.	.	.	1
140	.	.	.	4	.	.	.	.	.	.	.	.	4
150	.	.	.	12	.	.	.	.	.	.	.	.	12
160	.	.	.	16	.	.	.	.	.	.	.	.	16
170	.	.	.	8	.	.	.	.	.	.	.	.	8
210	.	.	.	1	.	.	.	.	.	.	.	.	1
220	.	.	.	1	.	.	.	.	.	.	.	.	1
230	.	.	.	1	.	.	.	.	.	.	.	.	1
240	.	.	.	1	.	.	.	.	.	.	.	.	1
260	.	.	.	2	.	.	.	.	.	.	.	.	2
270	.	.	.	4	.	.	.	.	.	.	.	.	4
300	.	.	1	3	2	.	.	.	.	.	.	.	6
310	.	.	.	4	2	.	.	.	.	.	.	.	6
320	.	.	.	2	.	.	.	.	.	.	.	.	2
340	.	.	.	1	.	.	.	.	.	.	.	.	1
350	.	.	.	2	.	.	.	.	.	.	.	.	2
360	.	.	.	2	.	.	.	.	.	.	.	.	2
400	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 8. Bering Cisco (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 BERING CISCO													
70	.	.	1	.	.	.	.	.	.	.	.	.	1
80	.	.	.	.	.	.	1	.	.	.	.	.	1
90	.	.	.	2	.	.	.	.	.	.	.	.	2
100	.	.	.	1	1	.	.	.	.	.	.	.	2
110	.	.	.	4	.	.	.	.	.	.	.	.	4
120	.	.	.	1	.	.	.	.	.	.	.	.	1
130	.	.	1	4	.	.	.	.	.	.	.	.	5
140	.	.	.	6	.	.	1	.	.	.	.	.	7
150	.	.	1	14	.	.	.	.	.	.	.	.	15
160	.	.	.	17	1	.	.	.	.	.	.	.	18
170	.	.	.	9	2	.	.	.	.	.	.	.	11
180	.	.	.	1	.	.	.	.	.	.	.	.	1
190	.	.	.	2	.	.	.	.	.	.	.	.	2
210	.	.	.	1	1	.	.	.	.	.	.	.	2
220	.	.	.	1	.	.	.	.	.	.	.	.	1
230	.	.	.	1	.	.	.	.	.	.	.	.	1
240	.	.	.	2	2	.	.	.	.	.	.	.	4
260	.	.	.	5	1	.	.	.	.	.	.	.	6
270	.	.	.	6	2	.	.	.	.	.	.	.	8
280	.	.	.	2	.	.	.	.	.	.	.	.	2
290	.	.	.	12	1	.	.	.	.	.	.	.	13
300	.	.	1	10	2	.	.	.	.	.	.	.	13
310	.	.	.	6	2	.	.	.	.	.	.	.	8
320	.	.	.	6	.	.	.	.	.	.	.	.	6
330	.	.	.	11	1	.	.	.	.	.	.	.	12
340	.	.	.	8	.	.	.	.	.	.	.	.	8
350	.	.	.	3	2	.	.	.	.	.	.	.	5
360	.	.	.	8	.	.	.	.	.	.	.	.	8
370	.	.	.	2	.	.	.	.	.	.	.	.	2
400	.	.	.	1	.	.	.	.	.	.	.	.	1
440	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 9. Length Frequency of Catch by Habitat and Time Period for Least Cisco

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
LEAST CISCO													
6/14/85 TO 6/30/85													
30	.	.	.	.	.	.	1	.	.	.	.	.	1
40	.	.	.	.	2	.	.	.	.	.	.	.	2
50	.	.	.	.	4	.	.	.	.	.	.	.	4
60	.	.	.	.	1	.	.	.	.	.	.	.	1
70	.	.	.	.	8	.	.	.	.	.	.	.	8
80	.	.	1	3	27	.	3	.	.	.	.	.	34
90	.	.	2	7	48	.	11	.	.	1	.	.	69
100	.	.	.	4	25	.	2	2	.	4	.	.	37
110	.	.	1	7	13	.	.	4	.	1	.	.	26
120	.	.	1	2	5	.	2	2	.	1	.	.	13
130	.	.	.	2	6	.	1	1	.	.	.	.	10
140	.	.	.	1	11	.	1	6	.	.	.	.	19
150	.	.	.	8	11	.	.	2	.	1	.	.	22
160	.	.	.	2	5	.	2	1	.	3	.	.	13
170	.	.	1	5	7	.	2	1	.	1	.	.	17
180	.	.	.	1	9	.	.	.	.	.	.	.	10
190	.	.	.	3	6	.	3	2	.	.	.	.	14
200	.	.	1	.	6	.	1	1	.	1	.	.	10
210	.	.	.	.	4	.	1	1	.	.	.	.	6
220	.	.	.	1	3	.	1	1	.	.	.	.	6
230	.	.	.	.	2	.	2	4	.	1	.	.	9
240	.	.	.	.	9	.	1	4	.	1	.	.	15
250	.	.	.	.	1	.	.	1	.	.	.	.	2
270	.	.	.	.	1	.	.	1	.	.	2	.	4
290	.	.	.	1	.	.	.	.	.	.	.	.	1
300	.	.	.	.	.	.	.	1	.	.	.	.	1
310	.	.	.	.	.	.	.	1	.	.	.	.	1
7/01/85 TO 7/15/85													
30	.	.	.	.	.	.	3	.	.	.	.	.	3
40	.	.	.	.	.	.	2	.	.	.	.	.	2
80	.	.	.	1	.	.	.	.	.	.	.	.	1
90	.	.	.	2	1	.	.	.	.	.	.	.	3
100	.	.	.	3	1	.	.	.	.	.	3	.	7
110	.	.	.	5	2	.	2	.	.	.	4	.	13
120	.	.	.	1	1	.	.	.	.	.	2	.	4
130	.	.	.	.	1	.	.	.	.	.	.	.	1
140	.	.	.	.	.	.	1	.	.	.	.	.	1
150	.	.	.	.	.	.	.	.	.	.	2	.	2
160	.	.	.	3	2	.	.	.	.	.	1	.	6
170	.	.	.	1	2	.	.	.	.	.	4	.	7
180	.	.	.	2	.	.	.	.	.	.	2	.	4
190	.	.	.	7	2	.	1	.	.	.	2	.	12
200	.	.	.	2	.	.	.	.	.	.	3	.	5
210	.	.	.	1	.	.	.	.	.	.	.	.	1
220	.	.	.	2	.	.	.	.	.	.	3	.	5
230	.	.	.	.	.	.	.	.	.	.	1	.	1
250	.	.	.	1	.	.	.	.	.	.	2	.	3
270	.	.	.	3	.	.	.	.	.	.	.	.	3
290	.	.	.	1	.	.	.	.	.	.	.	.	1
360	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 9. Least Cisco (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
LEAST CISCO CONT. 7/16/85 TO 7/31/85													
90	.	.	.	1	1	.	.	.	.	.	.	.	2
100	.	.	.	8	.	.	.	.	.	.	.	.	8
110	.	.	.	14	1	.	.	.	.	.	.	.	15
120	.	.	.	10	8	.	.	.	.	.	.	.	18
130	.	.	.	5	1	.	.	.	.	.	.	.	6
140	.	.	.	1	1	1	.	.	.	.	.	.	3
150	.	.	.	2	.	.	.	.	.	.	.	.	2
160	.	.	.	4	1	.	.	.	.	.	.	.	5
170	.	.	.	2	.	.	.	.	.	.	.	.	2
180	.	.	.	.	.	.	1	.	.	.	.	.	1
190	.	.	.	2	.	.	.	.	.	.	.	.	2
200	.	.	.	2	1	.	.	.	.	.	.	.	3
210	.	.	.	.	1	.	.	.	.	.	.	.	1
220	.	.	.	1	.	.	.	.	.	.	.	.	1
230	.	.	.	1	.	.	.	.	.	.	.	.	1
260	.	.	.	1	.	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
70	.	.	.	1	1	.	.	.	.	.	.	.	2
80	.	.	.	.	1	.	.	.	.	.	.	.	1
100	.	.	.	2	1	.	.	.	.	.	.	.	3
110	.	.	1	9	3	.	.	.	.	.	.	.	13
120	.	.	.	16	3	.	1	.	.	.	.	.	20
130	.	.	1	9	1	.	.	.	.	.	.	.	11
140	.	.	.	4	.	.	.	.	.	.	.	.	4
150	.	.	.	5	.	.	.	.	.	.	.	.	5
160	.	.	.	3	3	.	.	.	.	.	.	.	6
170	.	.	.	4	2	.	1	.	.	.	.	.	7
180	.	.	.	3	5	.	.	.	.	.	.	.	8
190	.	.	.	2	3	.	.	.	.	.	.	.	5
200	.	.	.	2	1	.	.	.	.	.	.	.	3
210	.	.	.	1	.	.	.	.	.	.	.	.	1
250	.	.	.	1	1	.	.	.	.	.	.	.	2
8/16/85 TO 8/31/85													
70	.	1	.	.	.	.	.	.	.	.	.	.	1
100	.	.	.	.	1	.	.	.	.	.	.	.	1
110	.	.	.	1	.	.	.	.	.	.	.	.	1
120	.	.	.	2	7	.	.	.	.	.	.	.	9
130	.	.	.	2	2	.	.	.	.	1	.	.	5
140	.	.	.	.	3	.	.	.	.	.	.	.	3
160	.	.	.	.	2	.	.	.	.	.	.	.	2
170	.	.	.	.	1	.	.	.	.	.	.	.	1
190	.	.	.	.	.	.	.	.	1	.	.	.	1
200	.	.	.	.	1	.	.	.	.	.	.	.	1
230	.	.	.	1	.	.	.	.	.	.	.	.	1
250	.	.	.	.	.	.	.	.	1	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 9. Least Cisco (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
LEAST CISCO CONT. 9/01/85 TO 9/18/85													
120	.	.	.	1	.	.	.	.	.	.	.	.	1
130	.	.	.	1	.	.	2	.	.	.	.	.	3
140	.	.	2	2	4	.	1	.	.	.	.	.	9
150	.	.	.	1	4	.	3	.	.	.	.	.	8
160	.	.	.	.	5	.	1	.	.	.	.	.	6
170	.	.	.	1	1	1	1	.	.	.	.	.	4
180	.	.	.	1	2	.	.	.	.	.	.	.	3
190	.	.	.	1	2	.	.	.	.	.	.	.	3
200	.	.	1	1	.	.	.	.	.	.	.	.	2
220	.	.	.	1	.	.	.	.	.	.	.	.	1

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 LEAST CISCO													
30	.	.	.	.	.	.	4	.	.	.	.	.	4
40	.	.	.	.	2	.	2	.	.	.	.	.	4
50	.	.	.	.	4	.	.	.	.	.	.	.	4
60	.	.	.	.	1	.	.	.	.	.	.	.	1
70	.	1	.	1	9	.	.	.	.	.	.	.	11
80	.	.	1	4	28	.	3	.	.	.	.	.	36
90	.	.	2	10	50	.	11	.	.	1	.	.	74
100	.	.	.	17	28	.	2	2	.	4	3	.	56
110	.	.	2	36	19	.	2	4	.	1	4	.	68
120	.	.	1	32	24	.	3	2	.	1	2	.	65
130	.	.	1	19	11	.	3	1	.	1	.	.	36
140	.	.	2	8	19	1	3	6	.	.	.	.	39
150	.	.	.	16	15	.	3	2	.	1	2	.	39
160	.	.	.	12	18	.	3	1	.	3	1	.	38
170	.	.	1	13	13	1	4	1	.	1	4	.	38
180	.	.	.	7	16	.	1	.	.	.	2	.	26
190	.	.	.	15	13	.	4	2	1	.	2	.	37
200	.	.	2	7	9	.	1	1	.	1	3	.	24
210	.	.	.	2	5	.	1	1	.	.	.	.	9
220	.	.	.	5	3	.	1	1	.	.	3	.	13
230	.	.	.	2	2	.	2	4	.	1	1	.	12
240	.	.	.	.	9	.	1	4	.	1	.	.	15
250	.	.	.	2	2	.	.	1	1	.	2	.	8
260	.	.	.	1	.	.	.	.	.	.	.	.	1
270	.	.	.	3	1	.	.	1	.	.	2	.	7
290	.	.	.	2	.	.	.	.	.	.	.	.	2
300	.	.	.	.	.	.	.	1	.	.	.	.	1
310	.	.	.	.	.	.	.	1	.	.	.	.	1
360	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 10. Length Frequency of Catch by Habitat and Time Period for Unidentified Cisco

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
UNIDENTIFIED CISCO													
6/14/85 TO 6/30/85													
110	.	.	.	.	.	.	.	1	.	.	.	.	1
120	.	.	.	.	.	.	.	.	.	1	.	.	1
7/16/85 TO 7/31/85													
30	.	.	.	.	1	.	.	.	.	.	.	.	1
40	9	.	.	10	21	6	10	.	.	20	.	.	76
50	40	.	.	30	127	16	12	.	.	35	.	.	260
60	13	.	.	15	31	4	3	.	.	4	.	.	70
70	.	.	.	11	3	2	.	.	.	1	.	.	17
80	.	.	.	1	.	.	.	.	.	.	.	.	1
90	.	.	.	1	.	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
40	.	.	.	2	5	.	3	.	.	1	.	.	11
50	.	2	8	28	48	2	8	.	.	28	.	.	124
60	12	.	13	54	34	9	6	.	.	17	.	.	145
70	24	.	6	21	10	18	2	.	.	.	.	.	81
80	10	.	.	.	1	5	.	.	.	.	.	.	16
90	.	.	.	.	1	.	.	.	.	.	.	.	1
110	.	.	.	.	1	.	.	.	.	.	.	.	1
120	.	.	.	.	1	.	.	.	.	.	.	.	1
130	.	.	.	.	1	.	.	.	.	.	.	.	1
140	.	.	.	.	1	.	.	.	.	.	.	.	1
150	.	.	.	.	1	.	.	.	.	.	.	.	1
8/16/85 TO 8/31/85													
40	.	.	.	1	3	.	.	.	.	.	.	.	4
50	.	.	.	18	21	.	.	.	.	12	.	.	51
60	.	.	2	58	74	.	5	.	.	44	.	.	183
70	.	.	.	39	69	.	17	.	.	25	.	.	150
80	.	.	1	14	10	.	5	.	.	4	.	.	34
90	.	.	.	1	.	.	1	.	.	2	.	.	4
9/01/85 TO 9/18/85													
50	.	.	.	.	1	.	.	.	.	.	.	.	1
60	.	.	.	4	14	3	4	.	.	.	.	.	25
70	.	2	2	11	29	3	9	.	.	1	.	.	57
80	.	.	4	21	26	6	10	.	.	.	.	.	67
90	2	.	2	21	15	1	4	.	.	.	.	.	45
100	3	.	3	9	4	2	.	.	.	.	.	.	21
110	1	.	1	4	.	.	.	.	.	.	.	.	6

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 10. Unidentified Cisco (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 UNIDENTIFIED CISCO													
30	.	.	.	.	1	.	.	.	.	.	.	.	1
40	9	.	.	13	29	6	13	.	.	21	.	.	91
50	40	2	8	76	197	18	20	.	.	75	.	.	436
60	25	.	15	131	153	16	18	.	.	65	.	.	423
70	24	2	8	82	111	23	28	.	.	27	.	.	305
80	10	.	5	36	37	11	15	.	.	4	.	.	118
90	2	.	2	23	16	1	5	.	.	2	.	.	51
100	3	.	3	9	4	2	.	.	.	.	.	.	21
110	1	.	1	4	1	.	.	1	.	.	.	.	8
120	.	.	.	.	1	.	.	.	.	1	.	.	2
130	.	.	.	.	1	.	.	.	.	.	.	.	1
140	.	.	.	.	1	.	.	.	.	.	.	.	1
150	.	.	.	.	1	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 11. Length Frequency of Catch by Habitat and Time Period for Unidentified Cisco and Whitefish

	HABITAT									
FORKLENGTH /A	1	2	4	5	6	7	9	10	11	TOTAL
UNIDENTIFIED CISCO AND WHITEFISH										
6/14/85 TO 6/30/85										
20	.	.	.	.	.	1	.	.	.	1
7/01/85 TO 7/15/85										
20	.	.	.	4	.	12	.	4	.	20
30	.	.	.	45	5	275	7	118	.	450
40	.	.	.	240	33	185	39	263	2	762
50	.	.	.	130	18	30	3	139	.	320
60	.	.	.	.	1	2	.	.	.	3
70	.	.	.	2	2	.	.	.	.	4
100	.	.	.	5	.	.	.	.	.	5
110	.	.	.	5	.	.	.	.	.	5
120	.	.	.	1	.	.	.	.	.	1
130	.	.	.	1	.	.	.	.	.	1
7/16/85 TO 7/31/85										
20	.	.	.	.	.	1	.	.	.	1
30	.	1	.	.	2	59	.	1	.	63
40	1	50	.	.	47	143	.	45	.	286
50	.	125	.	.	112	83	.	55	.	375
60	.	18	.	.	39	13	.	6	.	76
70	.	6	.	.	8	3	.	.	.	17
320	.	.	1	.	.	.	.	.	.	1

	HABITAT									
FORKLENGTH /A	1	2	4	5	6	7	9	10	11	TOTAL
6/14/85 TO 9/18/85 UNIDENTIFIED CISCO AND WHITEFISH										
20	.	.	.	4	.	14	.	4	.	22
30	.	1	.	45	7	334	7	119	.	513
40	1	50	.	240	80	328	39	308	2	1048
50	.	125	.	130	130	113	3	194	.	695
60	.	18	.	.	40	15	.	6	.	79
70	.	6	.	2	10	3	.	.	.	21
100	.	.	.	5	.	.	.	.	.	5
110	.	.	.	5	.	.	.	.	.	5
120	.	.	.	1	.	.	.	.	.	1
130	.	.	.	1	.	.	.	.	.	1
320	.	.	1	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 12. Length Frequency of Catch by Habitat and Time Period for Boreal Smelt

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
BOREAL SMELT													
6/14/85 TO 6/30/85													
40	.	.	.	.	1	.	9	.	.	.	.	.	10
50	.	.	.	2	5	.	11	.	.	.	.	.	18
60	.	.	.	1	2	.	2	.	.	.	.	.	5
90	1	.	1	.	.	.	1	.	.	.	.	.	3
100	.	.	.	.	1	.	5	.	.	.	.	.	6
110	.	.	2	.	.	.	3	.	.	.	.	.	5
120	1	.	2	.	.	.	.	.	.	.	.	.	3
130	.	.	1	.	.	.	.	.	.	.	.	.	1
140	.	.	4	.	.	.	6	.	.	.	.	.	10
150	.	1	6	.	.	1	1	.	.	.	.	.	9
160	.	1	8	.	.	4	3	.	.	.	.	.	16
170	.	1	5	.	.	2	3	.	.	.	.	.	11
180	.	.	7	.	.	4	2	.	.	.	.	.	13
190	.	3	2	.	.	.	1	.	.	.	.	.	6
200	.	1	3	.	.	.	.	.	.	.	.	.	4
210	.	.	1	.	.	.	.	.	.	.	.	.	1
220	.	.	1	.	.	1	1	.	.	.	.	.	3
260	.	.	.	.	.	.	1	.	.	.	.	.	1
7/01/85 TO 7/15/85													
110	.	.	.	1	.	.	.	.	.	.	.	.	1
120	.	.	.	1	.	.	.	.	.	.	.	.	1
130	.	.	.	2	.	.	.	.	.	.	.	.	2
170	.	.	.	1	.	.	.	.	.	.	.	.	1
7/16/85 TO 7/31/85													
60	1	3	.	.	.	.	.	.	.	.	.	.	4
70	1	7	.	.	.	.	.	.	.	.	.	.	8
80	.	15	.	.	.	.	.	.	.	.	.	.	15
90	7	12	.	.	.	.	.	.	.	.	.	.	19
100	15	3	.	.	.	.	.	.	.	.	.	.	18
110	17	.	.	.	.	.	.	.	.	.	.	.	17
120	10	.	.	.	.	.	.	.	.	.	.	.	10
130	7	.	.	.	.	.	.	.	.	.	.	.	7
140	6	.	.	1	.	.	.	.	.	.	.	.	7
150	2	.	.	.	.	.	.	.	.	.	.	.	2
160	.	.	.	1	.	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
50	8	.	4	1	.	3	2	.	.	.	.	.	18
60	25	1	21	.	.	.	1	.	.	.	.	.	48
70	42	.	26	.	.	.	.	.	.	.	.	.	68
80	16	.	23	.	.	.	.	.	.	.	.	.	39
90	10	.	3	.	.	.	.	.	.	.	.	.	13
100	12	.	.	.	.	.	.	.	.	.	.	.	12
110	17	.	2	.	.	.	.	.	.	.	.	.	19
120	8	.	2	2	.	.	.	.	.	.	.	.	12
130	4	.	1	3	.	.	.	.	.	.	.	.	8
140	5	.	.	1	.	.	.	.	.	.	.	.	6
150	.	.	.	1	.	.	.	.	.	.	.	.	1
160	1	.	.	.	1	.	.	.	.	.	.	.	2
170	1	.	.	.	1	.	.	.	.	.	.	.	2
200	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 12. Boreal Smelt (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
BOREAL SMELT CONT. 8/16/85 TO 8/31/85													
60	2	.	.	.	.	.	.	.	.	.	.	.	2
70	8	.	1	.	.	.	.	.	.	.	.	.	9
80	10	.	.	.	.	.	.	.	.	.	.	.	10
90	3	.	.	.	.	.	.	.	.	.	.	.	3
100	3	.	.	.	.	.	.	.	.	.	.	.	3
110	6	.	1	.	.	.	.	.	.	.	.	.	7
120	7	.	.	1	.	.	.	.	.	.	.	.	8
130	3	.	.	.	.	.	.	.	.	.	.	.	3
140	3	.	.	.	.	.	.	.	.	.	.	.	3
9/01/85 TO 9/18/85													
40	2	.	.	.	.	.	.	.	.	.	.	.	2
50	1	.	.	.	.	.	.	.	.	.	.	.	1
60	13	.	.	.	.	.	.	.	.	.	.	.	13
70	29	.	.	.	.	.	.	.	.	.	.	.	29
80	53	.	.	.	.	.	.	.	.	.	.	.	53
90	47	.	.	.	.	.	.	.	.	.	.	.	47
100	20	.	.	.	.	.	.	.	.	.	.	.	20
110	1	.	.	.	.	.	.	.	.	.	.	.	1
120	2	.	.	.	.	.	.	.	.	.	.	.	2
130	2	.	.	.	.	.	.	.	.	.	.	.	2
160	1	.	.	.	.	.	.	.	.	.	.	.	1

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 BOREAL SMELT													
40	2	.	.	.	1	.	9	.	.	.	.	.	12
50	9	.	4	3	5	3	13	.	.	.	.	.	37
60	41	4	21	1	2	.	3	.	.	.	.	.	72
70	80	7	27	.	.	.	.	.	.	.	.	.	114
80	79	15	23	.	.	.	.	.	.	.	.	.	117
90	68	12	4	.	.	.	1	.	.	.	.	.	85
100	50	3	.	.	1	.	5	.	.	.	.	.	59
110	41	.	5	1	.	.	3	.	.	.	.	.	50
120	28	.	4	4	.	.	.	.	.	.	.	.	36
130	16	.	2	5	.	.	.	.	.	.	.	.	23
140	14	.	4	2	.	.	6	.	.	.	.	.	26
150	2	1	6	1	.	1	1	.	.	.	.	.	12
160	2	1	8	1	1	4	3	.	.	.	.	.	20
170	1	1	5	1	1	2	3	.	.	.	.	.	14
180	.	.	7	.	.	4	2	.	.	.	.	.	13
190	.	3	2	.	.	.	1	.	.	.	.	.	6
200	.	1	3	1	.	.	.	.	.	.	.	.	5
210	.	.	1	.	.	.	.	.	.	.	.	.	1
220	.	.	1	.	.	1	1	.	.	.	.	.	3
260	.	.	.	.	.	.	1	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 13. Length Frequency of Catch by Habitat and Time Period for Pond Smelt

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
POND SMELT													
6/14/85 TO 6/30/85													
90	.	.	.	.	5	.	.	.	.	.	.	.	5
100	.	.	.	.	5	.	.	.	.	.	.	.	5
110	.	.	.	.	6	.	.	.	.	.	.	.	6
7/01/85 TO 7/15/85													
40	.	.	.	.	.	.	2	.	.	.	.	.	2
7/16/85 TO 7/31/85													
50	.	.	.	.	.	.	1	.	.	.	.	.	1
60	.	.	.	.	.	.	1	.	.	.	.	.	1
8/01/85 TO 8/15/85													
40	.	.	.	.	.	3	.	.	.	.	.	.	3
50	.	.	1	.	.	14	2	.	.	.	.	.	17
60	12	.	4	.	.	12	.	.	.	.	.	.	28
70	24	.	7	.	.	3	.	.	.	.	.	.	34
80	5	.	3	2	.	.	.	.	.	.	.	.	10
90	4	.	.	.	.	.	.	.	.	.	.	.	4
100	2	.	1	.	.	.	.	.	.	.	.	.	3
110	1	.	.	.	.	.	.	.	.	.	.	.	1
8/16/85 TO 8/31/85													
40	.	.	.	.	.	.	2	.	.	.	.	.	2
50	.	2	1	1	.	.	3	.	.	.	.	.	7
60	2	1	3	1	.	.	.	.	.	.	.	.	7
70	2	.	1	2	.	.	.	.	.	.	.	.	5
80	2	.	.	.	.	.	.	.	.	.	.	.	2
9/01/85 TO 9/18/85													
10	.	.	1	.	.	.	.	.	.	.	.	.	1
30	12	.	.	2	.	1	5	.	.	.	.	.	20
40	76	.	.	2	.	.	57	.	.	.	.	.	135
50	43	.	.	.	.	.	2	.	.	.	.	.	45
60	16	.	.	.	.	.	.	.	.	.	.	.	16
70	42	.	1	.	1	.	.	.	.	.	.	.	44
80	39	.	.	.	.	.	.	.	.	.	.	.	39
90	8	.	.	.	.	.	.	.	.	.	.	.	8
100	7	.	.	1	.	.	.	.	.	.	.	.	8
110	2	.	1	1	.	.	.	.	.	.	.	.	4
120	.	.	.	3	.	.	.	.	.	.	.	.	3
130	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 13. Pond Smelt (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 POND SMELT													
10	.	.	1	.	.	.	.	.	.	.	.	.	1
30	12	.	.	2	.	1	5	.	.	.	.	.	20
40	76	.	.	2	.	3	61	.	.	.	.	.	142
50	43	2	2	1	.	14	8	.	.	.	.	.	70
60	30	1	7	1	.	12	1	.	.	.	.	.	52
70	68	.	9	2	1	3	.	.	.	.	.	.	83
80	46	.	3	2	.	.	.	.	.	.	.	.	51
90	12	.	.	.	5	.	.	.	.	.	.	.	17
100	9	.	1	1	5	.	.	.	.	.	.	.	16
110	3	.	1	1	6	.	.	.	.	.	.	.	11
120	.	.	.	3	.	.	.	.	.	.	.	.	3
130	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 14. Length Frequency of Catch by Habitat and Time Period for Unidentified Smelt

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
UNIDENTIFIED SMELT													
7/16/85 TO 7/31/85													
30	.	1	.	.	.	.	.	.	.	.	.	.	1
40	.	15	.	.	.	.	.	.	.	.	.	.	15
50	.	12	.	.	.	.	.	.	.	.	.	.	12
70	.	1	.	.	.	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
20	.	.	.	.	.	.	25	.	.	.	.	.	25
30	.	1	26	.	.	1	190	.	.	.	.	.	218
40	.	.	19	.	.	4	8	.	.	.	.	.	31
50	.	.	13	.	.	1	.	.	.	.	.	.	14
60	.	.	3	.	.	.	.	.	.	.	.	.	3
8/16/85 TO 8/31/85													
20	.	.	.	.	.	.	2	.	.	.	.	.	2
30	.	1	.	.	.	.	18	.	.	.	.	.	19
40	.	.	.	.	.	.	7	.	.	.	.	.	7

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 UNIDENTIFIED SMELT													
20	.	.	.	.	.	.	27	.	.	.	.	.	27
30	.	3	26	.	.	1	208	.	.	.	.	.	238
40	.	15	19	.	.	4	15	.	.	.	.	.	53
50	.	12	13	.	.	1	.	.	.	.	.	.	26
60	.	.	3	.	.	.	.	.	.	.	.	.	3
70	.	1	.	.	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 15. Length Frequency of Catch by Habitat and Time Period for Ninespine Stickleback

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
NINESPINE STICKLEBACK													
6/14/85 TO 6/30/85													
30	.	.	.	.	.	.	1	.	.	.	.	.	1
40	.	1	.	.	33	.	9	.	.	.	.	.	43
50	.	.	.	.	141	.	3	2	.	.	.	.	146
60	.	.	.	.	10	.	2	1	.	.	.	.	13
7/01/85 TO 7/15/85													
40	.	.	.	1	.	.	.	.	.	.	.	.	1
50	.	.	.	1	.	.	.	.	.	.	.	.	1
60	.	.	.	.	.	.	.	.	1	.	.	.	1
7/16/85 TO 7/31/85													
40	20	1	.	.	2	.	.	.	.	.	.	.	23
50	25	4	.	.	26	.	6	.	.	.	.	.	61
60	.	4	.	.	23	.	2	.	.	.	.	.	29
70	.	1	.	.	.	.	.	.	.	1	.	.	2
8/01/85 TO 8/15/85													
20	.	.	.	.	2	.	10	.	.	.	.	.	12
30	.	2	4	1	3	.	24	.	.	.	.	.	34
40	1	.	14	.	.	2	4	.	.	.	.	.	21
50	18	.	4	5	.	.	1	.	.	.	.	.	28
60	22	.	2	4	.	1	.	.	.	.	.	.	29
70	.	.	1	.	.	.	.	.	.	.	.	.	1
8/16/85 TO 8/31/85													
20	.	.	.	1	23	.	.	.	.	.	.	.	24
30	.	4	.	2	64	.	1	.	.	7	.	.	78
40	.	5	1	.	20	.	.	.	.	34	.	.	60
50	1	3	.	2	20	.	.	.	.	21	.	.	47
60	4	2	.	3	25	.	.	.	.	21	.	.	55
70	.	.	.	.	3	.	.	.	.	4	.	.	7
9/01/85 TO 9/18/85													
20	.	10	.	.	11	.	.	.	.	.	.	.	21
30	23	37	2	9	64	.	15	.	.	.	.	.	150
40	10	67	.	21	48	1	9	.	.	1	.	.	157
50	13	21	.	10	27	1	2	.	.	.	.	.	74
60	8	11	.	.	14	.	1	.	.	.	.	.	34
70	1	5	.	1	3	.	.	.	.	.	.	.	10

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 15. Ninespine Stickleback (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 NINESPINE STICKLEBACK													
20	.	10	.	1	36	.	10	.	.	.	.	.	57
30	23	43	6	12	131	.	41	.	.	7	.	.	263
40	31	74	15	22	103	3	22	.	.	35	.	.	305
50	57	28	4	18	214	1	12	2	.	21	.	.	357
60	34	17	2	7	72	1	5	1	1	21	.	.	161
70	1	6	1	1	6	.	.	.	.	5	.	.	20

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 16. Length Frequency of Catch by Habitat and Time Period for Arctic Lamprey

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	13	TOTAL
ARCTIC LAMPREY													
6/14/85 TO 6/30/85													
50	.	.	.	.	.	.	1	.	.	.	.	.	1
60	.	.	.	.	.	.	1	.	.	.	.	.	1
100	.	.	.	.	.	.	1	.	.	.	.	.	1
120	.	.	.	.	2	.	5	.	.	.	.	.	7
130	.	.	.	.	.	2	1	.	.	.	.	.	3
140	.	.	1	.	.	1	2	.	.	.	.	.	4
150	.	1	.	.	.	.	1	.	.	.	.	.	2
160	.	.	1	.	.	.	.	.	.	.	.	.	1
180	.	.	.	.	.	1	.	.	.	.	.	.	1
7/01/85 TO 7/15/85													
60	.	.	.	.	.	.	1	.	.	.	.	.	1
90	.	.	.	.	.	.	3	.	.	.	.	.	3
100	.	.	.	.	.	.	2	.	.	.	.	.	2
120	.	.	.	.	.	.	1	.	.	.	.	.	1
130	.	.	.	.	.	1	.	.	.	.	.	.	1
7/16/85 TO 7/31/85													
160	1	.	.	.	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	13	TOTAL
6/14/85 TO 9/18/85 ARCTIC LAMPREY													
50	.	.	.	.	.	.	1	.	.	.	.	.	1
60	.	.	.	.	.	.	2	.	.	.	.	.	2
90	.	.	.	.	.	.	3	.	.	.	.	.	3
100	.	.	.	.	.	.	3	.	.	.	.	.	3
120	.	.	.	.	2	.	6	.	.	.	.	.	8
130	.	.	.	.	.	3	1	.	.	.	.	.	4
140	.	.	1	.	.	1	2	.	.	.	.	.	4
150	.	1	.	.	.	.	1	.	.	.	.	.	2
160	1	.	1	.	.	.	.	.	.	.	.	.	2
180	.	.	.	.	.	1	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 17. Length Frequency of Catch by Habitat and Time Period for Longnose Sucker

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	13	TOTAL
LONGNOSE SUCKER													
6/14/85 TO 6/30/85													
40	.	.	.	.	1	.	.	.	.	.	.	.	1
60	.	.	.	.	1	.	.	.	.	.	.	.	1
90	.	.	.	.	.	.	1	.	.	.	.	.	1
100	.	.	.	.	4	.	.	1	.	1	.	.	6
110	.	.	.	.	5	.	.	.	.	.	.	.	5
120	.	.	.	.	1	.	1	1	.	.	.	.	3
7/01/85 TO 7/15/85													
60	.	.	.	.	.	.	.	.	.	1	.	.	1
80	.	.	.	.	.	.	1	.	.	.	1	.	2
100	.	.	.	.	1	.	.	.	.	.	.	.	1
110	.	.	.	.	2	.	.	.	.	.	1	.	3
120	.	.	.	.	1	.	.	.	.	.	1	.	2
140	.	.	.	.	.	.	1	.	.	.	.	.	1
230	.	.	.	.	.	.	.	.	.	.	1	.	1
7/16/85 TO 7/31/85													
110	.	.	.	.	1	.	.	.	.	.	.	.	1
120	.	.	.	1	1	.	.	.	.	.	.	.	2
130	.	.	.	1	.	.	.	.	.	.	.	.	1
140	.	.	.	.	.	.	1	.	.	.	.	.	1
150	.	.	.	1	.	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
20	.	.	.	.	1	.	.	.	.	.	.	.	1
30	.	.	.	.	1	.	.	.	.	.	.	.	1
50	.	.	.	.	1	.	1	.	.	.	.	.	2
70	.	.	.	.	1	.	.	.	.	.	.	.	1
80	.	.	.	.	1	1	.	.	.	.	.	.	2
90	.	.	.	.	2	.	1	.	.	.	.	.	3
100	.	.	.	.	2	.	1	.	.	.	.	.	3
110	.	.	.	.	3	.	.	.	.	.	.	.	3
120	.	.	.	.	6	.	1	.	.	.	.	.	7
130	.	.	.	1	2	.	.	.	.	.	.	.	3
140	.	.	.	1	8	.	1	.	.	.	.	.	10
150	.	.	.	2	4	.	.	.	.	.	.	.	6
160	.	.	.	1	6	.	3	.	.	.	.	.	10
170	.	.	.	1	2	.	.	.	.	.	.	.	3
180	.	.	.	1	1	.	.	.	.	.	.	.	2
190	.	.	.	.	.	.	1	.	.	.	.	.	1
220	.	.	.	1	1	.	.	.	.	.	.	.	2
8/16/85 TO 8/31/85													
70	.	.	.	.	.	.	.	.	.	1	.	.	1
130	.	.	.	.	1	.	.	.	.	.	.	.	1
140	.	.	.	.	.	.	.	.	1	.	.	.	1
160	.	.	.	1	.	.	.	.	.	2	.	.	3
190	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 17. Longnose Sucker (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	13	TOTAL
6/14/85 TO 9/18/85 LONGNOSE SUCKER													
20	.	.	.	.	1	.	.	.	.	.	.	.	1
30	.	.	.	.	1	.	.	.	.	.	.	.	1
40	.	.	.	.	1	.	.	.	.	.	.	.	1
50	.	.	.	.	1	.	1	.	.	.	.	.	2
60	.	.	.	.	1	.	.	.	.	1	.	.	2
70	.	.	.	.	1	.	.	.	.	1	.	.	2
80	.	.	.	.	1	1	1	.	.	.	1	.	4
90	.	.	.	.	2	.	2	.	.	.	.	.	4
100	.	.	.	.	7	.	1	1	.	1	.	.	10
110	.	.	.	.	11	.	.	.	.	.	1	.	12
120	.	.	.	1	9	.	2	1	.	.	1	.	14
130	.	.	.	2	3	.	.	.	.	.	.	.	5
140	.	.	.	1	8	.	3	.	1	.	.	.	13
150	.	.	.	3	4	.	.	.	.	.	.	.	7
160	.	.	.	2	6	.	3	.	.	2	.	.	13
170	.	.	.	1	2	.	.	.	.	.	.	.	3
180	.	.	.	1	1	.	.	.	.	.	.	.	2
190	.	.	.	1	.	.	1	.	.	.	.	.	2
220	.	.	.	1	1	.	.	.	.	.	.	.	2
230	.	.	.	.	.	.	.	.	.	.	1	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 18. Length Frequency for Catch by Habitat and Time Period for Northern Pike

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	13	TOTAL
NORTHERN PIKE													
6/14/85 TO 6/30/85													
280	.	.	.	.	.	.	.	.	.	1	.	.	1
310	.	.	.	.	.	.	.	.	.	1	.	.	1
340	.	.	.	.	.	.	.	1	.	.	.	.	1
360	.	.	.	.	.	.	1	.	.	.	.	.	1
370	.	.	.	.	.	.	.	.	.	1	.	.	1
390	.	.	.	.	.	.	.	.	.	2	.	.	2
400	.	.	.	.	.	.	.	1	.	.	.	.	1
440	.	.	.	.	.	.	.	1	.	.	.	.	1
450	.	.	.	.	.	.	.	1	.	.	.	.	1
460	.	.	.	.	.	.	.	1	.	.	.	.	1
510	.	.	.	.	.	.	.	1	.	.	.	.	1
530	.	.	.	.	1	.	.	.	.	2	.	.	3
560	.	.	.	.	1	.	.	.	.	.	.	.	1
610	.	.	.	.	.	.	.	.	.	1	2	.	3
620	.	.	.	.	.	.	.	1	.	1	.	.	2
630	.	.	.	.	.	.	.	.	.	1	.	.	1
640	.	.	.	.	.	.	.	1	.	.	.	.	1
670	.	.	.	.	.	.	.	1	.	1	.	.	2
7/01/85 TO 7/15/85													
20	.	.	.	.	.	.	1	.	.	.	.	.	1
30	.	.	.	.	.	.	.	.	1	.	.	.	1
290	.	.	.	.	.	.	.	.	2	.	.	.	2
300	.	.	.	.	.	.	.	.	1	.	.	.	1
330	.	.	.	.	.	.	.	.	2	1	.	.	3
340	.	.	.	.	.	.	.	.	3	.	.	.	3
350	.	.	.	.	.	.	.	.	1	2	.	.	3
370	.	.	.	.	.	.	.	.	1	1	.	.	2
380	.	.	.	.	.	.	.	.	1	.	.	.	1
390	.	.	.	.	1	.	.	.	.	.	.	.	1
400	.	.	.	.	.	.	.	.	1	.	.	.	1
410	.	.	.	.	.	.	.	.	.	1	.	.	1
430	.	.	.	.	.	.	.	.	1	.	.	.	1
440	.	.	.	.	.	.	.	.	.	1	.	.	1
460	.	.	.	.	.	.	.	.	1	.	.	.	1
490	.	.	.	.	.	.	.	.	1	.	.	.	1
7/16/85 TO 7/31/85													
100	.	.	.	1	.	.	.	.	.	.	.	.	1
340	.	.	.	.	.	.	.	.	.	1	.	.	1
350	.	.	.	.	.	.	.	.	.	1	.	.	1
560	.	.	.	.	.	.	.	.	.	1	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 18. Northern Pike (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	13	TOTAL
NORTHERN PIKE CONT. 8/01/85 TO 8/15/85													
60	.	.	.	.	.	.	.	.	.	1	.	.	1
70	.	.	.	.	.	.	.	.	.	4	.	.	4
80	.	.	.	.	.	1	.	.	.	2	.	.	3
90	.	.	.	.	.	.	.	.	.	1	.	.	1
110	.	.	.	.	.	.	1	.	.	1	.	.	2
120	.	.	.	.	1	.	1	.	.	.	.	.	2
130	.	.	.	.	1	.	.	.	.	.	.	.	1
340	.	.	.	.	.	.	.	.	.	1	.	.	1
350	.	.	.	.	.	.	.	.	.	1	.	.	1
360	.	.	.	.	.	.	.	.	.	1	.	.	1
370	.	.	.	.	.	.	.	.	.	1	.	.	1
380	.	.	.	.	.	.	.	.	.	1	.	.	1
400	.	.	.	.	.	.	.	.	.	2	.	.	2
430	.	.	.	.	.	.	1	.	.	.	.	.	1
440	.	.	.	.	.	.	.	.	.	1	.	.	1
470	.	.	.	.	.	.	.	.	.	1	.	.	1
480	.	.	.	.	.	.	.	.	.	2	.	.	2
570	.	.	.	.	.	.	.	.	.	2	.	.	2
590	.	.	.	.	.	.	.	.	.	1	.	.	1
8/16/85 TO 8/31/85													
60	.	.	.	.	.	.	.	.	.	1	.	.	1
80	.	.	.	.	.	.	.	.	.	1	.	.	1
100	.	.	.	.	.	.	.	.	.	1	.	.	1
110	.	.	.	.	.	.	.	.	1	1	.	.	2
120	.	.	.	.	.	.	.	.	3	1	.	.	4
130	.	.	.	.	.	.	.	.	5	1	.	.	6
140	.	.	.	.	.	.	.	.	2	.	.	.	2
150	.	.	.	.	.	.	.	.	2	.	.	.	2
180	.	.	.	.	.	.	.	.	1	.	.	.	1
650	.	.	.	.	.	.	.	.	.	1	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 18. Northern Pike (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	13	TOTAL
6/14/85 TO 9/18/85 NORTHERN PIKE													
20	.	.	.	.	.	.	1	.	.	.	.	.	1
30	.	.	.	.	.	.	.	.	1	.	.	.	1
60	.	.	.	.	.	.	.	.	.	2	.	.	2
70	.	.	.	.	.	.	.	.	.	4	.	.	4
80	.	.	.	.	.	1	.	.	.	3	.	.	4
90	.	.	.	.	.	.	.	.	.	1	.	.	1
100	.	.	.	1	.	.	.	.	.	1	.	.	2
110	.	.	.	.	.	.	1	.	1	2	.	.	4
120	.	.	.	.	1	.	1	.	3	1	.	.	6
130	.	.	.	.	1	.	.	.	5	1	.	.	7
140	.	.	.	.	.	.	.	.	2	.	.	.	2
150	.	.	.	.	.	.	.	.	2	.	.	.	2
180	.	.	.	.	.	.	.	.	1	.	.	.	1
280	.	.	.	.	.	.	.	.	.	1	.	.	1
290	.	.	.	.	.	.	.	.	2	.	.	.	2
300	.	.	.	.	.	.	.	.	1	.	.	.	1
310	.	.	.	.	.	.	.	.	.	1	.	.	1
330	.	.	.	.	.	.	.	.	2	1	.	.	3
340	.	.	.	.	.	.	.	1	3	2	.	.	6
350	.	.	.	.	.	.	.	.	1	4	.	.	5
360	.	.	.	.	.	.	1	.	.	1	.	.	2
370	.	.	.	.	.	.	.	.	1	3	.	.	4
380	.	.	.	.	.	.	.	.	1	1	.	.	2
390	.	.	.	.	1	.	.	.	.	2	.	.	3
400	.	.	.	.	.	.	.	1	1	2	.	.	4
410	.	.	.	.	.	.	.	.	.	1	.	.	1
430	.	.	.	.	.	.	1	.	1	.	.	.	2
440	.	.	.	.	.	.	.	1	.	2	.	.	3
450	.	.	.	.	.	.	.	1	.	.	.	.	1
460	.	.	.	.	.	.	.	1	1	.	.	.	2
470	.	.	.	.	.	.	.	.	.	1	.	.	1
480	.	.	.	.	.	.	.	.	.	2	.	.	2
490	.	.	.	.	.	.	.	.	1	.	.	.	1
510	.	.	.	.	.	.	.	1	.	.	.	.	1
530	.	.	.	.	1	.	.	.	.	2	.	.	3
560	.	.	.	.	1	.	.	.	.	1	.	.	2
570	.	.	.	.	.	.	.	.	.	2	.	.	2
590	.	.	.	.	.	.	.	.	.	1	.	.	1
610	.	.	.	.	.	.	.	.	.	1	2	.	3
620	.	.	.	.	.	.	.	1	.	1	.	.	2
630	.	.	.	.	.	.	.	.	.	1	.	.	1
640	.	.	.	.	.	.	.	1	.	.	.	.	1
650	.	.	.	.	.	.	.	.	.	1	.	.	1
670	.	.	.	.	.	.	.	1	.	1	.	.	2

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 19. Length Frequency of Catch by Habitat and Time Period for Burbot

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
BURBOT													
6/14/85 TO 6/30/85													
70	.	.	.	.	1	.	1	.	.	.	.	.	2
90	.	.	.	.	1	.	.	.	.	.	.	.	1
100	.	.	.	.	1	.	.	.	.	.	.	.	1
120	.	.	.	.	1	.	.	.	.	.	.	.	1
130	.	.	.	.	2	.	.	.	.	.	.	.	2
230	.	.	.	.	1	.	.	.	.	.	.	.	1
260	.	.	.	.	1	.	.	.	.	.	.	.	1
280	.	.	.	.	1	.	2	.	.	.	.	.	3
290	.	.	.	.	1	.	.	.	.	.	.	.	1
300	.	.	.	.	2	.	.	.	.	.	.	.	2
310	.	.	.	.	1	.	1	.	.	.	.	.	2
330	.	.	.	.	2	.	.	.	.	.	.	.	2
340	.	.	.	.	1	.	1	.	.	.	.	.	2
350	.	.	.	.	.	.	3	.	.	.	.	.	3
360	.	.	.	.	.	.	1	.	.	.	.	.	1
370	.	.	.	.	1	.	.	.	.	.	.	.	1
380	.	.	.	.	.	.	1	.	.	.	.	.	1
390	.	.	.	.	1	.	.	.	.	.	.	.	1
400	.	.	.	.	.	.	1	.	.	.	.	.	1
410	.	.	.	.	.	.	1	.	.	.	.	.	1
420	.	.	.	.	2	.	1	.	.	.	.	.	3
430	.	.	.	.	.	.	3	.	.	.	.	.	3
450	.	.	.	.	.	.	1	.	.	.	.	.	1
460	.	.	.	.	.	.	.	.	.	.	2	.	2
480	.	.	.	.	.	.	1	.	.	1	.	.	2
490	.	.	.	.	.	.	1	.	.	.	.	.	1
620	.	.	.	.	.	.	1	.	.	.	.	.	1
660	.	.	.	.	1	.	.	.	.	.	.	.	1
710	.	.	.	.	.	.	1	.	.	.	.	.	1
780	.	.	.	.	1	.	.	.	.	.	.	.	1
7/01/85 TO 7/15/85													
20	.	.	.	.	.	.	71	.	.	.	.	.	71
30	.	.	.	.	.	3	110	.	.	.	.	.	113
40	.	.	.	.	.	.	8	.	.	1	.	.	9
80	.	.	.	.	1	.	.	.	.	.	.	.	1
110	.	.	.	.	.	.	1	.	.	.	.	.	1
230	.	.	.	.	1	.	.	.	.	.	.	.	1
270	.	.	.	.	.	.	1	.	.	.	.	.	1
280	.	.	.	.	1	.	.	.	.	.	.	.	1
330	.	.	.	.	1	.	.	.	.	.	.	.	1
440	.	.	.	.	1	.	.	.	.	.	.	.	1
670	.	.	.	.	.	.	.	.	.	.	1	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 19. Burbot (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
BURBOT CONT. 7/16/85 TO 7/31/85													
20	.	.	.	.	.	2	33	.	.	.	.	.	35
30	.	.	.	.	.	2	207	.	.	.	.	.	209
40	.	.	.	.	.	1	83	.	.	1	.	.	85
50	.	.	.	.	.	1	8	.	.	2	.	.	11
60	.	.	.	.	.	.	2	.	.	1	.	.	3
100	.	.	.	.	.	.	.	.	.	1	.	.	1
130	.	.	.	.	.	.	1	.	.	1	.	.	2
300	.	.	.	.	.	.	1	.	.	.	.	.	1
420	.	.	.	.	.	.	1	.	.	.	.	.	1
440	.	.	.	.	.	.	1	.	.	.	.	.	1
8/01/85 TO 8/15/85													
30	.	.	.	.	.	.	12	.	.	.	.	.	12
40	.	.	.	.	.	.	95	.	.	.	.	.	95
50	.	.	1	4	2	1	34	.	.	4	.	.	46
60	.	.	21	3	5	.	11	.	.	7	.	.	47
70	.	.	8	4	.	.	1	.	.	1	.	.	14
80	.	.	2	1	1	1	.	.	.	2	.	.	7
90	.	.	1	.	.	.	.	.	.	.	.	.	1
120	.	.	1	.	.	.	.	.	.	.	.	.	1
130	.	.	.	.	1	.	.	.	.	.	.	.	1
140	.	.	1	1	2	.	.	.	.	.	.	.	4
150	.	.	.	1	1	.	1	.	.	.	.	.	3
160	.	.	.	.	2	.	.	.	.	.	.	.	2
170	.	.	.	1	1	.	.	.	.	.	.	.	2
180	.	.	.	1	.	1	1	.	.	.	.	.	3
200	.	.	.	.	1	.	.	.	.	.	.	.	1
220	.	.	.	1	.	.	.	.	.	.	.	.	1
250	.	.	.	1	.	.	.	.	.	.	.	.	1
270	.	.	.	.	2	.	.	.	.	.	.	.	2
280	.	.	.	1	.	.	.	.	.	.	.	.	1
310	.	.	.	.	2	.	.	.	.	.	.	.	2
330	.	.	.	1	.	.	.	.	.	.	.	.	1
390	.	.	.	.	.	.	1	.	.	.	.	.	1
410	.	.	.	.	1	.	1	.	.	.	.	.	2
500	.	.	.	.	.	.	.	.	.	1	.	.	1
8/16/85 TO 8/31/85													
50	.	.	1	.	.	.	1	.	.	4	.	.	6
60	.	.	2	.	4	.	.	.	.	18	.	.	24
70	.	.	.	3	.	.	.	.	.	11	.	.	14
80	.	.	3	3	1	.	.	.	.	.	.	.	7
90	.	.	1	.	3	.	.	.	.	.	.	.	4
100	.	.	1	.	.	.	.	.	.	2	.	.	3
110	.	.	.	.	1	.	.	.	.	1	.	.	2
140	.	.	.	.	.	.	.	.	1	.	.	.	1
150	.	.	.	1	.	.	.	.	.	.	.	.	1
160	.	.	.	1	1	.	.	.	.	.	.	.	2
170	.	.	.	.	.	.	.	.	1	1	.	.	2

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 19. Burbot (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
BURBOT CONT.													
8/16/85 TO 8/31/85 CONT.													
180	.	.	.	.	3	.	.	.	1	.	.	.	4
190	.	.	.	.	1	.	.	.	2	.	.	.	3
200	.	.	.	.	.	.	.	.	2	.	.	.	2
210	.	.	.	1	.	.	1	.	.	.	.	.	2
410	.	.	.	.	.	.	.	.	.	1	.	.	1
420	.	.	.	.	.	.	.	.	.	1	.	.	1
460	.	.	.	.	.	.	.	.	.	1	.	.	1
470	.	.	.	.	.	.	.	.	.	2	.	.	2
570	.	.	.	.	.	.	.	.	.	1	.	.	1
630	.	.	.	.	.	.	.	.	.	1	.	.	1
650	.	.	.	.	.	.	.	.	1	.	.	.	1
660	.	.	.	.	.	.	.	.	.	3	.	.	3
670	.	.	.	.	.	.	.	.	.	1	.	.	1
780	.	.	.	.	.	.	.	.	.	1	.	.	1
790	.	.	.	.	.	.	.	.	.	1	.	.	1
9/01/85 TO 9/18/85													
50	.	.	.	.	.	.	1	.	.	.	.	.	1
60	.	.	1	.	.	1	1	.	.	2	.	.	5
70	.	.	.	1	.	4	1	.	.	4	.	.	10
80	.	.	.	.	.	5	.	.	.	3	.	.	8
90	.	.	.	.	.	.	.	.	.	1	.	.	1
100	.	.	3	.	1	.	.	.	.	.	.	.	4
110	.	.	.	.	1	.	.	.	.	.	.	.	1
120	.	.	.	.	1	.	.	.	.	.	.	.	1
140	.	.	.	1	1	.	.	.	.	.	.	.	2
190	.	.	2	.	.	.	.	.	.	.	.	.	2
200	.	.	2	1	1	.	.	.	.	.	.	.	4
210	.	.	.	.	1	.	.	.	.	.	.	.	1
220	.	.	.	.	3	.	.	.	.	.	.	.	3
230	.	.	.	.	1	.	.	.	.	.	.	.	1
250	.	.	.	.	1	.	.	.	.	.	.	.	1
260	.	.	.	.	1	.	1	.	.	.	.	.	2
290	.	.	.	.	.	.	1	.	.	.	.	.	1
320	.	.	.	.	.	.	1	.	.	.	.	.	1
500	.	.	.	.	.	.	.	.	.	1	.	.	1
670	.	.	.	.	.	.	.	.	.	1	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 19. Burbot (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 BURBOT													
20	.	.	.	.	.	2	104	.	.	.	.	.	106
30	.	.	.	.	.	5	329	.	.	.	.	.	334
40	.	.	.	.	.	1	186	.	.	2	.	.	189
50	.	.	2	4	2	2	44	.	.	10	.	.	64
60	.	.	24	3	9	1	14	.	.	28	.	.	79
70	.	.	8	8	1	4	3	.	.	16	.	.	40
80	.	.	5	4	3	6	.	.	.	5	.	.	23
90	.	.	2	.	4	.	.	.	.	1	.	.	7
100	.	.	4	.	2	.	.	.	.	3	.	.	9
110	.	.	.	.	2	.	1	.	.	1	.	.	4
120	.	.	1	.	2	.	.	.	.	.	.	.	3
130	.	.	.	.	3	.	1	.	.	1	.	.	5
140	.	.	1	2	3	.	.	.	1	.	.	.	7
150	.	.	.	2	1	.	1	.	.	.	.	.	4
160	.	.	.	1	3	.	.	.	.	.	.	.	4
170	.	.	.	1	1	.	.	.	1	1	.	.	4
180	.	.	.	1	3	1	1	.	1	.	.	.	7
190	.	.	2	.	1	.	.	.	2	.	.	.	5
200	.	.	2	1	2	.	.	.	2	.	.	.	7
210	.	.	.	1	1	.	1	.	.	.	.	.	3
220	.	.	.	1	3	.	.	.	.	.	.	.	4
230	.	.	.	.	3	.	.	.	.	.	.	.	3
250	.	.	.	1	1	.	.	.	.	.	.	.	2
260	.	.	.	.	2	.	1	.	.	.	.	.	3
270	.	.	.	.	2	.	1	.	.	.	.	.	3
280	.	.	.	1	2	.	2	.	.	.	.	.	5
290	.	.	.	.	1	.	1	.	.	.	.	.	2
300	.	.	.	.	2	.	1	.	.	.	.	.	3
310	.	.	.	.	3	.	1	.	.	.	.	.	4
320	.	.	.	.	.	.	1	.	.	.	.	.	1
330	.	.	.	1	3	.	.	.	.	.	.	.	4
340	.	.	.	.	1	.	1	.	.	.	.	.	2
350	.	.	.	.	.	.	3	.	.	.	.	.	3
360	.	.	.	.	.	.	1	.	.	.	.	.	1
370	.	.	.	.	1	.	.	.	.	.	.	.	1
380	.	.	.	.	.	.	1	.	.	.	.	.	1
390	.	.	.	.	1	.	1	.	.	.	.	.	2
400	.	.	.	.	.	.	1	.	.	.	.	.	1
410	.	.	.	.	1	.	2	.	.	1	.	.	4
420	.	.	.	.	2	.	2	.	.	1	.	.	5
430	.	.	.	.	.	.	3	.	.	.	.	.	3
440	.	.	.	.	1	.	1	.	.	.	.	.	2
450	.	.	.	.	.	.	1	.	.	.	.	.	1
460	.	.	.	.	.	.	.	.	.	1	2	.	3
470	.	.	.	.	.	.	.	.	.	2	.	.	2
480	.	.	.	.	.	.	1	.	.	1	.	.	2
490	.	.	.	.	.	.	1	.	.	.	.	.	1
500	.	.	.	.	.	.	.	.	.	1	.	.	1
570	.	.	.	.	.	.	.	.	.	1	.	.	1
580	.	.	.	.	.	.	.	.	.	1	.	.	1
620	.	.	.	.	.	.	1	.	.	.	.	.	1
630	.	.	.	.	.	.	.	.	.	1	.	.	1
650	.	.	.	.	.	.	.	.	1	.	.	.	1
660	.	.	.	.	1	.	.	.	.	3	.	.	4
670	.	.	.	.	.	.	.	.	.	2	1	.	3
710	.	.	.	.	.	.	1	.	.	.	.	.	1
780	.	.	.	.	1	.	.	.	.	1	.	.	2
790	.	.	.	.	.	.	.	.	.	1	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 20. Length Frequency of Catch by Habitat and Time Period for Blackfish

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	13	TOTAL
BLACKFISH													
6/14/85 TO 6/30/85													
60	.	.	.	.	.	.	1	.	.	.	.	.	1
70	.	.	.	.	.	.	.	.	.	2	.	.	2
7/01/85 TO 7/15/85													
70	.	.	.	.	.	.	.	.	.	1	.	.	1
80	.	.	.	.	.	.	.	.	.	1	.	.	1
7/16/85 TO 7/31/85													
90	.	.	.	.	.	.	.	.	.	1	.	.	1
8/01/85 TO 8/15/85													
50	.	.	.	.	.	.	.	.	.	1	.	.	1
60	.	.	.	.	.	.	.	.	.	11	.	.	11
70	.	.	.	.	.	.	.	.	.	2	.	.	2
80	.	.	.	.	.	.	.	.	.	7	.	.	7
90	.	.	.	.	.	.	.	.	.	1	.	.	1
100	.	.	.	.	.	.	.	.	.	3	.	.	3
8/16/85 TO 8/31/85													
50	.	.	.	.	.	.	.	.	.	2	.	.	2
60	.	.	.	.	.	.	.	.	.	8	.	.	8
70	.	.	.	.	.	.	.	.	.	7	.	1	8
80	.	.	.	.	.	.	.	.	.	4	.	1	5
90	.	.	.	.	.	.	.	.	.	4	.	7	11
100	.	.	.	.	.	.	.	.	.	2	.	8	10
110	.	.	.	.	.	.	.	.	.	2	.	7	9
120	.	.	.	.	.	.	.	.	.	.	.	7	7
130	.	.	.	.	.	.	.	.	.	.	.	2	2
140	.	.	.	.	.	.	.	.	3	.	.	3	6
150	.	.	.	.	.	.	.	.	5	.	.	2	7
160	.	.	.	.	.	.	.	.	1	.	.	1	2
9/01/85 TO 9/18/85													
80	.	.	.	.	.	.	.	.	.	1	.	.	1
90	.	.	.	.	.	.	.	.	.	1	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 20. Blackfish (Continued)

	HABITAT												
FORKLENGTH /A	1	2	3	4	5	6	7	8	9	10	11	13	TOTAL
6/14/85 TO 9/18/85 BLACKFISH													
50	.	.	.	.	.	.	.	.	.	3	.	.	3
60	.	.	.	.	.	.	1	.	.	19	.	.	20
70	.	.	.	.	.	.	.	.	.	12	.	1	13
80	.	.	.	.	.	.	.	.	.	13	.	1	14
90	.	.	.	.	.	.	.	.	.	7	.	7	14
100	.	.	.	.	.	.	.	.	.	5	.	8	13
110	.	.	.	.	.	.	.	.	.	2	.	7	9
120	.	.	.	.	.	.	.	.	.	.	.	7	7
130	.	.	.	.	.	.	.	.	.	.	.	2	2
140	.	.	.	.	.	.	.	.	3	.	.	3	6
150	.	.	.	.	.	.	.	.	5	.	.	2	7
160	.	.	.	.	.	.	.	.	1	.	.	1	2

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 21. Length Frequency of Catch by Habitat and Time Period for Trout-Perch

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	13	TOTAL
TROUT-PERCH													
6/14/85 TO 6/30/85													
40	.	.	.	.	.	.	1	.	.	.	.	.	1
7/01/85 TO 7/15/85													
30	.	.	.	.	.	.	.	.	.	6	.	.	6
40	.	.	.	.	.	.	.	.	.	2	.	.	2

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	13	TOTAL
6/14/85 TO 9/18/85 TROUT-PERCH													
30	.	.	.	.	.	.	.	.	.	6	.	.	6
40	.	.	.	.	.	.	1	.	.	2	.	.	3

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 22. Length Frequency of Catch by Habitat and Time Period for Starry Flounder

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
STARRY FLOUNDER													
6/14/85 TO 6/30/85													
30	.	.	.	.	1	.	1	.	.	.	.	.	2
40	.	.	.	.	1	.	.	.	.	.	.	.	1
70	.	.	.	.	1	.	.	.	.	.	.	.	1
100	.	.	.	.	1	.	.	.	.	.	.	.	1
110	.	.	.	.	1	.	1	.	.	.	.	.	2
120	.	.	.	9	3	.	1	.	.	.	.	.	13
130	.	.	.	2	1	.	1	.	.	.	.	.	4
140	.	.	.	3	3	.	.	.	.	.	.	.	6
150	.	.	.	2	.	.	.	.	.	.	.	.	2
160	.	.	.	2	1	.	1	.	.	.	.	.	4
170	.	.	.	3	.	.	.	.	.	.	.	.	3
190	.	.	.	.	1	.	.	.	.	.	.	.	1
210	.	.	1	.	.	.	.	.	.	.	.	.	1
220	.	.	.	1	.	.	1	.	.	.	.	.	2
7/01/85 TO 7/15/85													
110	.	.	.	2	.	.	.	.	.	.	.	.	2
120	.	.	.	2	.	.	.	.	.	.	.	.	2
130	.	.	.	1	.	.	.	.	.	.	.	.	1
150	.	.	.	1	.	.	.	.	.	.	.	.	1
160	.	.	.	1	.	.	.	.	.	.	.	.	1
170	.	.	.	1	.	.	.	.	.	.	.	.	1
180	.	.	.	1	.	.	.	.	.	.	.	.	1
190	.	.	.	2	.	.	.	.	.	.	.	.	2
7/16/85 TO 7/31/85													
70	.	.	.	.	1	.	3	.	.	.	.	.	4
80	.	.	.	1	.	.	.	.	.	.	.	.	1
90	.	.	.	1	.	.	.	.	.	.	.	.	1
110	.	.	.	1	.	.	.	.	.	.	.	.	1
120	.	.	.	4	.	.	.	.	.	.	.	.	4
130	.	1	.	5	3	.	.	.	.	.	.	.	9
140	.	.	.	14	6	.	1	.	.	.	.	.	21
150	.	.	.	13	11	.	.	.	.	.	.	.	24
160	.	.	.	5	1	.	.	.	.	.	.	.	6
170	.	.	.	6	5	.	.	.	.	.	.	.	11
180	.	.	.	4	3	.	.	.	.	.	.	.	7
190	.	.	.	2	1	.	.	.	.	.	.	.	3
200	.	.	.	2	3	.	.	.	.	.	.	.	5
210	.	.	.	.	1	.	.	.	.	.	.	.	1
230	.	.	.	1	.	.	.	.	.	.	.	.	1
240	.	.	.	1	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 22. Starry Flounder (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
STARRY FLOUNDER CONT.													
8/01/85 TO 8/15/85													
50	.	.	.	1	.	.	.	.	.	.	.	.	1
60	.	.	.	1	.	.	.	.	.	.	.	.	1
70	.	.	.	1	.	.	.	.	.	.	.	.	1
80	.	.	1	2	1	.	1	.	.	.	.	.	5
90	.	.	.	3	.	.	1	.	.	.	.	.	4
100	.	.	.	3	.	.	.	.	.	.	.	.	3
110	.	.	.	3	.	.	.	.	.	.	.	.	3
120	.	.	.	6	.	.	.	.	.	.	.	.	6
130	.	.	.	5	2	.	.	.	.	.	.	.	7
140	.	.	1	6	2	.	.	.	.	.	.	.	9
150	.	.	.	8	6	.	.	.	.	.	.	.	14
160	.	.	.	6	2	.	.	.	.	.	.	.	8
170	.	.	.	3	2	.	.	.	.	.	.	.	5
180	.	.	.	2	1	.	.	.	.	.	.	.	3
190	.	.	.	.	3	.	.	.	.	.	.	.	3
210	.	.	.	1	.	.	.	.	.	.	.	.	1
220	.	.	.	2	.	.	.	.	.	.	.	.	2
230	.	.	.	1	.	.	.	.	.	.	.	.	1
250	.	.	.	.	1	.	.	.	.	.	.	.	1
8/16/85 TO 8/31/85													
80	.	.	.	1	.	.	.	.	.	.	.	.	1
90	.	.	.	3	.	.	.	.	.	.	.	.	3
100	.	.	.	8	.	.	.	.	.	.	.	.	8
110	.	.	.	4	.	.	.	.	.	.	.	.	4
130	.	1	.	4	.	.	.	.	.	.	.	.	5
140	.	.	.	4	.	.	.	.	.	.	.	.	4
150	.	.	.	5	1	.	.	.	.	.	.	.	6
160	.	.	.	16	.	.	.	.	.	.	.	.	16
170	.	.	.	11	3	.	.	.	.	.	.	.	14
180	.	.	.	2	1	.	.	.	.	.	.	.	3
190	.	.	.	3	.	.	.	.	.	.	.	.	3
200	.	.	.	3	.	.	.	.	.	.	.	.	3
210	.	.	.	4	.	.	.	.	.	.	.	.	4
220	.	.	.	3	.	.	.	.	.	.	.	.	3
230	.	.	.	1	.	.	.	.	.	.	.	.	1
9/01/85 TO 9/18/85													
110	.	.	.	.	1	.	.	.	.	.	.	.	1
130	.	.	.	2	.	.	.	.	.	.	.	.	2
140	.	1	1	.	.	.	.	.	.	.	.	.	2
150	.	.	.	2	.	.	.	.	.	.	.	.	2
160	.	1	.	1	.	.	.	.	.	.	.	.	2
180	.	.	.	1	1	.	.	.	.	.	.	.	2
190	.	.	.	1	.	.	.	.	.	.	.	.	1
220	.	.	.	.	2	.	.	.	.	.	.	.	2

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 22. Starry Flounder (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 STARRY FLOUNDER													
30	.	.	.	.	1	.	1	.	.	.	.	.	2
40	.	.	.	.	1	.	.	.	.	.	.	.	1
50	.	.	.	1	.	.	.	.	.	.	.	.	1
60	.	.	.	1	.	.	.	.	.	.	.	.	1
70	.	.	.	1	2	.	3	.	.	.	.	.	6
80	.	.	1	4	1	.	1	.	.	.	.	.	7
90	.	.	.	7	.	.	1	.	.	.	.	.	8
100	.	.	.	11	1	.	.	.	.	.	.	.	12
110	.	.	.	10	2	.	1	.	.	.	.	.	13
120	.	.	.	21	3	.	1	.	.	.	.	.	25
130	.	2	.	19	6	.	1	.	.	.	.	.	28
140	.	1	2	27	11	.	1	.	.	.	.	.	42
150	.	.	.	31	18	.	.	.	.	.	.	.	49
160	.	1	.	31	4	.	1	.	.	.	.	.	37
170	.	.	.	24	10	.	.	.	.	.	.	.	34
180	.	.	.	10	6	.	.	.	.	.	.	.	16
190	.	.	.	8	5	.	.	.	.	.	.	.	13
200	.	.	.	5	3	.	.	.	.	.	.	.	8
210	.	.	1	5	1	.	.	.	.	.	.	.	7
220	.	.	.	6	2	.	1	.	.	.	.	.	9
230	.	.	.	3	.	.	.	.	.	.	.	.	3
240	.	.	.	1	.	.	.	.	.	.	.	.	1
250	.	.	.	.	1	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 23. Length Frequency of Catch by Habitat and Time Period for Arctic Flounder

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
ARCTIC FLOUNDER													
6/14/85 TO 6/30/85													
40	.	.	.	1	.	.	.	.	.	.	.	.	1
50	.	.	.	28	.	.	.	.	.	.	.	.	28
60	.	.	.	39	.	.	.	.	.	.	.	.	39
100	.	.	.	2	.	.	.	.	.	.	.	.	2
110	.	.	.	2	.	.	.	.	.	.	.	.	2
120	.	.	.	1	.	.	.	.	.	.	.	.	1
130	.	.	.	1	.	.	.	.	.	.	.	.	1
140	.	1	.	.	.	.	.	.	.	.	.	.	1
7/01/85 TO 7/15/85													
150	.	.	.	1	.	.	.	.	.	.	.	.	1
7/16/85 TO 7/31/85													
20	.	.	.	.	23	.	.	.	.	.	.	.	23
30	.	.	.	.	23	.	.	.	.	.	.	.	23
60	.	2	.	.	8	.	.	.	.	.	.	.	10
70	.	1	.	.	18	.	.	.	.	.	.	.	19
80	.	.	.	.	23	.	.	.	.	.	.	.	23
90	.	.	.	.	4	.	.	.	.	.	.	.	4
100	.	.	.	.	2	.	.	.	.	.	.	.	2
110	.	2	.	13	8	.	.	.	.	.	.	.	23
120	.	.	.	8	5	.	.	.	.	.	.	.	13
130	.	.	.	6	4	.	.	.	.	.	.	.	10
140	.	2	.	17	5	.	.	.	.	.	.	.	24
150	.	.	.	9	5	.	.	.	.	.	.	.	14
160	.	1	.	3	2	.	.	.	.	.	.	.	6
170	.	1	.	3	4	.	.	.	.	.	.	.	8
180	.	.	.	4	2	.	.	.	.	.	.	.	6
190	.	.	.	4	2	.	.	.	.	.	.	.	6
200	.	.	.	2	1	.	.	.	.	.	.	.	3
8/01/85 TO 8/15/85													
20	.	.	.	.	.	.	1	.	.	.	.	.	1
50	.	.	1	.	.	.	.	.	.	.	.	.	1
60	.	.	7	.	.	.	.	.	.	.	.	.	7
70	.	.	19	.	.	.	.	.	.	.	.	.	19
80	.	.	27	.	1	.	.	.	.	.	.	.	28
90	.	.	6	.	.	.	.	.	.	.	.	.	6
110	.	.	4	.	.	.	.	.	.	.	.	.	4
120	.	.	5	.	.	.	.	.	.	.	.	.	5
130	.	2	4	1	.	.	.	.	.	.	.	.	7
140	.	4	7	1	.	.	.	.	.	.	.	.	12
150	.	5	.	.	.	.	.	.	.	.	.	.	5
160	.	3	1	2	.	.	.	.	.	.	.	.	6
170	.	1	.	3	.	.	.	.	.	.	.	.	4
180	1	1	2	1	.	.	.	.	.	.	.	.	5
190	.	.	1	1	.	.	.	.	.	.	.	.	2
200	1	.	.	.	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 23. Arctic Flounder (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
ARCTIC FLOUNDER CONT. 8/16/85 TO 8/31/85													
40	.	.	.	1	.	.	.	.	.	.	.	.	1
50	.	.	.	.	7	.	.	.	.	.	.	.	7
60	.	.	1	.	1	.	.	.	.	.	.	.	2
70	.	.	.	4	.	.	.	.	.	.	.	.	4
80	.	.	2	9	3	.	.	.	.	.	.	.	14
90	.	.	.	7	3	.	.	.	.	.	.	.	10
100	.	.	1	2	4	.	.	.	.	.	.	.	7
110	.	.	.	7	2	.	.	.	.	.	.	.	9
120	.	.	2	8	.	.	.	.	.	.	.	.	10
130	.	.	8	8	.	.	.	.	.	.	.	.	16
140	2	.	4	7	2	.	.	.	.	.	.	.	15
150	.	1	13	15	2	.	.	.	.	.	.	.	31
160	.	1	4	7	6	.	.	.	.	.	.	.	18
170	4	.	2	2	3	.	.	.	.	.	.	.	11
180	.	.	2	6	3	.	.	.	.	.	.	.	11
190	.	.	1	4	3	.	.	.	.	.	.	.	8
9/01/85 TO 9/18/85													
20	.	.	.	1	.	.	.	.	.	.	.	.	1
30	.	.	.	.	22	.	.	.	.	.	.	.	22
40	.	.	.	6	20	.	.	.	.	.	.	.	26
50	.	1	.	4	5	.	.	.	.	.	.	.	10
70	.	1	.	.	.	.	.	.	.	.	.	.	1
90	.	1	.	1	.	.	.	.	.	.	.	.	2
100	.	2	.	1	.	.	.	.	.	.	.	.	3
110	.	.	.	1	.	.	.	.	.	.	.	.	1
120	.	.	.	1	.	.	.	.	.	.	.	.	1
130	.	3	.	.	.	.	.	.	.	.	.	.	3
140	.	4	.	1	.	.	.	.	.	.	.	.	5
150	.	.	.	1	.	.	.	.	.	.	.	.	1
170	.	1	.	.	.	.	.	.	.	.	.	.	1
180	.	.	.	1	1	.	.	.	.	.	.	.	2
190	.	1	.	.	.	.	.	.	.	.	.	.	1
200	.	1	.	.	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 23. Arctic Flounder (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 ARCTIC FLOUNDER													
20	.	.	.	1	23	.	1	.	.	.	.	.	25
30	.	.	.	.	45	.	.	.	.	.	.	.	45
40	.	.	.	8	20	.	.	.	.	.	.	.	28
50	.	1	1	32	12	.	.	.	.	.	.	.	46
60	.	2	8	39	9	.	.	.	.	.	.	.	58
70	.	2	19	4	18	.	.	.	.	.	.	.	43
80	.	.	29	9	27	.	.	.	.	.	.	.	65
90	.	1	6	8	7	.	.	.	.	.	.	.	22
100	.	2	1	5	6	.	.	.	.	.	.	.	14
110	.	2	4	23	10	.	.	.	.	.	.	.	39
120	.	.	7	18	5	.	.	.	.	.	.	.	30
130	.	5	12	16	4	.	.	.	.	.	.	.	37
140	2	11	11	26	7	.	.	.	.	.	.	.	57
150	.	6	13	26	7	.	.	.	.	.	.	.	52
160	.	5	5	12	8	.	.	.	.	.	.	.	30
170	4	3	2	8	7	.	.	.	.	.	.	.	24
180	1	1	4	12	6	.	.	.	.	.	.	.	24
190	.	1	2	9	5	.	.	.	.	.	.	.	17
200	1	1	.	2	1	.	.	.	.	.	.	.	5

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 24. Length Frequency of Catch by Habitat and Time Period for Arctic Saffron Cod

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
SAFFRON COD													
6/14/85 TO 6/30/85													
190	.	.	.	1	.	.	.	.	.	.	.	.	1
230	.	.	1	.	.	.	.	.	.	.	.	.	1
240	.	.	.	.	1	.	.	.	.	.	.	.	1
260	.	.	1	.	.	.	.	.	.	.	.	.	1
300	.	.	1	.	.	.	.	.	.	.	.	.	1
7/16/85 TO 7/31/85													
110	.	1	.	.	.	.	.	.	.	.	.	.	1
120	1	.	.	.	.	.	.	.	.	.	.	.	1
130	1	.	.	.	.	.	.	.	.	.	.	.	1
220	1	.	.	.	.	.	.	.	.	.	.	.	1
260	.	.	.	.	1	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
50	8	.	.	.	.	.	.	.	.	.	.	.	8
60	81	.	1	.	.	.	.	.	.	.	.	.	82
70	19	.	5	.	.	.	.	.	.	.	.	.	24
80	7	.	4	.	.	.	.	.	.	.	.	.	11
90	1	.	1	.	.	.	.	.	.	.	.	.	2
100	2	.	1	.	.	.	.	.	.	.	.	.	3
110	10	.	.	.	.	.	.	.	.	.	.	.	10
120	9	.	.	1	.	.	.	.	.	.	.	.	10
130	7	.	.	.	.	.	.	.	.	.	.	.	7
140	1	.	.	.	.	.	.	.	.	.	.	.	1
150	1	.	1	.	.	.	.	.	.	.	.	.	2
160	2	.	.	.	.	.	.	.	.	.	.	.	2
240	2	.	1	.	.	.	.	.	.	.	.	.	3
260	2	.	.	.	.	.	.	.	.	.	.	.	2
290	.	.	.	1	.	.	.	.	.	.	.	.	1
300	.	.	.	1	.	.	.	.	.	.	.	.	1
8/16/85 TO 8/31/85													
60	9	.	2	.	.	.	.	.	.	.	.	.	11
70	22	.	2	.	.	.	.	.	.	.	.	.	24
80	1	.	.	.	.	.	.	.	.	.	.	.	1
130	4	.	.	.	.	.	.	.	.	.	.	.	4
140	3	.	.	.	.	.	.	.	.	.	.	.	3
210	.	.	.	.	1	.	.	.	.	.	.	.	1
230	.	.	.	.	1	.	.	.	.	.	.	.	1
240	.	.	.	1	4	.	.	.	.	.	.	.	5
250	.	.	.	.	10	.	.	.	.	.	.	.	10
260	.	.	.	.	12	.	.	.	.	.	.	.	12
270	1	.	.	1	12	.	.	.	.	.	.	.	14
280	.	.	.	1	14	.	.	.	.	.	.	.	15
290	.	.	.	.	9	.	.	.	.	.	.	.	9
300	.	.	.	.	3	.	.	.	.	.	.	.	3
310	.	.	.	.	2	.	.	.	.	.	.	.	2
320	.	.	.	.	1	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 24. Saffron Cod (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
SAFFRON COD CONT. 9/01/85 TO 9/18/85													
70	26	.	.	.	.	.	.	.	.	.	.	.	26
80	62	.	.	.	.	.	.	.	.	.	.	.	62
90	21	.	.	.	.	.	.	.	.	.	.	.	21
100	1	.	.	.	.	.	.	.	.	.	.	.	1
110	1	.	.	.	.	.	.	.	.	.	.	.	1
130	.	.	1	.	1	.	.	.	.	.	.	.	2
140	.	.	2	3	.	.	.	.	.	.	.	.	5
150	.	.	3	.	.	.	.	.	.	.	.	.	3
160	.	.	1	1	.	.	.	.	.	.	.	.	2
170	.	.	3	1	.	.	.	.	.	.	.	.	4
180	.	.	4	1	.	.	.	.	.	.	.	.	5
190	.	.	1	.	.	.	.	.	.	.	.	.	1
200	.	.	2	1	1	.	.	.	.	.	.	.	4
210	.	.	1	.	.	.	.	.	.	.	.	.	1
220	.	.	8	1	2	.	.	.	.	.	.	.	11
230	.	.	1	1	3	.	.	.	.	.	.	.	5
240	.	.	1	5	7	.	.	.	.	.	.	.	13
250	.	.	7	6	17	.	.	.	.	.	.	.	30
260	.	.	5	13	15	.	.	.	.	.	.	.	33
270	.	.	3	11	16	.	.	.	.	.	.	.	30
280	.	.	5	14	17	.	.	.	.	.	.	.	36
290	.	.	4	9	12	.	.	.	.	.	.	.	25
300	.	.	2	4	14	.	.	.	.	.	.	.	20
310	.	.	3	4	9	.	.	.	.	.	.	.	16
320	.	.	1	1	6	.	.	.	.	.	.	.	8
330	.	.	1	1	.	.	.	.	.	.	.	.	2
340	.	.	.	2	2	.	.	.	.	.	.	.	4
350	.	.	.	.	1	.	.	.	.	.	.	.	1
380	.	.	.	.	1	.	.	.	.	.	.	.	1
390	.	.	.	2	.	.	.	.	.	.	.	.	2

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

Table 24. Saffron Cod (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 SAFFRON COD													
50	8	.	.	.	.	.	.	.	.	.	.	.	8
60	90	.	3	.	.	.	.	.	.	.	.	.	93
70	67	.	7	.	.	.	.	.	.	.	.	.	74
80	70	.	4	.	.	.	.	.	.	.	.	.	74
90	22	.	1	.	.	.	.	.	.	.	.	.	23
100	3	.	1	.	.	.	.	.	.	.	.	.	4
110	11	1	.	.	.	.	.	.	.	.	.	.	12
120	10	.	.	1	.	.	.	.	.	.	.	.	11
130	12	.	1	.	1	.	.	.	.	.	.	.	14
140	4	.	2	3	.	.	.	.	.	.	.	.	9
150	1	.	4	.	.	.	.	.	.	.	.	.	5
160	2	.	1	1	.	.	.	.	.	.	.	.	4
170	.	.	3	1	.	.	.	.	.	.	.	.	4
180	.	.	4	1	.	.	.	.	.	.	.	.	5
190	.	.	1	1	.	.	.	.	.	.	.	.	2
200	.	.	2	1	1	.	.	.	.	.	.	.	4
210	.	.	1	.	1	.	.	.	.	.	.	.	2
220	1	.	8	1	2	.	.	.	.	.	.	.	12
230	.	.	2	1	4	.	.	.	.	.	.	.	7
240	2	.	2	6	12	.	.	.	.	.	.	.	22
250	.	.	7	6	27	.	.	.	.	.	.	.	40
260	2	.	6	13	28	.	.	.	.	.	.	.	49
270	1	.	3	12	28	.	.	.	.	.	.	.	44
280	.	.	5	15	31	.	.	.	.	.	.	.	51
290	.	.	4	10	21	.	.	.	.	.	.	.	35
300	.	.	3	5	17	.	.	.	.	.	.	.	25
310	.	.	3	4	11	.	.	.	.	.	.	.	18
320	.	.	1	1	7	.	.	.	.	.	.	.	9
330	.	.	1	1	.	.	.	.	.	.	.	.	2
340	.	.	.	2	2	.	.	.	.	.	.	.	4
350	.	.	.	.	1	.	.	.	.	.	.	.	1
380	.	.	.	.	1	.	.	.	.	.	.	.	1
390	.	.	.	2	.	.	.	.	.	.	.	.	2

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 25. Length Frequency of Catch by Habitat and Time Period for Fourhorn Sculpin

	HABITAT												
FORKLENGTH /A	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
FOURHORN SCULPIN													
6/14/85 TO 6/30/85													
60	.	.	.	.	1	.	.	.	.	.	.	.	1
210	.	1	.	.	.	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
30	.	.	.	.	1	.	.	.	.	.	.	.	1
50	.	.	2	.	.	.	.	.	.	.	.	.	2
80	.	.	1	.	.	.	.	.	.	.	.	.	1
90	.	.	9	.	.	.	.	.	.	.	.	.	9
100	.	1	8	.	.	.	.	.	.	.	.	.	9
110	.	1	1	.	.	.	.	.	.	.	.	.	2
120	.	.	3	.	.	.	.	.	.	.	.	.	3
130	.	.	2	.	.	.	.	.	.	.	.	.	2
140	.	.	1	.	.	.	.	.	.	.	.	.	1
180	.	.	1	.	.	.	.	.	.	.	.	.	1
190	.	1	.	.	.	.	.	.	.	.	.	.	1
200	1	.	1	.	.	.	.	.	.	.	.	.	2
230	.	.	.	.	.	.	1	.	.	.	.	.	1
8/16/85 TO 8/31/85													
40	.	.	1		.	.	.	.	.	.	.	.	1
80	.	.	1	.	.	.	.	.	.	.	.	.	1
90	.	.	5	.	.	.	.	.	.	.	.	.	5
100	.	.	22	.	.	.	.	.	.	.	.	.	22
110	.	1	11	.	.	.	.	.	.	.	.	.	12
120	.	.	5	.	.	.	.	.	.	.	.	.	5
130	.	.	2	.	.	.	.	.	.	.	.	.	2
140	.	.	1	.	.	.	.	.	.	.	.	.	1
150	.	.	4	.	.	.	.	.	.	.	.	.	4
170	1	.	1	.	.	.	.	.	.	.	.	.	2
180	.	.	1	.	.	.	.	.	.	.	.	.	1
190	.	.	2	.	.	.	.	.	.	.	.	.	2
200	.	1	.	.	.	.	.	.	.	.	.	.	1
9/01/85 TO 9/18/85													
80	.	.	.	.	1	.	.	.	.	.	.	.	1
90	.	1	.	.	.	.	.	.	.	.	.	.	1
100	.	1	.	.	.	.	.	.	.	.	.	.	1
110	.	4	.	.	.	.	.	.	.	.	.	.	4
120	.	3	.	.	.	.	.	.	.	.	.	.	3
140	.	4	.	.	.	.	.	.	.	.	.	.	4
150	.	2	.	.	.	.	.	.	.	.	.	.	2
170	.	1	.	.	.	.	.	.	.	.	.	.	1
180	.	.	.	1	.	.	.	.	.	.	.	.	1
190	.	1	.	.	.	.	.	.	.	.	.	.	1
200	.	1	.	.	.	.	.	.	.	.	.	.	1
220	.	1	.	.	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 25. Fourhorn Sculpin (Continued)

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 FOURHORN SCULPIN													
30	.	.	.	.	1	.	.	.	.	.	.	.	1
40	.	.	1	.	.	.	.	.	.	.	.	.	1
50	.	.	2	.	.	.	.	.	.	.	.	.	2
60	.	.	.	.	1	.	.	.	.	.	.	.	1
80	.	.	2	.	1	.	.	.	.	.	.	.	3
90	.	1	14	.	.	.	.	.	.	.	.	.	15
100	.	2	30	.	.	.	.	.	.	.	.	.	32
110	.	6	12	.	.	.	.	.	.	.	.	.	18
120	.	3	8	.	.	.	.	.	.	.	.	.	11
130	.	.	4	.	.	.	.	.	.	.	.	.	4
140	.	4	2	.	.	.	.	.	.	.	.	.	6
150	.	2	4	.	.	.	.	.	.	.	.	.	6
170	1	1	1	.	.	.	.	.	.	.	.	.	3
180	.	.	2	1	.	.	.	.	.	.	.	.	3
190	.	2	2	.	.	.	.	.	.	.	.	.	4
200	1	2	1	.	.	.	.	.	.	.	.	.	4
210	.	1	.	.	.	.	.	.	.	.	.	.	1
220	.	1	.	.	.	.	.	.	.	.	.	.	1
230	.	.	.	.	.	.	1	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C

Table 26. Length Frequency of Catch by Habitat and Time Period for Pacific Herring

FORKLENGTH /A	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
PACIFIC HERRING													
6/14/85 TO 6/30/85													
190	1	.	.	.	.	.	.	.	.	.	.	.	1
250	1	.	.	.	.	.	.	.	.	.	.	.	1
7/16/85 TO 7/31/85													
50	1	.	.	.	.	.	.	.	.	.	.	.	1
60	1	.	.	.	.	.	.	.	.	.	.	.	1
70	2	.	.	.	.	.	.	.	.	.	.	.	2
80	15	.	.	.	.	.	.	.	.	.	.	.	15
90	55	.	.	.	.	.	.	.	.	.	.	.	55
100	44	.	.	.	.	.	.	.	.	.	.	.	44
110	18	.	.	.	.	.	.	.	.	.	.	.	18
120	4	.	.	.	.	.	.	.	.	.	.		4
130	5	.	.	.	.	.	.	.	.	.	.	.	5
140	7	.	.	.	.	.	.	.	.	.	.	.	7
150	7	.	.	.	.	.	.	.	.	.	.	.	7
160	3	.	.	.	.	.	.	.	.	.	.	.	3
170	1	.	.	.	.	.	.	.	.	.	.	.	1
180	1	.	.	.	.	.	.	.	.	.	.	.	1
200	1	.	.	.	.	.	.	.	.	.	.	.	1
8/01/85 TO 8/15/85													
80	2	.	.	.	.	.	.	.	.	.	.	.	2
90	1	.	.	.	.	.	.	.	.	.	.	.	1
100	5	.	.	.	.	.	.	.	.	.	.	.	5
8/16/85 TO 8/31/85													
110	1	.	.	.	.	.	.	.	.	.	.	.	1
130	1	.	.	.	.	.	.	.	.	.	.	.	1
9/01/85 TO 9/18/85													
30	1	.	.	.	.	.	.	.	.	.	.	.	1
50	1	.	.	.	.	.	.	.	.	.	.	.	1
90	1	.	.	.	.	.	.	.	.	.	.	.	1
100	1	.	.	.	.	.	.	.	.	.	.	.	1
110	4	.	.	.	.	.	.	.	.	.	.	.	4
120	7	.	.	.	.	.	.	.	.	.	.	.	7
130	4	.	.	.	.	.	.	.	.	.	.	.	4
140	1	.	.	.	.	.	.	.	.	.	.	.	1
150	1	.	.	.	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX C
Table 26. Pacific Herring (Continued)

/A FORKLENGTH	HABITAT 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/14/85 TO 9/18/85 PACIFIC HERRING													
30	1	.	.	.	.	.	.	.	.	.	.	.	1
50	2	.	.	.	.	.	.	.	.	.	.	.	2
60	1	.	.	.	.	.	.	.	.	.	.	.	1
70	2	.	.	.	.	.	.	.	.	.	.	.	2
80	17	.	.	.	.	.	.	.	.	.	.	.	17
90	57	.	.	.	.	.	.	.	.	.	.	.	57
100	50	.	.	.	.	.	.	.	.	.	.	.	50
110	23	.	.	.	.	.	.	.	.	.	.	.	23
120	11	.	.	.	.	.	.	.	.	.	.	.	11
130	10	.	.	.	.	.	.	.	.	.	.	.	10
140	8	.	.	.	.	.	.	.	.	.	.	.	8
150	8	.	.	.	.	.	.	.	.	.	.	.	8
160	3	.	.	.	.	.	.	.	.	.	.	.	3
170	1	.	.	.	.	.	.	.	.	.	.	.	1
180	1	.	.	.	.	.	.	.	.	.	.	.	1
190	1	.	.	.	.	.	.	.	.	.	.	.	1
200	1	.	.	.	.	.	.	.	.	.	.	.	1
250	1	.	.	.	.	.	.	.	.	.	.	.	1

A/ FORKLENGTH DENOTES BEGINNING OF LENGTH INTERVAL (E.G. 30=30 TO 39 MM)

APPENDIX D

STOMACH COMPOSITION

APPENDIX D

Table 1. Chinook Salmon Stomach Composition

SPECIES 8755010206-ONCORHYNCHUS TSHAWYTSCHA CHINOOK SALMON

FROM COLLECTIONS	FILE ID.	SAMPLE NO.	STATION LOC. NO.	SPECIMENS	COLLECTION TIME (PST)
	85JN16	BH1	30701	6	0
	85JN25	W 1	30301	3	1830

LIFE HISTORY STAGE
9 JUVENILE

TOTAL SAMPLE SIZE 9

NUMBER OF EMPTY STOMACHS 3
PERCENTAGE OF EMPTY STOMACHS 33.33
ADJUSTED SAMPLE SIZE(STOMACHS CONTAINING PREY) 6

PREY CODES TRUNCATED BY 0 DIGITS
LIFE HISTORY STAGES ARE UNPOOLED
DATA FORMAT = S240.33B

	MEAN	RANGE	S.D.
CONDITION FACTOR (1-7, EMPTY-DISTENDED)	3.7	2.-6.	1.9
DIGESTION FACTOR (1-5, COMPLETE-NONE)	4.3	3.-5.	.8
TOTAL CONTENTS WEIGHT (GRAMS)	.01	NEG.-.04	.02
TOTAL CONTENTS ABUNDANCE (NUMBERS)	13.8	1.0-39.0	19.1
NO. PREY CATEGORIES (PER STOMACH)	1.3	1.-3.	.8
LENGTH (MM)	65.4	38.-87.	20.22
WEIGHT (GRAMS)	3.07	.38-6.50	2.46
PCT RATIO OF CONTENTS WT TO PREDATOR WT	.44	.01-.99	.41

NOTE LENGTH AND WEIGHT STATISTICS ARE BASED ON THE TOTAL SAMPLE, INCLUDING EMPTY STOMACHS.

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
SADURIA ENTOMON	7-JUVENILE	33.3	75	12.5	37-38	19.4	.09	.01	.04-.05	.02	.0012	.0002	90.36	79.57	80.65
PLECOPTERA	H-NYMPH	16.7	1	.2	1-1	.4	.01	.00	.01-.01	.00	.0112	.0000	1.20	9.99	10.13
DIPTERA-CHIRONOMIDAE	6-LARVA	33.3	2	.3	1-1	.5	.00	.00	NEG.-.00	.00	.0012	.0008	2.41	2.05	2.08
DIPTERA-CHIRONOMIDAE	8-ADULT	16.7	1	.2	1-1	.4	.00	.00	NEG.-NEG.	.00	.0006	.0000	1.20	.54	.54

Table 1. Chinook Salmon (Continued)

SPECIES 8755010206-ONCORHYNCHUS TSHAWYTSCHA CHINOOK SALMON

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
PLANTS AND PLANT PARTS	0-UNSTAGED	33.3	4	.7	1- 3	1.2	.01	.00	NEG.- .01	.00	.0013	.0015	4.82	6.51	6.60
UNIDENTIFIED MATERIAL							.00	.00	.00- .00	.00				1.34	

TOTAL NUMBER OF PREY CATEGORIES 5

SHANNON-WEINER DIVERSITY INDEX (NORMALIZED) NUMBERS .63
BIOMASS 1.00

BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS .55

APPENDIX D

Table 2. Chum Salmon Stomach Composition

SPECIES 8755010202-ONCORHYNCHUS KETA CHUM SALMON

FROM COLLECTIONS

FILE ID.	SAMPLE NO.	STATION LOC. NO.	SPECIMENS	COLLECTION TIME (PST)
85JN17	P 1	30601	5	0
85JN19	P 1	30602	8	1956
85JN20	BH2	30703	11	0
85JN21	P 1	30101	3	1319
85JN21	P 2	30101	2	1427
85JN22	BH1	30704	9	1604
85JN23	W 1	30506	5	1820
85JN25	P 1	30202	6	1622
85JN25	P 1	30603	7	1222
85JN28	BH1	30708	5	0
85JN30	P 1	30201	10	1717
85JY07	BH1	30708	3	1040
85JY17	P 1	30601	4	1400
85JY21	P 2	30602	2	1650
85AU15	BH1	30708	2	1407

APPENDIX D

Table 2. Chum Salmon (Continued)

SPECIES 8755010202-ONCORHYNCHUS KETA CHUM SALMON

LIFE HISTORY STAGE
82 JUVENILE

TOTAL SAMPLE SIZE 82

NUMBER OF EMPTY STOMACHS 13
PERCENTAGE OF EMPTY STOMACHS 15.85
ADJUSTED SAMPLE SIZE(STOMACHS CONTAINING PREY) 69

PREY CODES TRUNCATED BY 0 DIGITS
LIFE HISTORY STAGES ARE UNPOOLED
DATA FORMAT = S240.33B

	MEAN	RANGE	S.D.
CONDITION FACTOR (1-7, EMPTY-DISTENDED)	4.2	2.-7.	1.5
DIGESTION FACTOR (1-5, COMPLETE-NONE)	4.4	2.-6.	.9
TOTAL CONTENTS WEIGHT (GRAMS)	.01	NEG.-.10	.02
TOTAL CONTENTS ABUNDANCE (NUMBERS)	18.6	1.0-115.0	25.9
NO. PREY CATEGORIES (PER STOMACH)	3.1	1.-8.	1.9
LENGTH (MM)	46.0	35.-84.	7.89
WEIGHT (GRAMS)	1.72	.24-79.10	8.67
PCT RATIO OF CONTENTS WT TO PREDATOR WT	1.58	.00-9.01	2.29

NOTE LENGTH AND WEIGHT STATISTICS ARE BASED ON THE TOTAL SAMPLE, INCLUDING EMPTY STOMACHS.

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
ARANEAE	C-J/A NOSEX	1.4	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0013	.0000	.08	.15	.15
ACARINA	C-J/A NOSEX	1.4	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.08	.01	.01
CRUSTACEA H-EXUVIAE	H-NYMPH	1.4	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0003	.0000	.08	.03	.03
DAPHNIA SP.	8-ADULT	2.9	2	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0002	.0001	.16	.03	.03
DAPHNIA SP.	A-JUV+ADULT	2.9	10	.1	3-7	.9	.00	.00	NEG.-NEG.	.00	.0001	.0000	.78	.10	.10
DAPHNIA SP.	C-J/A NOSEX	1.4	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0003	.0000	.08	.03	.03
BOSMINA SP.	8-ADULT	1.4	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.08	.01	.01

APPENDIX D

Table 2. Chum Salmon (Continued)

SPECIES 8755010202-ONCORHYNCHUS KETA CHUM SALMON

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
OSTRACODA	C-J/A NOSEX	4.3	4	.1	1-2	.3	.00	.00	NEG.-NEG.	.00	.0001	.0000	.31	.03	.03
CALANOIDA	8-ADULT	2.9	2	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0002	.0001	.16	.03	.03
CALANOIDA	A-JUV+ADULT	1.4	4	.1	4-4	.5	.00	.00	NEG.-NEG.	.00	.0001	.0000	.31	.05	.05
CALANOIDA	C-J/A NOSEX	2.9	4	.1	1-3	.4	.00	.00	NEG.-NEG.	.00	.0002	.0000	.31	.09	.09
CALANOIDA	F-COPEPODID	17.4	49	.7	1-12	2.1	.01	.00	NEG.-.00	.00	.0002	.0002	3.82	.99	1.00
EPISCHURA SP.	A-JUV+ADULT	2.9	26	.4	9-17	2.3	.02	.00	.01-.01	.00	.0006	.0000	2.02	1.81	1.83
EPISCHURA SP.	F-COPEPODID	8.7	28	.4	1-8	1.5	.01	.00	NEG.-.00	.00	.0005	.0002	2.18	1.58	1.60
HARPACTICOIDA	8-ADULT	5.8	37	.5	2-22	2.9	.00	.00	NEG.-NEG.	.00	.0000	.0000	2.88	.06	.06
CYCLOPOIDA	8-ADULT	5.8	8	.1	1-3	.5	.00	.00	NEG.-NEG.	.00	.0001	.0000	.62	.07	.07
CYCLOPOIDA	A-JUV+ADULT	11.6	205	3.0	4-64	11.8	.00	.00	NEG.-NEG.	.00	.0000	.0000	15.97	.43	.43
CYCLOPOIDA	F-COPEPODID	14.5	19	.3	1-5	.8	.00	.00	NEG.-NEG.	.00	.0001	.0000	1.48	.13	.13
SADURIA ENTOMON	7-JUVENILE	8.7	16	.2	1-5	.9	.02	.00	.00-.00	.00	.0013	.0005	1.25	2.13	2.16
GAMMARIDEA	7-JUVENILE	2.9	16	.2	1-15	1.8	.00	.00	NEG.-.00	.00	.0001	.0000	1.25	.29	.29
GAMMARIDAE	7-JUVENILE	1.4	29	.4	29-29	3.5	.01	.00	.01-.01	.00	.0002	.0000	2.26	.70	.71
INSECTA	6-LARVA	4.3	4	.1	1-2	.3	.00	.00	NEG.-.00	.00	.0006	.0003	.31	.32	.33
INSECTA	8-ADULT	2.9	2	.0	1-1	.2	.00	.00	NEG.-.00	.00	.0011	.0005	.16	.24	.24
INSECTA	C-J/A NOSEX	2.9	2	.0	1-1	.2	.00	.00	.00-.00	.00	.0018	.0005	.16	.40	.41
INSECTA H-EXUVIAE	C-J/A NOSEX	2.9	14	.2	2-12	1.5	.01	.00	NEG.-.00	.00	.0003	.0001	1.09	.60	.61
COLLEMBOLA	C-J/A NOSEX	8.7	34	.5	1-24	2.9	.01	.00	NEG.-.00	.00	.0003	.0001	2.65	.90	.91
EPHEMEROPTERA	H-NYMPH	1.4	1	.0	1-1	.1	.01	.00	.01-.01	.00	.0057	.0000	.08	.66	.66
HEPTAGENIIDAE	H-NYMPH	1.4	1	.0	1-1	.1	.01	.00	.01-.01	.00	.0083	.0000	.08	.96	.97
PLECOPTERA	H-NYMPH	13.0	13	.2	1-2	.5	.08	.00	.00-.02	.00	.0056	.0029	1.01	9.24	9.34
PSYLLIDAE	8-ADULT	1.4	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0012	.0000	.08	.14	.14
COLEOPTERA	6-LARVA	1.4	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0025	.0000	.08	.29	.29
STAPHYLINIDAE	8-ADULT	5.8	7	.1	1-3	.5	.01	.00	.00-.00	.00	.0014	.0005	.55	1.09	1.11
TRICOPTERA	8-ADULT	1.4	1	.0	1-1	.1	.01	.00	.01-.01	.00	.0052	.0000	.08	.60	.61

APPENDIX D

Table 2. Chum Salmon (Continued)

SPECIES 8755010202-ONCORHYNCHUS KETA CHUM SALMON

PREY ORGANISM PARTS	LIFE HISTORY STAGE CODE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
DIPTERA	6-LARVA	1.4	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0009	.0000	.08	.10	.10
DIPTERA	8-ADULT	5.8	5	.1	1-2	.3	.01	.00	NEG.-.01	.00	.0032	.0045	.39	1.54	1.56
DIPTERA H-EXUVIAE	G-PUPA	1.4	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.08	.01	.01
CERATOPOGONIDAE	6-LARVA	2.9	2	.0	1-1	.2	.00	.00	NEG.-.00	.00	.0008	.0007	.16	.18	.19
CERATOPOGONIDAE	8-ADULT	8.7	31	.4	1-12	1.8	.01	.00	NEG.-.01	.00	.0005	.0002	2.41	1.59	1.61
NEMATOCERA	8-ADULT	4.3	5	.1	1-2	.4	.00	.00	NEG.-.00	.00	.0005	.0004	.39	.29	.29
NEMATOCERA H-EXUVIAE	G-PUPA	1.4	3	.0	3-3	.4	.00	.00	.00-.00	.00	.0004	.0000	.23	.14	.14
TIPULIDAE	8-ADULT	1.4	4	.1	4-4	.5	.03	.00	.03-.03	.00	.0084	.0000	.31	3.85	3.89
SIMULIDAE	8-ADULT	2.9	2	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0007	.0001	.16	.16	.16
DIPTERA-CHIRONOMIDAE	6-LARVA	34.8	61	.9	1-12	2.0	.02	.00	NEG.-.01	.00	.0004	.0005	4.75	2.79	2.82
DIPTERA-CHIRONOMIDAE	8-ADULT	56.5	552	8.0	1-79	18.5	.50	.01	NEG.-.10	.02	.0007	.0005	42.99	58.11	58.79
DIPTERA-CHIRONOMIDAE H-EXUVIAE	A-JUV+ADULT	1.4	8	.1	8-8	1.0	.00	.00	.00-.00	.00	.0003	.0000	.62	.23	.23
DIPTERA-CHIRONOMIDAE	G-PUPA	11.6	37	.5	1-24	3.0	.02	.00	NEG.-.01	.00	.0008	.0002	2.88	2.44	2.47
DIPTERA-CHIRONOMIDAE H-EXUVIAE	G-PUPA	7.2	11	.2	1-3	.6	.00	.00	NEG.-NEG.	.00	.0003	.0001	.86	.31	.31
DIPTERA-BRACHYCERA	8-ADULT	4.3	3	.0	1-1	.2	.00	.00	NEG.-.00	.00	.0012	.0004	.23	.43	.43
DRYOMYZIDAE	8-ADULT	2.9	2	.0	1-1	.2	.00	.00	NEG.-.00	.00	.0019	.0018	.16	.43	.43
EPHYDRIDAE	8-ADULT	2.9	2	.0	1-1	.2	.00	.00	.00-.00	.00	.0022	.0003	.16	.51	.51
HYMENOPTERA	8-ADULT	1.4	2	.0	2-2	.2	.00	.00	.00-.00	.00	.0008	.0000	.16	.17	.17
TENTHREDINIDAE	8-ADULT	1.4	1	.0	1-1	.1	.01	.00	.01-.01	.00	.0064	.0000	.08	.74	.75
PLATYGASTERIDAE	8-ADULT	1.4	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0002	.0000	.08	.02	.02
TELEOSTEI	6-LARVA	1.4	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0042	.0000	.08	.48	.49
PLANTS AND PLANT PARTS	0-UNSTAGED	1.4	4	.1	4-4	.5	.00	.00	.00-.00	.00	.0003	.0000	.31	.13	.13

APPENDIX D
Table 2. Chum Salmon (Continued)

SPECIES 8755010202-ONCORHYNCHUS KETA	CHUM SALMON					
UNIDENTIFIED MATERIAL		.01	.00	.00- .00	.00	1.15

TOTAL NUMBER OF PREY CATEGORIES 55

SHANNON-WEINER DIVERSITY INDEX (NORMALIZED)	NUMBERS	3.40
	BIOMASS	2.81
BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS		3.30

APPENDIX D

Table 3. Coho Salmon Stomach Composition

SPECIES 8755010203-ONCORHYNCHUS KISUTCH COHO SALMON

FROM COLLECTIONS	FILE ID.	SAMPLE NO.	STATION LOC. NO.	SPECIMENS	COLLECTION TIME (PST)
	85JN18	BH1	30701	3	0
	85JN25	W 1	30301	1	1830
	85JN25	P 1	30603	1	1222

LIFE HISTORY STAGE
5 JUVENILE

TOTAL SAMPLE SIZE 5

NUMBER OF EMPTY STOMACHS 1
PERCENTAGE OF EMPTY STOMACHS 20.00
ADJUSTED SAMPLE SIZE(STOMACHS CONTAINING PREY) 4

PREY CODES TRUNCATED BY 0 DIGITS
LIFE HISTORY STAGES ARE UNPOOLED
DATA FORMAT = S240.33B

	MEAN	RANGE	S.D.
CONDITION FACTOR (1-7, EMPTY-DISTENDED)	5.0	3.-7.	2.3
DIGESTION FACTOR (1-5, COMPLETE-NONE)	5.0	5.-5.	.0
TOTAL CONTENTS WEIGHT (GRAMS)	.17	NEG.-.59	.28
TOTAL CONTENTS ABUNDANCE (NUMBERS)	5.8	1.0-17.0	7.5
NO. PREY CATEGORIES (PER STOMACH)	1.8	1.-4.	1.5
LENGTH (MM)	89.4	87.-94.	2.70
WEIGHT (GRAMS)	6.64	6.15-7.23	.41
PCT RATIO OF CONTENTS WT TO PREDATOR WT	2.74	.01-9.20	4.37

NOTE LENGTH AND WEIGHT STATISTICS ARE BASED ON THE TOTAL SAMPLE, INCLUDING EMPTY STOMACHS.

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
EPISCHURA SP.	F-COPEPODID	25.0	1	.3	1-1	.5	.00	.00	NEG.-NEG.	.00	.0001	.0000	4.35	.01	.01
SADURIA ENTOMON	7-JUVENILE	25.0	13	3.3	13-13	6.5	.09	.02	.09-.09	.05	.0072	.0000	56.52	13.39	13.40
PLECOPTERA	H-NYMPH	25.0	1	.3	1-1	.5	.00	.00	.00-.00	.00	.0029	.0000	4.35	.42	.42

APPENDIX D

Table 3. Coho Salmon (Continued)

SPECIES 8755010203-ONCORHYNCHUS KISUTCH COHO SALMON

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
ONCORHYNCHUS SP.	7-JUVENILE	25.0	2	.5	2- 2	1.0	.59	.15	.59- .59	.29	.2935	.0000	8.70	84.47	84.54
PLANTS AND PLANT PARTS	0-UNSTAGED	75.0	6	1.5	1- 3	1.3	.01	.00	NEG.- .01	.00	.0015	.0011	26.09	1.63	1.63
UNIDENTIFIED MATERIAL							.00	.00	.00- .00	.00				.09	

TOTAL NUMBER OF PREY CATEGORIES 5

SHANNON-WEINER DIVERSITY INDEX (NORMALIZED) NUMBERS 1.67

BIOMASS .72

BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS 1.38

APPENDIX D
Table 4. Pink Salmon Stomach Composition

SPECIES 8755010201-ONCORHYNCHUS GORBUSCHA PINK SALMON

FROM COLLECTIONS

FILE ID.	SAMPLE NO.	STATION LOC. NO.	SPECIMENS	COLLECTION TIME (PST)
85JN20	P 1	30603	2	1544
85JN20	BH2	30703	10	0
85JN21	P 1	30101	5	1319
85JN21	P 2	30101	3	1427
85JN22	BH1	30704	7	1604
85JN23	W 1	30506	2	1820
85JY07	BH1	30708	2	1040
85JY21	P 2	30602	2	1650

LIFE HISTORY STAGE
33 JUVENILE

TOTAL SAMPLE SIZE 33

NUMBER OF EMPTY STOMACHS 7
PERCENTAGE OF EMPTY STOMACHS 21.21
ADJUSTED SAMPLE SIZE(STOMACHS CONTAINING PREY) 26

PREY CODES TRUNCATED BY 0 DIGITS
LIFE HISTORY STAGES ARE UNPOOLED
DATA FORMAT = S240.33B

	MEAN	RANGE	S.D.
CONDITION FACTOR (1-7, EMPTY-DISTENDED)	3.7	2.-6.	1.3
DIGESTION FACTOR (1-5, COMPLETE-NONE)	4.7	3.-6.	.6
TOTAL CONTENTS WEIGHT (GRAMS)	.00	NEG.-.01	.00
TOTAL CONTENTS ABUNDANCE (NUMBERS)	18.5	1.0-62.0	15.5
NO. PREY CATEGORIES (PER STOMACH)	2.9	1.-6.	1.6
LENGTH (MM)	38.8	32.-67.	8.63
WEIGHT (GRAMS)	.37	.13-1.95	.42
PCT RATIO OF CONTENTS WT TO PREDATOR WT	.79	.03-2.88	.72

NOTE LENGTH AND WEIGHT STATISTICS ARE BASED ON THE TOTAL SAMPLE, INCLUDING EMPTY STOMACHS.

APPENDIX D
Table 4. Pink Salmon (Continued)

SPECIES 8755010201-ONCORHYNCHUS GORBUSCHA PINK SALMON

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUN- DANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
CALANOIDA	2-NAUPLIUS	7.7	2	.1	1- 1	.3	.00	.00	NEG.- NEG.	.00	.0001	.0000	.42	.47	.47
CALANOIDA	A-JUV+ADULT	3.8	16	.6	16- 16	3.1	.00	.00	NEG.- NEG.	.00	.0000	.0000	3.33	.70	.70
CALANOIDA	F-COPEPODID	34.6	166	6.4	1- 55	13.1	.00	.00	NEG.- .00	.00	.0000	.0000	34.51	9.11	9.11
EPISCHURA SP.	F-COPEPODID	19.2	16	.6	1- 9	1.9	.00	.00	NEG.- NEG.	.00	.0001	.0000	3.33	2.10	2.10
HARPACTICOIDA	8-ADULT	11.5	34	1.3	1- 27	5.4	.00	.00	NEG.- NEG.	.00	.0000	.0000	7.07	1.40	1.40
CANTHOCAMPTIDAE	8-ADULT	7.7	2	.1	1- 1	.3	.00	.00	NEG.- NEG.	.00	.0001	.0000	.42	.47	.47
CYCLOPOIDA	A-JUV+ADULT	30.8	132	5.1	3- 27	9.5	.00	.00	NEG.- NEG.	.00	.0000	.0000	27.44	6.78	6.78
CYCLOPOIDA	F-COPEPODID	11.5	11	.4	1- 8	1.6	.00	.00	NEG.- NEG.	.00	.0001	.0000	2.29	.93	.93
COLLEMBOLA H-EXUVIAE	C-J/A NOSEX	3.8	1	.0	1- 1	.2	.00	.00	NEG.- NEG.	.00	.0001	.0000	.21	.23	.23
COLLEMBOLA	C-J/A NOSEX	3.8	1	.0	1- 1	.2	.00	.00	NEG.- NEG.	.00	.0001	.0000	.21	.23	.23
HOMOPTERA	8-ADULT	3.8	1	.0	1- 1	.2	.00	.00	NEG.- NEG.	.00	.0004	.0000	.21	.93	.93
DIPTERA-CHIRONOMIDAE	6-LARVA	30.8	25	1.0	1- 12	2.5	.00	.00	NEG.- .00	.00	.0001	.0001	5.20	8.41	8.41
DIPTERA-CHIRONOMIDAE	8-ADULT	50.0	28	1.1	1- 8	1.8	.01	.00	NEG.- .00	.00	.0005	.0004	5.82	22.43	22.43
DIPTERA-CHIRONOMIDAE	G-PUPA	38.5	24	.9	1- 6	1.6	.01	.00	NEG.- .00	.00	.0007	.0004	4.99	33.18	33.18
DIPTERA-CHIRONOMIDAE H-EXUVIAE	G-PUPA	26.9	21	.8	1- 12	2.4	.01	.00	NEG.- .00	.00	.0001	.0001	4.37	12.15	12.15
PLANTS AND PLANT PARTS	1-EGG	3.8	1	.0	1- 1	.2	.00	.00	NEG.- NEG.	.00	.0002	.0000	.21	.47	.47
UNIDENTIFIED MATERIAL							.00	I*******-	.00	.00				.00	

TOTAL NUMBER OF PREY CATEGORIES 16

SHANNON-WEINER DIVERSITY INDEX (NORMALIZED) NUMBERS 2.78
BIOMASS 2.79

BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS 2.69

APPENDIX D

Table 5. Sheefish Stomach Composition

SPECIES 8755010501-STENODUS LEUCICHTHYS SHEEFISH-INCONNU

FROM COLLECTIONS

FILE ID.	SAMPLE NO.	STATION LOC. NO.	SPECIMENS	COLLECTION TIME (PST)
85JY07	BH2	30708	6	1105
85JY12	BH1	30708	5	1615
85JY17	P 1	30601	5	1400
85JY18	P 1	30201	5	1335
85JY21	P 2	30602	6	1650
85JY24	W 1	30404	8	1845
85JY24	W 1	30510	10	2200
85AU01	BH1	30708	5	1547
85AU11	P 2	30202	4	1945
85AU16	P 1	30201	4	1226
85AU19	W 1	30305	6	805
85AU28	W 1	30510	5	0
85SE12	W 1	30303	7	1025
85SE16	W 1	30512	7	1202
85SE16	W 1	30401	6	1008
85SE17	W 1	30405	5	1641

APPENDIX D
Table 5. Sheefish (Continued)

SPECIES 8755010501-STENODUS LEUCICHTHYS SHEEFISH-INCONNU

LIFE HISTORY STAGE
94 JUVENILE

TOTAL SAMPLE SIZE 94

NUMBER OF EMPTY STOMACHS 28
PERCENTAGE OF EMPTY STOMACHS 29.79
ADJUSTED SAMPLE SIZE(STOMACHS CONTAINING PREY) 66

PREY CODES TRUNCATED BY Ø DIGITS
LIFE HISTORY STAGES ARE UNPOOLED
DATA FORMAT = S240.33B

	MEAN	RANGE	S.D.
CONDITION FACTOR (1-7, EMPTY-DISTENDED)	3.2	2.-6.	1.1
DIGESTION FACTOR (1-5, COMPLETE-NONE)	4.6	2.-6.	.7
TOTAL CONTENTS WEIGHT (GRAMS)	.Ø3	NEG.-.33	.Ø5
TOTAL CONTENTS ABUNDANCE (NUMBERS)	7.8	1.Ø-46.Ø	9.9
NO. PREY CATEGORIES (PER STOMACH)	2.Ø	1.-7.	1.2
LENGTH (MM)	83.6	41.-127.	25.58
WEIGHT (GRAMS)	6.51	.43-19.Ø8	5.73
PCT RATIO OF CONTENTS WT TO PREDATOR WT	.35	.Ø1-1.76	.42

NOTE LENGTH AND WEIGHT STATISTICS ARE BASED ON THE TOTAL SAMPLE, INCLUDING EMPTY STOMACHS.

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
ACARINA	C-J/A NOSEX	1.5	2	.Ø	2-2	.2	.ØØ	.ØØ	NEG.-NEG.	.ØØ	.ØØØØ	.ØØØØ	.39	.Ø1	.Ø1
DAPHNIA SP.	8-ADULT	4.5	3	.Ø	1-1	.2	.ØØ	.ØØ	NEG.-NEG.	.ØØ	.ØØØ2	.ØØØ1	.58	.Ø4	.Ø4
DAPHNIA SP.	A-JUV+ADULT	6.1	16	.2	3-5	1.Ø	.ØØ	.ØØ	NEG.-NEG.	.ØØ	.ØØØ1	.ØØØ1	3.Ø9	.11	.11
BOSMINA SP.	8-ADULT	3.Ø	2	.Ø	1-1	.2	.ØØ	.ØØ	NEG.-NEG.	.ØØ	.ØØØ1	.ØØØØ	.39	.Ø1	.Ø1
OSTRACODA	C-J/A NOSEX	1.5	1	.Ø	1-1	.1	.ØØ	.ØØ	.ØØ-.ØØ	.ØØ	.ØØ18	.ØØØØ	.19	.11	.11
CALANOIDA	8-ADULT	3.Ø	4	.1	1-3	.4	.ØØ	.ØØ	NEG.-NEG.	.ØØ	.ØØØ1	.ØØØ1	.77	.Ø2	.Ø2
CALANOIDA	C-J/A NOSEX	1.5	1	.Ø	1-1	.1	.ØØ	.ØØ	.ØØ-.ØØ	.ØØ	.ØØ1Ø	.ØØØØ	.19	.Ø6	.Ø6

APPENDIX D

Table 5. Sheefish (Continued)

SPECIES 8755010501-STENODUS LEUCICHTHYS SHEEFISH-INCONNU

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
CALANOIDA	F-COPEPODID	15.2	17	.3	1-4	.7	.00	.00	NEG.-NEG.	.00	.0002	.0002	3.29	.16	.16
EPISCHURA SP.	8-ADULT	4.5	3	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0006	.0001	.58	.10	.10
EPISCHURA SP.	A-JUV+ADULT	1.5	4	.1	4-4	.5	.00	.00	.00-.00	.00	.0005	.0000	.77	.12	.12
CYCLOPOIDA	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.19	.01	.01
CYCLOPOIDA	A-JUV+ADULT	6.1	39	.6	5-17	2.6	.00	.00	NEG.-NEG.	.00	.0000	.0000	7.54	.08	.08
CYCLOPOIDA	F-COPEPODID	7.6	17	.3	1-8	1.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	3.29	.03	.03
MYSIDAE	7-JUVENILE	13.6	24	.4	1-6	1.1	.06	.00	.00-.02	.00	.0028	.0016	4.64	3.79	3.80
MYSIDAE	L-EGG-C FEM	3.0	2	.0	1-1	.2	.03	.00	.02-.02	.00	.0155	.0005	.39	1.80	1.81
NEOMYSIS SP.	7-JUVENILE	30.3	167	2.5	1-46	7.3	.88	.01	NEG.-.33	.05	.0046	.0026	32.30	51.64	51.87
NEOMYSIS SP.	A-JUV+ADULT	1.5	35	.5	35-35	4.3	.21	.00	.21-.21	.03	.0060	.0000	6.77	12.34	12.40
HAUSTORIIDAE	7-JUVENILE	21.2	89	1.3	1-42	5.4	.22	.00	NEG.-.05	.01	.0035	.0029	17.21	12.55	12.60
HAUSTORIIDAE	8-ADULT	1.5	1	.0	1-1	.1	.01	.00	.01-.01	.00	.0071	.0000	.19	.41	.42
CRANGONIDAE	7-JUVENILE	4.5	3	.0	1-1	.2	.02	.00	.00-.01	.00	.0061	.0046	.58	1.07	1.08
INSECTA	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0005	.0000	.19	.03	.03
EPHEMEROPTERA	H-NYMPH	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0003	.0000	.19	.02	.02
HEPTAGENIIDAE	H-NYMPH	3.0	2	.0	1-1	.2	.02	.00	.01-.01	.00	.0118	.0016	.39	1.37	1.38
PLECOPTERA	H-NYMPH	3.0	3	.0	1-2	.3	.01	.00	.00-.01	.00	.0031	.0022	.58	.64	.64
HEMIPTERA	8-ADULT	1.5	1	.0	1-1	.1	.01	.00	.01-.01	.00	.0064	.0000	.19	.37	.38
APHIDIDAE	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0006	.0000	.19	.04	.04
CERATOPOGONIDAE	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.19	.01	.01
NEMATOCERA	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0007	.0000	.19	.04	.04
TIPULIDAE	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0015	.0000	.19	.09	.09
BLEPHERICERIDAE	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0009	.0000	.19	.05	.05
DIPTERA-CHIRONOMIDAE	6-LARVA	15.2	14	.2	1-4	.6	.00	.00	NEG.-.00	.00	.0004	.0003	2.71	.29	.29
DIPTERA-CHIRONOMIDAE	8-ADULT	16.7	51	.8	1-28	3.6	.04	.00	NEG.-.02	.00	.0009	.0013	9.86	2.12	2.13
DIPTERA-CHIRONOMIDAE	G-PUPA	1.5	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0013	.0000	.19	.08	.08

APPENDIX D

Table 5. Sheefish (Continued)

SPECIES 8755010501-STENODUS LEUCICHTHYS SHEEFISH-INCONNU

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
EPHYDRIDAE	8-ADULT	3.0	2	.0	1-1	.2	.00	.00	.00-.00	.00	.0014	.0002	.39	.16	.16
TENTHREDINIDAE	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0028	.0000	.19	.16	.16
TELEOSTEI	6-LARVA	1.5	1	.0	1-1	.1	.01	.00	.01-.01	.00	.0115	.0000	.19	.67	.67
TELEOSTEI	C-J/A NOSEX	1.5	1	.0	1-1	.1	.11	.00	.11-.11	.01	.1079	.0000	.19	6.30	6.33
TELEOSTEI D-TAILS	C-J/A NOSEX	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0004	.0000	.19	.02	.02
PUNGITIS PUNGITIUS	7-JUVENILE	1.5	1	.0	1-1	.1	.05	.00	.05-.05	.01	.0456	.0000	.19	2.66	2.67
UNIDENTIFIED MATERIAL							.01	.00	.00-.00	.00				.44	

TOTAL NUMBER OF PREY CATEGORIES 39

SHANNON-WEINER DIVERSITY INDEX (NORMALIZED) NUMBERS 3.41
BIOMASS 2.53

BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS 3.26

APPENDIX D

Table 6. Humpback Whitefish Stomach Composition

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SPECIES 8755010199-COREGONUS CF PIDSCHIAN GROUP HUMPBACK WHITEFISH GP

FROM COLLECTIONS	FILE ID.	SAMPLE NO.	STATION LOC. NO.	SPECIMENS	COLLECTION TIME (PST)
	85JY08	W 1	30501	5	0
	85JY12	BH1	30708	5	1615
	85JY21	P 2	30602	8	1650
	85JY24	W 1	30404	5	1845
	85JY24	W 2	30510	5	1845
	85AU07	W 1	30406	5	1825
	85AU12	W 1	30602	5	1516
	85AU12	BH1	30702	5	1830
	85AU14	P 1	30602	5	1138
	85AU20	W 1	30404	5	1605
	85AU20	W 1	30510	5	1650
	85AU27	W 1	30404	5	1456
	85SE12	W 1	30303	7	1025
	85SE12	W 1	30406	4	1815
	85SE12	W 2	30513	5	1610
	85SE13	P 2	30602	10	1356
	85SE16	W 1	30512	5	1202
	85SE17	W 2	30511	5	1610

APPENDIX D

Table 6. Humpback Whitefish (Continued)

SPECIES 8755010199-COREGONUS CF PIDSCHIAN GROUP HUMPBACK WHITEFISH GP

LIFE HISTORY STAGE

99 JUVENILE

TOTAL SAMPLE SIZE 99

NUMBER OF EMPTY STOMACHS 31
PERCENTAGE OF EMPTY STOMACHS 31.31
ADJUSTED SAMPLE SIZE(STOMACHS CONTAINING PREY) 68

PREY CODES TRUNCATED BY 0 DIGITS
LIFE HISTORY STAGES ARE UNPOOLED
DATA FORMAT = S240.33B

	MEAN	RANGE	S.D.
CONDITION FACTOR (1-7, EMPTY-DISTENDED)	3.1	2.-6.	1.1
DIGESTION FACTOR (1-5, COMPLETE-NONE)	4.3	2.-6.	1.1
TOTAL CONTENTS WEIGHT (GRAMS)	.01	NEG.-.13	.02
TOTAL CONTENTS ABUNDANCE (NUMBERS)	45.4	1.0-440.0	84.1
NO. PREY CATEGORIES (PER STOMACH)	2.5	1.-12.	2.3
LENGTH (MM)	65.6	32.-97.	14.66
WEIGHT (GRAMS)	3.19	.21-11.10	2.18
PCT RATIO OF CONTENTS WT TO PREDATOR WT	.27	.00-3.51	.52

NOTE LENGTH AND WEIGHT STATISTICS ARE BASED ON THE TOTAL SAMPLE, INCLUDING EMPTY STOMACHS.

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
ROTIFERA	C-J/A NOSEX	7.4	170	2.5	1-117	14.6	.00	.00	NEG.-NEG.	.00	.0000	.0000	5.51	.15	.15
NEMATODA	C-J/A NOSEX	2.9	3	.0	1-2	.3	.00	.00	NEG.-NEG.	.00	.0001	.0000	.10	.04	.04
OLIGOCHAETA	C-J/A NOSEX	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.03	.02	.02
ARANEAE	C-J/A NOSEX	1.5	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0019	.0000	.03	.42	.42
ACARINA	C-J/A NOSEX	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.03	.02	.02
CRUSTACEA	1-EGG	1.5	5	.1	5-5	.6	.00	.00	NEG.-NEG.	.00	.0000	.0000	.16	.02	.02
CLADOCERA-EUCLADOCERA	8-ADULT	2.9	4	.1	2-2	.3	.00	.00	NEG.-NEG.	.00	.0000	.0000	.13	.04	.04

APPENDIX D

Table 6. Humpback Whitefish (Continued)

****
SPECIES 8755010199-COREGONUS CF PIDSCHIAN GROUP HUMPBACK WHITEFISH GP

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUN-DANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
CLADOCERA-EUCLADOCERA	C-J/A NOSEX	1.5	4	.1	4-4	.5	.00	.00	NEG.-NEG.	.00	.0000	.0000	.13	.02	.02
DAPHNIDAE	8-ADULT	1.5	2	.0	2-2	.2	.00	.00	NEG.-NEG.	.00	.0000	.0000	.06	.02	.02
DAPHNIA SP.	8-ADULT	1.5	3	.0	3-3	.4	.00	.00	NEG.-NEG.	.00	.0000	.0000	.10	.02	.02
BOSMINA SP.	8-ADULT	7.4	26	.4	1-21	2.6	.00	.00	NEG.-NEG.	.00	.0001	.0000	.84	.17	.18
BOSMINA SP.	A-JUV+ADULT	1.5	16	.2	16-16	1.9	.00	.00	NEG.-NEG.	.00	.0000	.0000	.52	.04	.04
CHYDORIDAE	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.03	.02	.02
CHYDORIDAE	A-JUV+ADULT	1.5	21	.3	21-21	2.5	.00	.00	NEG.-NEG.	.00	.0000	.0000	.68	.02	.02
OSTRACODA	C-J/A NOSEX	16.2	33	.5	1-8	1.4	.00	.00	NEG.-NEG.	.00	.0001	.0000	1.07	.39	.40
PENAEIDEA	2-NAUPLIUS	5.9	26	.4	1-14	2.1	.00	.00	NEG.-NEG.	.00	.0001	.0001	.84	.09	.09
CALANOIDA	2-NAUPLIUS	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.03	.02	.02
CALANOIDA	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0003	.0000	.03	.07	.07
CALANOIDA	A-JUV+ADULT	4.4	172	2.5	18-94	13.6	.01	.00	NEG.-.00	.00	.0000	.0000	5.58	1.16	1.17
CALANOIDA	F-COPEPODID	22.1	35	.5	1-20	2.4	.00	.00	NEG.-NEG.	.00	.0001	.0000	1.13	.35	.35
EURYTEMORA SP.	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.03	.02	.02
EURYTEMORA SP.	A-JUV+ADULT	4.4	249	3.7	17-129	19.9	.01	.00	NEG.-.00	.00	.0000	.0000	8.07	1.83	1.86
EURYTEMORA SP.	F-COPEPODID	2.9	4	.1	1-3	.4	.00	.00	NEG.-NEG.	.00	.0001	.0000	.13	.07	.07
HARPACTICOIDA	8-ADULT	13.2	26	.4	1-11	1.5	.00	.00	NEG.-NEG.	.00	.0001	.0000	.84	.28	.29
HARPACTICOIDA	A-JUV+ADULT	20.6	391	5.8	3-125	20.5	.00	.00	NEG.-.00	.00	.0000	.0000	12.67	1.07	1.08
HARPACTICOIDA	C-J/A NOSEX	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.03	.02	.02
HARPACTICOIDA	F-COPEPODID	5.9	24	.4	1-10	1.6	.00	.00	NEG.-NEG.	.00	.0000	.0000	.78	.09	.09
TACHIDIUS SP.	A-JUV+ADULT	7.4	1294	19.0	149-437	73.8	.01	.00	.00-.00	.00	.0000	.0000	41.94	2.12	2.15
CYCLOPOIDA	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.03	.02	.02
CYCLOPOIDA	A-JUV+ADULT	4.4	39	.6	6-26	3.3	.00	.00	NEG.-NEG.	.00	.0000	.0000	1.26	.17	.18
CYCLOPOIDA	F-COPEPODID	16.2	297	4.4	1-82	14.6	.00	.00	NEG.-.00	.00	.0000	.0000	9.63	.81	.82
MYSIDAE	7-JUVENILE	2.9	7	.1	1-6	.7	.02	.00	NEG.-.02	.00	.0022	.0026	.23	5.35	5.42
NEOMYSIS SP.	A-JUV+ADULT	1.5	10	.1	10-10	1.2	.04	.00	.04-.04	.01	.0043	.0000	.32	9.37	9.49

APPENDIX D

Table 6. Humpback Whitefish (Continued)

SPECIES 8755010199-COREGONUS CF PIDSCHIAN GROUP HUMPBACK WHITEFISH GP

PREY ORGANISM	PARTS	LIFE HISTORY STAGE CODE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
GAMMARIDEA		C-J/A NOSEX	5.9	4	.1	1-1	.2	.00	.00	NEG.-.00	.00	.0011	.0010	.13	.94	.95
HAUSTORIIDAE		7-JUVENILE	7.4	10	.1	1-3	.6	.02	.00	NEG.-.01	.00	.0016	.0005	.32	3.58	3.63
HAUSTORIIDAE		8-ADULT	4.4	3	.0	1-1	.2	.01	.00	.00-.01	.00	.0040	.0025	.10	2.60	2.63
HAUSTORIIDAE		A-JUV+ADULT	7.4	99	1.5	5-36	6.3	.27	.00	.01-.13	.02	.0028	.0007	3.21	59.07	59.84
COLLEMBOLA		C-J/A NOSEX	5.9	37	.5	1-20	2.9	.00	.00	NEG.-NEG.	.00	.0000	.0000	1.20	.11	.11
EPHEMEROPTERA		H-NYMPH	1.5	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0023	.0000	.03	.50	.51
APHIDIDAE		8-ADULT	1.5	3	.0	3-3	.4	.00	.00	NEG.-NEG.	.00	.0002	.0000	.10	.11	.11
COLEOPTERA		8-ADULT	1.5	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0010	.0000	.03	.22	.22
TRICOPTERA		8-ADULT	1.5	1	.0	1-1	.1	.01	.00	.01-.01	.00	.0117	.0000	.03	2.56	2.59
DIPTERA		6-LARVA	1.5	2	.0	2-2	.2	.00	.00	NEG.-NEG.	.00	.0003	.0000	.06	.13	.13
DIPTERA	H-EXUVIAE	G-PUPA	1.5	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0027	.0000	.03	.59	.60
DIPTERA-CHIRONOMIDAE		6-LARVA	20.6	30	.4	1-4	1.1	.01	.00	NEG.-.00	.00	.0003	.0004	.97	1.35	1.37
DIPTERA-CHIRONOMIDAE		8-ADULT	4.4	14	.2	1-12	1.5	.00	.00	NEG.-.00	.00	.0006	.0005	.45	.63	.64
DIPTERA-CHIRONOMIDAE	H-EXUVIAE	G-PUPA	2.9	3	.0	1-2	.3	.00	.00	NEG.-NEG.	.00	.0003	.0001	.10	.17	.18
DIPTERA-CHIRONOMIDAE		G-PUPA	2.9	3	.0	1-2	.3	.00	.00	NEG.-NEG.	.00	.0003	.0000	.10	.17	.18
DIPTERA-BRACHYCERA		6-LARVA	2.9	2	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0007	.0004	.06	.28	.29
UNIDENTIFIED		C-J/A NOSEX	1.5	1	.0	1-1	.1	.01	.00	.01-.01	.00	.0061	.0000	.03	1.33	1.35
UNIDENTIFIED MATERIAL								.01	.00	.00-.00	.00				1.29	

TOTAL NUMBER OF PREY CATEGORIES 50

SHANNON-WEINER DIVERSITY INDEX (NORMALIZED) NUMBERS 3.13
BIOMASS 2.59

BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS 3.09

86/02/13. 00.07.23.IULP, 1.285, TLAS001, GEMC000, H0, 81817 ** END OF LISTI

APPENDIX D
Table 7. Bering Cisco Stomach Composition

SPECIES 8755010102-COREGONUS LAURETTAE BERING CISCO

FROM COLLECTIONS

FILE ID.	SAMPLE NO.	STATION LOC. NO.	SPECIMENS	COLLECTION TIME (PST)
85AU10	P 1	30103	5	1713
85AU13	P 1	30101	5	1344
85SE10	P 2	30102	5	1455
85SE16	W 1	30401	5	1008

LIFE HISTORY STAGE
20 JUVENILE

TOTAL SAMPLE SIZE 20

NUMBER OF EMPTY STOMACHS 1
PERCENTAGE OF EMPTY STOMACHS 5.00
ADJUSTED SAMPLE SIZE(STOMACHS CONTAINING PREY) 19

PREY CODES TRUNCATED BY 0 DIGITS
LIFE HISTORY STAGES ARE UNPOOLED
DATA FORMAT = S240.33B

	MEAN	RANGE	S.D.
CONDITION FACTOR (1-7, EMPTY-DISTENDED)	3.9	2.-6.	1.5
DIGESTION FACTOR (1-5, COMPLETE-NONE)	5.2	4.-6.	.7
TOTAL CONTENTS WEIGHT (GRAMS)	.07	NEG.-.38	.12
TOTAL CONTENTS ABUNDANCE (NUMBERS)	122.7	1.0-545.0	162.4
NO. PREY CATEGORIES (PER STOMACH)	2.0	1.-4.	1.0
LENGTH (MM)	84.3	67.-103.	11.55
WEIGHT (GRAMS)	7.42	3.13-13.67	3.38
PCT RATIO OF CONTENTS WT TO PREDATOR WT	.71	.00-3.74	1.09

NOTE LENGTH AND WEIGHT STATISTICS ARE BASED ON THE TOTAL SAMPLE, INCLUDING EMPTY STOMACHS.

APPENDIX D
Table 7. Bering Cisco (Continued)

****
SPECIES 8756010102-COREGONUS LAURETTAE BERING CISCO

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
BIVALVIA	6-LARVA	5.3	1	.1	1-1	.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	.04	.01	.01
PODON SP.	7-JUVENILE	5.3	1	.1	1-1	.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	.04	.01	.01
PODON SP.	8-ADULT	10.5	2	.1	1-1	.3	.00	.00	NEG.-NEG.	.00	.0001	.0000	.09	.02	.02
CALANOIDA	2-NAUPLIUS	5.3	4	.2	4-4	.9	.00	.00	NEG.-NEG.	.00	.0000	.0000	.17	.01	.01
CALANOIDA	A-JUV+ADULT	68.4	2139	112.6	2-544	166.9	.06	.00	NEG.-.01	.00	.0000	.0000	91.76	5.23	5.31
CALANOIDA	F-COPEPODID	5.3	1	.1	1-1	.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	.04	.01	.01
HARPACTICOIDA	8-ADULT	5.3	1	.1	1-1	.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	.04	.01	.01
HARPACTICOIDA	A-JUV+ADULT	5.3	3	.2	3-3	.7	.00	.00	NEG.-NEG.	.00	.0000	.0000	.13	.01	.01
HARPACTICOIDA	F-COPEPODID	10.5	2	.1	1-1	.3	.00	.00	NEG.-NEG.	.00	.0001	.0000	.09	.02	.02
BALANOMORPHA	E-CYPRIS	5.3	1	.1	1-1	.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	.04	.01	.01
MYSIDAE	7-JUVENILE	5.3	1	.1	1-1	.2	.00	.00	NEG.-NEG.	.00	.0002	.0000	.04	.02	.02
NEOMYSIS SP.	7-JUVENILE	26.3	137	7.2	4-47	15.0	.96	.05	.02-.32	.11	.0068	.0008	5.88	78.08	79.30
BOPYRIDAE	C-J/A NOSEX	5.3	1	.1	1-1	.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	.04	.01	.01
HAUSTORIIDAE	8-ADULT	10.5	9	.5	1-8	1.8	.05	.00	.01-.04	.01	.0054	.0000	.39	3.91	3.98
HAUSTORIIDAE	A-JUV+ADULT	5.3	10	.5	10-10	2.3	.07	.00	.07-.07	.02	.0073	.0000	.43	5.88	5.98
CRANGONIDAE	6-LARVA	5.3	15	.8	15-15	3.4	.01	.00	.01-.01	.00	.0007	.0000	.64	.81	.82
DIPTERA-CHIRONOMIDAE	8-ADULT	10.5	2	.1	1-1	.3	.00	.00	NEG.-.00	.00	.0008	.0008	.09	.12	.12
TELEOSTEI	6-LARVA	5.3	1	.1	1-1	.2	.05	.00	.05-.05	.01	.0531	.0000	.04	4.30	4.37
UNIDENTIFIED MATERIAL							.02	.00	.00-.01	.00				1.55	

TOTAL NUMBER OF PREY CATEGORIES 18

SHANNON-WEINER DIVERSITY INDEX (NORMALIZED) NUMBERS .56
BIOMASS 1.20

BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS .54

APPENDIX D

Table 8. Least Cisco Stomach Composition

SPECIES 8755010105-COREGONUS SARDINELLA LEAST CISCO

FROM COLLECTIONS	FILE ID.	SAMPLE NO.	STATION LOC. NO.	SPECIMENS	COLLECTION TIME (PST)
	85JY12	BH1	30708	5	1615
	85JY18	P 1	30201	5	1335
	85JY24	W 1	30404	3	1845
	85JY24	W 2	30510	5	1845
	85JY26	P 1	30102	5	1450
	85AU14	P 1	30602	5	1138
	85AU27	W 3	30404	5	1456
	85AU27	W 3	30510	5	1330
	85AU30	BH1	30708	5	1300
	85SE12	W 1	30303	10	1025
	85SE12	W 1	30406	5	1850
	85SE12	W 1	30513	10	1610
	85SE13	P 1	30602	7	1304
	85SE16	W 1	30512	5	1202

APPENDIX D

Table 8. Least Cisco (Continued)

SPECIES 8755010105-COREGONUS SARDINELLA LEAST CISCO

LIFE HISTORY STAGE
80 JUVENILE

TOTAL SAMPLE SIZE 80

NUMBER OF EMPTY STOMACHS 15
PERCENTAGE OF EMPTY STOMACHS 18.75
ADJUSTED SAMPLE SIZE(STOMACHS CONTAINING PREY) 65

PREY CODES TRUNCATED BY 0 DIGITS
LIFE HISTORY STAGES ARE UNPOOLED
DATA FORMAT = S240.33B

	MEAN	RANGE	S.D.
CONDITION FACTOR (1-7, EMPTY-DISTENDED)	3.5	2.-6.	1.2
DIGESTION FACTOR (1-5, COMPLETE-NONE)	3.9	2.-6.	.9
TOTAL CONTENTS WEIGHT (GRAMS)	.01	NEG.-.05	.01
TOTAL CONTENTS ABUNDANCE (NUMBERS)	204.5	1.0-3552.0	599.5
NO. PREY CATEGORIES (PER STOMACH)	2.9	1.-8.	1.8
LENGTH (MM)	71.2	36.-147.	22.05
WEIGHT (GRAMS)	4.80	.30-39.58	6.29
PCT RATIO OF CONTENTS WT TO PREDATOR WT	.47	.00-4.15	.71

NOTE LENGTH AND WEIGHT STATISTICS ARE BASED ON THE TOTAL SAMPLE, INCLUDING EMPTY STOMACHS.

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
ARANEAE	C-J/A NOSEX	3.1	2	.0	1-1	.2	.00	.00	NEG.-.00	.00	.0011	.0006	.02	.37	.44
CLADOCERA-EUCLADOCERA	C-J/A NOSEX	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.01	.02	.02
DAPHNIA SP.	8-ADULT	3.1	2	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0002	.0001	.02	.05	.06
BOSMINA SP.	8-ADULT	6.2	9	.1	1-3	.6	.00	.00	NEG.-NEG.	.00	.0001	.0000	.07	.08	.10
BOSMINA SP.	A-JUV+ADULT	1.5	4	.1	4-4	.5	.00	.00	NEG.-NEG.	.00	.0001	.0000	.03	.05	.06
CHYDORIDAE	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.01	.02	.02
CHYDORIDAE	C-J/A NOSEX	7.7	21	.3	1-9	1.6	.00	.00	NEG.-NEG.	.00	.0001	.0000	.16	.08	.10

APPENDIX D

Table 8. Least Cisco (Continued)

SPECIES 8755010105-COREGONUS SARDINELLA LEAST CISCO

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
OSTRACODA	C-J/A NOSEX	3.1	12	.2	5-7	1.1	.00	.00	NEG.-NEG.	.00	.0000	.0000	.09	.08	.10
PENAEIDEA	2-NAUPLIUS	6.2	75	1.2	1-36	5.5	.00	.00	NEG.-NEG.	.00	.0000	.0000	.56	.07	.08
CALANOIDA	2-NAUPLIUS	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.01	.02	.02
CALANOIDA	8-ADULT	3.1	2	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0002	.0001	.02	.05	.06
CALANOIDA	A-JUV+ADULT	10.8	1336	20.6	3-408	80.7	.03	.00	NEG.-.01	.00	.0000	.0000	10.05	4.59	5.46
CALANOIDA	F-COPEPODID	26.2	508	7.8	1-198	30.0	.01	.00	NEG.-.00	.00	.0001	.0000	3.82	1.35	1.60
EURYTEMORA SP.	A-JUV+ADULT	15.4	1854	28.5	14-505	97.6	.06	.00	NEG.-.01	.00	.0000	.0000	13.95	10.04	11.92
EPILABIDOCERA LONGIPEDATA	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0007	.0000	.01	.12	.14
HARPACTICOIDA	8-ADULT	13.8	148	2.3	1-112	14.0	.00	.00	NEG.-NEG.	.00	.0000	.0000	1.11	.18	.22
HARPACTICOIDA	A-JUV+ADULT	10.8	272	4.2	6-138	18.4	.00	.00	NEG.-NEG.	.00	.0000	.0000	2.05	.33	.40
HARPACTICOIDA	F-COPEPODID	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.01	.02	.02
TACHIDIUS SP.	8-ADULT	1.5	2	.0	2-2	.2	.00	.00	NEG.-NEG.	.00	.0000	.0000	.02	.02	.02
TACHIDIUS SP.	A-JUV+ADULT	13.8	8102	124.6	2-3144	560.1	.08	.00	NEG.-.03	.01	.0000	.0000	60.94	13.12	15.58
CYCLOPOIDA	8-ADULT	3.1	2	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	.02	.03	.04
CYCLOPOIDA	A-JUV+ADULT	3.1	13	.2	4-9	1.2	.00	.00	NEG.-NEG.	.00	.0000	.0000	.10	.07	.08
CYCLOPOIDA	F-COPEPODID	21.5	613	9.4	1-212	37.5	.00	.00	NEG.-.00	.00	.0000	.0000	4.61	.70	.83
MYSIDAE	7-JUVENILE	3.1	3	.0	1-2	.3	.01	.00	NEG.-.01	.00	.0017	.0017	.02	1.03	1.23
NEOMYSIS SP.	7-JUVENILE	10.8	11	.2	1-3	.5	.04	.00	NEG.-.01	.00	.0035	.0028	.08	6.44	7.65
GAMMARIDEA	7-JUVENILE	3.1	4	.1	1-3	.4	.01	.00	NEG.-.01	.00	.0016	.0013	.03	1.38	1.64
GAMMARIDEA	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0018	.0000	.01	.30	.36
GAMMARIDEA	C-J/A NOSEX	4.6	3	.0	1-1	.2	.01	.00	.00-.01	.00	.0024	.0022	.02	1.22	1.44
HAUSTORIIDAE	7-JUVENILE	6.2	6	.1	1-3	.4	.02	.00	.00-.01	.00	.0031	.0014	.05	2.96	3.52
HAUSTORIIDAE	8-ADULT	3.1	3	.0	1-2	.3	.02	.00	.00-.01	.00	.0056	.0022	.02	3.03	3.60
HAUSTORIIDAE	A-JUV+ADULT	3.1	18	.3	4-14	1.8	.05	.00	.00-.05	.01	.0022	.0014	.14	8.36	9.93
INSECTA	6-LARVA	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0003	.0000	.01	.05	.06
INSECTA	8-ADULT	3.1	25	.4	1-24	3.0	.02	.00	NEG.-.02	.00	.0007	.0004	.19	4.01	4.77

APPENDIX D
Table 8. Least Cisco (Continued)

SPECIES 8755010105-COREGONUS SARDINELLA LEAST CISCO

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
COLLEMBOLA	C-J/A NOSEX	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0003	.0000	.01	.05	.06
EPHEMEROPTERA	H-NYMPH	3.1	2	.0	1-1	.2	.00	.00	.00-.00	.00	.0024	.0018	.02	.80	.95
PSOCOPTERA	8-ADULT	1.5	2	.0	2-2	.2	.00	.00	.00-.00	.00	.0023	.0000	.02	.77	.91
THYSANOPTERA	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.01	.02	.02
HOMOPTERA	8-ADULT	6.2	18	.3	1-10	1.4	.02	.00	NEG.-.01	.00	.0010	.0007	.14	3.65	4.33
APHIDIDAE	8-ADULT	4.6	4	.1	1-2	.3	.00	.00	NEG.-.00	.00	.0006	.0003	.03	.43	.51
TRICOPTERA	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0007	.0000	.01	.12	.14
DIPTERA	6-LARVA	1.5	2	.0	2-2	.2	.00	.00	NEG.-NEG.	.00	.0002	.0000	.02	.05	.06
DIPTERA	8-ADULT	1.5	5	.1	5-5	.6	.01	.00	.01-.01	.00	.0014	.0000	.04	1.13	1.34
CERATOPOGONIDAE	8-ADULT	12.3	26	.4	1-7	1.3	.02	.00	NEG.-.01	.00	.0010	.0012	.20	3.10	3.68
NEMATOCERA	8-ADULT	1.5	5	.1	5-5	.6	.00	.00	.00-.00	.00	.0005	.0000	.04	.45	.53
TIPULIDAE	8-ADULT	4.6	3	.0	1-1	.2	.01	.00	.00-.00	.00	.0023	.0010	.02	1.13	1.34
DIPTERA-CHIRONOMIDAE	6-LARVA	3.1	4	.1	1-3	.4	.00	.00	NEG.-NEG.	.00	.0001	.0001	.03	.07	.08
DIPTERA-CHIRONOMIDAE	8-ADULT	21.5	136	2.1	1-32	5.8	.04	.00	NEG.-.01	.00	.0004	.0002	1.02	6.68	7.93
CHAOBORIDAE	6-LARVA	1.5	2	.0	2-2	.2	.00	.00	NEG.-NEG.	.00	.0003	.0000	.02	.08	.10
DIPTERA-BRACHYCERA	8-ADULT	4.6	4	.1	1-2	.3	.01	.00	.00-.01	.00	.0029	.0010	.03	2.08	2.47
EPHYDRIDAE	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0015	.0000	.01	.25	.30
MUSCIDAE	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0031	.0000	.01	.52	.61
HYMENOPTERA	8-ADULT	4.6	8	.1	2-3	.6	.01	.00	.00-.00	.00	.0013	.0006	.06	1.63	1.94
APOCRITA	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	.00-.00	.00	.0038	.0000	.01	.63	.75
MYMARIDAE	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.01	.02	.02
EULOPHIDAE	8-ADULT	1.5	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0003	.0000	.01	.05	.06
PLATYGASTERIDAE	8-ADULT	4.6	6	.1	1-3	.5	.00	.00	NEG.-NEG.	.00	.0002	.0002	.05	.25	.30
UNIDENTIFIED	C-J/A NOSEX	1.5	2	.0	2-2	.2	.00	.00	NEG.-NEG.	.00	.0000	.0000	.02	.02	.02

APPENDIX D

Table 8. Least Cisco (Continued)

SPECIES 8755010105-COREGONUS SARDINELLA LEAST CISCO

UNIDENTIFIED MATERIAL	.10	.00	.00-.02	.01	15.81

TOTAL NUMBER OF PREY CATEGORIES 57

SHANNON-WEINER DIVERSITY INDEX (NORMALIZED)	NUMBERS	2.04
	BIOMASS	4.29
BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS		2.03

APPENDIX D

Table 9. Boreal Smelt Stomach Composition

SPECIES 8755030302-OSMERUS MORDAX BOREAL SMELT

FROM COLLECTIONS	FILE ID.	SAMPLE NO.	STATION LOC. NO.	SPECIMENS	COLLECTION TIME (PST)
	85JN23	W 1	30301	6	1830
	85JY22	W 1	30101	5	1130
	85JY22	P 1	30203	6	1351
	85JY26	P 1	30102	5	1450
	85AU04	W 1	30306	5	1200
	85AU10	P 1	30103	10	1713
	85AU13	P 1	30101	5	1344
	85SE04	P 1	30103	6	1633
	85SE10	P 1	30102	10	1241

LIFE HISTORY STAGE
49 JUVENILE
9 ADULT

TOTAL SAMPLE SIZE 58

NUMBER OF EMPTY STOMACHS 10
PERCENTAGE OF EMPTY STOMACHS 17.24
ADJUSTED SAMPLE SIZE(STOMACHS CONTAINING PREY) 48

PREY CODES TRUNCATED BY 0 DIGITS
LIFE HISTORY STAGES ARE UNPOOLED
DATA FORMAT = S240.33B

	MEAN	RANGE	S.D.
CONDITION FACTOR (1-7, EMPTY-DISTENDED)	5.0	3.-7.	1.1
DIGESTION FACTOR (1-5, COMPLETE-NONE)	4.6	3.-6.	.6
TOTAL CONTENTS WEIGHT (GRAMS)	.19	NEG.- 2.22	.37
TOTAL CONTENTS ABUNDANCE (NUMBERS)	98.4	1.0- 1836.0	299.6
NO. PREY CATEGORIES (PER STOMACH)	2.3	1.- 9.	1.6
LENGTH (MM)	96.1	57.- 148.	21.70
WEIGHT (GRAMS)	7.28	1.30- 25.43	4.97
PCT RATIO OF CONTENTS WT TO PREDATOR WT	1.76	.07- 8.74	1.76

NOTE LENGTH AND WEIGHT STATISTICS ARE BASED ON THE TOTAL SAMPLE, INCLUDING EMPTY STOMACHS.

APPENDIX D

Table 9. Boreal Smelt (Continued)

SPECIES 8755030302-OSMERUS MORDAX BOREAL SMELT

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
POLYCHAETA	6-LARVA	12.5	18	.4	1-10	1.5	.00	.00	NEG.-.00	.00	.0001	.0000	.38	.02	.02
PODON SP.	A-JUV+ADULT	6.3	90	1.9	10-68	10.0	.01	.00	NEG.-.00	.00	.0001	.0000	1.90	.06	.06
OSTRACODA	8-ADULT	2.1	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.02	.00	.00
CALANOIDA	8-ADULT	4.2	2	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0004	.0004	.04	.01	.01
CALANOIDA	A-JUV+ADULT	16.7	4052	84.4	28-1772	287.7	.35	.01	.00-.10	.02	.0001	.0000	85.76	3.88	3.89
CALANOIDA	F-COPEPODID	14.6	24	.5	1-8	1.6	.00	.00	NEG.-.00	.00	.0001	.0001	.51	.03	.03
EURYTEMORA SP.	F-COPEPODID	2.1	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.02	.00	.00
EPILABIDOCERA LONGIPEDATA	8-ADULT	12.5	12	.3	1-7	1.0	.01	.00	NEG.-.00	.00	.0006	.0003	.25	.08	.08
EPILABIDOCERA LONGIPEDATA	A-JUV+ADULT	2.1	10	.2	10-10	1.4	.00	.00	.00-.00	.00	.0002	.0000	.21	.03	.03
HARPACTICOIDA	8-ADULT	2.1	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.02	.00	.00
HARPACTICOIDA	F-COPEPODID	2.1	4	.1	4-4	.6	.00	.00	NEG.-NEG.	.00	.0000	.0000	.08	.00	.00
CYCLOPOIDA	F-COPEPODID	2.1	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0001	.0000	.02	.00	.00
BALANOMORPHA	E-CYPRIS	6.3	46	1.0	7-24	4.1	.00	.00	NEG.-.00	.00	.0001	.0000	.97	.05	.05
MYSIDAE	7-JUVENILE	31.3	324	6.8	1-83	20.3	.88	.02	NEG.-.23	.05	.0027	.0022	6.86	9.67	9.70
MYSIDAE	8-ADULT	16.7	12	.3	1-3	.6	1.41	.03	.08-.34	.07	.1209	.0382	.25	15.53	15.58
MYSIDAE	A-JUV+ADULT	2.1	4	.1	4-4	.6	.08	.00	.08-.08	.01	.0205	.0000	.08	.91	.91
MYSIDAE	L-EGG-C FEM	2.1	1	.0	1-1	.1	.13	.00	.13-.13	.02	.1311	.0000	.02	1.45	1.45
NEOMYSIS SP.	7-JUVENILE	8.3	7	.1	1-3	.5	.06	.00	NEG.-.04	.01	.0079	.0071	.15	.66	.66
NEOMYSIS SP.	8-ADULT	6.3	5	.1	1-2	.4	.20	.00	.03-.12	.02	.0434	.0228	.11	2.26	2.27
SADURIA ENTOMON	7-JUVENILE	4.2	2	.0	1-1	.2	.00	.00	.00-.00	.00	.0024	.0007	.04	.05	.05
GAMMARIDEA	7-JUVENILE	6.3	10	.2	1-8	1.2	.02	.00	.00-.02	.00	.0067	.0094	.21	.26	.26
GAMMARIDEA	8-ADULT	2.1	2	.0	2-2	.3	.03	.00	.03-.03	.00	.0143	.0000	.04	.32	.32
GAMMARIDEA	C-J/A NOSEX	2.1	1	.0	1-1	.1	.01	.00	.01-.01	.00	.0101	.0000	.02	.11	.11
ATYLUS SP.	8-ADULT	4.2	4	.1	2-2	.4	.03	.00	.01-.02	.00	.0075	.0019	.08	.33	.33
HAUSTORIIDAE	7-JUVENILE	4.2	2	.0	1-1	.2	.02	.00	.00-.02	.00	.0100	.0088	.04	.22	.22
HAUSTORIIDAE	8-ADULT	2.1	2	.0	2-2	.3	.05	.00	.05-.05	.01	.0231	.0000	.04	.51	.51

APPENDIX D

Table 9. Boreal Smelt (Continued)

SPECIES 8755030302-OSMERUS MORDAX BOREAL SMELT

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
AMPHIPODA-HYPERIIDEA	7-JUVENILE	2.1	2	.0	2-2	.3	.00	.00	.00-.00	.00	.0011	.0000	.04	.02	.02
AMPHIPODA-HYPERIIDEA	8-ADULT	4.2	2	.0	1-1	.2	.01	.00	.00-.00	.00	.0032	.0010	.04	.07	.07
PLEOCYEMATA-CARIDEA	3-ZOEA	2.1	1	.0	1-1	.1	.00	.00	NEG.-NEG.	.00	.0003	.0000	.02	.00	.00
PLEOCYEMATA-CARIDEA	6-LARVA	6.3	48	1.0	4-28	4.6	.01	.00	NEG.-.00	.00	.0002	.0000	1.02	.08	.08
DECAPODA-BRACHYURA	4-MEGALOP	4.2	12	.3	2-10	1.5	.07	.00	.01-.05	.01	.0059	.0010	.25	.72	.72
TELEOSTEI	6-LARVA	12.5	6	.1	1-1	.3	.20	.00	.01-.05	.01	.0335	.0123	.13	2.22	2.23
TELEOSTEI	7-JUVENILE	8.3	11	.2	2-5	.9	4.54	.09	.24-2.22	.38	.4002	.1962	.23	50.12	50.27
TELEOSTEI	C-J/A NOSEX	4.2	2	.0	1-1	.2	.54	.01	.10-.45	.07	.2720	.2491	.04	6.01	6.03
CLUPEA HARENGUS PALLASI	6-LARVA	4.2	2	.0	1-1	.2	.20	.00	.07-.12	.02	.0981	.0350	.04	2.17	2.17
CLUPEA HARENGUS PALLASI	7-JUVENILE	2.1	1	.0	1-1	.1	.17	.00	.17-.17	.02	.1700	.0000	.02	1.88	1.88
UNIDENTIFIED MATERIAL							.03	.00	.00-.01	.00				.29	

TOTAL NUMBER OF PREY CATEGORIES 36

SHANNON-WEINER DIVERSITY INDEX (NORMALIZED) NUMBERS 1.02
BIOMASS 2.59

BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS 1.00

86/02/14. 00.06.09.IULP, 0.225, TLAS001, GEMC000, H0, 81817 ** END OF LISTI

APPENDIX D
Table 10. Pond Smelt Stomach Composition

SPECIES 8755030102-HYPOMESUS OLIDUS POND SMELT

FROM COLLECTIONS	FILE ID.	SAMPLE NO.	STATION LOC. NO.	SPECIMENS	COLLECTION TIME (PST)
	85JN23	W 1	30505	5	1800
	85AU04	W 2	30306	5	0
	85AU10	P 1	30103	5	1713
	85AU10	P 1	30601	4	1128
	85AU12	P 1	30602	5	1516
	85AU13	P 1	30101	5	1344
	85SE04	P 1	30103	8	1633

LIFE HISTORY STAGE
37 JUVENILE

TOTAL SAMPLE SIZE 37

NUMBER OF EMPTY STOMACHS 3
PERCENTAGE OF EMPTY STOMACHS 8.11
ADJUSTED SAMPLE SIZE(STOMACHS CONTAINING PREY) 34

PREY CODES TRUNCATED BY 0 DIGITS
LIFE HISTORY STAGES ARE UNPOOLED
DATA FORMAT = S240.33B

	MEAN	RANGE	S.D.
CONDITION FACTOR (1-7, EMPTY-DISTENDED)	3.5	2.-6.	1.3
DIGESTION FACTOR (1-5, COMPLETE-NONE)	4.3	2.-6.	1.1
TOTAL CONTENTS WEIGHT (GRAMS)	.01	NEG.- .03	.01
TOTAL CONTENTS ABUNDANCE (NUMBERS)	278.5	1.0- 1764.0	477.6
NO. PREY CATEGORIES (PER STOMACH)	3.0	1.- 9.	2.2
LENGTH (MM)	66.4	44.- 103.	12.99
WEIGHT (GRAMS)	2.70	.42- 10.75	2.15
PCT RATIO OF CONTENTS WT TO PREDATOR WT	.58	.00- 3.57	.92

NOTE LENGTH AND WEIGHT STATISTICS ARE BASED ON THE TOTAL SAMPLE, INCLUDING EMPTY STOMACHS.

APPENDIX D
Table 10. Pond Smelt (Continued)

SPECIES 8755030102-HYPOMESUS OLIDUS POND SMELT

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
POLYCHAETA	6-LARVA	5.9	4	.1	1-3	.5	.00	.00	NEG.-NEG.	.00	.0001	.0000	.04	.10	.10
NOTOSTRACA	C-J/A NOSEX	14.7	235	6.9	12-126	23.1	.01	.00	NEG.-.00	.00	.0000	.0000	2.48	1.68	1.78
CLADOCERA-EUCLADOCERA	C-J/A NOSEX	2.9	4	.1	4-4	.7	.00	.00	NEG.-NEG.	.00	.0001	.0000	.04	.13	.14
BOSMINA SP.	7-JUVENILE	2.9	1	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	.01	.03	.03
BOSMINA SP.	A-JUV+ADULT	2.9	3	.1	3-3	.5	.00	.00	NEG.-NEG.	.00	.0000	.0000	.03	.03	.03
BOSMINA SP.	C-J/A NOSEX	8.8	10	.3	1-8	1.4	.00	.00	NEG.-NEG.	.00	.0001	.0000	.11	.13	.14
PODON SP.	8-ADULT	2.9	2	.1	2-2	.3	.00	.00	NEG.-NEG.	.00	.0001	.0000	.02	.07	.07
CALANOIDA	2-NAUPLIUS	17.6	4424	130.1	3-1424	365.7	.01	.00	NEG.-.00	.00	.0000	.0000	46.72	3.78	4.00
CALANOIDA	8-ADULT	5.9	5	.1	2-3	.6	.00	.00	NEG.-NEG.	.00	.0000	.0000	.05	.07	.07
CALANOIDA	A-JUV+ADULT	32.4	2766	81.4	2-659	167.8	.11	.00	NEG.-.03	.01	.0000	.0000	29.21	35.44	37.50
CALANOIDA	F-COPEPODID	44.1	424	12.5	1-128	29.7	.01	.00	NEG.-.00	.00	.0000	.0000	4.48	2.37	2.51
EURYTEMORA SP.	A-JUV+ADULT	2.9	2	.1	2-2	.3	.00	.00	NEG.-NEG.	.00	.0001	.0000	.02	.07	.07
EURYTEMORA SP.	F-COPEPODID	2.9	1	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	.01	.03	.03
EPILABIDOCERA LONGIPEDATA	8-ADULT	5.9	3	.1	1-2	.4	.00	.00	NEG.-.00	.00	.0007	.0001	.03	.69	.73
EPILABIDOCERA LONGIPEDATA	F-COPEPODID	2.9	1	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	.01	.03	.03
HARPACTICOIDA	8-ADULT	8.8	4	.1	1-2	.4	.00	.00	NEG.-NEG.	.00	.0001	.0000	.04	.10	.10
HARPACTICOIDA	A-JUV+ADULT	20.6	980	28.8	3-368	81.1	.02	.00	NEG.-.01	.00	.0000	.0000	10.35	5.53	5.85
HARPACTICOIDA	F-COPEPODID	2.9	10	.3	10-10	1.7	.00	.00	NEG.-NEG.	.00	.0000	.0000	.11	.07	.07
CYCLOPOIDA	A-JUV+ADULT	8.8	155	4.6	12-76	17.1	.00	.00	NEG.-.00	.00	.0000	.0000	1.64	1.18	1.25
CYCLOPOIDA	F-COPEPODID	20.6	109	3.2	2-41	8.3	.00	.00	NEG.-.00	.00	.0000	.0000	1.15	.99	1.04
MONSTRILLIDAE	8-ADULT	2.9	1	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0004	.0000	.01	.13	.14
BALANOMORPHA	E-CYPRIS	14.7	6	.2	1-2	.5	.00	.00	NEG.-NEG.	.00	.0001	.0000	.06	.26	.28
MYSIDAE	7-JUVENILE	8.8	16	.5	1-14	2.4	.02	.00	NEG.-.02	.00	.0008	.0007	.17	7.44	7.87
NEOMYSIS SP.	A-JUV+ADULT	2.9	4	.1	4-4	.7	.02	.00	.02-.02	.00	.0042	.0000	.04	5.53	5.85
GAMMARIDEA	7-JUVENILE	2.9	1	.0	1-1	.2	.00	.00	.00-.00	.00	.0010	.0000	.01	.33	.35
HAUSTORIIDAE	7-JUVENILE	14.7	225	6.6	7-148	26.0	.05	.00	NEG.-.03	.01	.0002	.0001	2.38	16.75	17.72

769

APPENDIX D

Table 10. Pond Smelt (Continued)

SPECIES 8755030102-HYPOMESUS OLIDUS POND SMELT

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
CRANGONIDAE	B-LARVA+JUV	8.8	49	1.4	4-40	6.9	.03	.00	.00-.02	.00	.0006	.0001	.52	9.58	10.13
INSECTA	6-LARVA	2.9	1	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0002	.0000	.01	.07	.07
INSECTA H-EXUVIAE	H-NYMPH	2.9	1	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0004	.0000	.01	.13	.14
COLLEMBOLA	C-J/A NOSEX	2.9	4	.1	4-4	.7	.00	.00	.00-.00	.00	.0003	.0000	.04	.39	.42
DIPTERA-CHIRONOMIDAE	6-LARVA	14.7	15	.4	1-8	1.5	.00	.00	NEG.-.00	.00	.0002	.0001	.16	1.12	1.18
DIPTERA-CHIRONOMIDAE	8-ADULT	2.9	4	.1	4-4	.7	.00	.00	NEG.-NEG.	.00	.0002	.0000	.04	.26	.28
UNIDENTIFIED MATERIAL							.02	.00	.00-.00	.00				5.50	

TOTAL NUMBER OF PREY CATEGORIES 32

SHANNON-WEINER DIVERSITY INDEX (NORMALIZED) NUMBERS 2.16
BIOMASS 3.01

BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS 2.15

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APPENDIX D

Table 11. Burbot Stomach Composition

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SPECIES 8791030801-LOTA LOTA BURBOT

FROM COLLECTIONS

FILE ID.	SAMPLE NO.	STATION LOC.	NO. SPECIMENS	COLLECTION TIME (PST)
85JY24	W 1	30510	4	2200
85AU01	BH1	30708	5	1547
85AU03	BH1	30702	5	1545
85AU08	W 2	30513	5	1930
85AU19	W 1	30305	5	805
85SE13	P 2	30602	5	1356

LIFE HISTORY STAGE

29 JUVENILE

TOTAL SAMPLE SIZE 29

NUMBER OF EMPTY STOMACHS 4
PERCENTAGE OF EMPTY STOMACHS 13.79
ADJUSTED SAMPLE SIZE(STOMACHS CONTAINING PREY) 25

PREY CODES TRUNCATED BY 0 DIGITS
LIFE HISTORY STAGES ARE UNPOOLED
DATA FORMAT = S240.33B

	MEAN	RANGE	S.D.
CONDITION FACTOR (1-7, EMPTY-DISTENDED)	4.8	2.-7.	1.5
DIGESTION FACTOR (1-5, COMPLETE-NONE)	4.3	3.-5.	.8
TOTAL CONTENTS WEIGHT (GRAMS)	.19	NEG.- .89	.24
TOTAL CONTENTS ABUNDANCE (NUMBERS)	27.0	1.0- 176.0	36.9
NO. PREY CATEGORIES (PER STOMACH)	2.3	1.- 6.	1.4
LENGTH (MM)	73.7	39.- 141.	28.61
WEIGHT (GRAMS)	4.35	.39- 20.51	5.51
PCT RATIO OF CONTENTS WT TO PREDATOR WT	3.70	.01- 10.27	3.46

NOTE LENGTH AND WEIGHT STATISTICS ARE BASED ON THE TOTAL SAMPLE, INCLUDING EMPTY STOMACHS.

APPENDIX D

Table 11. Burbot (Continued)

SPECIES 8791030801-LOTA LOTA BURBOT

PREY ORGANISM PARTS CODE	LIFE HISTORY STAGE	FREQ OCCUR	NUMBER TOTAL	NUMBER MEAN	NUMBER RANGE	NUMBER S.D.	BIOMASS TOTAL	BIOMASS MEAN	BIOMASS RANGE	BIOMASS S.D.	AVE. BIOMASS MEAN	AVE. BIOMASS S.D.	PERCENTAGES ABUNDANCE	PERCENTAGES BIOMASS	PERCENTAGES NORM. BIOMASS
OSTRACODA	C-J/A NOSEX	28.0	57	2.3	1-30	6.5	.01	.00	NEG.-.00	.00	.0001	.0000	8.44	.18	.18
CALANOIDA	A-JUV+ADULT	4.0	3	.1	3-3	.6	.00	.00	NEG.-NEG.	.00	.0001	.0000	.44	.00	.00
CALANOIDA	F-COPEPODID	4.0	1	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	.15	.00	.00
EURYTEMORA SP.	8-ADULT	4.0	2	.1	2-2	.4	.00	.00	NEG.-NEG.	.00	.0001	.0000	.30	.00	.00
EURYTEMORA SP.	A-JUV+ADULT	8.0	16	.6	7-9	2.2	.00	.00	NEG.-NEG.	.00	.0000	.0000	2.37	.02	.02
EURYTEMORA SP.	F-COPEPODID	4.0	4	.2	4-4	.8	.00	.00	NEG.-NEG.	.00	.0000	.0000	.59	.00	.00
HARPACTICOIDA	8-ADULT	8.0	4	.2	1-3	.6	.00	.00	NEG.-NEG.	.00	.0001	.0000	.59	.00	.00
CYCLOPOIDA	8-ADULT	4.0	2	.1	2-2	.4	.00	.00	NEG.-NEG.	.00	.0000	.0000	.30	.00	.00
CYCLOPOIDA	A-JUV+ADULT	8.0	121	4.8	20-101	20.4	.00	.00	NEG.-.00	.00	.0000	.0000	17.93	.04	.04
CYCLOPOIDA	F-COPEPODID	4.0	1	.0	1-1	.2	.00	.00	NEG.-NEG.	.00	.0001	.0000	.15	.00	.00
MYSIDAE	7-JUVENILE	12.0	42	1.7	2-29	6.1	.39	.02	.02-.25	.06	.0092	.0016	6.22	8.24	8.25
NEOMYSIS SP.	A-JUV+ADULT	32.0	301	12.0	11-69	21.1	1.97	.08	.06-.64	.17	.0057	.0026	44.59	41.53	41.56
SADURIA ENTOMON	7-JUVENILE	8.0	3	.1	1-2	.4	.03	.00	.00-.02	.00	.0113	.0126	.44	.53	.53
GAMMARIDEA	7-JUVENILE	4.0	2	.1	2-2	.4	.01	.00	.01-.01	.00	.0052	.0000	.30	.22	.22
HAUSTORIIDAE	7-JUVENILE	12.0	8	.3	1-5	1.1	.01	.00	.00-.01	.00	.0013	.0001	1.19	.20	.20
CRANGONIDAE	7-JUVENILE	4.0	1	.0	1-1	.2	.02	.00	.02-.02	.00	.0163	.0000	.15	.34	.34
COLLEMBOLA	C-J/A NOSEX	4.0	2	.1	2-2	.4	.00	.00	NEG.-NEG.	.00	.0002	.0000	.30	.01	.01
EPHEMEROPTERA	H-NYMPH	4.0	2	.1	2-2	.4	.02	.00	.02-.02	.00	.0098	.0000	.30	.41	.41
CERATOPOGONIDAE	6-LARVA	4.0	3	.1	3-3	.6	.00	.00	NEG.-NEG.	.00	.0001	.0000	.44	.00	.00
DIPTERA-CHIRONOMIDAE	6-LARVA	32.0	88	3.5	1-55	11.2	.01	.00	NEG.-.01	.00	.0002	.0003	13.04	.30	.30
DIPTERA-CHIRONOMIDAE	8-ADULT	8.0	3	.1	1-2	.4	.00	.00	NEG.-NEG.	.00	.0003	.0001	.44	.02	.02
TELEOSTEI	7-JUVENILE	4.0	1	.0	1-1	.2	.34	.01	.34-.34	.07	.3374	.0000	.15	7.12	7.13
COREGONUS SP.	7-JUVENILE	12.0	4	.2	1-2	.5	1.13	.05	.27-.50	.13	.3184	.1682	.59	23.91	23.93
STENODUS LEUCICHTHYS	7-JUVENILE	4.0	1	.0	1-1	.2	.50	.02	.50-.50	.10	.5041	.0000	.15	10.64	10.65
PUNGITIS PUNGITIUS	7-JUVENILE	8.0	3	.1	1-2	.4	.29	.01	.09-.20	.04	.1228	.1068	.44	6.18	6.19

APPENDIX D

Table 11. Burbot (Continued)

SPECIES 8791030801-LOTA LOTA BURBOT

UNIDENTIFIED MATERIAL	.00	.00	.00- .00	.00	.08

TOTAL NUMBER OF PREY CATEGORIES 25

SHANNON-WEINER DIVERSITY INDEX (NORMALIZED)	NUMBERS	2.60
	BIOMASS	2.37
BRILLOUIN-S DIVERSITY INDEX BASED ON NUMBERS		2.52

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