Environmental Assessment of the Alaskan Continental Shelf

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Environmental Assessment of the Alaskan Continental Shelf

July-September 1977 quarterly reports from Principal Investigators participating in a multi-year program of environmental assessment related to petroleum development of the Alaskan Continental Shelf. The program is directed by the National Oceanic and Atmospheric Administration under funding from and for use by the Bureau of Land Management.

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QUARTERLY REPORT

Contract 03-5-022-56
Research Unit #5
Reporting Period 7/1/77-9/30/77
Task Order Nos. 15, 20, 29, 30
Number of Pages: 7

THE DISTRIBUTION, ABUNDANCE, DIVERSITY AND PRODUCTIVITY OF BENTHIC ORGANISMS IN THE GULF OF ALASKA, TWO KODIAK BAYS, BERING SEA, CHUKCHI SEA, AND NORTON SOUND

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September 1977

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BERING SEA AND GULF OF ALASKA

I. TASK OBJECTIVES

A. Inventory and census of dominant species.

B. Description of spatial and seasonal distribution patterns of selected species.

C. Provide comparison of dominant species distribution with physical, chemical and geological factors.

D. Provide preliminary observations of biological interrelationships between selected segments of benthic marine communities.

II. FIELD AND LABORATORY ACTIVITIES

A. Grab Program

1. No cruises were scheduled for this quarter.

2. Analysis of all samples collected in the last two years is still in progress at the Marine Sorting Center and the Data Processing Section of the Institute of Marine Science.

3. Organization of data for reports and publications are in progress.

B. Trawl and Pipe Dredge Program

1. No cruises scheduled for this quarter.

2. All trawl and pipe dredge material from Cook Inlet and the Bering Sea were examined and data submitted for key punching.

3. Dominant clam species from Cook Inlet and the Bering Sea were examined for age and growth determinations. Data has been submitted for key punching. Age-growth history tables were organized.

III. RESULTS

A. Crab Programs

1. Data collected during R/V *Discoverer* Cruise DS001 in March

1976 has been key punched, and is in the initial stages of data analysis.

2. A chapter entitled, Numerical Analysis of the Benthic Infauna in the Northeastern Gulf of Alaska, is to be submitted shortly for publication in Volume II of the Proceedings of the 27th Alaska Science Conference. This chapter includes methodology and preliminary results of activities of the past two years on the analysis of benthic infauna in NEGOA.

3. Additional programs to further the analysis of NEGOA are being developed.

4. The Final Report is in progress.

B. Trawl and Pipe Dredge Program

1. Trawl and pipe dredge data from Cook Inlet and the Bering Sea has been key punched and printed out. Checking and analysis of this data is in progress.

2. Clam species from Cook Inlet and the Bering Sea have been aged, measured, data recorded on computer forms, and subjected to analysis. Species examined were: (1) Cook Inlet - *Spisula polynyma, Nuculana fossa, Tellina nuculoides, Glycymeris subobsoleta, Macoma calcarea, Nucula tenuis*, and (2) Bering Sea - *Spisula polynyma, Macoma calcarea, Tellina lutea, Nuculana fossa, Yoldia amygdalea*.

3. A manuscript on the feeding biology of the snow crab *Chionoecetes bairdi* in Cook Inlet is completed and will be available to the Final Report.

4. The Final Report is in progress.

IV. PRELIMINARY INTERPRETATION OF RESULTS

General interpretations of grab and trawl data are included in the 1976 and 1977 Annual Reports and in Institute of Marine Science Technical Report R76-8. Additional comments on this, pipe-dredge data, and food relationships will be included in the Final Report.

V. PROBLEMS ENCOUNTERED

No direct problems. However, the initial decisions by OCSEAP that, (1) our surveys in the Gulf, Cook Inlet, and the Bering Sea be primarily ones of assessment of distribution and abundance of invertebrates, (2) our survey should not examine crab stomachs, and (3) the fish stomach survey by Dr. Ron Smith should have minimal and limited funding (also that we should not examine any fish stomachs in our project), are now proving to be seriously in error. If it had not been directly suggested that we not look at stomachs as we progressed in our assessment program (and frequently time was available as was our desire to collect this type of data), we would now have a good and sound basis for benthic food webs. Now the program is moving into the shelf area less than 40 m, and we have a serious lack of understanding of food interactions of benthic organisms on the rest of the shelf. We have essentially no food data from the northeast Gulf of Alaska with only slightly better data from Cook Inlet. Bering Sea food data is spotty, and now this program is terminated. I would strongly suggest that data on food habits of fishes in these regions be collected in the near future.

ALITAK AND UGAK BAYS, KODIAK ISLAND

I. TASK OBJECTIVES

A. A quantitative inventory census of dominant benthic invertebrate epifaunal species.

B. A description of spatial distribution patterns of selected benthic invertebrate epifaunal species.

C. Observations of biological interrelationships between segments of the benthic biota.

II. FIELD AND LABORATORY ACTIVITIES

A. Field Program

No cruises were scheduled in this quarter.

B. Laboratory Program

1. Data was recorded on coding forms for key punching and computer analysis.

2. Computer printouts were checked.

3. Report preparation begun.

III. RESULTS

All data has been analyzed, and will be included in the Final Report now in the final stages of completion.

IV. PROBLEMS ENCOUNTERED

No immediate problems. Additional feeding data and data on infauna on the Kodiak shelf are essential.

CHUKCHI SEA AND NORTON SOUND

I. TASK OBJECTIVES

To conduct a survey of the benthic epifaunal invertebrates of the Chukchi Sea/Norton Sound areas.

II. SHIP OR LABORATORY ACTIVITIES

A. No ship activity this quarter.

B. All data has been key punched and submitted for data processing.

C. The Final Report is in progress.

III. RESULTS

A. Data on distribution and abundance, predator-prey relationships and reproductive notes have been examined and have been keypunched. An extensive report on the food of the starry flounder is in preparation. The report is based on 133 stomachs examined in the field using the frequency of occurrence method of analysis and 177 stomachs examined using volumetric and numerical methods of analysis.

B. Distribution and abundance data is now in computer printout format, and are presently being analyzed.

C. The final report is in preparation. Most figures for the report have been completed.

IV. PROBLEMS ENCOUNTERED

No immediate problems. However, lack of infaunal data from the study area will hamper interpretation of feeding data, and will limit distributional information on an important component of the benthos, the infauna. Infaunal samples should be collected when activities in this lease area intensify.

Milestones

It is intended to maintain a consistent schedule for report preparation in the next few months. Some of the reports will be subdivided into sections, each section to be submitted as it is completed. The latter procedure should increase the data flow and data interpretation available to OCSEAP. The schedule for report submissions are as follows:

1. Kodiak (Alitak and Ugak Bays) - early October
2. Norton Sound-Chukchi Sea - late November
3. Cook Inlet - mid January
4. Bering Sea Trawl Report - late January
5. Bering Sea crab and pipe dredge report - late February
6. NEGOA crab and trawl report - late March

QUARTERLY REPORT

Contract No. 03-5-022-68, Task Order 5
Research Unit #6
Reporting Period: 1 July - 30 September 1977

The distribution, abundance, diversity and productivity of the western Beaufort Sea benthos.

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September 26, 1977

Andrew G. Carey, Jr.
Principal Investigator

I. Task Objectives

A. General nature and scope of the problem

The distribution, abundance and natural variability of benthic macrofauna will be described on the southwestern Beaufort Sea continental shelf. Patterns of faunal distributions will be described and characterized using suitable bio-indices and multivariate techniques. Seasonal changes in the structure of benthic populations will be studied by sampling four times within a single year. Feeding interactions between organisms will be characterized by describing the benthic food web.

B. We propose to describe the benthic infauna of the western Beaufort Sea continental shelf including studies of both geographic and seasonal variability. Data are to be obtained on the faunal composition and abundance to form baselines to which potential future changes can be compared. The structure of the benthic food web will provide information on links in the food web that are important for the existence of the communities and by which pollutants may enter man's food web.

Specific objectives include the continuation of studies and analyses to:

1. Describe the distribution, species composition, numerical density, and biomass of the benthos in the area of interest.

2. Describe the spatial and seasonal variability of faunal distributions and abundances.

3. Describe the benthic communities present and delineate their geographical and environmental extent.

4. Describe the effect of seasons on population size and reproductivity activity of dominant species.

5. Determine the degree of correlation of species distributions and of various bio-indices with features of the benthic environment.

6. Determine the basic structure of the in situ benthic invertebrate food web from a literature review and gut content analyses of selected, abundant species.

II. Research Activities

A. Field Activities - OCS 7

1. Ship Schedule

During the period August - September 1977 Research Unit #6 participated in a food web cruise to the Chukchi and Beaufort Sea on the USCGC GLACIER to sample the biota of the water column in selected areas and to define trophic interrelationships.

2. Scientific Party (OSU Benthos)

R. Eugene Ruff	OSU	Head of the Benthos Group and Chief Scientist for the cruise
David Wilborn	OSU	Research Assistant (Temporary)

3. Methods

Benthic infauna were sampled by a 0.1 m^2 Smith-McIntyre bottom grab at selected stations. Five quantitative samples at each station were planned to provide adequate estimates of variability and enough species for description of the community composition. The samples were washed on shipboard with 0.42 mm screens to retain the macrofauna (0.50 mm and above). The samples were temporarily preserved in 10% neutralized formalin and shipped back to Oregon for laboratory analysis.

4. Sample Localities

As planned, a series of stations were sampled in the Chukchi Sea previous to undertaking the main operations in the Beaufort Sea. When in the Beaufort, the summer sea ice conditions were found to be open with the ice edge approximately 180 n mi offshore. The station positions, therefore, cover a large amount of territory. Benthic infaunal stations number 5 (approximate) in the Chukchi and 31 (approximate) in the Beaufort Sea (Table 1). A total of 158 biological and geological grab samples were collected for the benthic invertebrate research.

B. Laboratory Activities

1. Personnel

No changes in personnel during this quarterly reporting period. Andrew G. Carey, Jr., Principal Investigator, arrived 03 September 1977 from sabbatical leave from Oregon State University.

2. Methods

The techniques for sample processing have not been altered this quarter. However, due to international convention, the macrofauna are now defined as organisms in the size range 0.5 mm and above; this comprises the fauna that OSU Benthos has categorized as large meiofauna >0.42-1.00 mm. A major effort now must be made to process this size category and include these data in our analyses of the macro-infauna.

3. Data Analyzed

Smith-McIntyre grab samples from OCS-5 collected on the R/V ALUMIAC during the 1976 OCS coastal cruise have been picked, sorted to major taxonomic categories, and quantified. Organisms have been counted and wet-weighed. Gammarid amphipods have been identified and counted from OCS-5. Larger macro-infauna (>1.0 mm) have been picked, sorted and counted from the Hessler-Sandia 0.25 m^2 box cores collected during OCS-4 on the USCGC GLACIER.

Harpacticoid copepods (small macrofauna) from selected Smith-McIntyre grab samples collected at two stations during WEBSEC-71 have been identified and counted.

Table 1. Benthic Stations.* 1977 OCS USCGC GLACIER Summer Cruise. Tentative List.

OCS-7	Benthic Grab Stations Biological and/or Geological			
Station	Position			Samples
2	71°22'N	160°04'W		2
3	71°24'N	162°00'W		2
4	71°32'N	163°58'W		2
6	71°12'N	158°22'W		2
7	71°25'N	156°56'W		1
8	71°46'N	155°51'W		6
9	71°57'N	154°33'W		6
10	70°24'N	154°37'W		2
11	71°35'N	153°29'W		7
12	72°31'N	153°39'W		2
13	71°18'N	152°43'W	PPB-55	6
14	71°14'N	152°51'W	PPB-40	11
15	71°07'N	153°03'W	PPB-25	11
16	71°15'N	152°42'W	PPB-70	6
17	71°23'N	152°42'W	PPB-100	6
21	71°07'N	149°58'W		6
22	70°38'N	148°28'W		6
25	70°33'N	147°24'W		3
26	70°25'N	146°41'W		3
28	72°53'N	146°30'W		2
29	72°56'N	146°37'W		4
31	72°47'N	146°34'W		3
32	72°57'N	143°30'W		1
33	72°54'N	142°08'W		1
34	70°52'N	141°35'W		4
35	70°42'N	141°28'W		9
36	70°32'N	141°32'W		5
37	69°49'N	141°31'W		6
38	70°04'N	142°14'W		3
39	70°11'N	141°28'W		6
40	70°28'N	141°37'W		6
42	70°32'N	142°30'W		5
53	71°02'N	145°25'W		6
54	71°12'N	145°35'W		1
58	71°05'N	146°33'W		2
69	71°58'N	155°43'W		2
71	71°32'N	156°30'W		1
72	71°33'N	155°37'W		1
			TOTAL	158

*A revised and more detailed station listing will be submitted at the next report period after receipt of the necessary field information.

4. Milestone Chart and Data Submission Schedules

Category	Expected Completion
OCS-7 Station Data	1 January 1977
Detailed Milestone Chart for FY-78	1 January 1977
Sorting of OCS-7 Samples	To be arranged
Quantifying of OCS-7 Samples	To be arranged
Additional Taxonomic Data	To be arranged

Data transmission will be scheduled on the regular quarterly basis during FY-78. Additional taxonomic data from OCS 1-7 will be submitted. The extent and type of further data will be detailed at the time of the next quarterly report.

III. Results

A. Laboratory Results

1. Biomass

Wet weights for OCS-5 samples and stations are listed in Table 2.

2. Faunal Numerical Denisty

Animal densities for OCS 5 and OCS 4, are listed in Tables 3-6.

3. Gammarid Amphipods

The gammarid amphipods from OCS-5 stations have been identified and are listed in Tables 7-9.

4. WEBSEC-71 Small Macrofauna

Last year the small macro-infaunal fractions (1.00 <0.42 mm) of six Smith-McIntyre grab samples were picked and sorted to major taxonomic groups. These samples were chosen from the sample set collected during the WEBSEC-71 cruise aboard the USCGC GLACIER. The results of the analysis of the harpacticoid copepods are presented in Table 10.

As a point of comparison the data from the larger macro-infauna fraction (>1.00 mm) are also included in Table 10. It has been long recognized that the size of the mesh in the sieve used for washing benthic samples can bias results of the population estimates for smaller organisms. Harpacticoid copepods are a good test of this bias owning to their size. They range from 0.5 to 2.0 mm in length, but also possess long (0.25 to 0.5 mm) setae emanating from their caudal rami so that the total length of a harpacticoid averages over 1.00 mm, large enough to be retained on the larger screen. However, since harpacticoids are only about 0.5 mm wide any that "nosedives" will pass through the large sieve and be retained on the smaller 0.42 mm screen. Table 10 shows that most will do this, though a large portion of the population will remain in the 1.00 mm fraction.

Table 2: Biomass data per grab (0.1 m^2) from OCS-5, Narwhal Island Transect. Wet weight in grams per 0.1 m^2.

Station	Grab	Anthozoa	Polychaeta	Crustacea	Mollusca	Misc.Phyla	Total
NIB-5	1437	--	1.33	0.19	0.13	0.75	2.40
	1439	--	0.02	0.75	--	--	0.78
	1440	--	0.69	0.26	0.08	0.20	1.23
	1441	--	2.45	0.13	0.06	0.41	3.05
	1442	--	1.70	0.20	0.11	0.59	2.60
	Total		6.19	1.54	0.38	1.95	10.06
NIB-10	1450	--	0.92	0.28	0.04	0.46	1.70
	1451	0.27	2.07	0.64	0.06	0.03	3.07
	1452	--	1.86	0.52	0.29	0.15	2.82
	1453	--	1.32	0.07	0.47	0.30	2.16
	1454	--	1.83	0.23	0.70	0.10	2.86
	Total	0.27	8.00	1.74	1.56	1.04	12.61
NIB-15	1443	0.60	1.09	0.73	0.23	0.02	2.67
	1445	--	1.10	0.48	0.58	0.49	2.65
	1446	0.01	0.42	0.87	0.04	0.05	1.39
	1447	0.16	0.40	0.49	0.14	0.02	1.21
	1448	--	0.76	0.49	0.62	0.91	2.78
	Total	0.77	3.77	3.06	1.61	1.49	10.70

Table 3: Animal Densities per core for BSB-7 (71°43.6'N, 151°46.5'N) collected on 29 August 1976 during OCS-4. Samples taken with the Hessler-Sandia 0.25 m^2 Box Corer.

Box Core Number			BxC 48*	BxC 49*	BxC 50	
Depth m			1738	1643	1659	
Phylum:	Class:	Order				Total
Cnidaria:	Anthozoa		1	--	3	4
Annelida:	Polychaeta		75	56	172	303
Echiura			--	2	1	3
Arthropoda:	Crustacea:	Amphipoda	1	1	1	3
		Harpacticoida	1	--	1	2
		Isopoda	1	--	--	1
		Tanaidacea	8	1	2	11
		Cumacea	2	1	3	6
Mollusca:	Pelecypoda		86	41	51	178
Echinodermata:	Ophiuroidea		--	--	1	1
Total			175	102	235	512

* Box cores 48 and 49 are non-quantitative.

Table 4: Animal Densities per grab (0.1 m^2) for NIB-5 (OCS-5) collected on 27 August 1976.

			Grab Number					
Phylum:	Class:	Order	1437	1439	1440	1441	1442	Total
Cnidaria:	Anthozoa		--	--	--	1	--	1
Nematoda			1	--	--	3	--	4
Nemertinea			6	--	2	3	2	13
Annelida:	Polychaeta		120	13	81	222	107	543
Priapulida			--	--	1	1	--	2
Arthropoda:	Crustacea	Amphipoda	6	8	1	1	2	18
		Harpacticoda	--	--	1	--	--	1
		Cumacea	--	1	--	4	--	5
Mollusca:	Pelecypoda		2	--	--	--	--	2
	Gastropoda		1	--	3	7	7	18
Echinodermata:	Holothuroidea		1	--	1	--	--	2
Chordata:	Urochordata:	Ascidacea	6	--	5	9	7	27
Total			143	22	95	251	125	636

Table 5: Animal Densities per grab (0.1 m^2) for NIB-10 (OCS-5) collected on 28 August 1976.

Phylum:	Class:	Order	1450	1451	1452	1453	1454	Total
Cnidaria:	Anthozoa		--	1	--	--	--	1
Nematoda			9	2	5	2	28	46
Nemertinea			2	3	4	9	3	21
Annelida:	Polychaeta		212	228	159	183	556	1,338
Priapulida			--	1	--	--	3	4
Arthropoda:	Crustacea:	Amphipoda	1	3	13	5	3	25
		Harpacticoda	--	--	--	--	1	1
		Ostracoda	1	--	--	--	4	5
		Tanaidacea	6	3	5	4	16	34
		Cumacea	9	4	4	--	--	17
Mollusca:	Pelecypoda		1	1	28	4	22	56
	Gastropoda		4	5	12	2	20	43
Echinodermata:	Holothuroidea		5	2	5	3	--	15
	Ophiuroidea		1	--	1	--	--	2
Hemichordata			--	2	1	--	3	6
Chordata:	Urochordata:	Ascidacea	--	--	1	--	1	2
Total			251	255	238	212	660	1,616

Table 6: Animal Densities per grab (0.1 m^2) for NIB-15 (OCS-5) collected on 28 August 1976.

Phylum:	Class:	Order	1443	1445	1446	1447	1448	Total
Cnidaria:	Anthozoa		2	2	1	1	2	8
Nematoda			6	20	12	12	23	73
Nemertinea			2	8	8	3	5	26
Annelida:	Polychaeta		69	68	43	69	80	329
Sipuncula			--	1	--	--	--	1
Priapulida			--	--	--	--	1	1
Arthropoda:	Crustacea:	Amphipoda	3	5	3	5	3	19
		Harpacticoda	1	2	--	2	--	5
		Isopoda	1	1	2	--	3	7
		Ostracoda	2	--	--	3	1	6
		Tanaidacea	8	34	22	28	6	98
		Cumacea	21	87	22	21	22	173
Mollusca:	Pelecypoda		4	9	5	3	15	36
	Gastropoda		1	2	6	3	6	18
Echinodermata:	Holothuroidea		1	1	3	2	--	7
Hemichordata			--	--	--	--	1	1
Chordata:	Urochordata:	Ascidacea	--	1	4	--	2	7
Total			121	241	131	152	170	815

Table 7: The Gammarid Amphipods from NIB-5 collected during OCS-5. 2 species were represented in 5 specimens.

Family	Mean No./m^2	Frequency	Rank
Oedicerotidae			
Oediceros sagitus	2	1/5	2
Paroediceros lynceus	8	2/5	1

Table 8: The Gammarid Amphipods from NIB-10 collected during OCS-5. 8 species were represented in 26 specimens.

Family	Mean No./m^2	Frequency	Rank
Corophiidae			
Corophium clarencense	6	2/5	3
Gammaridae			
Gammaracanthus loricatus	2	1/5	4
Haustoriidae			
Pontoporeia femorata	2	1/5	4
Priscillina armata	24	3/5	1
Oedicerotidae			
Acanthostepheia behringiensis	2	1/5	4
Acanthostepheia malmgreni	2	1/5	4
Monoculodes borealis	8	2/5	2
Monoculopsis longicornis	6	1/5	3

Table 9: The Gammarid Amphipods from NIB-15 collected during OCS-5. 8 species were represented in 19 specimens.

Family	Mean No./m^2	Frequency	Rank
Corophiidae			
Goesia depressa	2	1/5	4
Haustoriidae			
Pontoporeia femorata	6	2/5	2
Oedicerotidae			
Aceroides latipes	2	1/5	4
Arrhis phyllonyx	2	1/5	4
Bathymedon sp.	14	3/5	1
Monoculodes borealis	4	2/5	3
Monoculodes longicornis	2	1/5	4
Paroediceros lynceus	4	2/5	3

Table 10: Harpacticoid copepods found at two stations during WEBSEC-71 cruise. Note the significant difference in abundance estimates of the two size categories of macrofauna.

Family	Station CG 29 >1.00 mm	Depth 338 m >0.42 mm	Station CG 30 >1.00 mm	Depth 100 m >0.42 mm
Cerviniidae				
Cervinia bradyi	--	--	2	--
Cervinia synarthra	--	1	23	57
Cletodidae				
Argestes mollis	--	--	1	5
Paranannopus echinatus	1	11	10	1
D'arcythompsonidae				
D'arcythomsonia sp. A	1	2	--	--
Diasaccidae				
Paramphiascopsis giesbrechti	--	--	1	2
Typhlamphiascus lamellifer	--	1	--	--
Ectinosomidae				
Bradya confluens	--	--	2	1
Bradya typica	--	4	--	1
Halectinosoma neglectum	--	--	1	1
Harpacticidae				
Harpacticus superflexus	--	10	12	7
Total	2	29	52	75

The data from the two stations show an interesting contrast. In station CG 29, there is a marked increase in the number of species found (from 2 to 6) when the smaller infauna fraction is analyzed. But the number of species found in CG 30 remains the same (8) in both fractions even though a higher density is again found in the smaller fraction. The important factor here is the number of individuals found. It appears if 30 or more are found in a station, that area can be characterized. This density occurs in only 4 of the 44 stations occupied during the cruise. It can be concluded that the communities of the smaller organisms, such as harpacticoids, ostracods, tanaids, nematodes and partially polychaetes will not be fully characterized until the smaller (1.00 <0.42 mm) fraction of the samples are picked and sorted. These data are essential for comparison with the Canadian eastern Beaufort Sea data set and for comparisons with world-wide data based on the total macrofauna.

IV. Preliminary Interpretation of Results

Interpretation will be undertaken when further samples have been processed and a more complete data set can be statistically analyzed.

V. Problems Encountered

1. Beaufort Sea food web cruise station selection and sampling. Difficulties arose from the unusually light sea ice conditions during the 1977 USCGC GLACIER OCS cruise. No large concentrations of marine mammals or birds could be found at locations on the inner shelf to choose as food web stations. The ice edge was too far off shore apparently to act as an ideal environment for benthic feeding water fowl and marine mammals.

2. The definition of macrofauna. Extensive detailed discussions with German, Canadian, and Japanese benthic investigators have forced me to redefine the size of organisms within the ecological group known as the macrofauna. By international convention, these organisms cover the size range, 0.5 mm and above. Our WEBSEC and OCS data must include these small macrofauna to allow direct standardized comparisons with other OCS, Canadian, U.S., and international benthic standing stock information. Additional time and funding will be necessary for completion of these objectives in the future.

VI. Estimate of Funds Expended.

	Budget	Spent	Committed	Spent This Quarter
Salaries & Wages	107,664	95,872	1,618	17,010
Materials & Services	24,875	19,954	708	502
Travel	9,900	10,206	253	1,891
Equipment	47,617	47,224	--	--
Payroll Assessment	16,803	14,368	333	2,704
Overhead	54,320	46,003	1,052	8,733
TOTAL	$261,179	$233,627	$3,711	$30,840

Quarterly Report

R.U. 19
July 1-Sept. 30

FINFISH RESOURCE SURVEYS IN NORTON SOUND AND KOTZEBUE SOUND

Principal Investigator

LOUIS H. BARTON
Alaska Department of Fish and Game
Commercial Fisheries Division
333 Raspberry Road
Anchorage

September 1977

I. Task Objectives

The objectives of this research unit are to:

1) Determine the spatial and temporal distribution, species composition and relative abundance of finfishes in the coastal waters of Norton Sound and Kotzebue Sound east of 166 Degrees West Longitude.

2) Determine the timing and routes of juvenile salmon migrations as well as examine age and growth, relative maturity and food habits of important species in Norton Sound and Kotzebue Sound east of 166 Degrees West Longitude.

3) Determine the spatial and temporal distribution and relative abundance of spawning populations of herring and other forage fish within the study area.

4) Monitor egg density, distribution and development and document types of spawning substrates of herring and other forage fish species.

5) Monitor local resident subsistence utilization of the herring fishery resource.

II. Field Activities

Activities during this quarter (July - September) included a continuation of data collection in the nearshore waters of Norton Sound. Adjustments were made with personnel and sampling effort, as necessitated by a budget cut in FY78, to insure 1977 fall sampling could be conducted.

The Royal Atlantic offshore sampling program was aborted on July 16 due to heavy ice conditions in parts of the study area. Pack ice at Cape Espenberg precluded entry into Kotzebue Sound. A total of 22 gillnet and 83 surface townet stations had been completed in the offshore waters of Norton Sound by this time (July 13). Data is still pending analysis as all personnel engaged in the large vessel program are being utilized on the nearshore studies which are still in operation.

Aerial coverage of the coastline for monitoring distribution and timing of spawning herring and other forage fish populations continued as weather conditions permitted. Coverage during this quarter included more than 4,500 kilometers of coastline and approximately 34 hours of airtime. The majority of this coverage was concentrated on the Seward Peninsula and in excess of 280 fish schools were documented. Nearly half of these were observed between Prince of Wales and Cape Espenberg in mid to late July.

Other activities during this quarter included updating all Data Management forms and submission of all unknown juvenile and larval fish to the National Marine Fisheries Service in Seattle(NWFC) for identification. In addition, a new FY78 work proposal had to be completed and resubmitted after receiving word that the original FY78 proposal submitted last quarter (156.8K) was cut nearly 65%. The actual funding level was 60K.

III. Results and Preliminary Interpretation

None at this time.

IV. Problems and Changes

The frequency of aerial surveys and results of each were hindered a great deal this quarter due to inclement weather and heavy smoke conditions. The extensive amount of acreage ablaze in Alaska in July and August (much of which was on the Seward Peninsula) and resulting smoke severly reduced the number of surveys which could be flown due to poor visibility. Fires were eventually extinguished with the help of fall rain storms. These storms are appearing more frequently as winter approaches and leave coastal waters extremely turbid for extended periods making observations difficult if not impossible.

To supplement data collection on the timing and distribution of fish species during such periods, flights are made to selected coastal villages and information gathered from local subsistence fishermen and hunters. News releases were also made in most coastal villages requesting anyone with information concerning the arrival of herring and other forage fish species to the coastal waters in their areas to contact the Alaska Department of Fish and Game.

A second problem has been associated with determining species identification of many fish schools observed during aerial surveys. Realizing from last years investigations that this would be a problem in view of no float or amphibious plane service in the study area, attempts were made to relocate field sampling crews into areas where large concentrations of fish schools have been observed. This was usually done as soon as possible upon completion of a particular survey and test fishing conducted with variable mesh gillnets.

Finally, the FY78 actual funding level (60K) has affected this past quarters work. Sampling effort and monies have had to be redistributed in such a manner to insure fall sampling in 1977 can be conducted. This was only possible with limited FY77 carryover monies to supplement next years funds in view of the nearly 65% cutback from the originally requested FY78 funding level.

V. Estimate of Funds Expended

A balance of approximately $29,000 exists as of September 15,1977. With the exception of salaries which will be paid from 9/16-9/30 and a few unposted aircharter expenses, remaining monies will be carried over and supplement the FY78 allocation in order to complete fall sampling this season as agreed upon by OCSEAP.

Quarterly Report

Contract #03-5-022-69
Research Unit #19E
Reporting Period July 1, 1977 - September 30, 1977
Number of Pages: 2

Forage Fish Assessment, Southern Bering Sea: R.U. 19 Extension

Irving M. Warner
Alaska Department of Fish and Game
P.O. Box 686
Kodiak, Alaska 99615

September 30, 1977

I. Task Objectives

A. To determine the spatial and temporal distribution of spawning forage fish stocks between Cape Sarichef, north to the Yukon Delta, and investigate their life history parameters with emphasis on their late spring and summer spawning periods.

B. Continuance of assessment studies inititated for boreal smelt, herring and capelin in FY 76.

II. Field or Laboratory Activities

The field crew returned to the Kodiak base on July 7, 1977. Up to that time they had been resident at Meshik field facility sampling forage fish stocks at the site fished in FY 76. Processing of the specimens had begun before the return of this crew, but continued through this quarter and concluded on August 31, 1977. Forage fish specimens collected ancillary to regular ADF&G functions in the Togiak area were returned to Kodiak base, and processed as an integral part of this research unit.

Analysis began on September 1, 1977 of all data, and is continuing at this time by editing, compiling and analyzing computer runs of 1976-77 R.U. 19 forage fish data. Generation of the project completion report began around September 7, 1977 and will continue until December 1, 1977.

Four aerial surveys were completed in early July under the conditions of this research unit. All results were recorded on EDP aerial survey forms. All aerial survey data were edited and prepared for key punching, which is pending as of September 15, 1977.

III. Results

The project completion report is in progress, and will be completed by December 1, 1977.

IV. Preliminary Interpretation of Results

In progress, hence not applicable at this time.

V. Problems Encountered/Recommended Changes

On September 6, 1977 (23 days prior to the date anticipated) we ran out of funds for this research unit due to increased project expenditures due to the ongoing air strike, the increase of salaries, and the compulsory payment of overtime, all of which took place during the FY 77 phase of this study. Monies have been since released to continue this study, and no problems are anticipated in having a project completion report submitted to the project office by December 1, 1977.

It should be noted that in 1976 a fall fishing phase was conducted at Meshik in mid-October. Since the primary purpose of this extension was as a continuance of studies initiated in FY 76 on boreal smelt, herring and capelin, for a full complimentary study to be done, a fall fishing phase should seriously be considered, especially in view of the fact that a critical life history parameter of the boreal smelt has been since discovered and needs further fall investigation. To date all Pacific sources indicate that *Osmerus eperlanus* spawn once in the spring; OCSEAP investigations have strongly indicated that there is a double run, i.e., one in the spring and one in either late summer or early fall. Last fall's fishing effort indicates that this second run might take place in the fall. To gain a basic spatial understanding of this forage fish, (if indeed there is a second run) this second run should be better known. If this effort is to be made, this office will need an additional 1.5 K of funding to accomplish it.

VI. Estimate of Funds Expended

Line Item Balances

Date	Line 100	Line 200	Line 300	Line 400
7/1	$8,325.78	$2,690.40	$5,527.89	$308.78
9/30	$ 0	$ 0	$ 0	$ 0

QUARTERLY REPORT

Contract No.
Research Unit #78
Reporting Period-July 1-September 30, 1977
Number of Pages - 11

BASELINE/RECONNAISSANCE CHARACTERIZATION LITTORAL BIOTA, GULF OF ALASKA AND BERING SEA

by

Charles E. O'Clair
Theodore R. Merrell, Jr.

Northwest and Alaska Fisheries Center Auke Bay Laboratory
OUTER CONTINENTAL SHELF ENERGY ASSESSMENT PROGRAM
Sponsored by
U.S. Department of the Interior
Bureau of Land Management

October 1, 1977

ABSTRACT

Our initial studies of biological interactions among rocky intertidal biota at Point Barber, Hinchinbrook Island have focused on *Pisaster ochraceus*, *Mytilus edulis* and *Alaria marginata*. We made counts and feeding observations on *Pisaster*, and took size measurements of all three species. *Mytilus* abundance was recorded on permanent plots.

At Point Barber, reduced feeding activity in *Pisaster* apparently continues later in the spring than in Puget Sound. The size frequency distribution and mean size of *Pisaster* at Point Barber are similar to those of populations of *Pisaster* at Monterey Bay whose main food source is barnacles. Change in coverage of *M. edulis* on one permanent plot between May and July, 1977 and general observations of mussel mortality in July, 1977 at Point Barber suggest that *Pisaster* may be as important to community structure here as elsewhere in the North Pacific.

Measurements of *Alaria* show that between May and July, 1977 at Point Barber the rates of erosion of the fronds tended to be greater than the growth rates of the plants. The rate of erosion relative to growth rate in this species may be a useful biological indication of exposure.

At Constantine Harbor we made observations on and photographed sections of two transects which were established in May, 1977. In addition, we measured *Cucumaria pseudocurata*, weighed *Echiurus echiurus alaskensis* and *Archidoris montereyensis* and made feeding observations of *Pycnopodia helianthoides*. There appeared to be fewer *Echiurus* holes in July than in May, but because of inadequate field time in July we were unable to determine whether this was a real change in the abundance of the echiuran.

II. Objectives

The objectives of this task are to characterize the coastline of Alaska according to major littoral habitat types, and to describe the distribution and abundance patterns of biotic populations within habitats.

III. Field or Laboratory Activities

Our field activities during this quarter entailed the continuation of those studies begun at Hinchinbrook Island in May, 1977 (Zimmerman and Merrell 1977) of the changes in intertidal community structure over time with emphasis on the key biological interactions and physical factors important to community organization. An understanding of community organization is crucial to the prediction of the effects of oil spills on natural communities. These intensive studies have been terminated by direction of the Juneau Project Office of OCSEAP.

A. Schedule: July 31 and August 1, 1977. Charter vessel: Cora B.

B. Scientific Party:

Name	Affiliation	Role
Joyce Gnagy	ABL	Muddy intertidal investigator
Charles O'Clair	ABL	Rocky intertidal investigator

C. Methods:

1. Rocky intertidal area.

We counted *Pisaster ochraceus* and examined each starfish for a tag (53 tagged in May, 1977). Disc width, arm length and wet weight had been taken on tagged and untagged *Pisaster* in May. Tagged *Alaria marginata* were measured. We photographed permanent plots emplaced in patches dominated by *Mytilus edulis* in May, 1977 and randomly placed and photographed four more permanent plots.

2. Muddy intertidal area.

We made observations on and photographed sections of two transects established in May, 1977 in Constantine Harbor.

D. Sample Collection Localities

1. Point Barber (Rocky intertidal area).

The intertidal area at Point Barber is a gently sloping bedrock platform. It is partially protected from open ocean waves and swells by the southwestern peninsula of Hinchinbrook Island and nearby Porpoise Rocks, but it probably receives severe wave shock during winter storms.

2. Constantine Harbor (Muddy intertidal area).

The study area in Constantine Harbor encompasses about 500 meters square on the south shore of the harbor. The substrate consists of mud, gravel and small boulders.

E. Data Collected

Number and type of measurements and observations.

1. Rocky intertidal area

Number	Type of observation
1	Count of *Pisaster ochraceus*.
53	*P. ochraceus* tagged with a floy tag on the aboral surface in the base of the arm opposite the madreporite.
69	Measurements of disk diameter (measured on the aboral surface between the bases of opposite arms through the madreporite), arm length (measured on aboral surface from center of disk to tip of longest arm), and wet weight of *P. ochraceus*.
25	*Alaria marginata* tagged with surveyors flagging proximal to sporophytes and measured (length from holdfast to tip of frond).
15	*A. marginata* marked by punching a hole at the intersection of the midrib and blade at a distance of from 5 to 10 cm from the distalmost sporophyll.

2. Muddy intertidal area

Number	Type of observation
94	Observations along two transects.
24	Photographs of sections of two transects.
248	Measurements of lengths *Cucumaria pseudocurata* expanded (tentacular crowns not included).
50	Measurements of wet weights of *Archidoris montereyensis*.
100	Measurements of wet weights of *Echiurus echiurus alaskensis*.

IV. Results

1. Rocky intertidal area.

No tagged *Pisaster* were recovered in July. We attribute this to tag loss. A brief laboratory study using *Evasterias troschelii* (*Pisaster* is not readily available locally at Auke Bay) indicated that these starfish can force floy tags out of their arms. Vital stains which have been used successfully to mark *Pisaster* elsewhere (Feder 1955) were not available to us in July.

The mean size (329.4 gms) and size distribution of *Pisaster* (Fig. 1) at Point Barber in May, 1977 are similar to those of natural populations of *Pisaster* at Monterey Bay, California whose food source is mainly barnacles (Feder 1970). Food available to *Pisaster* at Point Barber includes *Mytilus edulis* and *Balanus* spp. Our data on the diet of *Pisaster* there are inadequate; only 7% of the starfish examined (n=90) in May were feeding. At San Juan Island, Washington the proportion of *Pisaster* feeding decreases in winter, but returns to 25% to 50% by May (Mauzey 1966). The apparent late resumption in feeding of *Pisaster* at Point Barber as compared with that at San Juan Island may reflect latitudinal differences in the seasonal periodicity of feeding and reproduction of the starfish, but our data are inadequate for examining the question. Since *Pisaster* is the keystone species (see Section V) in Pacific Northwest rocky intertidal communities, spatial variability in the seasonal periodicity of feeding and reproduction of this starfish

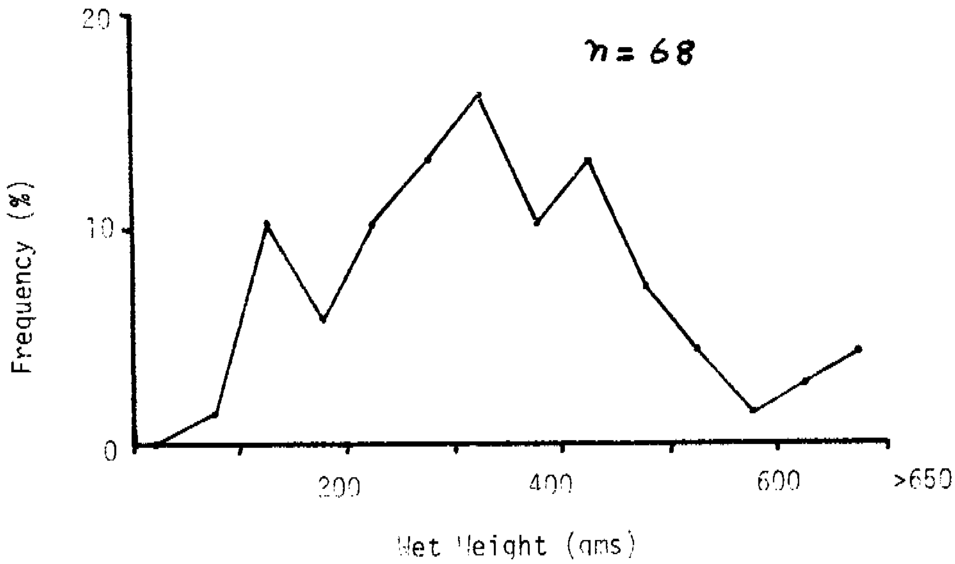

Fig. 1. Weight-frequency curve of Pisaster at Pt. Barber on May 4 and 5 (compare with Fig. 9 of Feder (1970)).

may cause spatial differences in community structure.

Twenty four percent of the Alaria tagged in May, 1977 still had tags in July. The mean change in length of these plants was -66.5 cm (SD 56.6 cm). Apparently the rate of erosion of the fronds was on the average greater than the rate of growth in the interval May to July. Holes punched in the fronds of Alaria in May were not visible in July; therefore, we have no measure of growth during this period.

Analysis of the coverage data from fixed quadrats is incomplete. Generally Fucus cover increased on plots in patches of M. edulis because of growth of Fucus plants present on these plots in May. Changes in Mytilus densities were variable; some plots showed no obvious changes. One plot showed a striking reduction in Mytilus cover (from 37% to 2%). We attribute this reduction to Pisaster predation; several Pisaster surrounded by empty mussel shells and barnacle plates were congregated near the plot.

2. Muddy intertidal area.

As a result of the preliminary survey made in May, 1977, we have observed four abundant animals whose role in the community structure may be followed. These principal animals are:

a. Cucumaria pseudocurata-sea cucumber- detritus feeder
b. Archidoris montereyensis-dorid nudibranch- carnivore, preys on Halichondria panicea (Fig. 3).
c. Echiurus echiurus alaskensis-echiurid worm- detritus feeder
d. Pycnopodia helianthoides-sea star- carnivore.

On the May trip we were able to make observations and gather data on abundance, size, reproductive state, and feeding behavior. In July, we were only able to work two tides (1 day). We used this time to monitor seasonal changes. The most obvious difference was the growth of a mat-forming filamentous green algae in much of the area. The Echiurus holes were not apparent and there was not enough time to dig for the worms to see whether they were still present. Any kind of

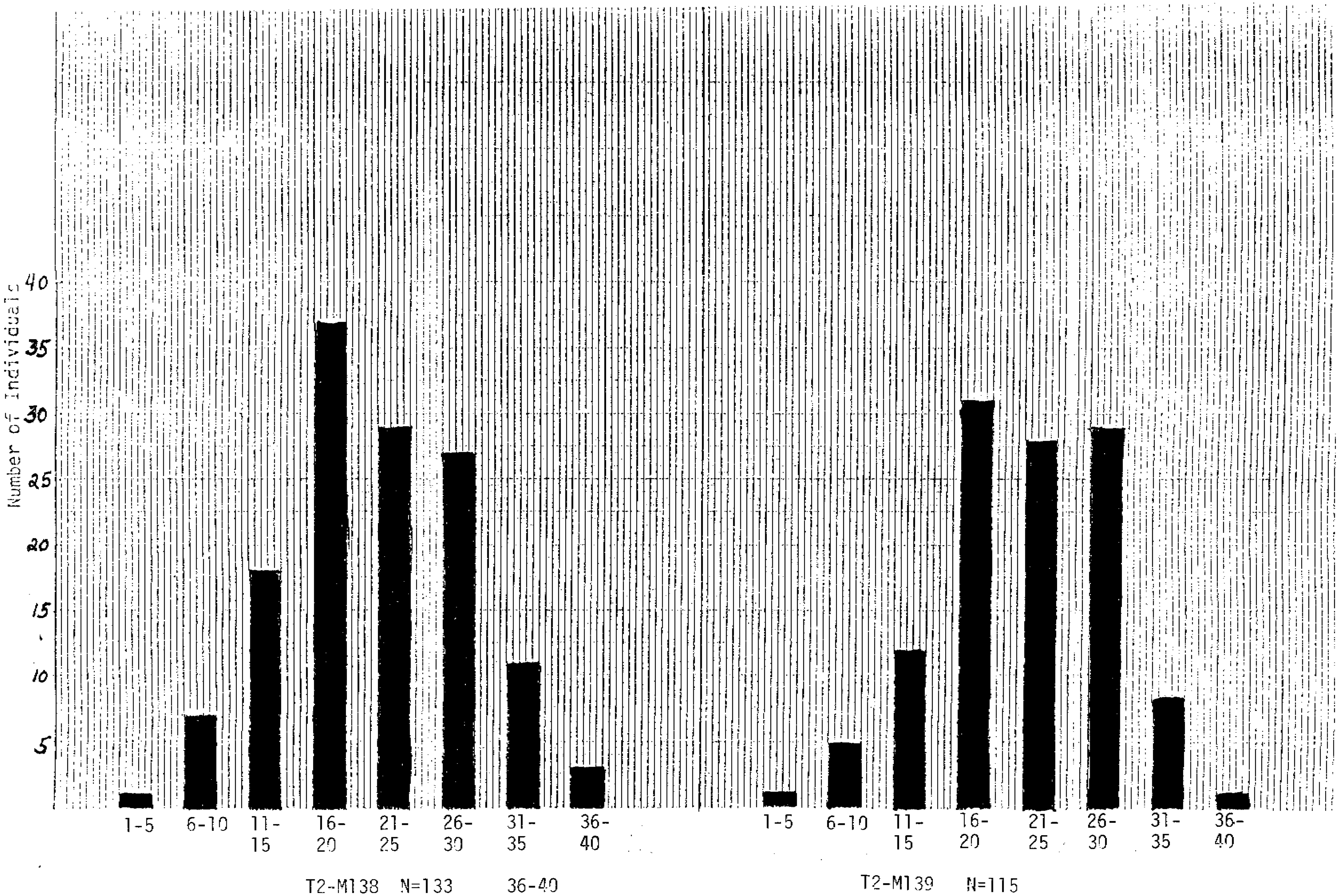

Fig. 2. Cucumaria pseudocurata lengths in mm (expanded, live, crowns not counted) from two 1/16 m^2 quadrat collections along a transect line in Constantine Harbor, May 7, 1977.

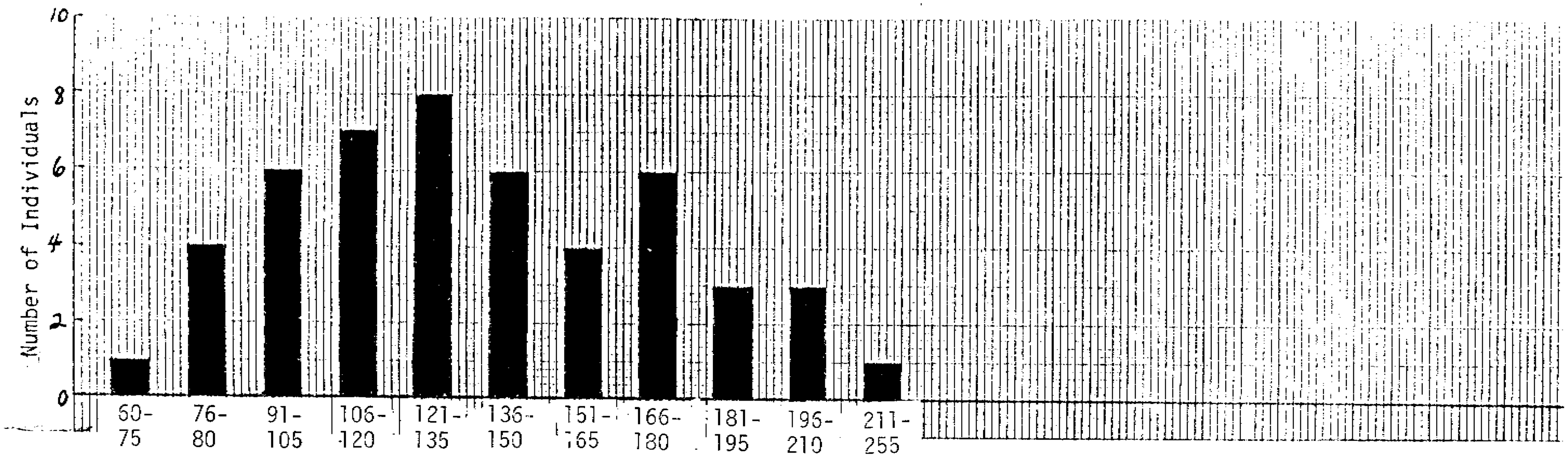

Fig. 3. Archidoris montereyensis weight in grams. Vicinity of Transect II, approximate level of m 13. May 6, 1977 n=50

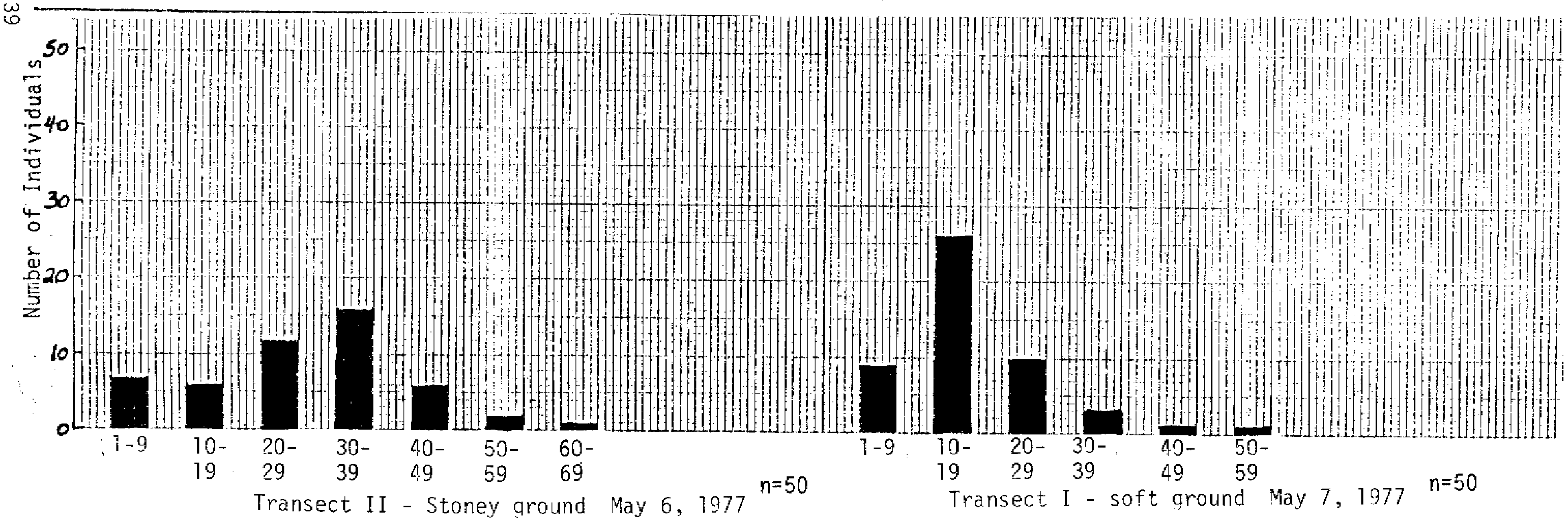

Fig. 4. Echiurus echiurus alaskensis weights in grams. Random samples near transects I and II.

field work is time consuming; work in soft bottom areas requires digging and sieving to expose the populations one is studying. In the present phase many questions remain unanswered.

The computer files scheduled for submission to NODC in October are in the final stages of updating.

V. Preliminary Interpretation of Results

In a recent review of research needs on the effect of organic contaminants on ecosystems for the National Science Foundation, Neuhold and Ruggerio (1975) conclude that "one of the largest gaps in our present knowledge concerns species interaction" and that "the extent to which the system will be affected will greatly depend upon previous established species interactions". The key interaction on rocky shores of the outer coast of Washington and probably elsewhere in the eastern North Pacific is that of predation by *Pisaster ochraceus* on *Mytilus californianus*. This interaction prevents the monopolization of space by *Mytilus* thereby mediating the persistance of competitively inferior invertebrates (Paine 1966) and algae (Dayton 1975) in the system. Echinoderms generally and *Pisaster* specifically are especially sensitive to oil pollution (Nelson-Smith 1972). Even if *Pisaster* alone were removed from the system by an oil spill it is likely that there would be profound changes in community structure as a result.

M. californianus is absent from Point Barber. Its ecological equivalent, *M. edulis*, has been shown to be a potentially dominant competitor in the mid-intertidal region on New England rocky shores (Menge 1976). Our preliminary data show that *Pisaster* preys on *M. edulis* and therefore probably plays a key role in intertidal communities at Point Barber as in Washington.

VI. Auxiliary Material

A. Bibliography of references

Dayton, P.K. 1975 Experimental evaluation of ecological dominance in a rocky intertidal algal community. Ecological Monographs 45:137-159.

Feder, H.M. 1955 The use of vital stains in marking Pacific Coast starfish. Calif. Fish and Game 41:245-246.

Feder, H.M. 1970 Growth and predation by the Ochre sea star, Pisaster ochraceus (Brandt), in Monterey Bay, California. Ophelia 8:161-185.

Mauzey, K.P. 1966 Feeding behavior and reproductive cycles in Pisaster ochraceus. Biol. Bull. 131:127-144.

Menge, B.A. 1976 Organization of the New England rocky intertidal community: role of predation, competition, and environmental heterogeneity. Ecological Monographs 46:355-393.

Nelson-Smith, A 1972 Oil pollution and marine ecology. Elek Science, London 269 pp.

Neuhold, J.M. and L.F. Ruggerio 1975 Ecosystem processes and organic contaminants: research needs and an interdisciplinary perspective. U.S. Government Printing Office, Washington, D.C. 52 pp.

Paine, R.T. 1966 Food web complexity and species diversity. Am. Nat. 100:65-75.

Zimmerman, S.T. and T.R. Merrell, Jr. 1977 Baseline/reconnaissance characterization littoral biota, Gulf of Alaska and Bering Sea. Quarterly Report April 1-June 30, 1977, Outer Continental Shelf Energy Assessment Program. 8 pp.

B. Papers in preparation or in print

1. In preparation:

Zimmerman, S.T., J.T. Fujioka, J.A. Gharrett, and J.S. MacKinnon 1977 Intertidal biota of the Kodiak Island area. Northwest and Alaska Fisheries Center Auke Bay Laboratory, Auke Bay, Alaska.

2. In print:

Sears, H.S. and S.T. Zimmerman 1977 Alaska Intertidal Survey Atlas. Northwest and Alaska Fisheries Center Auke Bay Laboratory, Auke Bay, Ak. 385 pp.

Rosenthal, R.J., D.C. Lees and T.M. Rosenthal 1977 Ecological assessment of sublittoral plant communities in the northern Gulf of Alaska for National Marine Fisheries Service, Auke Bay Laboratory. Final Report. Dames & Moore, Anchorage, Ak. 150 pp.

C. Oral presentations

During the period August 23-26 we presented the form of a poster presentation at the Ninth International Seaweed Symposium at Santa Barbara, California the results of a cooperative study with the Environmental Research Institute of Michigan (ERIM) on the use of multispectral scanning to assess littoral algal cover.

VII. Problems encountered and recommended changes

More frequent visits to our study sites would have alerted us to the tag loss problem with Pisaster and to the rapid disappearance of the punched holes in the fronds of Alaria and would have allowed us to modify our methods sooner. We were able to spend only 2 days at Hinchinbrook Island in July because of anticipated budget cuts.

In the future, should funds become available for intensive studies at Hinchinbrook Island or elsewhere, we recommend that the minimum visitation frequency of field sites in the first year, and perhaps longer, be bimonthly with more frequent visits optional for certain phases. Alternatively, a study site with appropriate species should be designated nearer Auke Bay for feasibility tests of methodology. Visits to field sites should last at least 1 week.

SUPPLEMENT TO

RESEARCH UNIT # 78

ALASKA INTERTIDAL SURVEY ATLAS

by

Howard S. Sears
Steven T. Zimmerman

Available from

National Marine Fisheries Service
Northwest and Alaska Fisheries Center
Auke Bay Laboratory
P.O. Box 155
Auke Bay, Alaska

FINAL REPORT

Supplement to Research Unit 78 (Sub-contract Report)

ECOLOGICAL ASSESSMENT OF SUBLITTORAL PLANT COMMUNITIES IN THE NORTHERN GULF OF ALASKA

FOR

NATIONAL MARINE FISHERIES SERVICE
AUKE BAY FISHERIES LABORATORY

EO
AN
RLM-LA
RCM-AN
DCL-AN

DAMES & MOORE
JOB NO. 6797-001-20
SEPTEMBER 16, 1977

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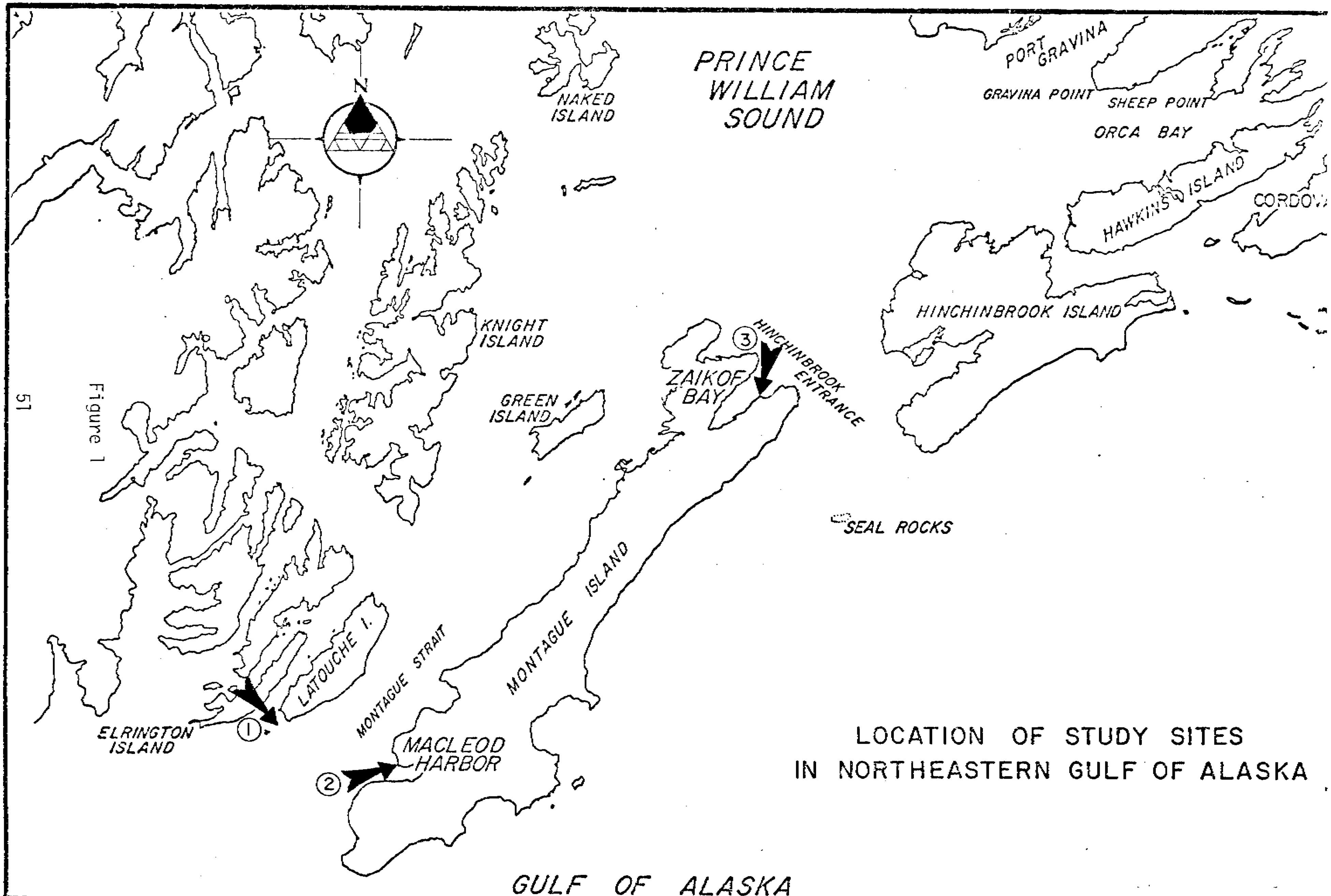

PRINCE WILLIAM SOUND
NAKED ISLAND
KNIGHT ISLAND
GREEN ISLAND
PORT GRAVINA
GRAVINA POINT
SHEEP POINT
ORCA BAY
HAWKINS ISLAND
CORDOV
HINCHINBROOK ISLAND
HINCHINBROOK ENTRANCE
ZAIKOF BAY
SEAL ROCKS
MONTAGUE ISLAND
MONTAGUE STRAIT
LATOUCHE I.
ELRINGTON ISLAND
MACLEOD HARBOR
GULF OF ALASKA
①
②
③
N
LOCATION OF STUDY SITES
IN NORTHEASTERN GULF OF ALASKA

Figure 1

The solid substratum covers a wide range of geological facies, ranging from patches of gravel and cobbles to extensive reefs composed of exposed bedrock or pavement. Typically, the biota is attached to, or associated with the hard substrate. Because the populations inhabiting various substrata and microhabitat types are frequently different, they require different sampling and study regimes.

The present field study began on July 22, 1975, when diver-biologists associated with Dames & Moore made observations in Zaikof Bay. The nearshore stations were revisited subsequently in mid-September 1975, late November 1975, mid-March 1976 and late June 1976. These observations and sampling periods spanned five seasons from summer 1975 through early summer 1976. Each location was sampled at least three times, and one of the stations (Latouche Point) was visited on five separate occasions.

GENERAL STUDY OBJECTIVES

The purpose of this study was to provide an inventory of the biological resources and ecological composition of three rocky sublittoral sites in the northeastern Gulf of Alaska. This was accomplished by first making a reconnaissance survey of the study sites in order to make a qualitative assessment of the habitat types present. After this phase, more intensive sampling was conducted at each location.

During this baseline investigation, we attempted to provide a characterization of habitats, biotic assemblages and species composition that reflected seasonal or temporal differences. The intent was to examine the baseline parameters that would partially serve as a basis for assessment of impacts and provide the background data necessary for designing long-term monitoring studies.

METHODS

Most of the direct observations were made while scuba diving at depths from MLLW to about 30 meters below the sea surface. A total of 52 dives, representing approximately 119 man hours, were spent underwater during this phase of the project. Our normal procedure was to spend between 3 and 4 days working at each site. More casual observations dealing with usage of the inshore zone by birds and mammals were made either in route to, or while anchored on station. Movement to the OCS study sites and living accommodations while in the field were provided by the M.V. Humdinger, a 36' commercial troller that is equipped for diving and intertidal research.

Numerical information was gathered from specific locations in the subtidal zone. Except when collecting specimens, we tried not to disturb the organisms or their environment. All observations were made during daylight hours.

Because of the multitude of species present within the shallow subtidal zone, we chose to limit our sampling to the more conspicuous or characteristic species in the assemblage. Characteristic or representative important species are: (1) species of obvious numerical (biomass) importance, (2) species that are known to have important structural roles for furnishing habitat, (3) the competitive dominants or key predators which may be uncommon, but which are considered likely to have important functional roles in the maintenance of the community and (4) species of aesthetic or present-day commercial value.

Several types of quantitative data have been collected about the characteristic species present at each site. Included are estimates of density (number of specimens per meter^2), frequency (spatial distribution), and percent cover (primary and secondary space). Methods of estimating percent cover, or the amount of surface area occupied by a particular taxon or group varied. Usually this information was obtained from replicated 0.25m^2 quadrats. The quadrats were either placed in a haphazard (unbiased) manner, or stratified in such a way that a particular habitat or microhabitat was sampled in the sublittoral zone. The surface or floating seaweed canopies were estimated visually.

Random or haphazard transect bands of various dimensions were also used in each location to estimate density (abundance). The transects were usually run along a specific isobath or depth contour. However, due to physical heterogeneity, some changes in depth and substrate were frequently encountered.

Biomass estimates have been generated for selected species at the study sites as a first step toward estimating consumption rates, and to provide information on temporal variations in population structure at specific sites. Measurements of linear size (length, width, aperture width, etc.) and weight (wet or dry weight of soft tissue) have also been obtained.

In addition to the numerical information derived from the quadrats and transects, species-specific interactions or natural history phenomena involving feeding and reproduction were also recorded. These methods assisted in describing the conditions at each study site and permitted examination of the differences between seasons and locations.

THE MARINE PLANT COMMUNITY

From the high water mark or splash zone of the littoral zone down to a depth of about 30 meters below the sea surface, the rocky habitats in the northern Gulf of Alaska are visually dominated by marine vegetation. The macroscopic seaweeds and seagrasses (macrophytes) form a conspicuous belt along the seashore. However, this band is not continuous, and is occasionally broken or interrupted by conditions in the physical environment that are unfavorable or preclude plant colonization and growth. Some of the marine plants that occur either in shallow waters, or grow along the beachlines are visible at various stages of the tide. There are a few subtidal species that form floating canopies that periodically become visible to even the casual observer. However, most of the vegetative band is below the low tide level, and is therefore unseen by surface observers.

The terms community and assemblage are used freely and often times interchanged throughout this report. The question of whether a community is an organized unit (system), or simply a collection of species with similar biological requirements is unresolved at the present time. However, a definition we have been able to work with is simply "a community is a group of species which are often found living together" (Fager, 1963).

The rocky sublittoral waters generally contain the greatest number of seaweed species. Typically this habitat is dominated by the broad-leafed brown algae or kelps which display high standing crop. Frequently, the attached benthic plants form dense stands or beds that are comparable to a meadow or terrestrial forest. In some parts of the North Gulf Coast the vegetative belt is wide and extends approximately 5 to 6 kilometers from shore; in other locations where vertical relief is sharp, the width of the belt is less than a few hundred meters (Rosenthal, unpublished data). In most areas, significant development of algal assemblages is limited to the upper 25 meters of the water column.

Marine plant communities are highly productive systems (Dawson, 1966; Mann, 1973), which typically attract or contain numerous animals, many of the species are of commercial or high aesthetic value. Some of the associated species live year-round or complete their life cycle in these habitats, while others, such as the herring or king crab, have a more temporary or transitory occurrence.

Recent studies (review by Mann, 1973) have pointed out the important role of macrophytes in coastal productivity. For example, Mann (1972) estimated the primary production in the seaweed zone in St. Margaret's Bay, Nova Scotia averaged 1750 grams of carbon per square meter per year. This was about three times more than the total phytoplankton production in the same bay. Additional studies by Westlake (1963) indicate annual levels of production of seaweeds in northern latitudes between 1,000 to 2,000g c/m^2/yr. Since these figures apply only to a narrow zone adjacent to land, the estimates are even more important when evaluating the contribution of the seaweeds to the production of carbon in Prince William Sound, a marine ecosystem dominated by its' lengthy, rocky shoreline and extensive macrophyte zone.

The floristic components of sublittoral algal assemblages in southern Alaska have received very little attention until the past decade. Recently, Rosenthal and Barilotti (1973), and Dayton (1975) provided descriptive information on kelp bed ecosystems off the west coast of Chichagof Island, Alexander Archipelago and Amchitka Island in the Aleutian Chain. Additional studies conducted by Rosenthal and Lees (in Dames & Moore, 1976a) in Kachemak Bay; Lees and Rosenthal (in Dames & Moore, 1977) on the Outer Kenai Peninsula, and Rosenthal (in Dames & Moore, 1976b) in northeastern Prince William Sound provide lists of species, vegetative profiles and estimates of density and percent cover for the characteristic seaweeds in these general locations.

Johansen (1971) made a relatively complete collection of the macroalgae from the Prince William Sound region. Thirty-three shoreline stations in the Sound were occupied approximately 15 months after the earthquake of March 27, 1964. However, all of the collections and observations were made in the intertidal zone, and no information was obtained from the shallow sublittoral waters adjacent to the shore.

In 1913, the U.S. Department of Agriculture conducted a survey of the kelp beds of Alaska (Cameron, 1915). This investigation was primarily designed to inventory the location, size, type and estimated yield of existing kelp beds in southern Alaska. The importance of this kind of information to present day research has been in providing historical records of the size and exact location of Alaskan kelp beds. Two of the locations in this present study, namely, Macleod Harbor and the southwest end of Latouche Island, are listed in the kelp bed inventory of western Alaska (Rigg, 1915).

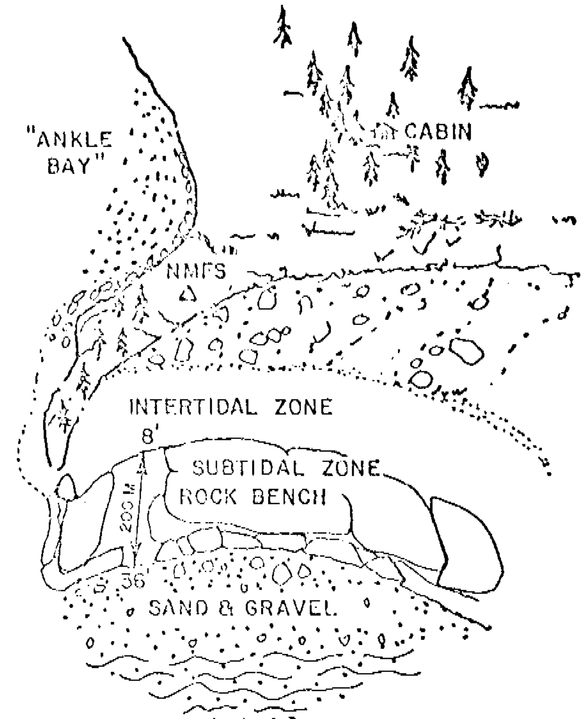
RESULTS

DESCRIPTION OF THE STUDY SITE (LATOUCHE POINT)

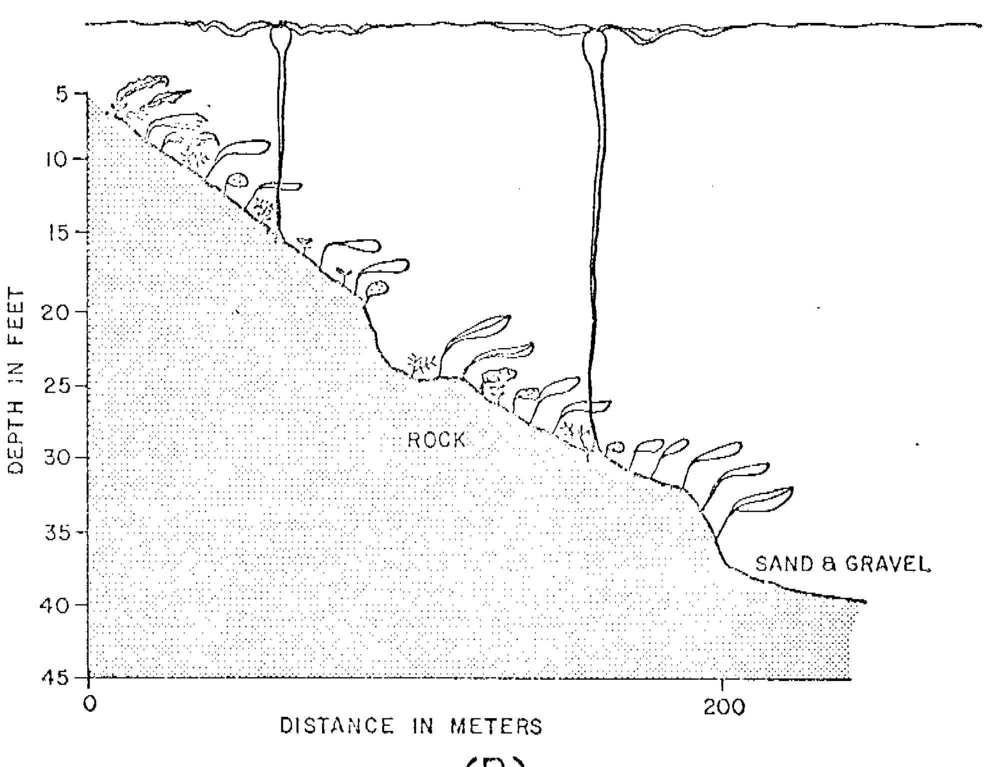
Latouche Island is situated on the southwest edge of Prince William Sound. The primary site in this present study was off the extreme southwestern end of the island near a rocky promontory that we have appropriately named Latouche Point (Figure 1). The point is strategically situated between Latouche Passage on the north and Montague Strait to the south. Both waterways are major arteries connecting the Sound to the Gulf of Alaska. The entire island underwent dramatic land-level changes during the March 27, 1964 earthquake, resulting in the shoreline being uplifted approximately 10 feet (Plafker, 1969). The present-day shoreline is rocky and moderately wooded with spruce and hemlock. Salt grass (Elymus) is common above the high water mark.

The point is exposed to westerly ocean swells, and a great deal of drift accumulates along the beachline, especially during early fall and spring. Tidal currents are typically moderate to weak in the lee of the Point. However, further offshore or in Latouche passage where the water mass is not deflected by land, the tidal currents can exceed 2 nautical miles per hour.

The rocky bench that fringes the southwest end of the island projects at least 200 meters horizontally into the shallow sublittoral zone (Figure 2). These measurements were made directly seaward or southwest of the NMFS intertidal transect, from the intertidal-subtidal



(A)



(B)

Figure 2

LATOUCHE POINT

DRAWING OF THE STUDY SITE (A)
AND THE SUBTIDAL VEGETATIVE CANOPIES (B)

fringe to a point where the rock and unconsolidated sediments merge. An overall change in water depth from between 9 and 10 meters was recorded between these two ecotones. Surge channels cut through the rock bench and generally run in a perpendicular fashion with respect to the shoreline. Beyond the rockbench the seafloor becomes somewhat homogenous, and the bottom is composed mainly of coarse sands, gravel and shell debris. Ripple marks were prominent features of the unconsolidated substrate.

BIOLOGICAL SETTING (ALGAL ASSEMBLAGE)

Much of the subtidal study area off Latouche Point was covered by a heavy growth of macroalgae. During summer months a large bed of bull kelp (*Nereocystis luetkeana*) grew on the shoal area between Latouche Point and Danger Island. The floating portion of the kelp bed was highly visible at slack low tide. Most of the *Nereocystis* grew on either the rock pavement or boulders. Individual plants were found from the intertidal-subtidal fringe, out to depths in excess of 20 meters. The densest part of the bed was between the 3 and 15 meter depth contour. Densities ranging up to 1.40 individuals/m^2 were observed for mature bull kelp (Tables 1 and 2). The average density during all sample periods was 0.35 plants/m^2. Juvenile *Nereocystis* were present in the study area during spring and summer; juveniles peaked in the spring and early summer and adult plants peaked in summer and early fall.

The vegetative understory beneath this floating or surface canopy was multi-layered, or composed of a number of separate algal canopies. The second canopy level during summer was composed of the annual brown alga *Cymathere triplicata*. Typically, *Cymathere* grew on cobbles, gravel and shell debris. It was extremely common in early summer (1976), and densities during the June survey averaged 3.16 plants/m^2 (Table 2). The plants were highly aggregated with a maximum of 11.60/m^2 in the band transects. Some of these plants were 2 to 3 meters in length. The third canopy level was composed of *Laminaria*

TABLE 1

DENSITY ESTIMATES OF SOME DOMINANT MACROPHYTES AT LATOUCHE POINT
(estimates were derived from band transects of different lengths)

Taxon	9-17-75	9-17-75	11-26-75	11-26-75	11-26-75	11-27-75	3-18-76	3-18-76
Nereocystis luetkeana	3 0.12/m^2	0	0	0	1 0.06/m^2	14 0.93/m^2	0	0
Laminaria spp.	116 4.64/m^2	251 10.04/m^2	84(15)* 6.60/m^2	74(61)* 5.60/m^2	171(61)* 15.47/m^2	Not counted	126 12.6/m^2	83 8.30/m^2
Agarum cribrosum	37 1.48/m^2	49 1.96/m^2	40 2.67/m^2	26 1.73/m^2	25 1.67/m^2	Not counted	14 1.40/m^2	4 0.40/m^2
Pleurophycus gardneri	7 0.28/m^2	7 0.28/m^2	0	0	2 0.13/m^2	Not counted	16 1.60/m^2	9 0.90/m^2
Constantinea spp.	Not counted	Not counted	16 1.07/m^2	24 1.60/m^2	10 0.67/m^2	Not counted	Not counted	Not counted
Opuntiella californica	Not counted	Not counted	8 0.53/m^3	16 1.07/m^2	34 2.27/m^2	Not counted	Not counted	Not counted
Ptilota filicina	Not counted	Not counted	17 1.37/m^2	6 0.40/m^2	31 2.07/m^2	Not counted	Not counted	Not counted
Area sampled:	25 x 1m	25 x 1m	15 x 1m	15 x 1m	15 x 1m	15 x 1m	10 x 1m	10 x 1m
Depth:	12m	12m	12m	14m	7m	7-8m	10m	8m
Substrate type:	Rock	Rock	Rock & Sand	Rock & Sand	Rock	Rock	Rock & Sand	Rock & Gravel

* Number in parenthesis indicates these plants had undergone blade renewal.

TABLE 2

DENSITY ESTIMATES OF SOME DOMINANT MACROPHYTES
AT LATOUCHE POINT

(Estimates Were Derived from Band Transects of Different Lengths)

Taxon	6-25-76	6-25-76	6-25-76	6-25-76	6-25-76	6-25-76	6-25-76	6-26-76	6-26-76	6-26-76	6-26-76	6-26-76
Nereocystis luetkeana	6 1.20/m^2	1 0.20/m^2	3 0.60/m^2	2 0.40/m^2	1 0.20/m^2	1 0.20/m^2	7 1.40/m^2	4 0.13/m^2	0	3 0.60/m^2	0	7 0.23/m^2
*Laminaria groenlandica**	27 5.40/m^2	21 4.20/m^2	48 9.60/m^2	0	0	0	0	Not counted	19* 3.80/m^2	20* 4.00/m^2	29* 5.80/m^2	Not counted
Laminaria yezoensis	11 2.20/m^2	13 2.60/m^2	19 3.80/m^2	28 5.60/m^2	1 0.20/m^2	0	0	Not counted	5 1.00/m^2	0	2 0.40/m^2	Not counted
Laminaria dentigera	-	-	-	22 4.40/m^2	37 7.40/m^2	44 8.80/m^2	32 6.40/m^2	Not counted	-	-	-	Not counted
Agarum cribrosum	10 2.00/m^2	4 0.80/m^2	1 0.20/m^2	5 1.00/m^2	1 0.20/m^2	0	0	Not counted	7 1.40/m^2	3 0.60/m^2	8 1.60/m^2	Not counted
Pleurophycus gardneri	1 0.20/m^2	0	0	2 0.40/m^2	5 1.00/m^2	24 4.80/m^2	30 6.00/m^2	Not counted	0	2 0.40/m^2	4 0.80/m^2	Not counted
Cymathere triplicata	1 0.20/m^2	7 1.40/m^2	8 1.60/m^2	10 2.00/m^2	53 10.60/m^2	0	0	Not counted	0	58 11.60/m^2	21 4.20/m^2	Not counted
Alaria sp.	1 0.20/m^2	3 0.60/m^2	3 0.60/m^2	0	0	4 0.80/m^2	13 2.60/m^2	Not counted	0	1 0.20/m^2	0	Not counted
Area sampled:	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	30x1 m	5x1 m	5x1 m	5x1 m	30x1 m
Depth:	15 m	13.5 m	13.5 m	6 m	5 m	3.5 m	3.5 m	9 m	9 m	9 m	9 m	9 m
Substrate type:	Sand, gravel & cobble	Gravel, cobble & rock	Gravel, sand & rock	Rock	Rock	Rock	Rock	Rock	Rock	Rock	Rock	Rock

TABLE 3

QUADRAT DATA (0.25m^2) FROM LATOUCHE POINT, SUBTIDAL
SEPTEMBER 17, 1975

Taxon	No. 1	No. 2	No. 3
Laminaria spp.	50%(6)	70%	16%
Pleurophycus		20%	
Agarum			40%(1)
Constantinea	20%(7)		20%(4)
Ptilota	P		
Membranoptera	15%		
Foliose, reds, unid.		10%	1%
Encrusting coralline	50%	P	60%
Articulated coralline	5%		20%
Hildenbrandia sp.	2%	5%	
Synoicum	1%		
Musculus vernicosus	P		P
Acmaea mitra	(1)		
? *Scrupocellaria*			1%
Pagurids	(3)		(2)
Tonicella spp.			(1)
Chelyosoma sp.			(1)
Balanus nubilus			(1)
Depth (meters):	11.0	11.0	11.0
Substrate type:	Boulder & Gravel	Gravel	Boulder & Gravel

TABLE 4

QUADRAT DATA ($0.25m^2$) FROM LATOUCHE POINT, SUBTIDAL
NOVEMBER 26, 1975

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4	No. 5
Agarum	0	0	40%(2)	0	0
Laminaria spp.	50%(2)(5)*	10%(2)*	5%(2)*	60%(2)	95%(5)(1)*
Ptilota	2%(1)	10%(1)	0	1%(1)	0
Encrusting coralline	80%	25%	90%	95%	40%
Constantinea	0	1%(1)	0	0	2%(2)
Articulated coralline	20%(8)	0	15%(9)	15%(6)	0
Opuntiella	5%(3)	0	5%(1)	0	5%(2)
Foliose reds, unid.	5%	5%	2%	0	0
Rhynchozoon	5%	1%	0	0	0
Styela	(1)	0	0	0	0
Yellow spatter sponge	3%	0	2%	0	0
Cancer oregonensis	0	(1)	0	0	0
Trichotropis	5%	0	0	0	0
Encrusting sponge	0	1%	2%	0	0
Synoicum	0	5%	2%	1%	0
Pagurids	(1)	0	0	0	0
Serpulidae	(2)	0	(1)	(1)	0
Syconid sponge	(1)	0	0	0	0
Tonicella	(1)	0	0	0	0
Orange globular sponge	0	0	1%	1%	0
White globular sponge	0	0	1%	0	0

Depth (meters): 7.0-8.0
Substrate type: rock bench

* Plants undergoing blade renewal

TABLE 5

QUADRAT DATA (0.25m^2) FROM LATOUCHE POINT, SUBTIDAL
NOVEMBER 26, 1975

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4
Agarum	30%(2)	25%(2)	30%(1)	20%(1)
Laminaria spp.	40%(7)	20%(2)	30%(2)	15%(1)
Ptilota	2%(1)	1%(1)	15%(1)	0
Encrusting coralline	45%	60%	80%	95%
Constantinea	8%(2)	0	0	5%(1)
Articulated coralline	5%(3)	30%(10)	40%(13)	15%(7)
Opuntiella	0	5%(1)	5%(1)	0
Foliose reds, unid.	5%	2%	0	0
Musculus vernicosus	(2)	(1)	(1)	0
Microporina	1%	5%	5%	0
Synoicum	1%	2%	5%	1%
Pagurids	(7)	(4)	(7)	(3)
Cryptolithodes	0	(1)	0	0
Abietinaria	0	0	1%(1)	0
Lichenopora	0	0	1%	1%
Tricellaria	0	0	2%	1%
Orange globular sponge	(1)	0	0	0
Tonicella	0	0	0	(1)
Encrusting sponge	0	0	(1)	0

Depth (meters): 10.0
Substrate type: Rock bench

TABLE 6

QUADRAT DATA (0.25m^2) FROM LATOUCHE POINT, SUBTIDAL
NOVEMBER 26, 1975

Taxon	Percent Cover (number of individuals)			
	No. 1	No. 2	No. 3	No. 4
Agarum	15%	50%(2)	60%(4)	15%(2)
Laminaria spp.	10%(3)	70%(2)	25%(1)	40%(2)
Ptilota	20%(4)	4%(2)	25%(1)	5%(1)
Encrusting coralline	90%	65%	50%	50%
Constantinea	0	2%(3)	0	0
Articulated coralline	10%(5)	25%(8)	2%(4)	15%(8)
Opuntiella	0	0	2%(1)	0
Hildenbrandia	0	0	1%	0
Membranoptera	0	0	0	2%
Foliose reds, unid.	0	2%	1%	0
Musculus vernicosus	0	(3)	(7)	0
Synoicum	1%	1%	0	0
Rhynchozoon	1%	1%	0	0
Tricellaria	2%	2%	3%	5%
Fusitriton	(1)	0	0	0
Strongylocentrotus	0	(1)	0	0
Orthasterias	0	0	0	(1)
Boltenia	0	0	0	(1)
Microporina	0	0	0	1%
Dendrobeania	0	2%	0	4%

TABLE 6 (Cont.)

QUADRAT DATA ($0.25m^2$) FROM LATOUCHE POINT, SUBTIDAL
NOVEMBER 26, 1975

Taxon	Percent Cover (number of individuals)			
	No. 1	No. 2	No. 3	No. 4
Amphissa	0	0	0	(3)
Pagurids	(2)	(2)	(2)	(4)
Yellow spatter sponge	0	0	0	2%

Depth (meters): 12.0
Substrate type: Rock bench

TABLE 7

QUADRAT DATA (0.25m^2) FROM LATOUCHE POINT, SUBTIDAL
NOVEMBER 26, 1975

Taxon	Percent Cover (number of individuals)			
	No. 1	No. 2	No. 3	No. 4
Agarum	15%	0	10%(1)	0
Laminaria yezoensis	40%(2)	5%	30%(2)	0
Laminaria spp.	40%(2)	0	30%(3)*	40%(3)(3)*
Bossiella	8%(4)	0	0	0
Corallina	5%(4)	5%(1)	1%(1)	8%(5)
Ptilota	1%(1)	1%(1)	1%(1)	1%(1)
Constantinea	2%(1)	0	0	0
Foliose reds, unid.	0	2%	2%	3%
Encrusting coralline	80%	80%	75%	90%
Hildenbrandia	0	0	10%	0
Microporina	40%	10%	30%	30%
Syconid sponge	0	0	0	(1)
Musculus vernicosus	(8)	0	0	(8)
Triopha carpenteri	0	(1)	0	0
Serpulidae	0	0	(1)	0
Synoicum	1%	1%	1%	0
Tricellaria	1%	1%	1%	0
Dendrobeania	0	0	1%	1%
Pagurids	0	(3)	0	(1)
Heteropora	0	0	0	1%

TABLE 7 (Cont.)

QUADRAT DATA ($0.25m^2$) FROM LATOUCHE POINT, SUBTIDAL
NOVEMBER 26, 1975

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4
Diodora	0	0	(1)	0
Calliostoma	0	0	0	(1)
Yellow spatter sponge	0	0	2%	1%

Depth (meters): 12.0-14.9
Substrate type: Rock bench

* Plants undergoing blade renewal

TABLE 8

QUADRAT DATA (0.25m^2) FROM LATOUCHE POINT, SUBTIDAL
NOVEMBER 27, 1975

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4	No. 5
Agarum	40% (3)	25% (0)	0	25% (1)	15%
Laminaria yezoensis	0	0	0	20% (1)	30% (2)
Laminaria spp.	10%	40% (3) (1)*	40% (4)	20%	30% (3) (2)*
Laminaria (holdfast)	30%	35%	40%	40%	40%
Hildenbrandia	30%	10%	2%	10%	5%
Bossiella	10% (4)	5% (2)	0	2% (1)	1% (1)
Corallina	0	2% (1)	0	0	15% (4)
Foliose reds, unid.	2%	1%	2%	6%	2%
Ptilota	0	0	0	2%	0
Rhodymenia spp.	0	0	0	0	1% (2)
Microporina	5%	5%	3%	35%	40%
Yellow spatter sponge	3%	0	0	3%	1%
White globular sponge	0	0	0	(1)	0
Dendrobeania	0	0	1%	1%	2%
Rhynchozoon	5%	0	0	0	0
Eudendrium	1% (3)	1% (1)	1% (3)	0	0
Synoicum	1%	0	2%	2%	1%
Serpulidae	0	0	0	(1)	0
Syconid sponge	0	0	0	0	1%
Acmaea mitra	(1)	0	0	0	0
Lichenopora	0	0	1% (2)	2% (1)	0

TABLE 8 (Cont.)

QUADRAT DATA ($0.25m^2$) FROM LATOUCHE POINT, SUBTIDAL
NOVEMBER 27, 1975

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4	No. 5
Abietinaria	2%(1)	1%(1)	0	1%(1)	2%(2)
Chiton (unid.)	0	(1)	0	0	0
Gravel	25%	50%	80%	25%	20%
Tricellaria	1%	0	0	3%	5%
Balanus ? *alaskensis*	(1)	0	0	0	0
Musculus vericosus	(1)	0	0	0	(10)
Crossaster	0	0	(1)	0	0
Fusitriton	0	0	(1)	0	0
Trichotropis	0	0	0	(1)	0
Pagurids	0	0	0	0	(1)
Heteropora	0	0	0	(1)	0
Styela	0	0	0	0	(1)
White spatter sponge	0	0	0	1%	0

Depth (meters): 10-12m
Substrate type: boulders, gravel and rock pavement

* Plants undergoing blade renewal

TABLE 9

QUADRAT DATA (0.25m^2) FROM LATOUCHE POINT, SUBTIDAL
NOVEMBER 27, 1975

Taxon		No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13	No. 14
Laminaria groenlandica		(2)	(2)		(1)			(3)		(1)		(2)	(1)	(1)	
Laminaria spp.				(2)		(2)			(4)		(1)			(1)	
Agarum cribrosum	(2)	(2)	(2)	(1)				(2)		(1)	(1)	(2)	(4)		
Opuntiella	P			P				P		P			P		
Constantinea			P	P				P			P	P			
Ralfsia								10%							
Ptilota		P	P					P		10%		P			5%
Odonthalia						5%									
Foliose red, unid.							10%		P						
Encrusting coralline	60%	70%	50%					75%					50%		
Articulated coralline				7%				2%				15%	4%		
Hildenbrandia				25%				15%		20%			40%	20%	
Styela													(1)		
Henricia		(2)						(1)					(2)		
Tonicella			(2)												
Trophonopsis			(1)												
Microporina		20%													
Fusitriton															(1)
Depth (meters):		11.5	11.5	11.5	12.0	12.5	12.5	12.0	12.5	12.5	12.5	12.5	12.0	12.5	12.5
Substrate type:		Rock pave-ment	Rock pave-ment	Rock	Rock	Gravel	Gravel	Rock	Gravel	Sand-rock	Sand-rock	Rock-gravel	Rock	Rock	Sand-rock

TABLE 10

QUADRAT DATA (0.25m^2) FROM LATOUCHE POINT, SUBTIDAL
March 16, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4
Laminaria yezoensis	50%(1)**	40%**	20%**	50%**
Laminaria groenlandica	0	(2)	(1)	(3)
Laminaria (juveniles)	(3)	0	(10)	0
Agarum	20%(2)	25%(2)	25%	25%(2)
Pleurophycus	0	0	20%(1)	10%(1)
Encrusting coralline	80%	80%	95%	90%
Ptilota	0	20%(1)	10%(1)	0
Constantinea	0	15%(3)	2%(1)	0
Rhodymenia	6%	5%	0	2%
Corallina	4%	20%	20%	25%
Bossiella	2%	2%	5%	0
Hildenbrandia	0	2%	0	2%
Ralfsia	0	5%	0	0
Microporina	5%	10%	0	0
Lichenopora	2%	0	0	0
Distaplia	2%	0	0	0
Synoicum	1%	10%	2%	2%
Gray colonial ascidian	1%	2%	1%	0
Orange encrusting sponge	1%	1%	0	0
Tricellaria	0	0	0	1%

TABLE 10 (Cont.)

QUADRAT DATA ($0.25m^2$) FROM LATOUCHE POINT, SUBTIDAL
MARCH 16, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4
Eudendrium	0	0	0	1%
Amphissa	0	(1)	(1)	0
Velutina sp.	0	(1)	0	(1)
Acmaea mitra	0	0	(2)	0
? *Rhynchozoon*	0	0	0	1%
Pagurids	0	(4)	(1)	(1)
Henricia spp.	0	(1)	0	0
Ophiopholis	0	0	present	0

Depth (meters): 9.0
Substrate type: Rock pavement and boulders

* Total *Laminaria* cover in quadrat

TABLE 11

QUADRAT DATA (0.25m^2) FROM LATOUCHE POINT, SUBTIDAL
MARCH 16, 1977

Taxon	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12
Laminaria groenlandica		(3)	(2)	(3)	(1)	(1)	(2)	(1)				(3)
Laminaria yezoensis				(1)	(1)	(3)						(2)
Laminaria spp.			(3)	(2)		(1)	(6)					(3)
Agarum cribrosum						(2)	(1)		(1)		(1)	
Pleurophycus gardneri		(1)						(4)				
Ralfsia spp.		5%		5%							5%	
Rhodymenia		10%				15%	5%	2%	10%		5%	5%
Delesseria		10%				10%	10%	15%	2%	5%		
Callophyllis								10%				
Constantinea		10%	10%	10%	10%	2%				5%	10%	
Membranoptera		10%								20%		
Ptilota		5%		5%		5%	20%	10%		10%	5%	5%
Filamentous brown			10%									
Oruntiella					2%							
Monostroma											2%	
Articulated coralline		5%		3%			15%		10%		2%	
Encrusting coralline		50%	20%	60%		70%	85%	70%	20%	25%	25%	50%
Calliostoma		(1)				(1)						(1)
Acmaea mitra			(1)							(1)		(1)
Tonicella												(1)
Depth (meters):	10.0	10.0	10.0	10.0	10.0	10.0	9.0	9.0	9.0	9.0	9.0	9.0
Substrate type:	Gravel	Rock-Gravel	Rock-Gravel	Rock	Gravel	Gravel-Sand	Rock	Rock	Rock	Rock-Gravel	Rock-Sand	Rock

TABLE 12

QUADRAT DATA ($0.25m^2$) FROM LATOUCHE POINT, SUBTIDAL
MARCH 17, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4
Laminaria yezoensis	50%(1)**	80%(8)**	35%**	20%(1)**
Laminaria groenlandica	(1)	0	(3)	0
Laminaria (juveniles)	0	(2)	0	0
Pleurophycus	0	0	25%(3)	20%
Encrusting coralline	40%	50%	30%	50%
Ptilota	1%	2%	5%	2%
Constantinea	5%(1)	0	2%(1)	0
Rhodymenia	0	0	0	5%
Corallina	15%	15%	8%	15%
Bossiella	1%	4%	0	0
Ralfsia	2	0	10%	0
Opuntiella	20%	0	0	12%
Delesseria	1%	0	1%	5%
Microporina	5%	2%	2%	1%
Lichenopora	0	1%	1%	0
Synoicum	5%	2%	15%	10%
Gray colonial ascidian	15%	2%	10%	2%
Orange encrusting sponge	2%	0	0	1%
Tricellaria	0	0	0	1%
Orange colonial ascidian	0	0	0	1%
Green colonial ascidian	0	2%	2%	0
Velutina	0	0	0	(1)

TABLE 12 (Cont.)

QUADRAT DATA (0.25m^2) FROM LATOUCHE POINT, SUBTIDAL
MARCH 17, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4
Serpulidae	0	(1)	(5)	0
Pagurids	0	0	(2)	(5)
Henricia	0	0	(1)	0
Ophiopholis	0	present	present	present
Yellow globose sponge	0	0	0	1%
Lacuna	0	present	present	0
Styela	0	0	(2)	0
Searlesia	0	0	0	(1)
Margarites	0	0	0	(1)
Trophon	0	0	(2)	0
Placiphorella	(1)	0	0	0
Cancer oregonensis	0	(1)	0	0
Oregonia	0	0	0	(1)

Depth (meters): 8.0-9.0
Substrate type: Rock pavement and boulders

** Total *Laminaria* cover in quadrat

TABLE 13

QUADRAT DATA ($0.25 m^2$) FROM LATOUCHE POINT, SUBTIDAL
MARCH 17, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3
Laminaria yezoensis	40%(2)*	50%(2)	60%
Laminaria groenlandica	(1)	(1)	0
Laminaria (juveniles)	(3)	(2)	(13)
Pleurophycus	10%(2)	20%(1)	0
Encrusting coralline	40%	70%	50%
Ptilota	2%	10%	0
Constantinea	0	0	2%
Rhodymenia	2%	5%	0
Corallina	2%	15%	4%
Bossiella	0	0	3%
Hildenbrandia	2%	0	0
Opuntiella	10%	20%	5%
Delesseria	2%	2%	0
Microporina	15%	0	4%
Lichenopora	1%	1%	1%
Synoicum	6%	8%	6%
Gray colonial ascidian	15%	8%	30%
Orange encrusting sponge	1%	1%	2%
Abietinaria	0	0	2%
Green colonial ascidian	0	4%	1%
Tonicella	0	(2)	(2)

TABLE 13 (Cont.)

QUADRAT DATA (0.25m^2) FROM LATOUCHE POINT, SUBTIDAL
MARCH 17, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3
Pagurids	(2)	(12)	(6)
? *Rhynchozoon*	0	0	1%
Searlesia	(1)	0	0
Heteropora	1%	0	0
Trophon	0	0	(1)
Entodesma	(1)	0	0

Depth (meters): 7.0-8.0
Substrate type: Rock pavement and boulders

* Total *Laminaria* cover in quadrat

TABLE 14

QUADRAT DATA ($0.25 m^2$) FROM LATOUCHE POINT, SUBTIDAL
MARCH 18, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4
Laminaria yezoensis	70%**	50%**	75%(1)**	60%(1)**
Laminaria groenlandica	(2)	(0)	(5)	(2)
Laminaria (juvenile)	0	(2)	0	0
Pleurophycus	0	25%(1)	0	30%(2)
Agarum	0	25%(1)	10%(2)	0
Encrusting coralline	60%	50%	80%	45%
Ptilota	25%	0	5%	20%
Constantinea	30%	0	0	8%
Rhodymenia	0	0	0	2%
Corallina	40%	20%	25%	8%
Bossiella	10%	5%	0	2%
Opuntiella	0	5%	5%	0
Delesseria	0	8%	1%	1%
Membranoptera	0	0	0	2%
Lichenopora	0	1%	1%	1%
Synoicum	2%	0	5%	5%
Distaplia	10%	5%	2%	0
Orange encrusting sponge	3%	0	0	1%
Tricellaria	0	1%	1%	1%
Didemnum or *Trididemnum*	1%	3%	0	0
Chelyosoma productum	0	0	1%(1)	0

TABLE 14 (Cont.)

QUADRAT DATA ($0.25m^2$) FROM LATOUCHE POINT, SUBTIDAL
MARCH 18, 1976

Taxon	Percent Cover (number of individuals)			
	No. 1	No. 2	No. 3	No. 4
Lacuna	0	0	0	0
Acmaea mitra	0	(2)	(2)	(1)
Searlesia	(1)	(1)	0	0
Tonicella	0	(3)	(1)	0
Serpulidae	0	0	0	0
Ophiopholis	0	0	0	0
Pagurids	0	(4)	(2)	(2)
Margarites	0	(2)	0	0

Depth (meters): 6.0-10.0
Substrate type: Rock bench and boulders

** Total *Laminaria* cover in quadrat

TABLE 15

QUADRAT DATA (0.25m^2) FROM LATOUCHE POINT, SUBTIDAL
MARCH 18, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4
Laminaria yezoensis	25%(1)**	40%(1)**	60%**	5%**
Laminaria groenlandica	0	(1)	(1)	0
Laminaria (juvenile)	0	0	(8)	(4)
Pleurophycus	0	10%(2)	0	15%
Agarum	10%	0	0	0
Encrusting coralline	40%	60%	50%	70%
Ptilota	40%	15%	20%	15%
Constantinea	16%(2)	0	0	5%
Corallina	40%	30%	40%	40%
Bossiella	1%	0	0	1%
Hildenbrandia	1%	0	0	0
Ralfsia	0	5%	0	0
Delesseria	0	0	0	1%
Alaria sp.	0	15%	0	20%(1)
Lichenopora	0	1%	0	0
Synoicum	20%	5%	5%	1%
Distaplia	5%	5%	0	0
Orange encrusting sponge	2%	1%	0	8%
Tricellaria	1%	0	1%	0
? *Leucosolenia*	0	0	1%	0

TABLE 15 (Cont.)

QUADRAT DATA ($0.25m^2$) FROM LATOUCHE POINT, SUBTIDAL
March 18, 1976

Taxon	Percent Cover (number of individuals)			
	No. 1	No. 2	No. 3	No. 4
Yellow encrusting sponge	0	0	2%	0
Acmaea mitra	(1)	0	0	(3)
Searlesia	0	0	0	(2)
Tonicella	0	0	0	(2)
Serpulidae	0	0	0	present

Depth (meters): 5.0-6.0
Substrate type: Rock bench

** Total *Laminaria* cover in quadrat

TABLE 16

QUADRAT DATA ($0.25 m^2$) FROM LATOUCHE POINT, SUBTIDAL
JUNE 25 and 26, 1976

Taxon	Percent Cover (Number of Individuals) No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13	No. 14	No. 15	No. 16
Laminaria yezoensis	5%(1)	5%(1)				5%(1)		65%(4)		40%(3)	75%(2)					10%(1)
Laminaria groenlandica/ dentigera	0	60%	5%(1)		60%(4)	40%(3)	90%(7)								10%	40%(1)
Laminaria saccharina	0			50%(1)												
Laminaria spp.	5%(10)	2%(3)			2%(2)	5%(10)		8%(5)	2%(3)		10%(2)		30%(20)	2%(5)		
Pleurophycus	30%(3)					25%(2)	10%(1)			10%(1)						
Agarum	20%(3)	25%		5%	25%(1)					2%(1)	10%				15%	
Cymathere			50%	15%				25%(4)			15%					
Alaria sp.													5%(1)			
Nereocystis													15%(2)			
Opuntiella	10%					10%	15%									
Rhodymenia		5%							15%		8%		10%			8%
Constantinea	10%(3)									10%	15%				10%	15%
Microcladia	5%								2%							
Ptilota	5%			2%	5%	10%	20%			10%	2%			2%		15%
Pterosiphonia			5%		2%		5%									
Membranoptera				5%						10%	5%					
foliose reds, unid.		5%	10%	20%				5%	5%		5%		15%	10%		
Delesseria					2%	5%	2%			15%						
Callophyllis							5%			15%					15%	15%
filamentous reds, unid.							15%			5%						
encrusting coralline	60%	10%			50%	70%	80%	15%		60%	25%	2%	20%	5%		40%
articulated coralline	10%				5%	5%	2%									20%
Palfsia sp.	2%					2%				2%						2%
Odonthalia Kamtschatica													15%			
Bossiella sp.	15%					2%				10%	10%					
Hildenbrandia sp.	15%															
Desmarestia viridis									2%	5%						
Microporina					60%	2%	8%									2%
Heteropora	5%					2%				2%						
Distaplia					30%	15%	10%			5%						5%
Synoicum	2%				5%	15%	30%								5%	
Dendrobeania murryani	2%															
Musculus vernicosus	P	P	P	P	P	P	P	P	P	P			P	P	P	P
Musculus discors																(1)
Calliostoma						(5)				P						
Searlesia						(1)	(1)									
Acmaea mitra										(1)			P			
Crossaster										(1)	(1)				(1)	
Henricia																(1)
? *Leptasterias* sp.										(1)						
pagurids							(1)							(1)		
Strongylocentrotus spp.		(1)														(1)
Trichotropis sp.							(1)									
Olivella														(1)		
Tonicella spp.	(1)					(1)	(1)			(2)						(2)
Pycnopodia												(1)				
Depth (meters):	14.5	14.5	12.0	12.0	10.5	5.5	5.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	10.5	10.5
Substrate type:	Rock & gravel	Gravel	Sand, shell and gravel	Sand, shell and gravel	Rock	Rock	Rock	Gravel and shell	Gravel and shell	Gravel and rock	Gravel and rock	Gravel	Gravel and rock	Gravel	Rock & gravel	Rock & gravel

generally lies prostrate on the substratum. Density estimates ranged from 0-2.67/m^2 in the transect bands, however densities up to 16.00/m^2 were recorded for Agarum in the quadrats.

Beneath the brown algal undergrowth was another layer of foliose and peltate reds, comprised of Constantinea spp., Opuntiella californica, Ptilota filicina, ? Schizymenia epiphytica and ? Kallymenia oblongifructa. Other ephemeral seaweeds in this red algal guild were Rhodymenia spp.; Delesseria decipiens; Odonthalia kamtschatica; Callophyllis spp.; Membranoptera sp. and Pterosiphonia bipinnata. Crustose and articulated corallines such as Lithothamnion, Bossiella and Corallina, and encrusting layers of Hildenbrandia and Ralfsia formed the final vegetative veneer on the rock substrate.

During summer months the hair-like brown algae Desmarestia aculeata and D. viridis, and a ligulate member of this group, Desmarestia ligulata var. ligulata were scattered around the study area. Typically this genus was found on cobbles, shells and gravel. Both Desmarestia aculeata and D. viridis are perennials, while D. ligulata is reputed to be an annual (Chapman, 1972).

To date, a total of 54 species of macroalgae have been identified from the shallow sublittoral zone off Latouche Point (Table 17). Of these, more are undoubtedly present in this location, however only the more conspicuous species were collected or included in the species inventory. The coralline algae still need to be properly identified since they are such a difficult group taxonomically.

TABLE 17

LIST OF MACROALGAE COLLECTED AT OCS STUDY SITES
IN THE NORTHEASTERN GULF OF ALASKA

	Latouche Point	Macleod Harbor	Zaikof Bay
CHLOROPHYTA (greens)			
Codium fragile	X		
Enteromorpha ? linza		X	X
Enteromorpha intestinalis			X
Halicystis ovalis	X		
Monostroma ? fuscum	X	X	X
Monostroma sp.	X	X	X
Spongomorpha sp.		X	
Ulva spp.		X	X
PHAEOPHYTA (browns)			
Agarum cribrosum	X	X	X
Alaria fistulosa	X drift		
Alaria ? pylaii	X	X	X
Alaria ? marginata		X	
Chordaria flagelliformis		X	
Costaria costata	X	X	X
Cymathere triplicata	X	X	X
Desmarestia aculeata	X	X	
Desmarestia ligulata var. *ligulata*	X	X	X
Desmarestia viridis	X	X	X
Fucus distichus	X	X	X
Laminaria groenlandica	X	X	X
Laminaria saccharina	X	X	X
Laminaria dentigera	X		
Laminaria yezoensis	X	X	X
Melanosiphon intestinalis		X	X
Nereocystis luetkeana	X	X	X
Pleurophycus gardneri	X	X	X
Pylaiella ? littoralis		X	X
Ralfsia fungiformis	X	X	X
Ralfsia pacifica	X	X	X
Scytosiphon lomentaria			X
Sphacelaria sp.		X	
RHODOPHYTA (reds)			
Antithamnion sp.			X
Bossiella orbigniana	X	X	X
Bosiella sp.	X	X	
Callophyllis edentata	X	X	X
Callophyllis flabellulata	X	X	X
Callophyllis cristata		X	
Callophyllis ? crenulata	X	X	X
? *Clathromorphum circumscriptum*	X		
Constantinea simplex	X	X	X
Constantinea subulifera	X	X	X

TABLE 17 (Cont.)

LIST OF MACROALGAE COLLECTED AT OCS STUDY SITES
IN THE NORTHEASTERN GULF OF ALASKA

	Latouche Point	Macleod Harbor	Zaikof Bay
Corallina frondescens	X	X	X
Corallina vancouveriensis	X	X	X
Cryptopleura sp.	X		
? Cryptonemia sp.	X		
Delesseria decipiens	X	X	
Erythrophyllum delesserioides		X	
Gigartina spp.	X	X	X
Halosaccion glandiforme	X	X	X
Hildenbrandia ? occidentalis	X	X	X
Iridea sp.			
? Kallymenia oblongifructa	X	X	X
Lithothamnion sp.	X	X	X
Lithothrix aspergillum	X		X
Membranoptera dimorpha	X	X	X
Membranoptera ? multiramosa	X		
Microcladia borealis	X	X	X
Odonthalia floccosa		X	X
Odonthalia kamtschatica	X	X	X
Opuntiella californica	X	X	X
Phycodrys sp.	X	X	X
Platythamnion sp.			X
? Peyssonelia pacifica	X	X	
Polyneura latissima	X		
Polysiphonia pacifica			X
Polysiphonia sp.	X	X	X
Porphyra spp.	X	X	X
Pterosiphonia bipinnata			X
Ptilota filicina	X	X	X
Ptilota tenuis	X	X	
Rhodoglossum affine		X	
Rhodymenia palmata	X	X	X
Rhodymenia pertusae	X	X	X
Schizymenia spp.	X	X	X
Stenogramme interrupta			X

No. taxa or species = 75

EPIFAUNA AND TROPHIC INTERACTION

Within the three study areas about 211 different taxa of macroinvertebrates (Table 18), and 30 species of inshore fishes (Table 19) were either identified or categorized for future taxonomic verification. Of all groups seen in the seaweed zone, the mollusks were represented by the greatest number of species, and accounted for 36 percent (n=76) of the total macroinvertebrate inventory. Despite this expression of diversity, the molluscan members of the seaweed community appeared to be only a moderate component of the overall biomass. Based on the information obtained from the quadrats ($0.25m^2$), the attached or sessile fauna such as sea anemones, hydroids, sponges, bryozoans and ascidians were dominants in terms of percent cover and biomass.

The seaweed canopy at Latouche Point provided both food and cover for the animal components of the nearshore system; it also served as living substrate for other plants and animals. For example, some serpulid worms such as Spirorbis spp. and encrusting bryozoans spend the entire life cycle following the initial settling stage attached to seaweeds. Other species such as a tiny mussel Musculus vernicosus covered extensive portions of the shallow sublittoral zone during the summers of 1974, 1975 and 1976. Musculus was most often attached to living marine plants, however it was also found on sedentary animals and solid inorganic substrate. Many of the seaweeds off Latouche Point were almost entirely covered by M. vernicosus, which typically attaches with the foot and byssal threads. It occurred in 26 of 86 quadrats, for

TABLE 18

LIST OF BENTHIC MACROINVERTEBRATES COLLECTED AT THE THREE STUDY SITES IN NORTHEASTERN GULF OF ALASKA (1975-76)

Porifera (sponges)	Latouche Point	Macleod Harbor	Zaikof Bay
Cliona celata	X	X	X
Halichondria ? panicea		X	X
Esperiopsis spp.	X		
Suberites fiscus		X	X
? *Mycale adhaerens*		X	X
White globose, unid.	X		X
Yellow spatter, unid.	X	X	X
Red globose, unid.	X	X	
Cnidaria			
Abietinaria spp.			
Sertularella turgita		X	
Anthopleura xanthogrammica	X		
Cribinopsis ? assimilis	X	X	X
Peachia ? parasitica	X		
Telia crassicornis	X	X	X
Tealia spp.	X	X	X
Ptilosarcus gurneyi		X	X
? *Stomphia* sp.	X		
Metridium senile	X	X	X
Campanularia verticellata	X		X
Hydractinia sp.	X		X
Obelia sp.			X
Grammaria sp.			X
Eudendrium sp.	X		
Gersemia rubiformis	X		
Lafoea sp.		X	X
Haliclystus ? auricula	X	X	X
Cyanea capillata	X	X	X
? *Epizoanthus scotinus*	X		
Halcampa sp.			X
Nemertea (ribbon worms)			
Unid. species A (orange)			X
Unid. species B (white bands)	X		
Mollusca (mollusks)			
Cryptochiton stelleri	X	X	X
Katharina tunicata	X	X	X

TABLE 18 (Cont.)

LIST OF BENTHIC MACROINVERTEBRATES COLLECTED AT THE THREE STUDY SITES IN NORTHEASTERN GULF OF ALASKA (1975-76)

Mollusca (mollusks)	Latouche Point	Macleod Harbor	Zaikof Bay
Tonicella lineata	X	X	X
Tonicella insignis	X	X	X
Placiphorella spp.	X	X	X
Mopalia muscosa		X	X
? *Ischnochiton mertensii*	X	X	X
Mopalia spp.	X	X	X
Puncturella multistriata	X	X	X
Diadora aspera	X	X	X
Crepipatella lingulata	X	X	X
Crepidula nummaria		X	
Cryptobranchia concentrica		X	X
Collisella instabilis	X	X	X
Acmaea mitra	X	X	X
Fusitriton oregonensis	X	X	X
Trichotropis cancellata	X	X	X
Trichotropis insignis			X
Margarites ? *pupillus*	X	X	X
Calliostoma annulatum	X		
Calliostoma ligatum	X	X	X
Velutina rubens	X		
Natica spp.	X	X	X
Lacuna carinata	X	X	X
Olivella baetica	X		
Nassarius mendicus		X	
Ceratostoma nuttallii		X	
Trophon multicostatus	X	X	
Amphissa columbiana	X	X	X
Trophonopsis insignis			X
Searleisa dira	X	X	X
Volutharpa ampullacea			X
Thais ? *canaliculata*			
Thais lamellosa	X	X	X
Neptunea lirata			X
Turridae, unid.		X	
Trophonopsis lasius			X
Beringinus kenneycotti			X
Aglaja ocelligera		X	
Gastropteron pacificum	X	X	X
Dirona aurantia	X		
Tochuina tetraguetra	X		
Melibe leonina			X
Dendronotus dalli	X		X
Dendronotus spp.		X	
Aeolidia papillosa		X	
Hermissenda crassicornis	X	X	X

TABLE 18 (Cont.)

LIST OF BENTHIC MACROINVERTEBRATES COLLECTED AT THE THREE STUDY SITES IN NORTHEASTERN GULF OF ALASKA (1975-76)

Mollusca (mollusks)	Latouche Point	Macleod Harbor	Zaikof Bay
Coryphella sp.			X
Triopha carpenteri	X	X	
Diaulula sandiegensis	X		
Anisodoris nobilis	X		
Archidoris odneri	X	X	
Cadlina luteomarginata	X	X	
Cadlina sp.	X		
Pododesmus macroschisma	X	X	X
Pecten caurinus		X	
Chlamus spp.	X	X	X
Glycymeris ? *subobsoleta*		X	
Hiatella arctica	X	X	X
Mytilus edulis	X	X	X
Modiolus modiolus	X	X	
Musculus vernicosus			
Musculus discors	X	X	X
Musculus ? *niger*			X
Tellina sp.		X	
Clinocardium nuttalli		X	X
Clinocardium ciliatum			X
Thracia trapezoides			X
Lyonsia californica	X	X	X
Prototchaca staminea		X	X
Mya truncata			X
Astarte sp.		X	X
Saxidomus giganteus		X	X
Humilaria kennerlyi	X	X	X
Macoma spp.		X	X
Octopus sp.	X		X
Annelida (segmented worms)			
Onuphis iridescens		X	
Phyllodoce ? *groenlandica*		X	
Lumbrineris ? *similabris*		X	
Scoloplos ? *acmeceps*		X	
Chone ? *mollis*		X	
Flabelligera infundibularis		X	
Nereis ? *pelagica*		X	
Phyllodoce sp.		X	
? *Sigalion* sp.		X	

TABLE 18 (Cont.)

LIST OF BENTHIC MACROINVERTEBRATES COLLECTED AT THE THREE STUDY SITES IN NORTHEASTERN GULF OF ALASKA (1975-76)

Annelida (segmented worms)	Latouche Point	Macleod Harbor	Zaikof Bay
Axiothella rubrocincta		X	
Haploscolops elongatus		X	
Maldanidae, unid.		X	X
Pectinaria (Cistenides) sp.		X	X
Eudistylia vancouveri	X	X	X
Myxicola sp.	X	X	
Spirorbis spp.	X	X	X
Abarenicola sp.		X	
Serpula vermicularis	X	X	X
? Schizobranchia insignis			X
Sipincula (peanut worms)			
Eubonellia valida			X
Arthropoda (jointed foot)			
Balanus cariosus		X	
Balanus crenatus		X	X
Balanus nubilus	X	X	
Balanus ? rostrotus alaskensis		X	
Cancer magister			X
Cancer oregonensis	X		
Cryptolithodes sitchensis	X		X
Phyllolithodes papillosus			
Hapalogaster mertensii	X		
Rhinolithodes wosnesenskii			X
Placetron wosnesenskii			X
Pagurus ochotensis	X	X	
Pagurus ? beringanus			X
Pagurus stenuensae			X
Elassochirus tenuimanus	X	X	
Elassochirus gilli	X	X	X
Oregonia gracilis	X	X	X
Chionoecetes bairdi			X
Pugettia gracilis	X	X	X
Pugettia ? richii		X	
Hyas lyratus		X	
Telmessus cheiragonus		X	X
Pandalus danae	X	X	X
Pandalus sp.		X	X
Sclerocrangon sp.			X
Eualus spp.		X	X
Heptacarpus spp.	X	X	X

TABLE 18 (Cont.)

LIST OF BENTHIC MACROINVERTEBRATES COLLECTED AT THE THREE STUDY SITES IN NORTHEASTERN GULF OF ALASKA (1975-76)

Arthropoda	Latouche Point	Macleod Harbor	Zaikof Bay
Idotea sp.	X		
Caprella sp.	X	X	X
Gammaridea	X	X	X
Mysidacea	X	X	X
? Discorsopagurus schmitti			X
Echinodermata (spiny skin)			
Ophiopholis aculeata	X	X	X
Ophiura ? sarsii		X	
Leptasterias spp.	X	X	X
Pteraster tesselatus			
Dermasterias imbricata	X	X	X
Henricia leviuscula	X	X	X
Henricia tumida	X		
Orthasterias koehleri	X	X	X
Pisaster ochraceus	X	X	X
Evasterias troschelii	X	X	X
Pycnopodia helianthoides	X	X	X
Crossaster papposus	X	X	X
Solaster stimpsoni	X	X	X
Solaster dawsoni	X	X	X
Tosiaster acticus	X	X	
Strongylocentrotus droebachiensis	X	X	X
Strongylocentrotus ? pallidus	X	X	
Strongylocentrotus franciscanus	X		
Parastichopus californicus		X	X
Psolus chitonoides	X	X	X
Cucumaria miniata	X	X	X
Bryozoa (moss animals)			
Flustrella ? gigantea			X
Heteropora spp.	X	X	X
? Lichenopora sp.	X	X	X
Disporella sp.		X	X
Microporina borealis	X	X	X
Tricellaria gracilis	X	X	X
Dendrobeania murryana	X	X	X
Hippodiplosia insculpta	X	X	X

TABLE 18 (Cont.)

LIST OF BENTHIC MACROINVERTEBRATES COLLECTED AT THE THREE STUDY SITES IN NORTHEASTERN GULF OF ALASKA (1975-76)

Bryozoa	Latouche Point	Macleod Harbor	Zaikof Bay
Membranipora sp.		X	
? Phidolopora pacifica	X	X	X
Costazia sp.	X	X	X
? Myriozoum coarctatum		X	
Crisia sp.	X	X	
Alcyonidium pedunculatum		X	X
Carbasea carbasea			X
Gromia oviformis	X	X	X
Brachiopoda			
Terebratalia transversa	X	X	X
Terebratulina unguicula		X	X
Urochordata			
Styela montereyensis	X		X
Chelyosoma productum	X		X
Corella willmeriana			X
Ascidia paratropa			X
Boltenia villosa	X	X	X
Halocythia igaboja			
Halocynthia aurantium	X		X
Cnemidocarpa finmarkiensis	X	X	
Metandrocarpa taylori	X	X	X
Clauelina sp.	X		
Distaplia occidentalis	X	X	X
? Synoicum sp.	X		
Didemnum or Trididemnum	X	X	X

TABLE 19

FISHES OBSERVED IN THE THREE STUDY SITES
DURING 1975-76

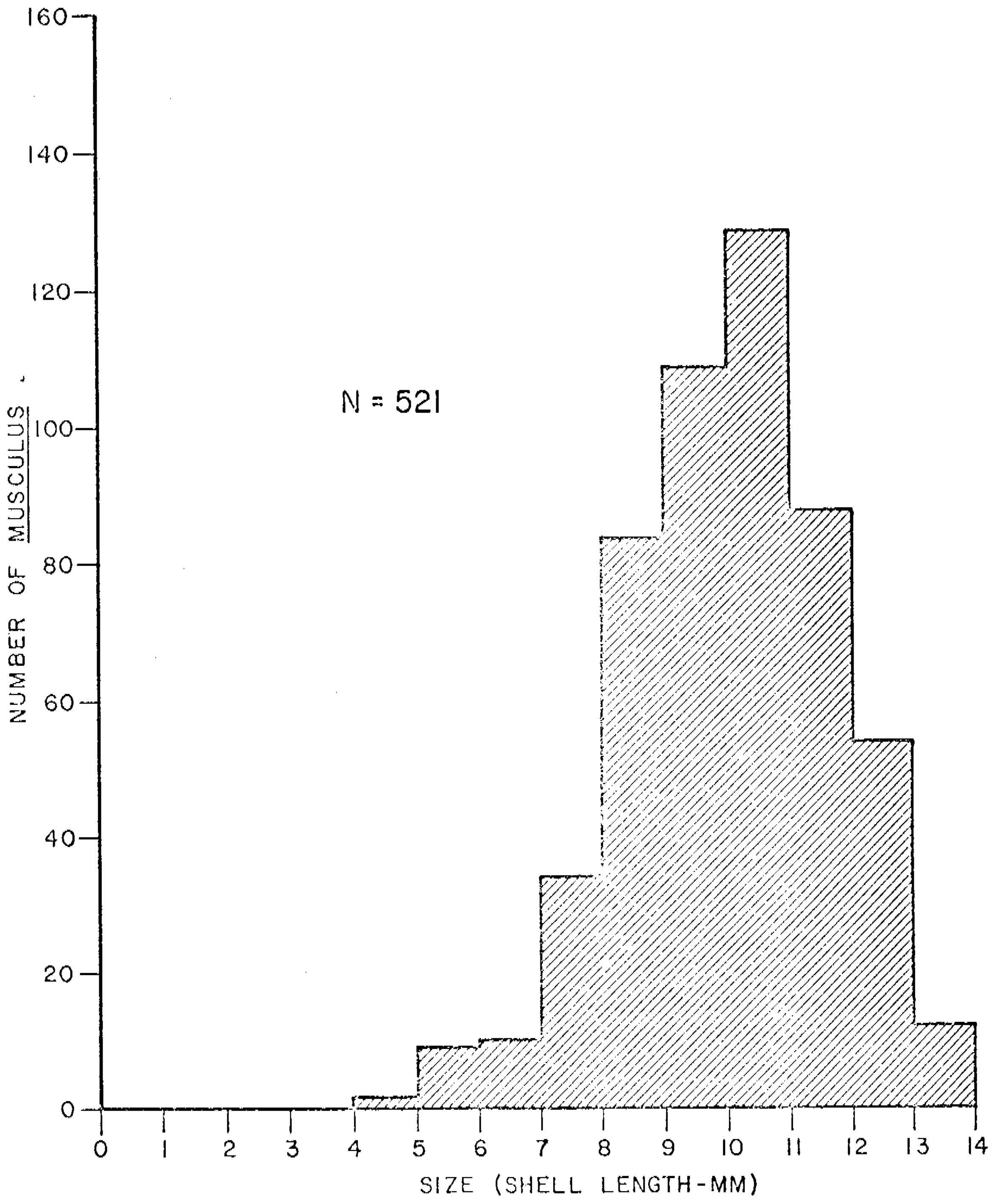
COMMON NAME	SCIENTIFIC NAME	LOCATION
Rock greenling	Hexagrammos lagocephalus	L;M;Z
White spotted greenling	Hexagrammos stelleri	M;Z
Kelp greenling	Hexagrammos decagrammus	L;M;Z
Masked greenling ?	Hexagrammos octogrammus	L;M
Lingcod	Ophiodon elongatus	L
Great sculpin	Myoxocephalus polyacanthocephalus	M;Z
Buffalo scuplin	Enophrys bison	M
Blackfin sculpin ?	Malacottus kincaidi	M
Red irish lord	Hemilepidotus hemilepidotus	L;M
Yellow irish lord	Hemilepidotus jordani	L
Northern sculpin ?	Icelinus borealis	L
Grunt sculpin	Rhamphocottus richardsoni	L
Silverspotted scuplin	Blespsias cirrhosus	M
Pacific staghorn sculpin	Leptocottus garmatus	M
Antlered sculpin	Enophrys diceraus	L;M;Z
Sturgeon poacher	Agonus acipenserinus	Z
Pacific spiny lumpsucker	Eumicrotremus orbis	Z
Black rockfish	Sebastes melanops	L;M;Z
Copper rockfish	Sebastes caurinus	L;M
Yellowtail rockfish	Sebastes flavidus	L
Rockfishes, unid. juv.	f: scorpaenidae	L;M;Z
Searcher	Bathymaster signatus	L
Northern ronquil	Ronquilus jordani	L;M;Z
Starry flounder	Platichthys stellatus	M
Yellowfin sole	Limanda aspera	M;Z
Pacific halibut	Hippoglossus stenolepis	L
Snake prickleback	Lumpenus sagitta	M
Prickleback, unid.	f; stichaeidae	L;M;Z
Crescent gunnel	Pholis laeta	L;M;Z
Artic shanny	Stichaeus punctatus	L;M;Z
Pacific tomcod	Microgadus proximus	L;M;Z
Sand lance	Ammodytes hexapterus	L;M;Z
Pink salmon	Oncorhynchus gorbuscha	L

Location Symbols:

L = Latouche Point
M = Macleod Harbor
Z = Zaikof Bay

which density ranged up to about 2,084 individuals/m^2. From one 0.25m^2 quadrat we removed 521 M. vernicosus that were attached to two elephant-ear kelps (Laminaria groenlandica), each approximately one meter in blade length. Individual Musculus ranged in shell length from 4 to 13mm (Figure 3), however smaller Musculus (<3mm) were also present in the sample, but were not included in the size-frequency histogram. Musculus is a suspension or filter feeder that appears to thrive either in exposed locations of the northern Gulf, or in ocean entrances that are exposed to rapid water exchange. No doubt, Musculus contributes appreciable amounts of energy to secondary consumers. Major predators of Musculus in this location were sea stars, fin fishes and sea otters. Other probable predators are diving sea ducks such as the harlequin and surf scoter, which frequency raft or roost along the rocky shoreline during late spring and summer.

A number of other species utilize the seaweed resource not only for concealment and sites of attachment, but also as a source of food. For example, the limpet Collisella instabilis has only been seen attached to the taller statured understory kelps off Latouche Point. In this case the kelp provides the limpet with both food and cover. One known predator of C. instabilis is the sun star (Pycnopodia helianthoides) which frequently climbs the attached kelps in search of food or potential prey. The limpet seeks refuge from bottom dwelling invertebrates by living on the vegetation suspended above the seafloor.



MUSCULUS VERNICOSUS

SIZE CLASS DISTRIBUTIONS

FROM A SUBTIDAL .25 M^2 QUADRAT OFF LATOUCHE ISLAND

Figure 3

There are a number of herbivores which feed directly on living marine vegetation, and others that feed on the plants only after they have died. However, before the seaweeds and seagrasses are available to most consumers they must be broken down by bacterial action. Some of the conspicuous herbivores are listed in Table 20. Of these five genera, the most abundant and frequently encountered were the chitons, particularly Tonicella spp. and Mopalia spp. During four of the field surveys Tonicella occurred in 14 of 86 haphazardly placed quadrats (Tables 3 through 16). Densities ranged from 0 to 9.00/m^2; the average density was 0.98/m^2. Tonicella was represented in this location by at least two species: T. lineata and T. insignis. It is a microherbivore that reputedly grazes on algal sporelings, and the diatom film that coats the rock surfaces. Other microherbivores were also common; the limpet Acmaea mitra occurred in 11 of 86 quadrats (.025m^2), and density estimates ranged from 0 to 9.00/m^2. The snail Calliostoma ligatum had a frequency of occurrence of 8/86, and an average density of 0.60/m^2. Acmaea mitra was most frequently seen on the algal turf, while Calliostoma was seen equally on rock and vegetative substrates. Asteroids or sea stars were the most important identifiable group of predators on the microherbivore guild at Latouche Point.

Probably the most important macroherbivore in the seaweed assemblages of the north Pacific is the sea urchin. At least two species have been found in this location, the green sea urchin (Strongylocentrotus drobachiensis) and the giant red urchin (Strongylocentrotus franciscanus). Despite their occurrence off Latouche Point, they were

TABLE 20

CHARACTERISTIC OR REPRESENTATIVE IMPORTANT SPECIES
(RIS) OFF LATOUCHE POINT, SUBTIDAL

Species	Occurrence	Major Taxon	Trophic Category
Agarum cribrosum (P)	A	Brown alga	Producer
Laminaria groenlandica (P)	A	Brown alga	Producer
Laminaria yezoensis (P)	A	Brown alga	Producer
Pleurophycus gardneri (P)	A	Brown alga	Producer
Nereocystis luetkeana (A)	A	Brown alga	Producer
Cymathere triplicata (A)	C	Brown alga	Producer
Constantinea spp. (P)	C	Red alga	Producer
Ptilota filicina (?)	C	Red alga	Producer
Opuntiella californica (?)	C	Red alga	Producer
Microporina borealis (?)	C	Bryozoan	Suspension feeder
Encrusting coralline algae (P)	A	Red Alga	Producer
Crossaster papposus (P)	C	Sea star	Predator
Pycnopodia helianthoides (P)	C	Sea star	Predator
Musculus vernicosus (A)	A	Mussel	Suspension feeder
Acmaea mitra (P)	C	Snail	Herbivore
Tonicella spp. (P)	C	Snail	Herbivore
Enhydra lutris (P)	C	Sea otter	Predator
Henricia spp. (P)	C	Sea star	? Suspension feeder
Orthasterias koehleri (P)	C	Sea otter	Predator
Calliostoma ligatum (P)	C	Snail	Herbivore
Ophiopholis aculeata (P)	C	Brittle star	Predator
? Distaplia occidentalis (P)	C	Ascidian	Suspension feeder
Strongylocentrotus spp. (P)	U	Sea urchin	Herbivore
Dermasterias imbricata (P)	C	Sea star	Predator
Searlesia dira (P)	C	Snail	Predator
Pagurus spp. (P)	A	Hermit crab	Scavenger/Herbivore

Key:
- (P) = perennial
- (A) = annual
- A = abundant
- C = common
- U = uncommon

typically cryptic in behavior and relatively uncommon. Most of the sea urchins were small individuals, and densities for both species combined ranged up to about 4.00/m^2; however, sea urchins occurred in only 3 of 86 quadrats. These data are in agreement with the findings of the transect sampling; densities ranged from 0 to 0.12/m^2 with an average of 0.03/m^2 in 470 square meters of seafloor that was examined during 1975-76 (Table 21).

Grazers of lesser numerical importance were the limpets (Diadora aspera), gumboot chiton (Cryptochiton stelleri), chink shell (Lacuna variegata) and the snail (Margarites spp.). There are numerous other obligatory herbivores that know doubt play key roles in the macrophyte system, i.e. isopods, gammarid amphipods, etc., however no information is available at this time on their distribution or abundance. Most of the crustaceans seem to be highly seasonal in appearance, with peak influx into the inshore zone during spring and summer. Included in the herbivore guild are the facultative consumers which are more catholic in their diet, and as such either browse on marine plants or ingest vegetation incidental to the uptake of animal material. Some of the common members of this group are the hermit crabs, decorator crabs (Oregonia gracilis and Pugettia gracilis) and the leather star (Dermasterias imbricata).

A great percentage of the epibenthic fauna in this area are suspension or filter feeding types. This group of consumers probably represents the bulk of the biomass off Latouche Point. A few of these species are listed in the characteristic of representative important species category, and numerous others are probably noteworthy of this ranking. The articulated bryozoan (Microporina borealis) covered considerable portions of the rock substrate; percent cover estimates ranged from 0 to 60 percent during this period of time. Microporina appeared to be either an annual species or somewhat ephemeral in abundance and frequency of occurrence. Two predators of Microporina that have been identified to date, are the leather star Dermasterias and the nudibranch Triopha carpenteri. The compound ascidian Distaplia sp. and the blood star (Henricia spp.) are both listed as suspension feeders. Both animals are common off Latouche Point, for example, Henricia spp. ranged up to $0.36/m^2$, with an average density in the band transects of $0.11/m^2$ (Table 21). Distaplia is exquisite in both form and color; it covered between 0 and 30 percent of the rock substratum that was examined during 1975-76.

Seven predators are listed in Table 20. Other important secondary consumers at this location were crustaceans, gastropods, sea anemones, fishes and marine mammals. The sea stars are visual dominants in the shallow waters of the northern Gulf of Alaska. Feeding behavior of some common species off the coast of Washington has been adequately described by Mauzey, Birkeland and Dayton (1968). Since this group has such an important functional role in the rocky sublittoral zone, a great deal of time and energy has been devoted to estimating relative abundance, population size structure and gathering information on the

TABLE 21

DENSITY ESTIMATES OF SOME COMMON ECHINODERMS FROM LATOUCHE POINT

Taxon	9-17-75						
Pycnopodia helianthoides	4 0.16/m^2	5 0.33/m^2	9 0.36/m^2	1 0.04/m^2	0	3 0.12/m^2	5 0.20/m^2
Dermasterias imbricata	0	0	1 0.04/m^2	1 0.04/m^2	0	2 0.08/m^2	0
Orthasterias koehleri	1 0.04/m^2	0	2 0.08/m^2	0	0	0	3 0.12/m^2
Crossaster papposus	2 0.08/m^2	0	1 0.04/m^2	0	0	0	1 0.04/m^2
Solaster spp.	1 0.04/m^2	0	0	0	0	0	0
Henricia spp.	9 0.36/m^2	3 0.20/m^2	0	1 0.04/m^2	0	3 0.12/m^2	6 0.24/m^2
Strongylocentrotus spp.	1 0.04/m^2	0	1 0.04/m^2	0	1 0.04/m^2	0	3 0.12/m^2
Area sampled: Depth:	25 x 1m 12m	15 x 1m 9-11m	25 x 1m 9-11m	25 x 1m 9m	15 x 1m 9m	25 x 1m 9m	25 x 1m 12m

TABLE 21 (Cont.)

DENSITY ESTIMATES OF SOME COMMON ECHINODERMS FROM LATOUCHE POINT

Taxon	11-26-75	11-26-75	11-26-75	3-17-76	3-17-76	6-26-76	6-26-76
Pycnopodia helianthoides	1 $0.06/m^2$	1 $0.06/m^2$	0	2 $0.02/m^2$	11 $0.11/m^2$	2 $0.66/m^2$	1 $0.20/m^2$
Dermasterias imbricata	0	0	1 $0.02/m^2$	1 $0.01/m^2$	5 $0.05/m^2$	1 $0.03/m^2$	0
Orthasterias koehleri	1 $0.06/m^2$	1 $0.06/m^2$	0	3 $0.03/m^2$	2 $0.02/m^2$	5 $0.17/m^2$	0
Crossaster papposus	1 $0.06/m^2$	2 $0.13/m^2$	4 $0.08/m^2$	0	1 $0.01/m^2$	0	0
Solaster spp.	0	0	0	0	0	0	0
Henricia spp.	2 $0.13/m^2$	1 $0.06/m^2$	1 $0.02/m^2$	0	16 $0.16/m^2$	0	1 $0.20/m^2$
Strongylocentrotus spp.	1 $0.06/m^2$	0	0	0	1 $0.01/m^2$	0	0
Area sampled: Depth:	15 x 1m 12m	15 x 1m 12m	25 x 2m 13-14m	50 x 2m 8-11m	50 x 2m 3-8m	30 x 1m 9m	5 x 1m 9m

foraging behavior of some of the common species. Four conspicuous species off Latouche Point were the sun star (Pycnopodia helianthoides); leather star (Dermasterias imbricata); Crossaster papposus and Orthasterias koehleri. Pycnopodia ranged in density from 0 to 0.66/m^2, with an average of 0.17/m^2 (Table 21). Individual sun stars varied in size (radius) from 27 to 185 mm. Hundreds of Pyncopodia were examined for food items; of those feeding 15 were found eating Musculus vernicosus; 3 sea urchin (Strongylocentrotus drobachiensis); 2 Musculus discors; 2 snail (Calliostoma spp.); 3 brittle star (Ophiopholis aculeata; 3 crab (Pugettia gracilis); 2 hermit crab (Pagurus spp.); 2 butter clam (Saxidomus gigantea); 1 snail (Trophonopsis sp.); 1 chiton (Placiphorella sp.); 2 crab (Cancer oregonensis); 1 chiton (Mopalia sp.); and 1 blood star (Henricia sp.).

Orthasterias koehleri is one of the most colorful stars on the reef complex; density estimates ranged from 0 to 0.17/m^2, with an average density of 0.04/m^2 in the band transects (Table 21). Individual Orthasterias ranged in size from 30 to 191 mm; most preyed on mussels (Musculus vernicosus and M. discors; clam (Humilaria kenneryli); rock jingle (Pododesmus macroschisma) and barnacle (Balanus spp.).

The leather star (Dermasterias imbricata) was somewhat less common; density estimates ranged from 0 to 0.08/m^2, and the average was 0.02/m^2. Individual Dermasterias ranged in size from 18 to 180 mm. Dermasterias frequently preyed upon Musculus vernicosus; sea anemone

(*Tealia* spp.); the clavate ascidian (*Synoicum*); bryozoa (*Microporina borealis*); compound ascidians (several species) and red algae.

Another conspicuous sea star in this location was *Crossaster papposus*. *Crossaster* is one of the smaller stars in this water, individuals are typically less than 50 mm in radius. Frequently it was found on rock and seaweed substrates, and repeatedly it was attached to understory kelps. Density estimates ranged from 0 to 0.13/m^2, with an average of 0.03/m^2. Identifiable prey included *Musculus* and the serpulid (*Spirorbis*).

There is sufficient evidence of trophic interaction to present a very qualitative food web for the conspicuous organisms at Latouche Point (Figure 4). The suspected major pathways were from the macrophytes to herbivores such as snails and sea urchins. Organic debris flowed to clams, mussels and bryozoans, and phytoplankton was ingested by clams, mussels and sponges. Linkages from all categories to tertiary consumers such as predators and scavengers are included in the food web.

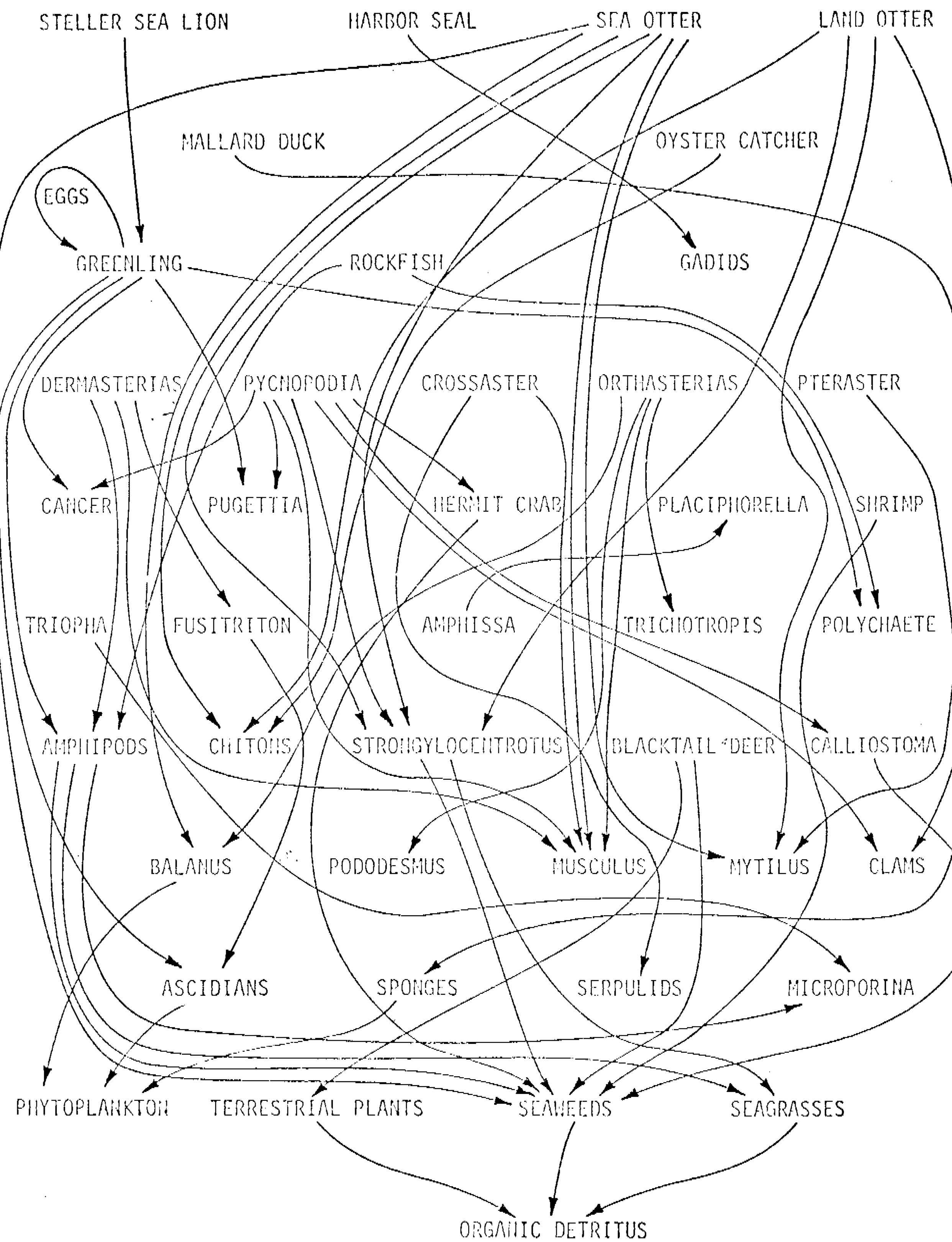


Figure 4

FOOD WEB FOR THE ROCKY SUBLITTORAL ZONE AT LATOUCHE POINT, GULF OF ALASKA

SEASONAL PATTERNS

The seaweed zone at Latouche Point underwent a marked alteration in appearance with the change of season. One seasonal change that was obvious to even the casual observer was the oscillation in areal cover of the floating portion of the kelp bed. The surface canopy, consisting of bull kelp (*Nereocystis*), reached peak development and covered considerable areas of the underlying seafloor during the summers of 1974, 1975 and 1976 (Rosenthal, unpublished data). *Nereocystis* is reputed to be an annual plant, that reaches great size in a single season (Vadas, 1972; Markham, 1969). Most of the growth takes place during the spring and early summer. Fertile plants were observed as early as March, 1976. When bull kelp is mature, zoosporangial sori fall out of the blade and drift to the bottom. Release of zoospores apparently follows soon after. Young sporelings have been observed during early spring, most reached the surface in about 2 to 3 months, and the growth phenology seems to be correlated closely with periods of maximum available light (Vadas, 1972).

During summer, the bull kelp canopy at Latouche Point covered an estimated 50 percent of the underlying seafloor in the central part of the kelp bed (Figures 5 and 6). This same part of the kelp bed was revisited in late November 1975, and at this time the floating canopy was reduced to an estimated 20 percent coverage. Not only was there a reduction in areal cover, but also a heavy attrition of attached plants. Cohorts of adult *Nereocystis* growing adjacent to one another frequently

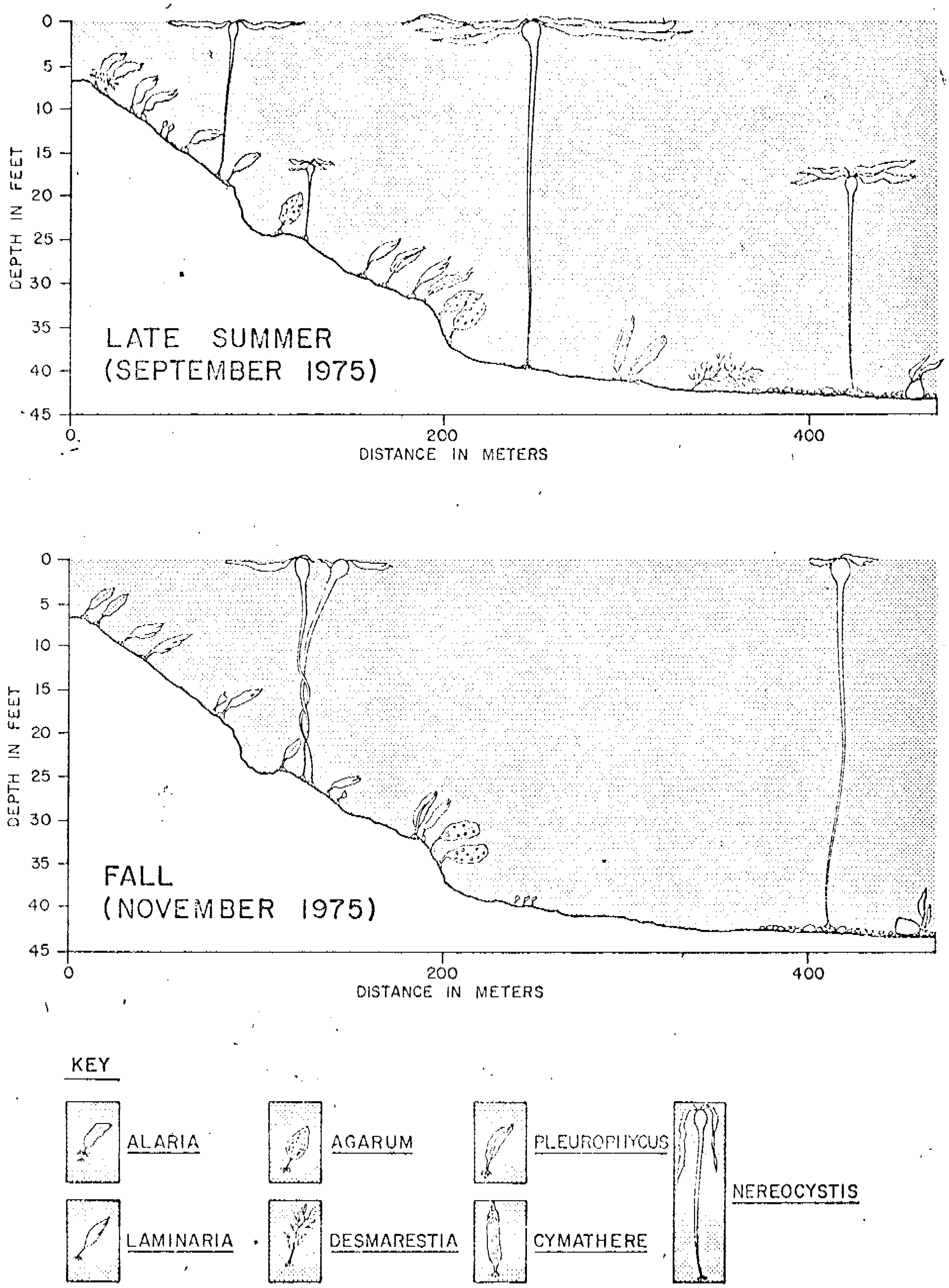
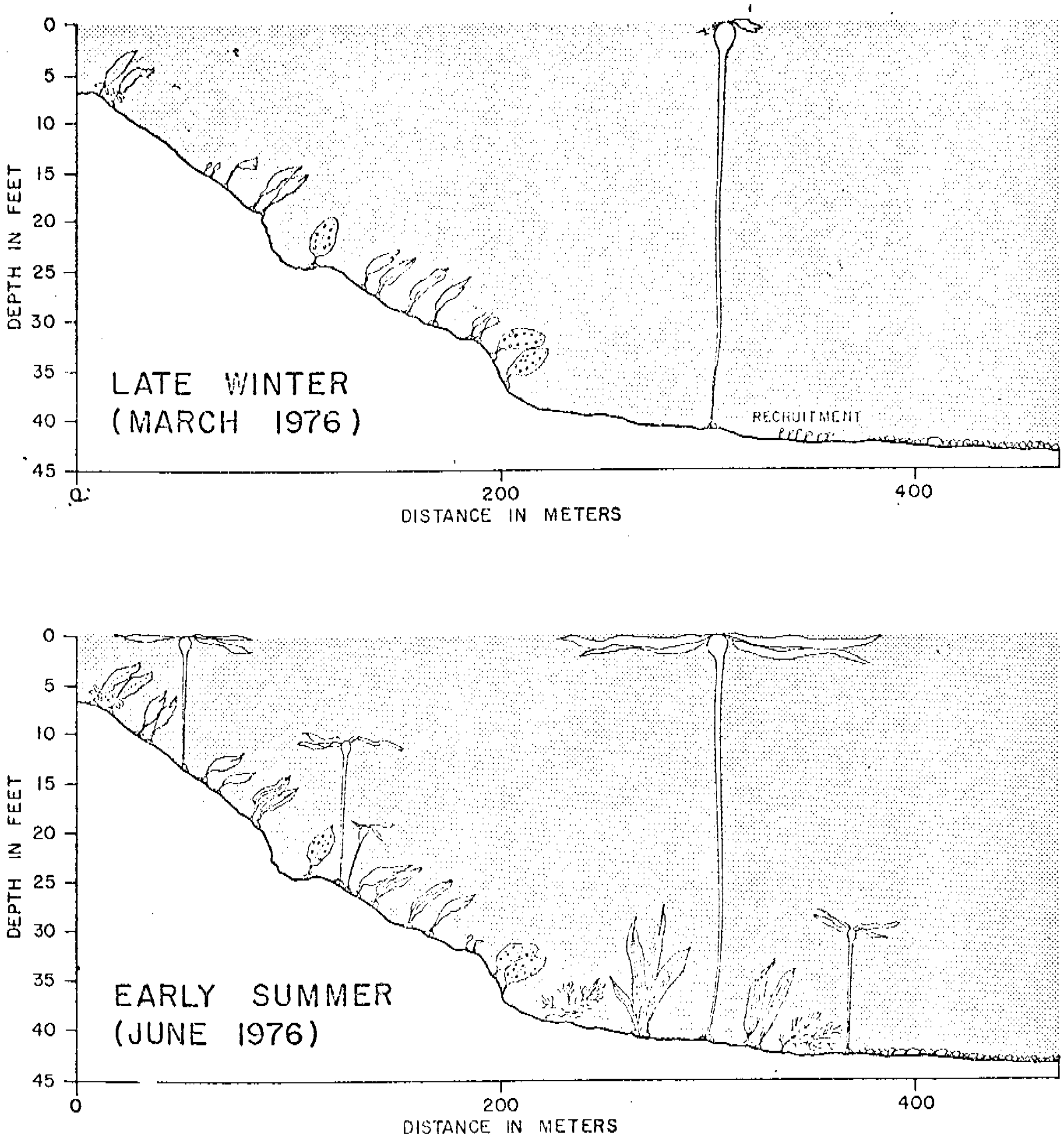


Figure 5

SUBTIDAL VEGETATIVE PROFILES
LATOUCHE POINT



SUBTIDAL VEGETATIVE PROFILES
LATOUCHE POINT

Figure 6

become entangled (Figure 5). Other bull kelp plants that have been detached by storms, substrate dislodgment, and/or grazing, frequently drift through the beds and become entangled with the attached kelps. Mutual entanglement results, thereby leading to further plant mortality. This same source of kelp mortality was described by Rosenthal, Clarke and Dayton (1974) in the stands of giant kelp (Macrocystis) off the coast of southern California.

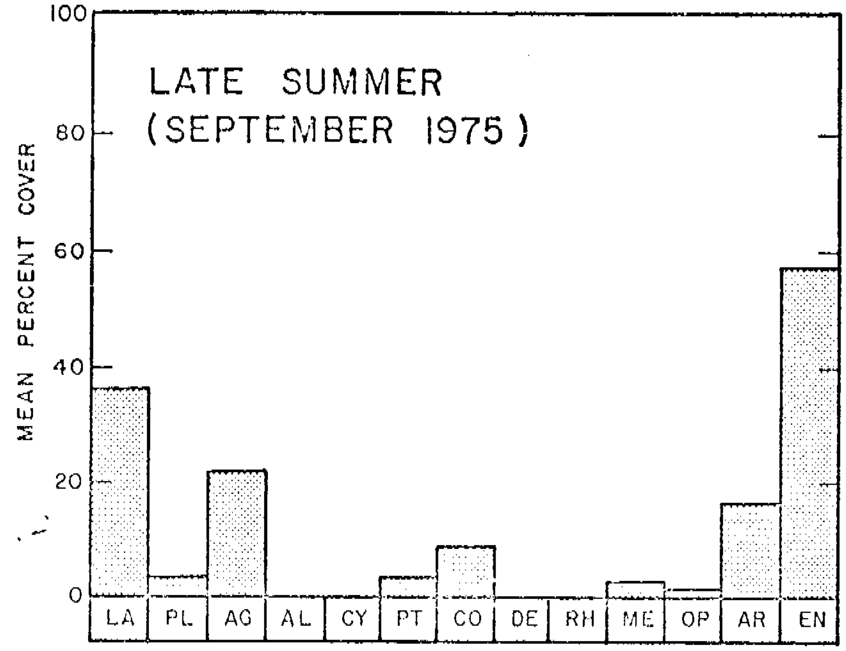
Dives were made off Latouche Point during oceanic winter (March 1976); at this time the surface canopy covered less than 5 percent of the seafloor. Attached Nereocystis was still present in this location; however, the blades of most had either eroded away or were reduced in surface area. Since grazing by macroherbivores is of minor importance at this site, the major cause of bull kelp mortality was probably physical detachment and/or old age (senility). No distinguishable juvenile plants were seen in the area during the March visit, however, by late June 1976 the annual cycle had been renewed, and once again the bull kelp bed was fully developed and supported a heavy surface canopy.

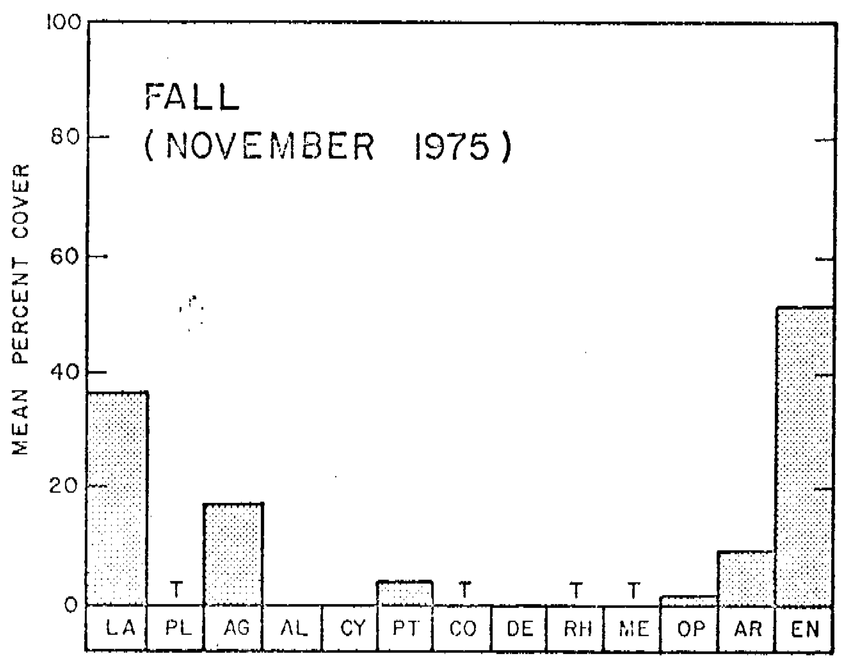
The understory complex or vegetative undergrowth beneath the floating canopy underwent similar change in areal cover and standing crop. The algal understory was typically composed of perennial species such as Laminaria groenlandica; L. yezoensis; L. saccharina; Agarum cribrosum and Pleurophycus gardneri. Annual or more ephemeral algae such as Cymathere triplicata and Desmarestia ligulata var. ligulata were highly seasonal in appearance; typically these species occurred in the shallow subtidal zone during the summer and disappeared during winter

(Figures 7 and 8). Other fleshy reds, i.e. *Delesseria decipiens*; *Pterosiphonia bipinnata*; *Rhodymenia* spp.; *Membranoptera* spp.; and browns *Desmarestia viridis* and *D. aculeata* were short-lived (ephemeral) or perennated (died-back) following the growing season.

In contrast to the growth strategies of the annual species, the perennials such as *Agarum*, *Laminaria* and *Pleurophycus* grow rapidly in the winter and early spring. Whereas, most annuals usually appear during late spring and grow rapidly reaching peak development during the summer. Another seasonal phenomena that is typical of the understory canopy is the shedding of fronds by many of the kelp species. Mann (1973) found that *Laminaria* and *Agarum* from eastern Canada completely renewed the tissue of the frond (blade) between one and five times a year. Of the 329 *Laminaria* spp. examined off Latouche Point during late November 1975, 25 percent (n = 86) had lost or shed a major part of the blade. Only the holdfast, stipe and meristematic growth zone remained of the kelps that were regenerating the blade prior to the active winter growth phase. During the fall when the plants lose their blades a great deal of drift material is present at this site. The surge channels or bathymetric lows in the rocky substrate served as collection points of a great deal of the drift plant material. The process of blade renewal had a significant change in the understory canopy, permitting more available light to reach the seafloor. Kelp germination was apparent during the later winter and spring of 1976.

Seasonal changes in the epifauna were also conspicuous at this location. For example, the mytilid *Musculus vernicosus* displayed strong



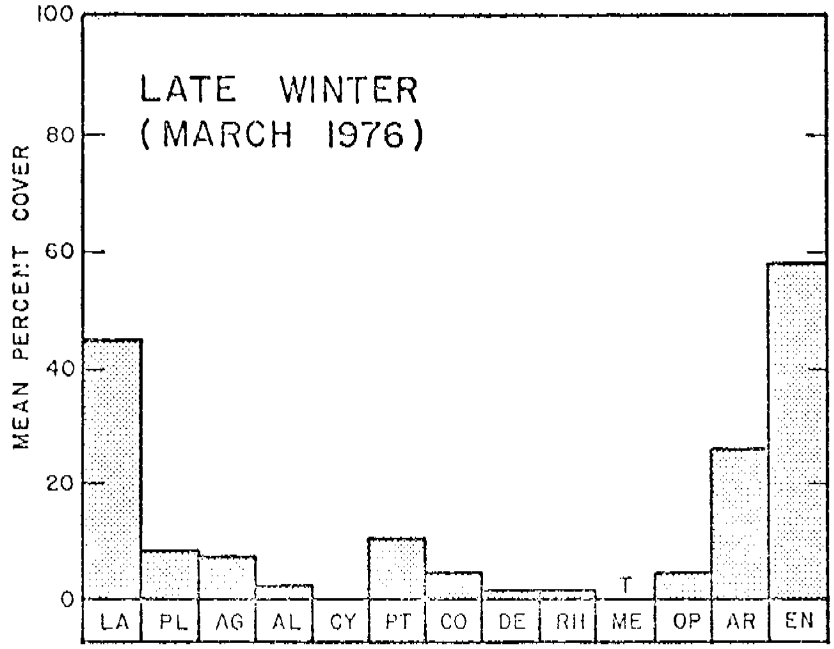


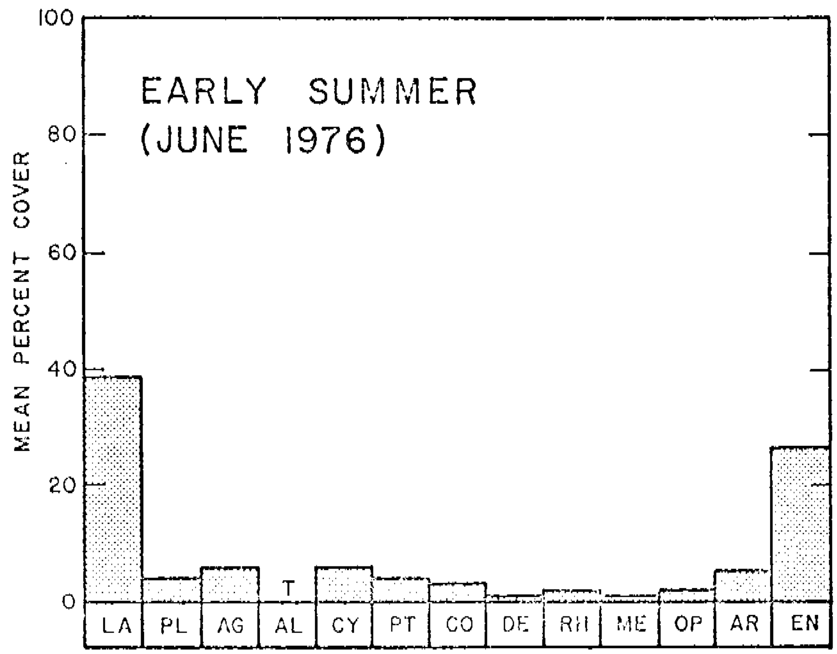
KEY

LA = LAMINARIA	DE = DELESSERIA
PL = PLEUROPHYCUS	RH = RHODYMENIA
AG = AGARUM	ME = MEMBRANOPTERA
AL = ALARIA	OP = OPUNTIELLA
CY = CYMATHERE	AR = ARTICULATED CORALLINES
PT = PTILOTA	EN = ENCRUSTING CORALLINES
CO = CONSTANTINEA	T = TRACE

Figure 7

ALGAL COVER AT LATOUCHE POINT





ALGAL COVER AT LATOUCHE POINT

Figure 8

seasonal variation in cover and abundance. Since Musculus encrusts large portions of the blades of seaweeds in the lower canopies it is strongly affected by changes in the condition of the marine vegetation. Musculus vernicosus is either annual or bi-annual in terms of life history pattern, most disappeared by winter or early spring. The life history pattern agrees with the recorded longevity of the algal substrates, since the blades of most are continually being removed, and only those mussels that adhere to either the stipes or holdfast portions remain. Possibly because of predation pressures, adult Musculus are rarely successful on the bottom and so decline sharply after fall shedding of the plants. Spring and early summer marked the arrival of the juvenile spat which initially covered the understory seaweeds in such high densities that the bottom had a snow-like appearance. Juveniles were present at each sample period, however, their growth during winter is probably slow, and rapid growth commences concurrently with spring plankton blooms.

Other seasonal patterns were evident in the shallow water zone. For example, the inshore fishes, i.e. rockfish, greenling, flatfish and tomcod etc., which were prominent members of the seaweed assemblages during summer and early fall, tend to either move offshore, or become more secretive in habit. Solitary fishes were common under rock ledges and overhangs, however, schools of fish were not seen in this location until late spring. Even larger vertebrates, such as the ubiquitous sea otter, moved into more protected regions of the Sound; most could be seen either resting or feeding in the embayments and waterways of Elrington, Evans and Latouche Islands.

DESCRIPTION OF THE STUDY SITE (ZAIKOF BAY)

Zaikof Bay is located on the northeast end of Montague Island. The mouth of the bay is 2.5 miles wide and is situated on the west side of Hinchinbrook Entrance (Figure 1). The shoreline is heavily wooded with Sitka Spruce and Hemlock; the beach is narrow and rocky. The inner confines of the bay are generally protected from ocean swell; however, at times the surface waters are exposed to storm force winds. The winds generally blow from a southeasterly direction during spring and fall. Local jet stream winds or "williwaws" are known to move through these mountain canyons in excess of 120 mph. For example, during the September (1975) survey we were literally driven from Zaikof Bay by rain and storm force winds in excess of 80 mph.

The NMFS intertidal site is located on a rocky promontory on the south side of the bay. An Alaska Department of Fish & Game stream marker served as a reference point for the sublittoral work. Below the tree line the beach is composed of cobbles and large boulders. The shallow sublittoral zone appears to be a continuum of the exposed portion of the beach. At the intertidal-subtidal fringe the substratum is pavement rock; below this point is a boulder field interspersed with sand and shell material (Figure 9). A fine layer of silt covered most of the solid substratum and marine vegatation during the four seasons of observation. At a depth of approximately 10 to 12m below the sea surface

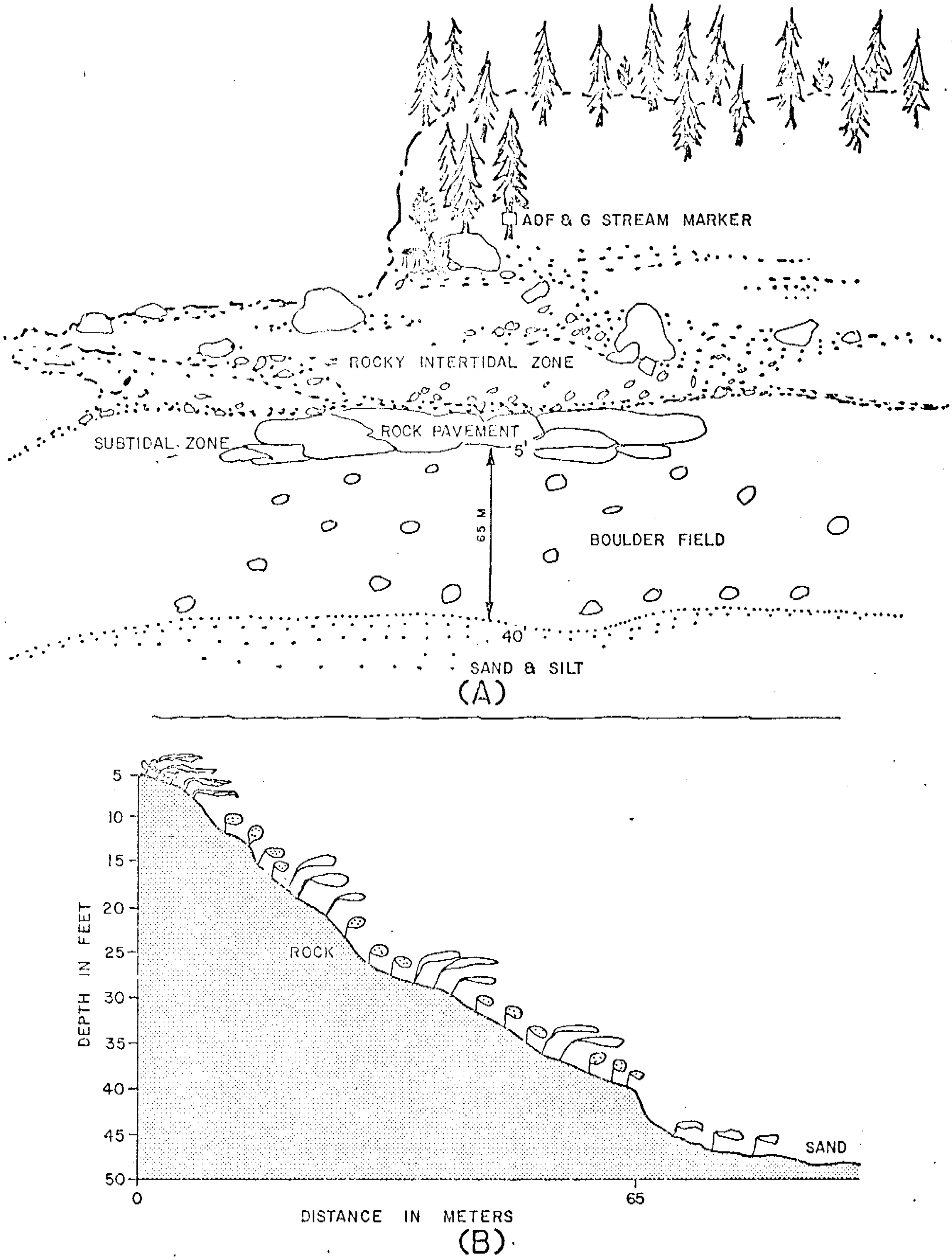


Figure 9

ZAIKOF BAY

DRAWING OF THE STUDY SITE (A)
AND THE SUBTIDAL VEGETATIVE CANOPIES (B)

the band of exposed rock stopped and was replaced by sand and silty clay. Shell debris, particularly those of the clams *Saxidomus*, *Mya* and *Humilaria* were common in this location.

BIOLOGICAL SETTING (ALGAL ASSEMBLAGE)

Rockweed (Fucus distichus), formed the most conspicuous algal belt in the high intertidal zone during 1975-76. The brown alga, Alaria ? marginata was common at the MLLW mark, a major break point between the intertidal and shallow subtidal zones. The sublittoral macrophyte band was approximately 65 meters wide in the vicinity of the NMFS station (Figure 9). Most of the macroalgae was confined to the rock pavement or shallow water terrace, and the boulder field that borders the shoreline. However, a few kelp plants were found growing on the soft or unconsolidated substratum. Most of these plants were attached to empty clam shells and/or small stones.

Sieve kelp (Agarum cribrosum) was the numerical dominant in the seaweed zone. Density estimates during three of the sample periods ranged from $2.12/m^2$ to $8.20/m^2$ in the band transects (Tables 22 and 23); the average density in all transects combined was $4.62/m^2$. In 52 quadrats ($0.25/m^2$) the density ranged from 0 to $28.00/m^2$; with an average of $7.77/m^2$. Elephant-ear kelp (Laminaria groenlandica) was also abundant in this location; density estimates ranged from $0.20/m^2$ to $4.80/m^2$ with an average density of $2.48/m^2$ in the transect bands. These data agree well with the quadrat counts; the range in 41 haphazard casts ($0.25/m^2$) was 0 to $16.00/m^2$, and the mean density was $2.83/m^2$ (Tables 24 through 31). Laminaria yezoensis was also present, although relatively uncommon except in the shallow (9.0m) part of the seaweed band. The average density in the belt transects was $0.74/m^2$, compared with $1.07/m^2$ in the

TABLE 22

DENSITY ESTIMATES OF SOME DOMINANT MACROPHYTES FROM ZAIKOF BAY
(estimates were derived from band transects of different lengths)

Taxon	11-23-75	11-24-75	3-20-76	3-20-76	3-20-76
Nereocystis leutkeana	0	0	0	0	0
Laminaria groenlandica	/	/	23 $2.30/m^2$	33 $3.30/m^2$	14 $1.40/m^2$
Laminaria yeozoensis	/	/	0	0	12 $1.20/m^2$
Laminaria spp.	39 $.78/m^2$	43 $1.72/m^2$	0	0	0
Agarum cribrosum	172 $3.44/m^2$	53 $2.12/m^2$	52 $5.20/m^2$	59 $5.90/m^2$	82 $8.20/m^2$
Pleurophycus gardneri	0	0	0	0	0
Area sampled:	25 x 2m	25 x 1m	10 x 1m	10 x 1m	10 x 1m
Depth:	11.0-12.0	12.0-13.0	10.5m	7.5m	4.5m
Substrate Type:	Rock	Rock & Sand	Boulders	Boulders	Boulders & rock pavement

/ = placed under the category of *Laminaria* spp.

TABLE 23

DENSITY ESTIMATES OF SOME DOMINANT MACROPHYTES FROM ZAIKOF BAY

(Estimates Were Derived from Band Transects of Different Lengths)

Taxon	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76
Nereocystis luetkeana	0	0	0	0	0	0	0	0	0	0	2 $0.40/m^2$
Laminaria groenlandica	3 $0.60/m^2$	1 $0.20/m^2$	5 $1.00/m^2$	2 $0.40/m^2$	19 $3.80/m^2$	23 $4.60/m^2$	22 $4.40/m^2$	16 $3.20/m^2$	24 $4.80/m^2$	11 $2.20/m^2$	Not counted
Laminaria yezoensis	0	0	0	0	0	0	3 $0.60/m^2$	1 $0.20/m^2$	2 $0.40/m^2$	0	Not counted
Agarum cribrosum	11 $2.20/m^2$	19 $3.80/m^2$	15 $3.00/m^2$	22 $4.40/m^2$	24 $4.80/m^2$	35 $7.00/m^2$	28 $5.60/m^2$	29 $5.80/m^2$	27 $5.40/m^2$	12 $2.40/m^2$	Not counted
Pleurophycus gardneri	0	0	0	0	1 $0.20/m^2$	0	2 $0.40/m^2$	4 $0.80/m^2$	3 $0.60/m^2$	34 $6.80/m^2$	Not counted
Area sampled:	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m
Depth:	13.5 m	13.5 m	12.0 m	12.0 m	10.5 m	10.5 m	9.0 m	9.0 m	7.6 m	6.1 m	4.6 m
Substrate type:	Rock & sand	Rock & sand	Rock & sand	Rock & sand	Rock & sand	Boulders	Rock	Rock	Rock	Boulders	Boulders

TABLE 24

QUADRAT DATA (0.25m^2) FROM ZAIKOF BAY, SUBTIDAL
NOVEMBER 23, 1975

Taxon	Percent Cover (number of individuals)				
	No. 1	No. 2	No. 3	No. 4	No. 5
Laminaria spp.	0	5%	30%(2)	5%	25%(1)
Agarum	20%(1)	0	20%(1)	5%(1)	40%(2)
Constantinea	1%(1)	0	0	0	0
Ralfsia	15%	20%	10%	20%	15%
encrusting coralline	80%	60%	90%	80%	80%
Hildenbrandia	0	0	1%	0	1%
Microcladia spp.	0	0	0	1%	0
Microporina borealis	40%	20%	25%	15%	50%
Didemnum/Trididemnum	1%	1%	1%	5%	1%
pagurids	(2)	(2)	(5)	(1)	(1)
Heteropora sp.	1%	5%	1%	1%	5%
Phidolopora pacifica	1%	1%	1%	1%	5%
Cryptobranchia concentrica	(1)	0	0	0	0
? *Rhynchozoon*	1%	0	0	0	0
Trichotropis cancellata	0	(1)	0	(1)	0
Crossaster papposus	0	(1)	0	0	0
serpulidae	0	(4)	(2)	(1)	(1)
Crepipatella lingulata	0	(1)	(0)	(1)	0
Acmaea mitra	0	0	(1)	0	0
Flustrella	0	0	2%	35%	0
Pycnopodia helianthoides	0	0	(1)	0	0

TABLE 24 (Cont.)

QUADRAT DATA (0.25m^2) FROM ZAIKOF BAY, SUBTIDAL
NOVEMBER 23, 1975

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4	No. 5
Hydroida (unid.)	1%	1%	0	5%	1%
Dendrobeania	0	0	0	1%	0
Thais lamellosa	0	0	0	0	(2)
globular red sponge	(1)	0	(1)	0	0

Location: 100m offshore of NMFS Transect
Depth (meters): 10.0-16.0M
Substrate type: rock outcrop

TABLE 25

QUADRAT DATA ($0.25m^2$) FROM ZAIKOF BAY, SUBTIDAL ZONE
NOVEMBER 24, 1975

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4
Laminaria spp.	30%(5)	40%(4)	20%(2)	10%(1)
Agarum	40%(2)	10%(2)	20%(2)	40%(1)
Microcladia spp.	1%	1%	3%	2%
Encrusting coralline	30%	40%	15%	40%
Ralfsia spp.	0	10%	0	0
Hildenbrandia	5%	0	15%	5%
Microporina borealis	5%	10%	2%	2%
Flustrella sp.	5%	5%	5%	0
Distaplia	5%(1)	0	0	0
Pagurids	(5)	(3)	(1)	(1)
Didemnum/Trididemnum	1%	0	0	0
Dendrobeania	1%	0	0	0
Puncturella multistriata	0	0	0	(1)
Tonicella spp.	(2)	(2)	(1)	(2)
Calliostoma ligatum	(1)	0	0	0
Cancer oregonensis	0	0	0	(1)
Heteropora sp.	0	2%	0	0
Crepipatella lingulata	(1)	0	0	0
Globose red sponge	(2)	0	(3)	0
Colonial ascidian (convoluted)	0	2%	2%	0

Depth (meters): 7.0-8.0

Substrate type: Boulders, cobbles and shell debris

Location: 100m off NMFS transect

TABLE 26

QUADRAT DATA (0.25m^2) FROM ZAIKOF BAY, SUBTIDAL ZONE
MARCH 19, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4	No. 5
Laminaria yezoensis	0	25%(3)	0	15%	20%
Laminaria groenlandica	0	0	0	0	0
Laminaria spp.	0	(2)	0	0	(2)
Agarum	90%(6)	15%(7)	80%(5)	50%(2)	25%(7)
Constantinea	0	6%	0	0	1%
Ralfsia	5%	0	10%	15%	10%
encrusting coralline	30%	5%	15%	10%	20%
Hildenbrandia	0	0	0	25%	0
Corallina	0	0	0	1%	2%
filamentous reds	6%	4%	5%	2%	10%
Microporina	0	1%	10%	20%	15%
Didemnum/Trididemnum	1%	0	0	0	1%
pagurids	(6)	(3)	(1)	(2)	(2)
Heteropora	0	0	0	0	2%
Trichotropis	(1)	(1)	(1)	0	0
serpulidae	(2)	(5)	(1)	(2)	(7)
Flustrella	5%	2%	10%	5%	2%
yellow sponge	2%	0	0	0	0
Distaplia	1%	0	5%	0	1%
Margarites	(1)	0	0	(1)	0

TABLE 26 (Cont.)

QUADRAT DATA (0.25m^2) FROM ZAIKOF BAY, SUBTIDAL ZONE
MARCH 19, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4	No. 5
Abietinaria	5%	0	0	0	0
Lacuna	present	0	0	0	0
Cancer oregonensis	(1)	0	0	0	0
? *Distaplia*	2%	0	0	8%	5%
Halocynthia aurantium	(1)	0	0		
Tonicella spp.				(2)	0
Phyllolithodes	0	0	0	0	(1)
Balanus spp.	15%	8%	40%	10%	20%

Location: off NMFS Site

Depth (meters): 6.0-7.0

Substrate type: boulders

TABLE 27

QUADRAT DATA ($0.25m^2$) FROM ZAIKOF BAY, SUBTIDAL ZONE
MARCH 20, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4
Laminaria yezoensis	4	0	0	0
Laminaria groenlandica	10%	25%	25%(1)	40%(1)
Laminaria spp.	0	0	(2)	(2)
Agarum	60%(4)	0	25%(2)	50%(5)
Constantinea	10%	20%	10%	1%
Ralfsia	40%	40%	10%	25%
encrusting coralline	40%	40%	10%	65%
Corallina	15%	15%	10%	15%
Bossiella	0	2%	0	2%
Ptilota	0	0	20%	20%
Rhodymenia	0	0	0	5%
Microporina	40%	15%	20%	10%
Flustrella	5%	0	0	0
orange globular ascidian	0	0	2%	0
Didemnum/Trididemnum	0	0	0	1%
Metandrocarpa	0	0	1%	0
pagurids	0	(3)	(3)	(3)
Balanus sp.	0	1%	1%	0
Ophiopholis	present	present	0	0
Tonicella	(1)	0	0	0

TABLE 27 (Cont.)

QUADRAT DATA ($0.25m^2$) FROM ZAIKOF BAY, SUBTIDAL ZONE
MARCH 20, 1976

Taxon	Percent Cover (number of individuals)			
	No. 1	No. 2	No. 3	No. 4
Pododesmus	0	0	0	(2)
Amphissa	0	(2)	0	0
Lacuna	present	0	present	present
Searlesia	0	(3)	0	0
Volutharpa ampullacea	0	(1)	0	0
Myxicola	(3)	0	0	0
serpulidae	(9)	(16)	(2)	(3)

Location: off NMFS Transect

Depth (meters): 4.0-5.0

Substrate type: rock pavement

TABLE 28

QUADRAT DATA (0.25m^2) FROM ZAIKOF BAY, SUBTIDAL ZONE
MARCH 20, 1976

Cover and Composition:

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4	No. 5
Laminaria yezoensis	0	0	(1)	0	0
Laminaria groenlandica	25%(3)	0	25%(1)	25%(2)	15%
Laminaria (juveniles)	0	0	0	0	(1)
Agarum	70%(1)	25%	15%(2)	10%	75%(3)
Constantinea	2%	1%	0	0	0
Ralfsia	30%	10%	0	5%	0
encrusting coralline	30%	20%	15%	30%	20%
Hildenbrandia	5%	5%	0	20%	25%
filamentous reds	1%	1%	0	3%	0
Microporina	3%	2%	5%	5%	(3)
pagurids	(2)	0	(4)	(2)	(3)
Heteropora	0	0	0	1%	0
Trichotropis	0	0	(1)	(2)	0
serpulidae	0	10%	0	(1)	0
Flustrella	1%	2%	1%	15%	5%
Distaplia	2%	0	0	0	1%
Margarites	0	0	0	(1)	(1)
? *Archidistoma*	0	2%	1%	1%	0
orange globular ascidian	0	0	0	8%	7%
Halocynthia aurantium	(1)	0	0	0	0
Tonicella	(2)	(2)	(1)	(2)	(1)
Musculus discors	(2)	0	0	0	0
Cryptobranchia	present	present	0	present	present
Trichotropis	0	0	(1)	(2)	0
Puncturella	(1)	0	0	0	0
Fusitriton	0	0	(1)	0	0
Trophon	(1)	0	(3)	(1)	0
Ophiopholis	present	0	0	0	0
Strongylocentrotus	0	0	(1)	0	0
Balanus sp.	5%	12%	10%	15%	2%

Location: NMFS Site
Depth: 9-10m
Substratum: Boulder Field

TABLE 29

HAPHAZARD QUADRAT CASTS (0.25m^2)
FROM THE SUBLITTORAL ZONE IN ZAIKOF BAY
MARCH 20, 1976

(No. 1) Depth 10.5m; Sand, Shell Debris & Silt

Taxon	Percent Cover (number of individuals)
Laminaria (juvenile)	(1)
Rhodymenia	2%(2)
diatom scum	80%

(No. 2) Depth 10.5m; Sand & Silt

Taxon	Percent Cover (number of individuals)
Laminaria (juveniles)	(3)
unid. foliose red	(1)
diatom scum	90%
Orthasterias	(1)

(No. 3) Depth 10.5m; Sand & Silt

Taxon	Percent Cover (number of individuals)
diatom scum	80%
shell debris	20%

(No. 4) Depth 10m; Rock & Shell Debris

Taxon	Percent Cover (number of individuals)
Laminaria groenlandica	(1)
Rhodymenia	(1)
Desmarestia	(1)
Unid. filamentous reds	2%

(No. 5) Depth 9m; Rock

Taxon	Percent Cover (number of individuals)
Agarum	(1)
Constantinea	5%(1)
Callophyllis	10%
Flustrella	5%
Microporina	30%
Evasterias	(1)

TABLE 29 (Cont.)

HAPHAZARD QUADRAT CASTS (0.25m2)
FROM THE SUBLITTORAL ZONE IN ZAIKOF BAY
MARCH 20, 1976

(No. 5) Cont.

Taxon	Percent Cover (number of individuals)
Ischnochiton	(1)
pagurids	(1)
unid. cottid	(1)

(No. 6) Depth 8.5m; Rock

Taxon	Percent Cover (number of individuals)
Laminaria groenlandica	(1)
Agarum	(3)
Callophyllis	2%
encrusting corallines	30%
Microporina	25%
Pycnopodia	(2)

(No. 7) Depth 8.5m; Rock

Taxon	Percent Cover (number of individuals)
Agarum	(5)
Callophyllis	2%
encrusting corallines	25%
Microporina	30%
Balanus	40%
Calliostoma	(2)

(No. 8) Depth 8.5m; Rock

Taxon	Percent Cover (number of individuals)
Agarum	(1)
Callophyllis	2%
Microporina	15%
Balanus	60%
Heteropora	5%

TABLE 29 (Cont.)

HAPHAZARD QUADRAT CASTS ($0.25m^2$)
FROM THE SUBLITTORAL ZONE IN ZAIKOF BAY
MARCH 20, 1976

(No. 9) Depth 7.5m; Rock

Taxon	Percent Cover (number of individuals)
Agarum	(1)
Callophyllis	5%
encrusting corallines	15%
Flustrella	5%
Microporina	5%
Balanus	25%
Calliostoma	(1)
Ischnochiton	(1)
Puncturella	(1)

(No. 10) Depth 8m; Rock

Taxon	Percent Cover (number of individuals)
Laminaria groenlandica	(2)
Laminaria (juveniles)	(2)
Agarum	(2)
Callophyllis	5%
encrusting corallines	60%
Microporina	10%
Flustrella	2%
Evasterias	(1)
Trichotropis	present

(No. 11) Depth 8m; Rock

Taxon	Percent Cover (number of individuals)
Laminaria groenlandica	(1)
Agarum	(1)
Callophyllis	5%
encrusting corallines	40%
Flustrella	5%
Balanus	2%
Trichotropis	(4)

TABLE 29 (Cont.)

HAPHAZARD QUADRAT CASTS (0.25m^2)
FROM THE SUBLITTORAL ZONE IN ZAIKOF BAY
MARCH 20, 1976

(No. 12) Depth 6.5m; Rock

Taxon	Percent Cover (number of individuals)
Laminaria groenlandica	(4)
Agarum	(3)
Callophyllis	2%
encrusting corallines	75%
Microporina	10%
Dendrobeania	2%
Flustrella	5%
Pycnopodia	(1)
Musculus discors	present

(No. 13) Depth 7m; Rock & Shell Debris

Taxon	Percent Cover (number of individuals)
Agarum	(4)
Callophyllis	5%
Microporina	10%
Balanus	20%

(No. 14) Depth 4.5m; Rock & Shell Debris

Taxon	Percent Cover (number of individuals)
Laminaria yezoensis	(1)
Laminaria groenlandica	(4)
Laminaria (juveniles)	(3)
Agarum	(5)
Rhodymenia	2%(1)
Odonthalia	5%
encrusting corallines	60%
Dendrobeania	2%
Balanus	30%

(No. 15) Depth 5m; Rock

Taxon	Percent Cover (number of individuals)
Laminaria groenlandica	(1)
Agarum	(6)

TABLE 29 (Cont.)

HAPHAZARD QUADRAT CASTS ($0.25m^2$)
FROM THE SUBLITTORAL ZONE IN ZAIKOF BAY
MARCH 20 1976

(No. 15) Cont.

Taxon	Percent Cover (number of individuals)
Rhodymenia	5%
Constantinea	(2)
unid. filamentous reds	20%
Hildenbrandia	5%
encrusting corallines	80%

(No. 16) Depth 5m; Rock

Taxon	Percent Cover (number of individuals)
Laminaria groenlandica	(1)
Agarum	(6)
Rhodymenia	5%
Constantinea	1%(2)
unid. filamentous reds	20%
Hildenbrandia	5%
encrusting coralline	80%

(No. 17) Depth 3m; Rock

Taxon	Percent Cover (number of individuals)
Laminaria yezoensis	(2)
Agarum	(2)
Rhodymenia	15%
Ptilota	30%
Corallina	5%
encrusting corallines	85%

TABLE 30 & 31

QUADRAT DATA (0.25 m^2) FROM
ZAIKOF BAY, SUBTIDAL ZONE
JUNE 22 and 23, 1976

Percent Cover (Number of Individuals)

Taxon	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12
Laminaria yezoensis	0	0	0	0	0	0	0	0	0	0	0	0
Laminaria groenlandica	0	0	0	0	20%(1)	0	0	0	0	0	80%(4)	30%(1)
Laminaria spp.	0	5%(6)	2%(5)	2%(2)	0	1%(1)	5%(6)	0	0	5%(10)	2%(15)	2%(4)
Agarum	0	0	0	0	50%(1)	30%(1)	35%	65%(1)	50%	0	15%	50%(2)
Pleurophycus	0	0	0	0	0	0	0	25%(1)	30%(1)	5%	0	0
Desmarestia viridis	25%	2%	15%	0	15%	35%	0	5%	0	20%	5%	0
Desmarestia ligulata var. ligulata	0	0	0	5%	0	0	0	0	0	2%	0	0
Ralfsia	P	0	0	0	0	0	0	0	0	P	0	0
encrusting coralline	0	0	25%	2%	5%	0	0	60%	60%	0	50%	30%
Hildenbrandia	0	0	0	0	0	0	0	0	20%	0	0	0
filamentous reds	0	2%	0	2%	15%	10%	0	0	5%	0	0	0
Callophyllis	0	0	0	0	0	0	0	0	5%	0	0	0
Microcladia	0	0	0	2%	0	0	2%	2%	0	0	20%	0
Phycodrys	0	0	0	0	0	0	0	0	2%	0	0	5%
Bossiella	0	0	0	0	0	0	0	0	0	0	0	2%
Microporina	0	0	5%	5%	25%	10%	25%	25%	60%	25%	20%	0
pagurids	0	(4)	0	(1)	0	(1)	0	0	0	0	(2)	(3)
Trichotropis	0	0	0	0	0	0	0	0	0	0	0	0
serpulidae	0	0	0	0	0	0	0	0	0	0	0	0
Flustrella	0	0	0	0	0	0	0	0	0	0	5%	5%
Balanus sp.	30%	15%	10%	0	0	0	5%	30%	0	0	0	0
Didemnum	0	0	0	0	5%	5%	5%	5%	10%	5%	5%	0
Dendrobeania	0	2%	0	0	0	15%	0	0	0	10%	10%	10%
foliose reds, unid.	0	0	0	0	0	0	10%	0	0	0	0	0
Abietinaria	5%	0	5%	0	0	2%	0	0	0	0	0	0
Heteropora	2%	0	0	0	0	0	0	0	0	0	0	0
Distaplia	2%	0	0	0	0	0	0	0	0	0	0	0
Tricellaria	0	0	2%	0	0	0	0	0	0	0	2%	2%
Grammaria sp.	30%	5%	10%	5%	25%	15%	10%	0	0	0	0	0
Hippodiplosia	2%	0	0	0	0	0	2%	0	0	0	0	0
Alcyonidium	0	0	0	0	5%	5%	2%	0	5%	0	0	2%
Hydractinea	P	0	0	0	0	0	0	0	0	0	0	0
Fusitriton	(1)	0	0	0	0	0	0	0	0	0	0	0
Ishnochiton spp.	(1)	0	0	0	0	0	0	(1)	0	0	0	0
Tonicella spp.	(2)	0	0	0	0	0	0	(1)	0	(1)	0	(1)
Corella	0	0	(1)	0	0	0	0	0	0	0	0	0
Henricia spp.	0	0	0	0	0	(1)	0	(1)	0	0	0	0
Orthasterias	0	0	0	0	0	0	(1)	0	0	0	0	(1)
Musculus ? discors	0	0	0	0	P	0	0	0	0	0	0	0
Pycnopodia	0	0	0	0	(1)	0	0	0	0	0	0	0
Solaster stimpsoni	0	0	0	(1)	0	0	0	0	0	0	0	0
Phidolopora	0	0	0	0	0	0	0	2%	0	0	0	0
Diadora	0	0	0	0	0	0	0	0	(1)	0	0	0
Trichotropis	0	0	0	0	0	0	0	0	(1)	0	0	(1)
Acmaea mitra	0	0	0	0	0	0	0	0	0	(1)	0	0
fan bryozoan	0	0	0	2%	5%	0	0	0	0	0	0	0
Depth:	15.5m	15.5m	13.5m	13.5m	12.0m	12.0m	12.0m	10.5m	10.5m	9.0m	9.0m	7.5m
Substrata:	Sand, rock & shell debris	Rock, sand & shell debris	Rock, sand & shell debris	Rock, sand & shell debris	Rock & shell debris	Rock	Rock	Rock	Rock	Rock & coarse sand	Rock & sand	Rock

quadrat counts. The third important member of this understory kelp guild was Pleurophycus gardneri. During the first three visits we did not record this species. Despite our oversight, Pleurophycus was obviously present since mature individuals were seen in the shallow regions of the reef complex during the June (1976) survey. The greatest number of Pleurophycus were attached to boulders in the 5-7 meter depth contour. For example, in June (1976) densities ranged from 0 to $6.80/m^2$; the average in 10 band transects was $0.88/m^2$ (Table 23) compared with an average density of $0.67/m^2$ in the quadrat counts for the same sample period (Table 31).

The other conspicuous or characteristic macroalgae in this location were the reds: Callophyllis spp., Constantinea, Microcladia borealis and Rhodymenia spp. Crustose and articulated coralline algae were typically shallow in distribution and abundance. Drift or detached bull kelp (Nereocystis) was seen along the southern shores of Zaikof Bay, however it was not until June of 1976 that we actually observed attached bull kelp in the study site. Young Nereocystis or juvenile sporophytes grew on the rock substrate within the boulder field; densities averaged $0.14/m^2$ during the summer survey (1976).

EPIFAUNA AND TROPHIC INTERACTION

A variety of epifaunal forms were observed in the relatively narrow macrophyte belt below MLLW. Suspension or filter feeders were abundant in this location. Most of these animals occurred along a narrow portion of the shoreline that was dominated by rock pavement and large rocks or boulders. The suspension feeders, along with the macrophyte species flourished from MLLW down to approximately 10 meters below the "0" elevation of the tide. The vertical faces of the rock substrates generally supported the greatest number of organisms. The dominant sessile forms were the bryozoans *Microporina borealis*, *Flustrella gigantea*, *Heteropora* spp. and *Dendrobeania murryani*; barnacles *Balanus* spp., serpulid worms; a nestling mytilid *Musculus discors* and the ascidians *Distaplia* ? *occidentalis*, *Halocynthia aurantium*, and *Didemnum* or *Tridideninum*. Hydroids were also common on rock substrata; the genera *Abietinaria* and *Grammaria* were particularly common during the June (1976) survey. For example, the tall statured *Grammaria* was recorded in 7/12 quadrats (.25m^2), with estimates of percent cover ranging between 0 and 30 percent, with an average coverage of 8.3 percent during this summer sample period.

Microherbivores were common on these same rock substrates. A few of the common species are listed in Table 32. Of the three genera, the most abundant and frequently encountered in the vegetative undergrowth was hermit crabs of the genus *Pagurus*. Hermit crabs occurred in 26/52 quadrats, with maximum densities of 24.0/m^2. The average density

TABLE 32

CHARACTERISTIC OR REPRESENTATIVE IMPORTANT SPECIES
AT ZAIKOF BAY, ROCKY SUBLITTORAL

Species	Occurrence	Major Taxon	Trophic Category
Agarum cribrosum (P)	A	Brown alga	Producer
Laminaria groenlandica (P)	C	Brown alga	Producer
Laminaria yezoensis (P)	C	Brown alga	Producer
Pleurophycus gardneri (P)	C	Brown alga	Producer
Desmarestia viridis (A)	C	Brown alga	Producer
Encrusting coralline (P)	A	Red alga	Producer
Microcladia borealis (?)	C	Red alga	Producer
Constantinea spp. (P)	C	Red alga	Producer
Callophyllis spp. (?)	C	Red alga	Producer
Ralfsia spp. (P)	C	Brown alga	Producer
Microporina borealis (A)	C	Bryozoan	Suspension feeder
Flustrella gigantea (P)	C	Bryozoan	Suspension feeder
Balanus spp. (P)	A	Barnacle	Suspension feeder
Grammaria sp.	C	Hydroid	Suspension feeder
Heteropora sp. (P)	C	Bryozoan	Suspension feeder
Pycnopodia helianthoides (P)	C	Sea star	Predator
Orthasterias koehleri (P)	C	Sea star	Predator
Dermasterias imbricata (P)	C	Sea star	Predator
Crossaster papposus (P)	C	Sea star	Predator
Henricia spp. (P)	C	Sea star	Suspension feeder/predator
Evasterias troschelii (P)	C	Sea star	Predator
Fusitriton oregonensis (P)	C	Snail	Predator/scavenger
Musculus discors (A)	C	Mussel	Suspension feeder
Tonicella spp. (P)	C	Chiton	Herbivore
Pagurus spp. (P)	A	Hermit crab	Herbivore/Scavenger
Margarites pupillus	C	Snail	Herbivore
Enhydra lutris (P)	C	Sea otter	Predator

Key: (P) = perennial
(A) = Annual
A = abundant
C = common
U = uncommon

was 5.1/m^2 in all quadrats combined. Members of this genus are reputed to be opportunistic consumers, and some species are known to consume both plant and animal matter. Herbivory was observed on attached macroalgae, particularly along the erroded edges of older blades where bacterial decomposition and tissue breakdown was no doubt great.

Several chitons (Tonicella insignis, T. lineata; Mopalia spp. and Ishnochiton spp.) and snails (Margarites pupillus, Calliostoma ligatum, Cryptobranchia spp., Puncturella spp., and Acmaea mitra) were also common in this location. The most common genera was Tonicella, and densities ranged as high as 8.0/m^2. Tonicella spp. occurred in 15 of 52 quadrats (.25m^2). Margarites and Calliostoma both reached densities of 4.0/m^2, and most often were seen on either rock or algal substrates. Most of these mollusks are microherbivores, and as such feed on the diatom film or algal turf that is generally composed of gametophytes and algal sporelings.

Macroherbivores, such as sea urchins were uncommon in this location, although a few relatively small individuals were encountered during the quadrat sampling efforts. Most of the green sea urchins (Strongylocentrotus drobachiensis) were less than 30 cm in diameter and were typically cryptic in habit. Densities of S. drobachiensis ranged from 0 to 4.00/m^2, and averaged 0.04/m^2 in the 52 haphazardly placed quadrats. Frequency of occurrence was 1/52 in this same quadrats.

These data are comparable to the transect sampling, for only 1 green sea urchin was encountered during this phase of the field work, and densities ranged from 0 to 0.02/m^2 in the 292 square meters of seafloor that was sampled by band transects (Tables 33 and 34).

There are a number of other herbivores in the inshore system; i.e. amphipods, isopods, fishes etc.; however, no information has been generated from these groups of organisms since their occurrence at Zaikof Bay was more transient or ephemeral over the 1-year (1975-76) sample period. Other invertebrate species which utilized the seaweed resource in the bay were Lacuna carinata (snail); Diadora aspera (limpet); Mopalia spp. (chitons); Pugettia gracilis (decorator crab); Punturella spp. (snail) and Dermasterias imbricata (sea star).

As stated earlier, the sedentary or attached organisms were common on the solid substratum, and most of these species because of restrictions of mobility gather or collect food items that have either fallen or drifted to them in the water column. Most of the detritus that reaches the seafloor probably needs to be reworked further or broken down by bacterial action before it can be assimilated by the macroinvertebrates of the reef. Conspicuous members of this trophic guild included the articulated bryozoan Microporina borealis, which occurred in 40 of 52 quadrats, and covered between 0 and 60 percent of solid substrate. The average coverage over the 1-year period was 12.56 percent (Tables 24-31). Microporina longevity is unknown, although in some locations of the Northern Gulf the colonies appeared to be short-lived. Another

TABLE 33

DENSITY ESTIMATES OF SOME COMMON ECHINODERMS AT ZAIKOF BAY
(estimates were derived from band transects)

Taxon	11-23-75	11-23-75	11-23-75	11-24-75	11-24-75	03-19-76	03-20-76	03-20-76	03-20-76
Pyncopodia helianthoides	19 0.38/m^2	5 0.25/m^2	12 0.48/m^2	16 0.64/m^2	4 0.18/m^2	11 0.22/m^2	8 0.80/m^2	3 0.30/m^2	9 0.90/m^2
Dermasterias imbricata	2 0.04/m^2	0	1 0.04/m^2	0	0	0	0	0	0
Orthasterias koehleri	3 0.06/m^2	1 0.05/m^2	1 0.04/m^2	0	1 0.05/m^2	5 0.10/m^2	1 0.10/m^2	1 0.10/m^2	0
Crossaster papposus	2 0.04/m^2	2 0.05/m^2	1 0.04/m^2	0	4 0.18/m^2	4 0.08/m^2	1 0.10/m^2	1 0.10/m^2	0
Solaster spp.	1 0.02/m^2	1 0.03/m^2	0	0	1 0.05/m^2	0	0	0	0
Henricia spp.	1 0.02/m^2	3 0.07	4 0.16/m^2	1 0.04/m^2	2 0.09/m^2	5 0.10/m^2	1 0.10/m^2	0	1 0.10/m^2
Evasterias troschelii	3 0.06/m^2	1 0.03/m^2	2 0.08/m^2	2 0.08/m^2	0	7 0.14/m^2	0	2 0.20/m^2	0
Strongylocentrotus spp.	0	0	0	0	0	1 0.02/m^2	0	0	0
Area sampled:	25 x 2m	20 x 2m	25 x 1m	25 x 1m	22 x 1m	50 x 1m	10 x 1m	10 x 1m	10 x 1m
Depth:	11-12m	10-11m	6-7m	12-13m	7-8m	7-12m	10.5m	8m	4.5m
Substrate type:	Rock	Rock & Sand	Rock	Rock & Sand	Rock	Rock	Rock & Sand	Rock	Rock

TABLE 34

DENSITY ESTIMATES OF SOME COMMON ECHINODERMS
AT ZAIKOF BAY

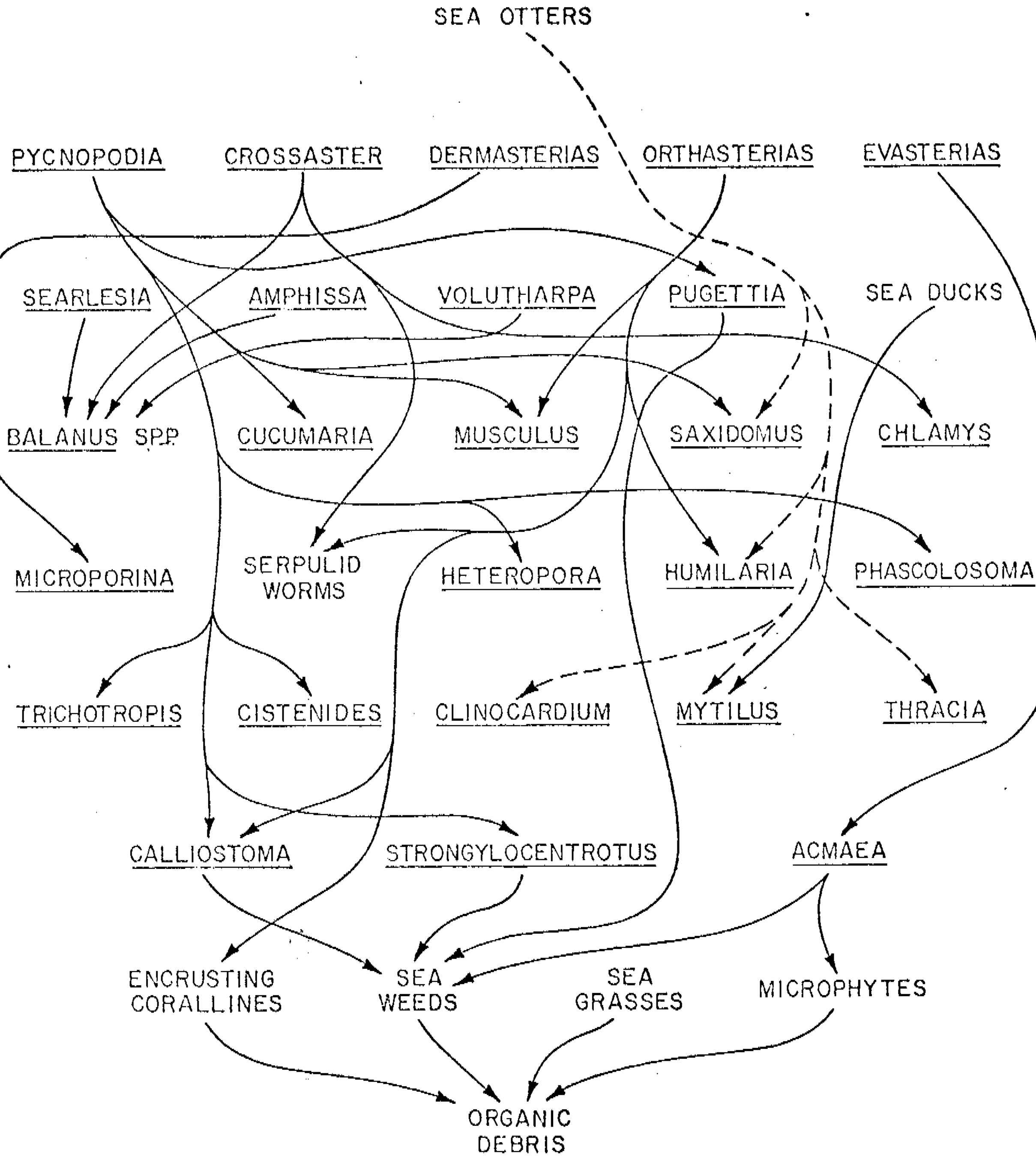
(Estimates Were Derived from Band Transects)

Taxon	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76	6-22-76	Combined $\bar{x}/m^2$
Pycnopodia helianthoides	2 $0.40/m^2$	1 $0.20/m^2$	0	1 $0.20/m^2$	4 $0.80/m^2$	0	1 $0.20/m^2$	3 $0.60/m^2$	1 $0.20/m^2$	3 $0.60/m^2$	0.39
Dermasterias imbricata	0	1 $0.20/m^2$	0	0	0	0	0	0	0	3 $0.60/m^2$	0.01
Orthasterias koehleri	0	1 $0.20/m^2$	2 $0.40/m^2$	0	1 $0.20/m^2$	0	1 $0.20/m^2$	0	1 $0.20/m^2$	0	0.09
Crossaster papposus	1 $0.20/m^2$	0	0	0	0	0	0	0	0	0	0.04
Solaster spp.	0	0	0	0	0	0	0	0	0	0	0.01
Henricia spp.	0	0	0	0	1 $0.20/m^2$	0	1 $0.20/m^2$	0	2 $0.40/m^2$	0	0.08
Evasterias troschelii	0	0	0	0	0	0	0	0	0	0	0.03
Strongylocentrotus spp.	0	0	0	0	0	0	0	0	0	0	
Area sampled:	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	5x1 m	
Depth:	13.5 m	13.5 m	12.0 m	12.0 m	10.5 m	10.5 m	9.0 m	9.0 m	7.6 m	6.1 m	
Substrate type:	Rock & sand	Rock & sand	Rock & sand	Rock & sand	Boulders	Boulders	Rock	Rock	Boulders	Boulders	

common bryozoan in this area was Flustrella gigantea, which frequently grew in either mat-like encrustations between boulders or attached to the shell of Fusitriton oregonensis (snail). Estimated coverage of Flustrella ranged between 0 and 35 percent, with an average in all quadrats combined of 2.83 percent. The frequency of occurrence in the shallow water zone was 23/52. Based on observations made in Kachemak Bay (ADF&G, 1977), the canopy produced by Flustrella colonies are important habitats or nursery areas for juvenile crabs and shrimps. The colonies appeared to be perennial, and the only predator known to feed upon Flustrella in Prince William Sound is the white dorid nudibranch (Archidoris odhneri).

A third bryozoan, Heteropora spp. formed calcareous, branched colonies that are frequently referred to as coral by the fishermen of the Sound. Heteropora occurred in 10/52 quadrats, with maximum coverage of 5 percent in the haphazardly placed quadrats. Duration of life is unknown, however, judging from the size of some colonies it appeared to be long-lived. Few predators of Heteropora are known from this site, however, one occasional predator is the sun star, Pycnopodia helianthoides (Figure 10), and another known predator from the Northern Gulf is the China rockfish, Sebastes nebulosus, which probably ingests the colonies incidental to eating the brittle star (Ophiopholis aculeata) (Rosenthal, unpublished data).

Balanoid barnacles: Balanus nubilus, B. ? crenatus and B. glandula encrusted substantial portions of the rock substrate beneath



FOOD WEB FOR THE CONSPICUOUS SPECIES IN THE SHALLOW SUBLITTORAL ZONE AT ZAIKOF BAY, MONTAGUE ISLAND

Figure 10

the vegetative undergrowth. Estimates of barnacle coverage ranged between 0 and 60 percent, with an average of 7.8 percent in all of the quadrats (.25m^2). Barnacles occurred in 23 of 52 quadrats. Some of the predators of Balanus spp. in this location included the snails: Searlesia dira, Amphissa columbiana and Volutharpa ampullacea; the sea stars Crossaster papposus and Orthasterias koehleri.

The mytilid, Musculus discors is another member of the suspension feeding guild. It occupies a considerably different niche than it's congener M. vernicosus, and has adopted a substantially different pattern of life history. Most live in byssus nests attached to the vertical faces of rocks, or the holdfast portion of kelps. The population at Zaikof Bay contained a large proportion of adults (Figure 11), which brood tremendous numbers of eggs within the byssal nests until the juveniles are at least 0.5 mm in shell length. A length-weight regression for the winter population is presented in Figure 12. Shell debris at the base of the reef indicate that Musculus populations have been successful in this location during the past few years.

Some of the major predators at Zaikof Bay are listed in Table 32, and of these 6 species are sea stars, 1 is a snail and 1 a sea mammal. Other important tertiary consumers in the bay include crabs, shrimps, gastropods, sea anemones, fishes, marine mammals and sea ducks. Sea stars were the visual dominants in this trophic level. The sun star Pycnopodia was the numerical dominant in the 292 square meters of seafloor that was quantitatively sampled by band transects (Tables 33 and

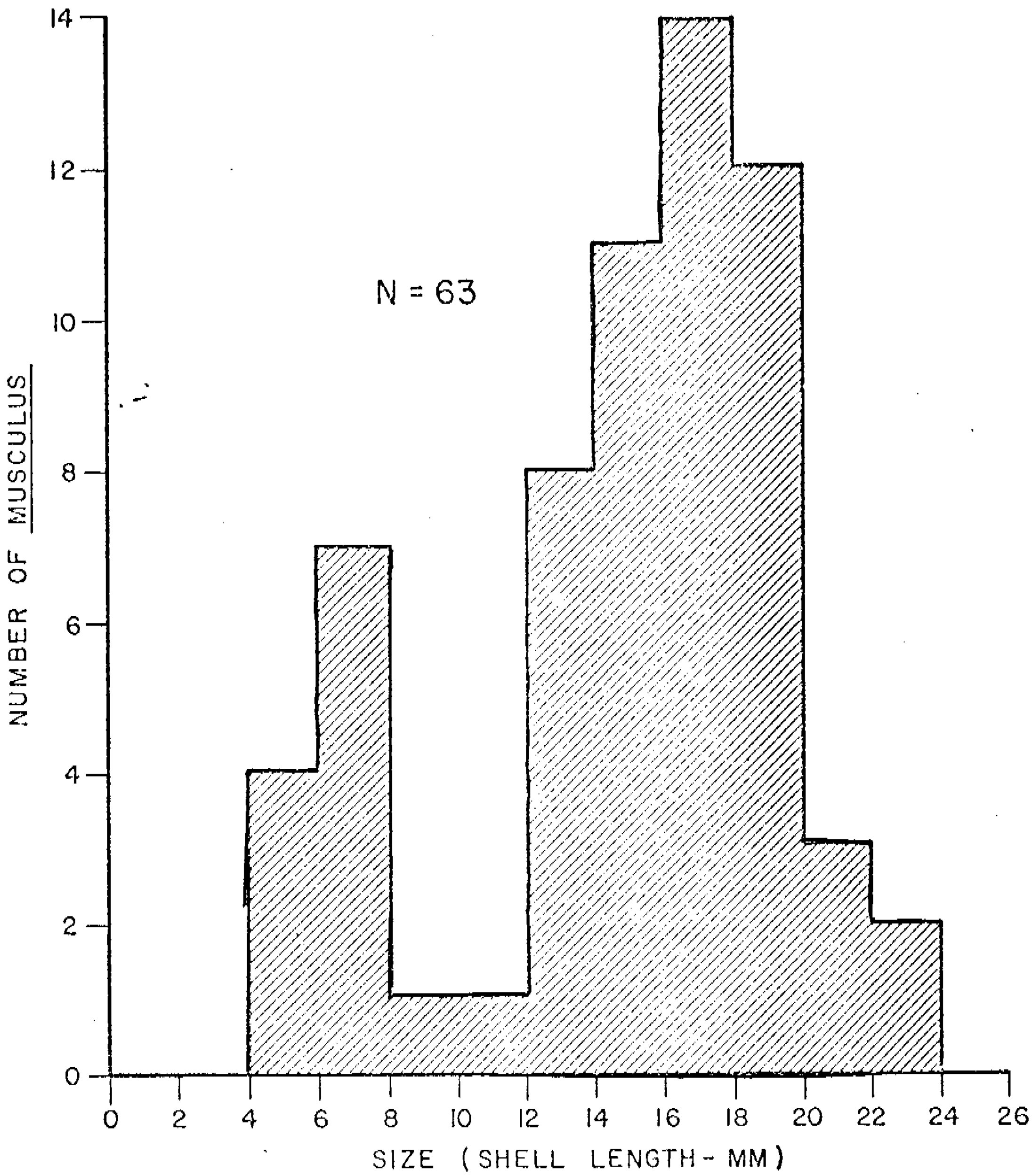
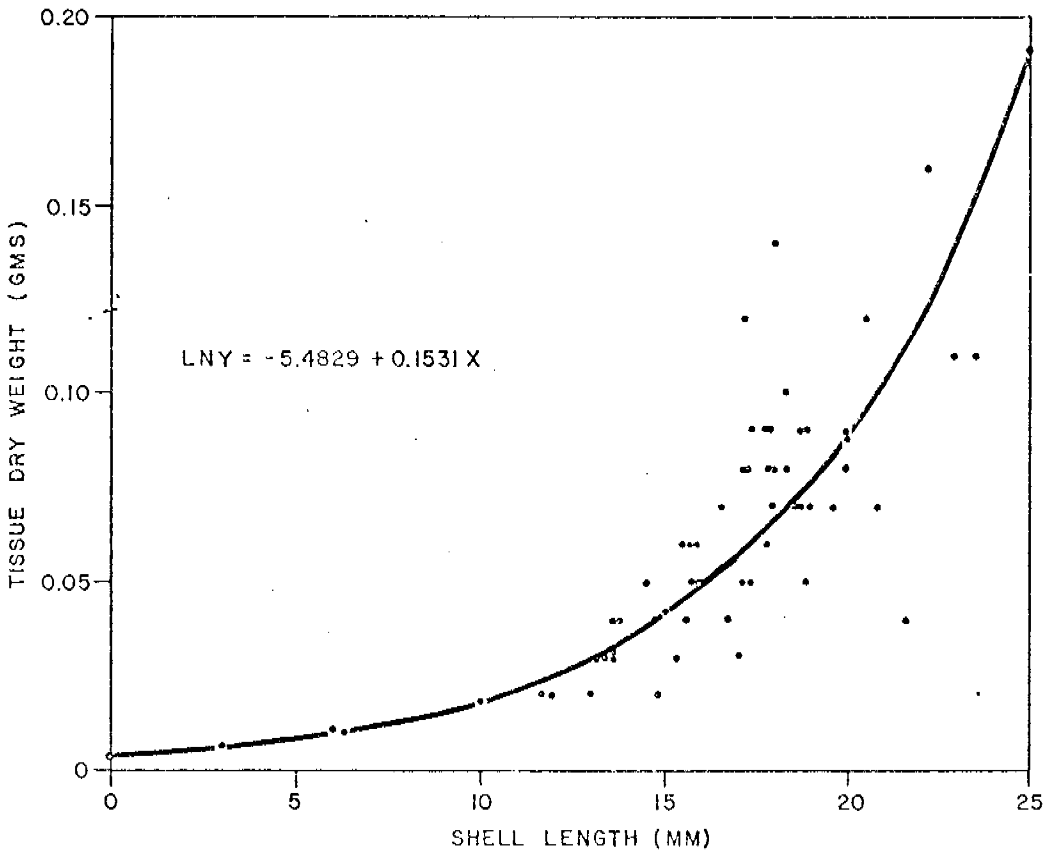


Figure 11

MUSCULUS DISCORS

COLLECTED FROM THE SUBTIDAL ZONE IN ZAIKOF BAY

3/20/76



A SAMPLE OF

MUSCULUS DISCORS

POPULATION FROM ZAIKOF BAY

3/20/76

Figure 12

34). Density estimates ranged between 0 and 0.90 individuals/m^2; average density in all of the combined transects was 0.39/m^2. Pycnopodia is an opportunistic predator, and was observed to prey on a wide variety of species and trophic levels such as: Trichotropis spp. (snail); Calliostoma ligatum (snail); Musculus spp. (mussel); Saxidomus gigantea (clam); Cucumaria spp. (sea cucumber); Strongylocentrotus drobachiensis (sea urchin); Cistenides (polychaete); Heteropora spp. (bryozoan); Phascolosoma (sipunculid), and Pugettia gracilis (crab).

The second most abundant sea star was Orthasterias koehleri; density estimates ranged from 0 to 0.20/m^2, with an average of 0.09/m^2 in the band transects. Typically, it preyed on bivalve mollusks such as Musculus discors, Humilaria kennerlyi (clams) and barnacles Balanus spp.

The blood star Henricia spp. was the third most abundant genus in the shallow sublittoral zone. Since individuals were not identified to species, feeding type cannot be identified. However, one of the species present in this location H. leviuscula, is reputed to be a suspension feeder. Mode of feeding in the other species (H. tumida) is unknown. Densities of Henricia ranged from 0 to 0.40/m^2 with the average density of 0.08/m^2.

Another common sea star was the multi-rayed star Crossaster papposus; estimates of density ranged from 0 to 0.20/m^2, and the average density in all band transects was 0.04/m^2. Individuals were seen eating serpulid worms, balanoid barnacles and a scallop Chlamys ? rubida. Most were seen either on rock substrate, or were attached to taller statured kelps in the algal understory.

Two other genera, the mottled star (Evasterias troschelli), and the genus Solaster are listed in Tables 33 and 34. Estimates of Evasterias ranged from 0 to 0.20/m^2, with an average density of 0/03/m^2. Solaster stimpsoni and S. dawsoni are presented under the one genus, and as such ranged from 0 to 0.05/m^2. The mean density in all transects during 1975-76 was 0.01/m^2.

Numerous predators and scavengers were seen in Zaikof Bay, and these included several species of fish, namely rock, whitespotted and kelp greenling, great sculpin, antlered sculpin, irish lord, rockfish, northern ronquil and flounder (Table 31). Although marine birds and mammals were not surveyed, several species of sea duck, i.e. white-winged scoter, barrow's goldeneye, and great scaup (Table 35), were seen feeding in the shallow waters of the bay. Scoters were seen diving for bay mussels (Mytilus edulis) during the March and June (1976) surveys.

Sea otters are common in Zaikof Bay, with some of the feeding directed at the clams Humilaria, Saxidomus, Clinocardium, Thracia and bay mussel (M. edulis). Shell debris was moderately abundant on the sandy slope below the boulder field.

TABLE 35

A LIST OF AQUATIC BIRDS AND MAMMALS OBSERVED AT THE OCS STUDY SITES DURING 1975-76

COMMON NAME	SCIENTIFIC NAME	LOCATION
	WATER BIRDS	
Harlequin duck	Histrionicus histrionicus	L;Z
White-winged scoter	Melanitta deglandi	L;M;Z
Oldsquaw	Clangula hyemalis	M;Z
Mallard duck	Anas platyrhynchos	L
Greater scaup	Aythya marila	M;Z
Barrow's goldeneye	Bucephala islandica	M;Z
Cormorant	Phalacrocorax sp.	L
Black-legged kittiwake	Rissa tridactyla	L
Glaucous-winged gull	Larus glaucescens	L;M;Z
Grebe	Podiceps sp.	M
Common murre	Uria aalge	L
Murrelet	Brachyramphus sp.	L;M;Z
Pigeon guillemot	Cepphus columba	L
Black oyster catcher	Haematopus bachmani	L;M
	MAMMALS	
Sea otter	Enhydra lutris	L;M;Z
Land otter	Lutra canadensis	L
Harbor seal	Phoca vitulina	L;M;Z
Steller sea lion	Eumetopias jubata	L;M;Z
Harbor porpoise	Phocoena phocoena	L;M;Z
Killer whale	Orcinus orca	L;Z
Dall porpoise	Phocoenoides dalli	Z
Minke whale	Balaenoptera acutorostrata	L

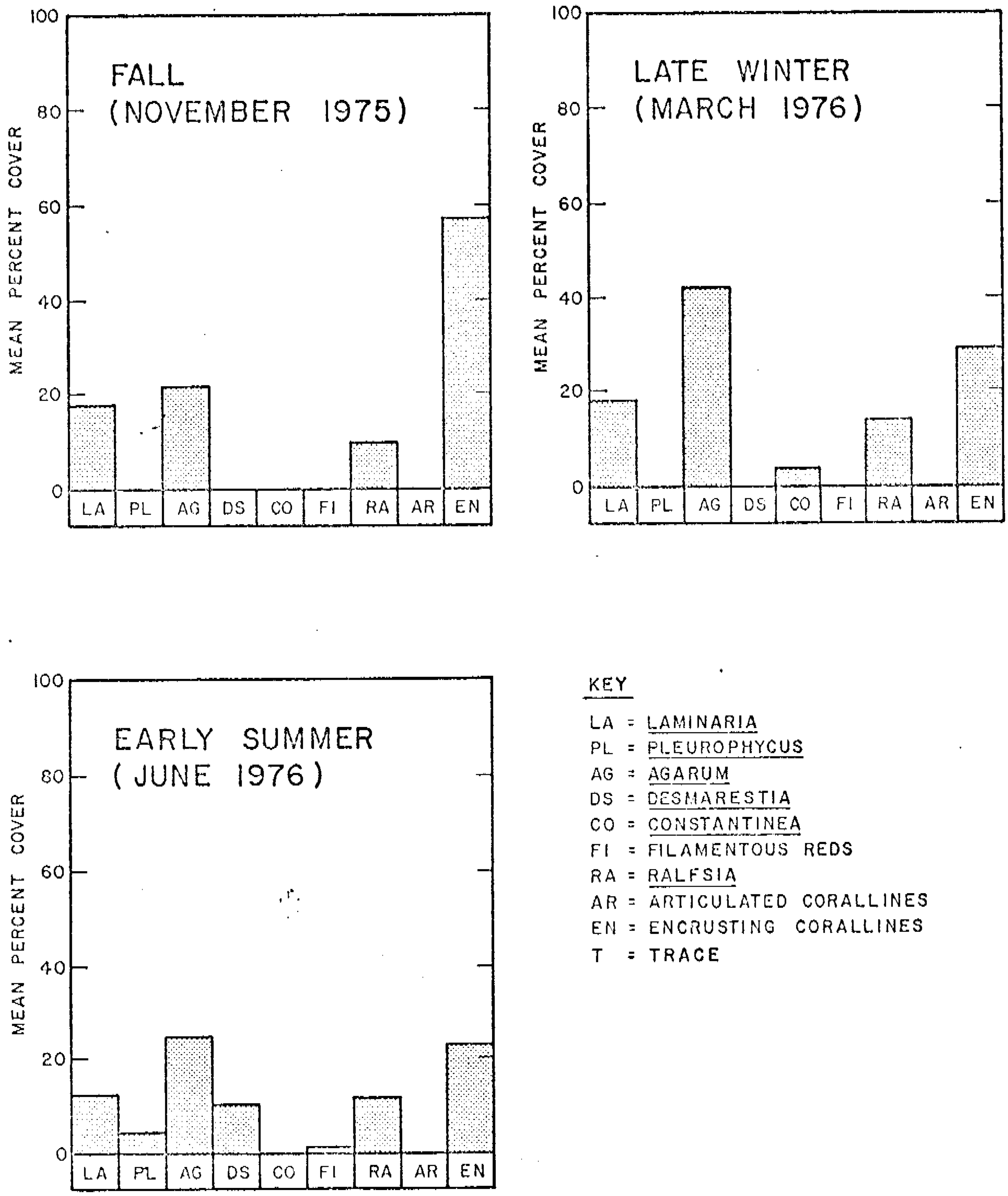
Location Symbols:

L = Latouche Point
M = Macleod Harbor
Z = Zaikof Bay

SEASONAL PATTERNS

The macrophyte assemblage in the shallow waters of Zaikof Bay exhibited changes in both algal cover, and number of species present with the movement of time from July, 1975, until June, 1976. The most pronounced change was in the algal undergrowth, particularly the brown algae or phaerophytes. For example, during the November (1975) survey most of the laminarian kelps had either shed or lost most of the blade material above the meristematic growth region. Drift and/or detached pieces of plants, particularly sieve kelp (Agarum); elephant-ear kelp (Laminaria groenlandica) and leaves or turions of eelgrass (Zostera marina) were prominent on the bottom, particularly on soft substratra below the boulder field. Even leaves of terrestrial origin, such as alder were conspicuous in the shallow subtidal.

One of the seaweeds in the brown algal guild that oscillated in areal cover with the change of seasons was hair-kelp (Desmarestia viridis). Desmarestia viridis was rare in the study area during November, however, by late June, it occurred in 8/12 quadrats, and covered between 0 and 35 percent of the area contained in these .25m^2 quadrats. Average coverage for this same time period was 10 percent (Figure 13). Desmasteria viridis is reputed to be perennial alga (Champan 1974), however, it does undergo a perennation (die back) process during fall, with renewed growth during late winter and early spring. Many of the foliose (leaf-like), and filamentous varieties of red algae are also highly seasonal in occurrence and physical appearance. Some of these like the filamentous



ALGAL COVER AT ZAIKOF BAY

Figure 13

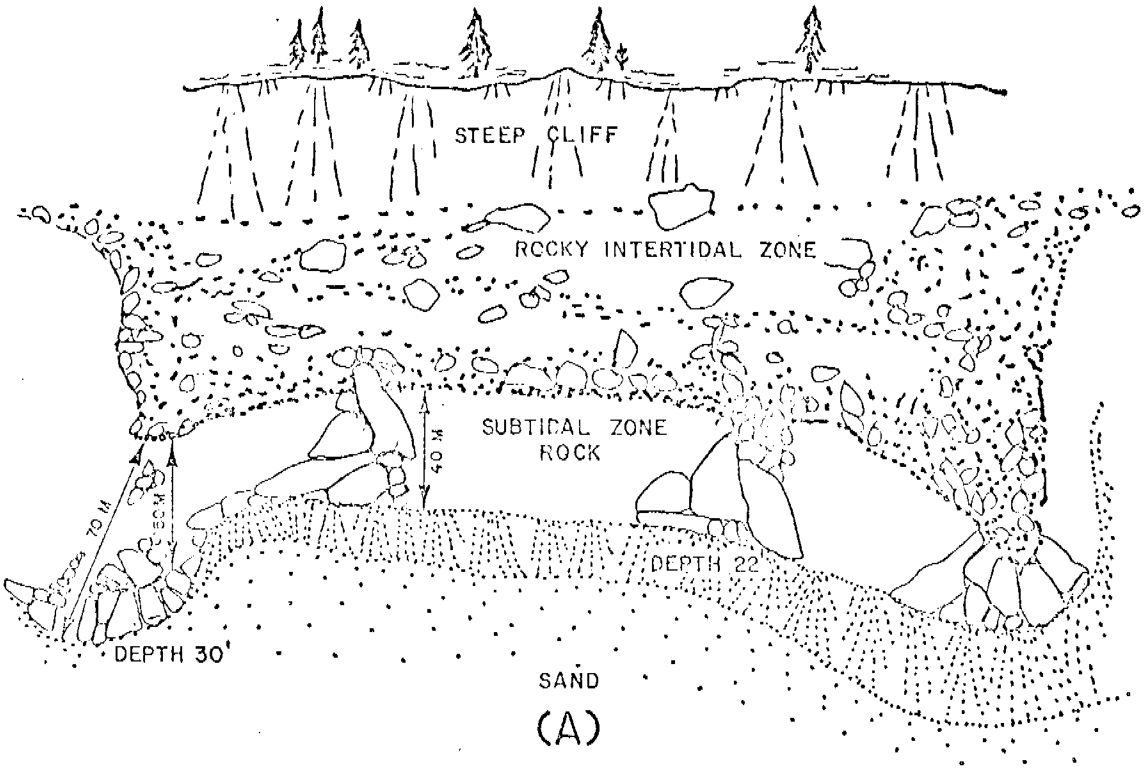
reds *Pterosiphonia bipinnata* and *Polysiphonia pacifica* are summer plants, while others such as the peltate red *Constantinea subulifera* apparently persist for a number of years provided the plant remains attached to the seafloor.

Several changes in the epifauna were also evident in this location. For instance, during 1975-76, the hydroids *Grammaria* sp. and *Lafoea* varied in abundance (coverage) in a similar fashion as the macroalgae; both hydroids covered up to 30 percent of the available surface area in the .25m^2 quadrats. However, prior to the summer survey both genera were rare or absent in this location. *Grammaria* and *Lafoea* both appear to be either annuals or exhibit substantial variation in cover and relative abundance during a year's time.

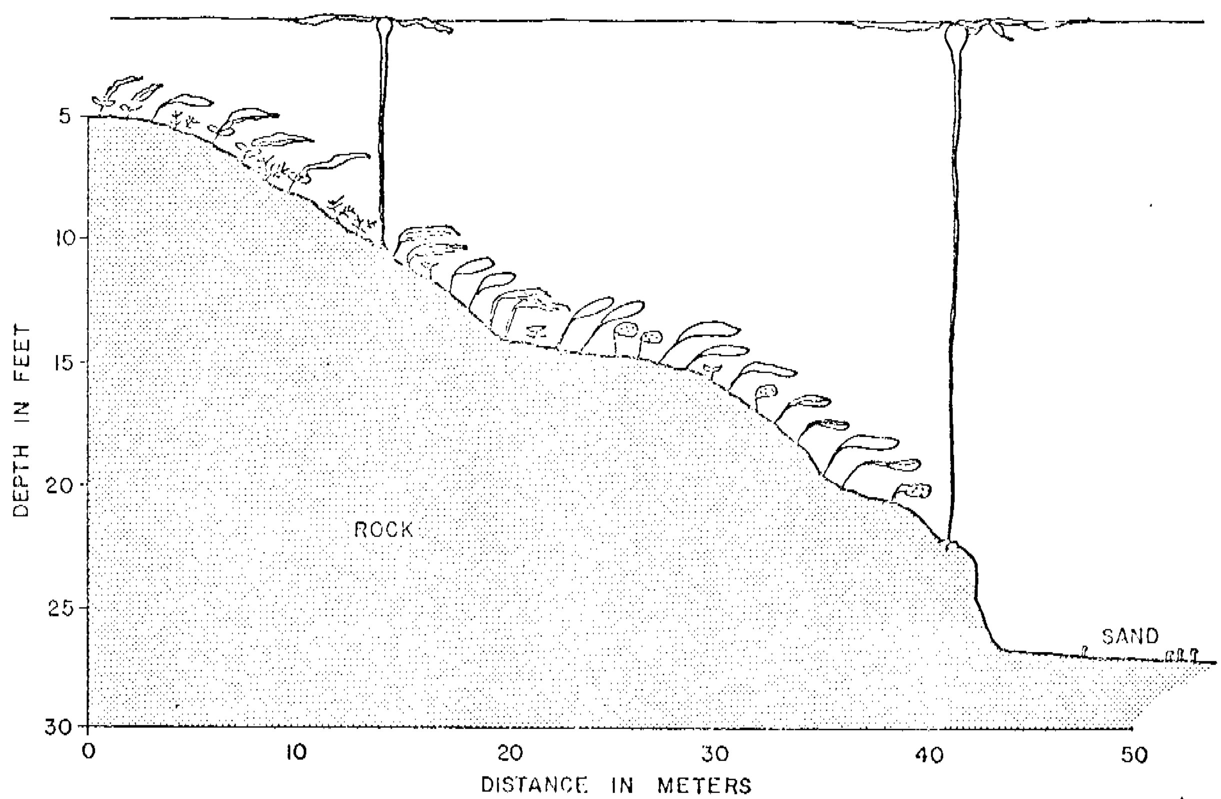
DESCRIPTION OF THE STUDY SITE (MACLEOD HARBOR)

Macleod Harbor, located on the southwest end of Montague Island (Figure 1) is generally protected from the Gulf of Alaska; however, it does receive some ocean swell and storm surf from Montague Strait. The northern shoreline from the entrance at Point Woodcock to about midway into the harbor is rocky and irregular. The head of the bay is shallow and fed by a large freshwater stream. Fresh water is a prominent feature of the upper part of the water column. The southwest coast of Montague Island was raised by as much as 30 feet during the Good Friday Earthquake of 1964 (Plafker, 1969). One effect of the quake was to separate the pre-earthquake littoral zone from the post earthquake shoreline.

At present, the shoreline is characterized by a band of solid substratum composed of boulders and cobbles (Figure 14). Steeply sloping rocky cliffs overlook the NMFS intertidal station on the northern shores of Macleod Harbor. Sitka spruce and hemlock grow above the rocky buttress. A number of exposed low profile ridges, extend from shore into the shallow subtidal zone. Between these ridges or fingers of rock are broad surge channels. The sublittoral zone in this part of Macleod Harbor is composed of a narrow band of bedrock approximately 40 to 70m wide. Seaward of the exposed bedrock, at depths ranging between 6 and 9m below the sea surface, the seafloor was comprised of sand, silt and moderate amounts of shell material. The surface of the sand was usually covered by a thin layer of benthic diatoms, and sulfur bacteria spotted numerous areas of the bottom.



(A)



(B)

Figure 14

MACLEOD HARBOR

DRAWING OF THE STUDY SITE (A)
AND THE SUBTIDAL VEGETATIVE CANOPIES (B)

BIOLOGICAL SETTING (ALGAL ASSEMBLAGE)

A prominent feature of this location was the fringing bed of bull kelp (Nereocystis luetkeana) that occurred along the northern shoreline. During summer, the bed extended from the rocky promontory midway into the bay to approximately .25 nautical miles beyond Pt. Woodcock. Most of the bull kelp was scattered along the rocky reefs and in only a few locations was the surface canopy moderately heavy. Plants grew from MLLW to approximately 12 meters below the sea surface. Density estimates ranged from 0 to $0.46/m^2$, with an average density of $0.07/m^2$ (Table 36).

A thin band of rockweed (Fucus distichus) grew on the rock substrate above MLLW. Below the Fucus zone around the intertidal-subtidal fringe was a narrow girdle of Alaria ? tenuifolia. The brown alga, Costaria costata also occurred in the shallow water. Costaria is an annual species, and during March (1976) juvenile sporophytes were common in this location. Along most the rocky shoreline the seaweed belt was 40 to 70 meters wide; the width was largely determined by the availability of the hard or rock substrate. The sublittoral algal association was comprised of several layers or canopy levels. Laminaria groenlandica was the most abundant brown alga in the understory complex (Tables 37-50). Density estimates ranged from 0 to $64.00/m^2$, the average density during March 1976 was $14.80/m^2$ (Tables 44 to 50). Another congener, L. yezoensis was also common; densities ranged between

TABLE 36

DENSITY ESTIMATES OF SOME DOMINANT MACROPHYTES AT MACLEOD HARBOR
(estimates were derived from band transects of different lengths)

Taxon	9-15-75	9-15-75	9-15-75	3-13-76	3-13-76	3-15-76
Nereocystis luetkeana	0	0	23 $0.46/m^2$	0	0	0
Laminaria spp.	83 $16.6/m^2$	71 $14.2/m^2$	Not counted	42 $2.80/m^2$	31 $3.10/m^2$	36 $5.14/m^2$
Agarum cribrosum	35 $7.0/m^2$	13 $2.6/m^2$	Not counted	28 $1.87/m^2$	30 $3.00/m^2$	12 $1.71/m^2$
Pleurophycus gardneri	5 $1.0/m^2$	14 $2.8/m^2$	Not counted	0	18 $1.80/m^2$	2 $0.28/m^2$
Area sampled:	10 x 5m	10 x 5m	25 x 2m	15 x 1m	10 x 1m	7 x 1m
Depth:	7-8m	7-8m	5m	10m	4.5m	7.5-8.5m
Substrate type:	Rock & Kelp	Rock & Kelp	Rock	Rock & Sand	Rock	Rock & Sand

TABLE 37

QUADRAT DATA ($0.25m^2$) FROM MACLEOD HARBOR, SUBTIDAL
NOVEMBER 29, 1975

Taxon	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Laminaria spp.	(3)	(2)	(3)	(3)	(1)	(9)		(13)	(7)	(6)	(3)	(1)	(1)
Agarum cribrosum	(2)				(1)						(1)	(1)	(1)
Constantinea						P							
Opuntiella						P	P	10%					
Encrusting coralline			15%			30%	80%	80%	50%				
Microporina	45%	20%		5%	2%		60%	25%		15%	10%	15%	30%
Dendrobeania	5%				2%				2%			2%	
Tricellaria							2%						
Heteropora							5%						
Didemnum/Trididemnum	2%					5%	5%						
Hippodiplosia				P									
Halocynthia aurantium												(2)	
Musculus									P				
Pycnopodia			(1)	(1)	(1)					(1)			
Dermasterias							(1)						
Thais lamellosa						(1)							
Tonicella						(1)							
Halocynthia igaboja						(1)							
Trophonopsis			(1)										
Depth (meters)	9.0	9.0	9.0	9.0	10.0	5.0	3.0	3.0	5.0	10.0	10.0	10.0	13.0
Substrate type:	Rock & sand	Rock & sand	Rock & sand	Rock & sand	Rock & sand	Rock	Rock	Rock	Rock & sand	Rock & sand	Rock & sand	Rock & sand	Rock & sand

TABLE 38

QUADRAT DATA (0.25m^2) FROM MACLEOD HARBOR, SUBTIDAL
NOVEMBER 29, 1975

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3
Agarum	50%	15%(1)	25%(3)
Laminaria spp.	0	10%(2)	50%(3)
Alaria sp.	0	10%	0
Encrusting coralline	70%	50%	40%
Hildenbrandia	20%	30%	20%
Didemnum/*Trididemnum*	3%	5%	2%
Yellow spatter sponge	15%	5%	5%
Sertularella	1%	0	2%
? *Scrupocellaria*	1%	0	Present
Microporina	50%	50%	30%
? *Rhynchozoon*	5%	1%	2%
Musculus discors	(1)	(1)	0
Tonicella	(3)	(1)	(1)
Serpulidae	(1)	0	0
Trichotropis	(3)	(1)	(1)
Metandrocarpa	0	Present	0
Synoicum	Present	0	Present
Crepipatella	(1)	(1)	(1)

Depth (meters): 10.0
Substrate type: Rock pavement
Location: Rock projection off NMFS station

TABLE 39

QUADRAT DATA (0.25m^2) FROM MACLEOD HARBOR, SUBTIDAL
NOVEMBER 29, 1975

Taxon	Percent Cover (number of individuals) No. 1	No. 2
Laminaria groenlandica	90%(3)(1)*	100%(13)(4)
Laminaria yezoensis	(2 holdfasts)	5%(2)
Agarum	0	10%(1)
Corallina	2%(1)	0
Encrusting coralline	80%	80%
Foliose reds, unid.	2%	0
Musculus vernicosus	1%	0
Tonicella	(3)	0
Acmaea mitra	(3)	(2)
Dendrobeania	0	3%
Sertularella	0	3%
Microporina	15%	15%
Pycnopodia	(1)	(2)
Pagurids	0	(5)
Cryptobranchia concentrica	0	(5)
Synoicum	0	1%
? *Rhynchozoon* sp.	1%	3%
Crepipatella lingulata	6%	5%
Yellow spatter sponge	1%	1%

Depth (meters): 6.0-7.0
Substrate type: Rock and boulders
Location: 200m S.E. NMFS station

* Plants undergoing blade renewal

TABLE 40

QUADRAT DATA (0.25m^2) FROM MACLEOD HARBOR, SUBTIDAL
NOVEMBER 29, 1975

Taxon	Percent Cover (number of individuals)			
	No. 1	No. 2	No. 3	No. 4
Laminaria groenlandica	4% (25)	15%	50% (6)	90% (3)
Laminaria yezoensis	5% (25)	15% (5)	10% (3)	0
Laminaria spp.	4% (25)	0	0	0
Cymathere triplicata	0	30% (7)	0	0
Desmarestia viridis	0	20%	0	0
Ptilota	0	0	0	5% (1)
Opuntiella californica	0	0	0	5% (1)
Constantinea	0	1% (1)	2% (3)	0
Hildenbrandia sp.	1%	0	0	0
Bossiella	0	0	0	2%
Corallina	0	0	5%	2%
Foliose reds, unid.	1%	1%	2%	5%
Ralfsia	0	0	0	0
Encrusting coralline	70%	5%	40%	20%
Musculus vernicosus	25%	20%	40%	10%
Tonicella	(3)	0	0	0
Acmaea mitra	(4)	0	0	0
Dendrobeania	1%	0	1%	1%
Sertularella	1%	0	0	0
Plumularia sp.	1%	0	0	0
Microporina borealis	0	0	5%	15%

TABLE 40 (Cont.)

QUADRAT DATA (0.25m^2) FROM MACLEOD HARBOR, SUBTIDAL
NOVEMBER 29, 1975

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4
Serpulidae	10%	0	0	0
Orange encrusting sponge	1%	0	2%	0
Yellow spatter sponge	0	0	5%	2%
Tricellaria sp.	0	0	0	2%
Pycnopodia	(1)	0	(1)	0
Didemnum/Trididemnum	0	0	0	1%
? Ritterella	0	0	0	1%(1)
Distaplia sp.	0	0	0	2%(1)
Pagurids	0	0	0	0
Balanus ? alaskiensis	0	0	0	(1)
Sand	25%	50%	0	25%

Depth (meters): 5.0
Substrate type: Rock outcrop
Location: 200m S.E. NMFS station

* Plants undergoing blade renewal

TABLE 41

QUADRAT DATA ($0.25m^2$) FROM MACLEOD HARBOR, SUBTIDAL
NOVEMBER 29, 1975

Taxon	Percent Cover (number of individuals) No. 1	No. 2
Laminaria groenlandica	40%(4)	20%(4)
Laminaria yezoensis	20%(5)	20%(5)
Cymathere triplicata	5%(2)	0
Constantinea	2%(3)	0
Corallina	5%(2)	0
Foliose reds, unid.	10%	1%
Ralfsia spp.	1%	0
Encrusting coralline	20%	10%
Musculus vernicosus	20%	25%
Tonicella	0	(1)
Dendrobeania	1%	0
Microporina borealis	5%	1%
Yellow spatter sponge	5%	0
Pycnopodia	(1)	0
Pagurids	(3)	0
Distaplia	0	0
White colonial ascidian	1%(1)	0

Depth (meters): 5.0
Substrate type: Rock outcrop
Location: 200m S.E. NMFS station

TABLE 43

QUADRAT DATA ($0.25m^2$) FROM MACLEOD HARBOR, SUBTIDAL
NOVEMBER 30, 1975

Taxon	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Laminaria groenlandica	(1)	(4)	(2)	(2)	(2)	(2)		(1)		
Laminaria yezoensis										(1)
Laminaria spp.		(1)								(2)
Agarum cribrosum		(1)	(1)			(4)	(4)	(1)		
Ralfsia spp.						P				2%
Opuntiella						P				
Constantinea										
Hildenbrandia						5%			15%	
Microporina	5%	25%	30%	10%		60%	50%	15%	20%	
Tricellaria		2%								20%
Abietinaria										2%
Heteropora									2%	
Encrusting coralline		25%	20%		10%	85%	75%	60%	30%	60%
Dendrobeania										
Distaplia										
? *Ritterella*			2%							
Pycnopodia										
Tonicella										(1)
Dermasterias										
Amphissa								(1)		
Calliostoma										
? *Lichenopora*						2%				
Evasterias						(1)				
Henricia							(1)			
Algal debris	50%		5%	5%	15%					
Acmaea mitra										
Depth (meters):	11.0	11.0	11.0	11.0	11.0	7.0	7.0	7.5	7.5	7.5
Substrate type:	Rock & sand	Rock & sand	Rock & sand	Rock & sand	Rock & sand	Rock & sand	Rock	Rock	Rock	Rock

TABLE 42

QUADRAT DATA (0.25m^2) FROM MACLEOD HARBOR, SUBTIDAL
NOVEMBER 30, 1975

Taxon	No. 11	No. 12	No. 13	No. 14	No. 15	No. 16	No. 17	No. 18	No. 19	No. 20
Laminaria groenlandica	(2)		(1)	(3)	(2)	(5)	(3)		(8)	(5)
Laminaria yezoensis		(1)	(1)							
Laminaria spp.	(3)	(3)		(2)	(8)	(6)	(13)	(1)	(7)	(19)
Agarum cribrosum	(3)		(2)	(1)						
Ralfsia spp.										
Opuntiella	10%		P	P		P	P	P		P
Constantinea				P						
Hildenbrandia		20%	10%	20%	5%		10%	10%	15%	10%
Microporina	20%	60%	25%	25%	30%	20%	20%	20%	5%	10%
Tricellaria					5%				5%	
Abietinaria										10%
Heteropora	5%									
Encrusting coralline	70%	80%	70%	60%	70%	70%	60%	70%	60%	70%
Dendrobeania		5%								5%
Distaplia sp.			5%							
? *Ritterella*					2%			2%		
Pycnopodia								(1)		
Tonicella										(1)
Dermasterias						(1)				
Amphissa					(3)					
Calliostoma			(1)	(2)						
Evasterias										
Henricia							(1)			
Algal debris										
Acmaea mitra							(1)			
Depth (meters):	6.0	6.0	6.0	6.0	5.0	5.0	5.0	5.0	3.5	3.5
Substrate type:	Rock	Rock	Rock	Rock	Rock	Rock	Rock	Rock	Rock	Rock

TABLE 44

QUADRAT DATA ($0.25m^2$) FROM MACLEOD HARBOR, SUBTIDAL
MARCH 13, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3	No. 4	No. 5
Laminaria groenlandica	40%(13)	50%(16)	90%(6)	40%(12)	60%(7)
Agarum	(1)	(1)	0	25%(2)	0
Encrusting coralline	60%	70%	70%	60%	60%
Corallina	0	0	0	10%	0
Bossiella	0	15%	0	0	10%
Hildenbrandia	Present	Present	30%	20%	0
Opuntiella	0	(2)	0	0	0
Microporina	0	15%	0	1%	0
Distaplia	0	5%	0	0	0
Serpulidae	(2)	0	0	0	0
Tonicella	0	(1)	0	0	0
Musculus vernicosus	Present	Present	Present	Present	Present
Pagurids	0	(2)	0	0	0

Depth (meters): 3.0-5.0
Substrate type: Survey channel with rock bedrock

TABLE 45

QUADRAT DATA ($0.25m^2$) FROM MACLEOD HARBOR, SUBTIDAL
MARCH 14, 1976

Taxon	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
Laminaria groenlandica		(1)	(2)	(4)	(3)	(5)		(5)	(3)	(3)	(4)
Laminaria yezoensis			(2)							(11)	(1)
Laminaria spp. (juv.)	(14)	(2)	(5)	(8)	(3)				(10)	(4)	(4)
Agarum cribrosum	(1)	(4)	(8)	(2)	(5)	(1)					(1)
Pleurophycus gardneri	(1)		(2)		(3)				(2)		
Ralfsia spp.			5%			5%					
Costaria costata									(3) juv.		
Nereocystis luetkeana											
Opuntiella		10%	2%		10%	10%					
Rhodymenia spp.						5%				2%	
Delesseria		2%			5%	15%	15%	10%	5%		
Callophyllis			2%		10%						
Hildenbrandia	10%	20%	15%			10%					
Microcladia	2%										
Encrusting coralline	60%	80%	80%	80%	85%	70%		75%	70%	10%	15%
Articulated coralline	5%	2%		15%	10%	5%		10%		10%	
Constantinea	2%								5%		
Tonicella	(1)	(1)	(2)		(1)					(1)	
Acmaea mitra					(1)	(1)					
Pycnopodia	(1)		(1)								
Musculus		P	P	P	P	P			P	P	P
Depth (meters):	8.0	8.0	6.0	6.0	.50	5.0	3.0	3.0	4.0	7.0	7.0
Substrate type:	Rock & sand	Rock	Rock	Rock	Rock	Rock	Rock	Rock	Rock	Rock & sand	Rock & sand

TABLE 46

QUADRAT DATA (0.25m^2) FROM MACLEOD HARBOR, SUBTIDAL
MARCH 14, 1976

Taxon	No. 12	No. 13	No. 14	No. 15	No. 16	No. 17	No. 18	No. 19	No. 20	No. 21	No. 22
Laminaria groenlandica	(1)	(2)	(1)	(6)	(15)	(5)	(8)	(2)	(1)	(2)	(3)
Laminaria yezoensis	(8)	(1)	(5)		(6)				(1)		(1)
Laminaria spp. (juv.)	(2)	(8)	(10)	(10)	(20)	(10)	(10)	(9)	(25)	(4)	(12)
Agarum cribrosum			(2)	(1)						(2)	
Pleurophycus gardneri											
Ralfsia spp.			5%	2%							
Costaria costata											
Nereocystis luetkeana											(3)
Opuntiella	5%		2%	5%		5%	15%	10%		2%	2%
Rhodymenia spp.	5%	2%				2%				5%	
Delesseria		2%	2%		2%	5%		5%			
Callophyllis											
Hildenbrandia				2%	10%	50%		10%			
Microcladia			5%	2%			20%				
Encrusting coralline	80%	50%	80%		50%	60%		65%	15%	20%	30%
Articulated coralline	5%					10%					
Constantinea		2%									
Tonicella	(1)										
Acmaea mitra	(1)		(1)								
Pycnopodia								(1)		(1)	
Musculus	P	P	P	P	P			P	P	P	P
Depth (meters):	7.0	7.0	6.0	6.0	6.0	5.0	4.0	6.0	5.0	5.0	6.0
Substrate type:	Rock	Rock	Rock	Rock & sand	Rock	Rock	Rock	Rock	Rock & sand	Rock & sand	Rock & sand

TABLE 47

QUADRAT DATA ($0.25m^2$) FROM MACLEOD HARBOR, SUBTIDAL
MARCH 14, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3
Laminaria spp.	5%(1)	60%(5)	80%(14)
Costaria (juveniles)	2%(3)	5%(3)	0
Alaria ? *marginata*	80%(1)	0	0
Constantinea	10%(6)	2%(1)	0
Rhodymenia	20%	5%	2%
Corallina	20%	1%	0
Bossiella	20%	0	0
Encrusting coralline	30%	40%	60%
Membranoptera spp.	0	0	0
Phycodrys sp.	0	5%	10%
Distaplia	0	1%	0
Yellow sponge	0	1%	0
Orange encrusting sponge	0	0	2%
Dendrobeania	0	0	1%
Diatom film	0	50%	50%
Musculus spp.	Present	Present	Present
Tonicella	0	(2)	0

Depth (meters): 3.0-5.0
Substrate type: Rock
Location: Off NMFS transect

TABLE 48

QUADRAT DATA ($0.25m^2$) FROM MACLEOD HARBOR, SUBTIDAL
MARCH 14, 1976

Taxon	No. 1	No. 2	No. 3
	Percent Cover (number of individuals)		
Laminaria spp.	0	25%(4)	50%(3)
Costaria (juveniles)	5%(1)	5%(1)	0
Alaria ? *Marginata*	50%(3)	60%(1)	10%
Constantinea	0	15%(3)	0
Rhodymenia	15%	5%	15%
Corallina	1%	40%	0
Bossiella	0	40%	2%
Encrusting coralline	80%	30%	60%
Membranoptera sp.	0	60%	0
Phycodrys sp.	10%	0	10%
Thais canaliculata	0	(1)	(4)
Distaplia	0	1%	1%
Yellow sponge	0	0	2%
Serpulidae	0	0	(1)
Pagurids	0	0	(5)
Orange encrusting sponge	1%	0	0
Dendrobeania	0	0	0
Diatom film	25%	0	25%
Musculus vernicosus	Present	Present	Present
Tonicella	0	0	(3)

Depth (meters): 3.5-5.0
Substrate type: Rock pavement

TABLE 49

QUADRAT DATA ($0.25m^2$) FROM MACLEOD HARBOR, SUBTIDAL
MARCH 15, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3
Laminaria yezoensis	(5)	(2)	(2)
Laminaria groenlandica	50%(6)**	25%(3)**	25%(1)**
Agarum	5%	0	5%
Rhodymenia	0	1%	1%
Encrusting coralline	60%	30%	50%
Corallina	8%	1%	2%
Bossiella	8%	0	1%
Delesseria	0	0	0
Opuntiella	0	0	0
Hildenbrandia	0	2%	0
Ralfsia	1%	0	0
Distaplia sp.	7%	0	1%
Microporina	0	0	0
Tonicella	(1)	0	(2)
Searlesia	0	(1)	(1)
Pagurids	(6)	(4)	0
Musculus vernicosus	Present	Present	Present
Dendrobeania	0	0	0
Serpulidae	(2)	0	0
Acmaea mitra	0	(1)	0
Crepipatella	Present	0	0

TABLE 49 (Cont.)

QUADRAT DATA (0.25m^2) FROM MACLEOD HARBOR, SUBTIDAL
MARCH 15, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3
Cryptobranchia	0	Present	Present
Puncturella	(1)	0	0
Pycnopodia	0	0	(1)

Depth (meters): 6.0-8.0
Substrate type: Rock

** Total *Laminaria* cover in the quadrat

TABLE 50

QUADRAT DATA (0.25m^2) FROM MACLEOD HARBOR, SUBTIDAL
MARCH 15, 1976

Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3
Laminaria yezoensis	0	(1)	0
Laminaria groenlandica	10%(3)**	60%(6)**	75%(8)**
Agarum	60%(5)	15%	15%
Rhodymenia	1%	.0	2%
Encrusting coralline	75%	60%	50%
Corallina	3%	1%	2%
Bossiella	8%	3%	3%
Delesseria	0	5%(1)	15
Opuntiella	0	5%	10%
Hildenbrandia	0	10%	1%
Ralfsia spp.	0	10%	0
Distaplia	3%	3%	15%
Microporina	0	1%	0
Tonicella	0	(2)	0
Metandrocarpa	0	5%	0
Pagurids	(2)	(10)	(5)
Musculus	Present	Present	Present
Dendrobeania	1%	1%	2%
Serpulidae	(1)	0	0
Acmaea mitra	0	(2)	(1)
Crepipatella	Present	0	0

TABLE 50 (Cont.)

QUADRAT DATA (0.25m^2) FROM MACLEOD HARBOR, SUBTIDAL
MARCH 15, 1976

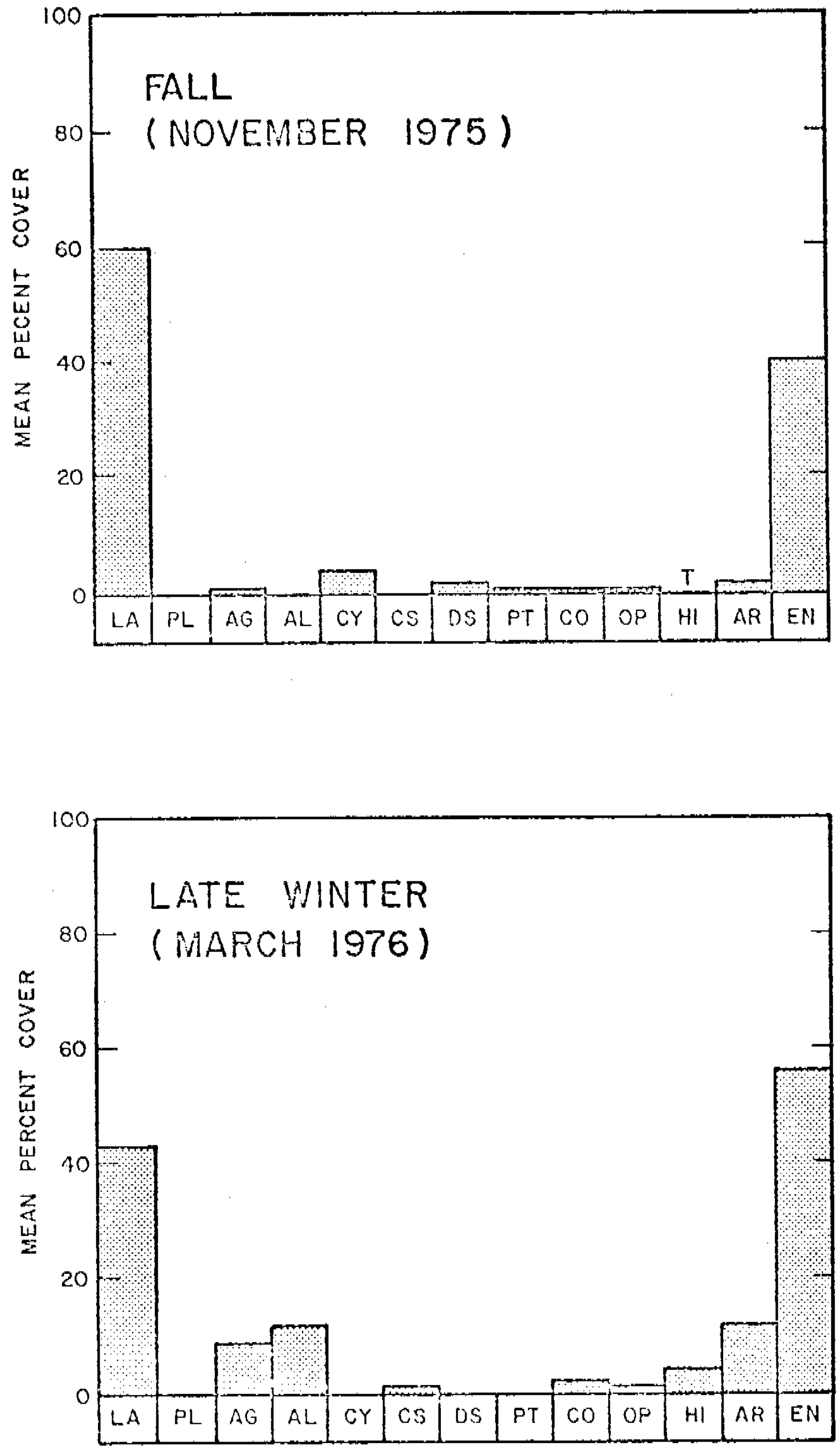
Taxon	Percent Cover (number of individuals) No. 1	No. 2	No. 3
Cryptobranchia	0	Present	Present
Lichenopora	0	1%	0
Puncturella	0	0	(1)

Depth (meters): 6.0
Substrate type: Rock
Location: Off NMFS transect

** Total *Laminaria* cover in quadrat

0 to 44.00/m^2 and averaged 4.97/m^2 during this same sample period. Another conspicuous species in this assemblage was sieve kelp (Agarum), the average density in 37 quadrats (0.25m^2) during March 1976 was 3.68/m^2. These estimates are in good agreement with the average estimate of 3.24/m^2 that was obtained from the band transects (Table 36). Pleurophycus gardneri was an important member of this brown algal understory; density estimates ranged from 0 to 2.80/m^2 in the band transects, the average density in all of the transects was 1.05/m^2. Density estimates from the 0.25m^2 quadrats averaged 0.86/m^2.

The other conspicuous brown algae in this location were Cymathere triplicata and Desmarestia viridis. Both species were somewhat ephemeral in occurrence, and were uncommon except during the summer and fall seasons of the year (Figure 15). Below the kelp canopies were the fleshy, erect reds such as Opuntiella californica, Callophyllis spp., Membranoptera spp., Rhodymenia palmata and R. pertusa, Constantinea and Ptilota filicina. The final vegetative layer in Macleod Harbor included the rock encrusting forms: Corallina spp., Lithothamnium spp., Ralfsia spp., and Hildenbrandia sp.



KEY

LA = *LAMINARIA*
PL = *PLEUROPHYCUS*
AG = *AGARUM*
AL = *ALARIA*
CY = *CYMATHERE*
CS = *COSTARIA*
DS = *DESMARESTIA*
PT = *PTILOTA*
CO = *CONSTANTINEA*
OP = *OPUNTIELLA*
HI = *HILDENBRANDIA*
AR = ARTICULATED CORALLINES
EN = ENCRUSTING CORALLINES
T = TRACE

Figure 15
ALGAL COVER AT MACLEOD HARBOR

EPIFAUNA AND TROPHIC INTERACTION

The major rock habitats examined in Macleod Harbor were the (1) rock fingers which extended from shore, (2) surge channels between the rock-like appendages, and the (3) rock/sand interface at the base of the shoreline. The fingers are deeply fissured, with numerous over-handing ledges and shelves. Many large blocks and boulders were located around the base of the steeply sloped platform. Typically, the larger boulders were interspersed with sandy channels and patches of gravel and cobble.

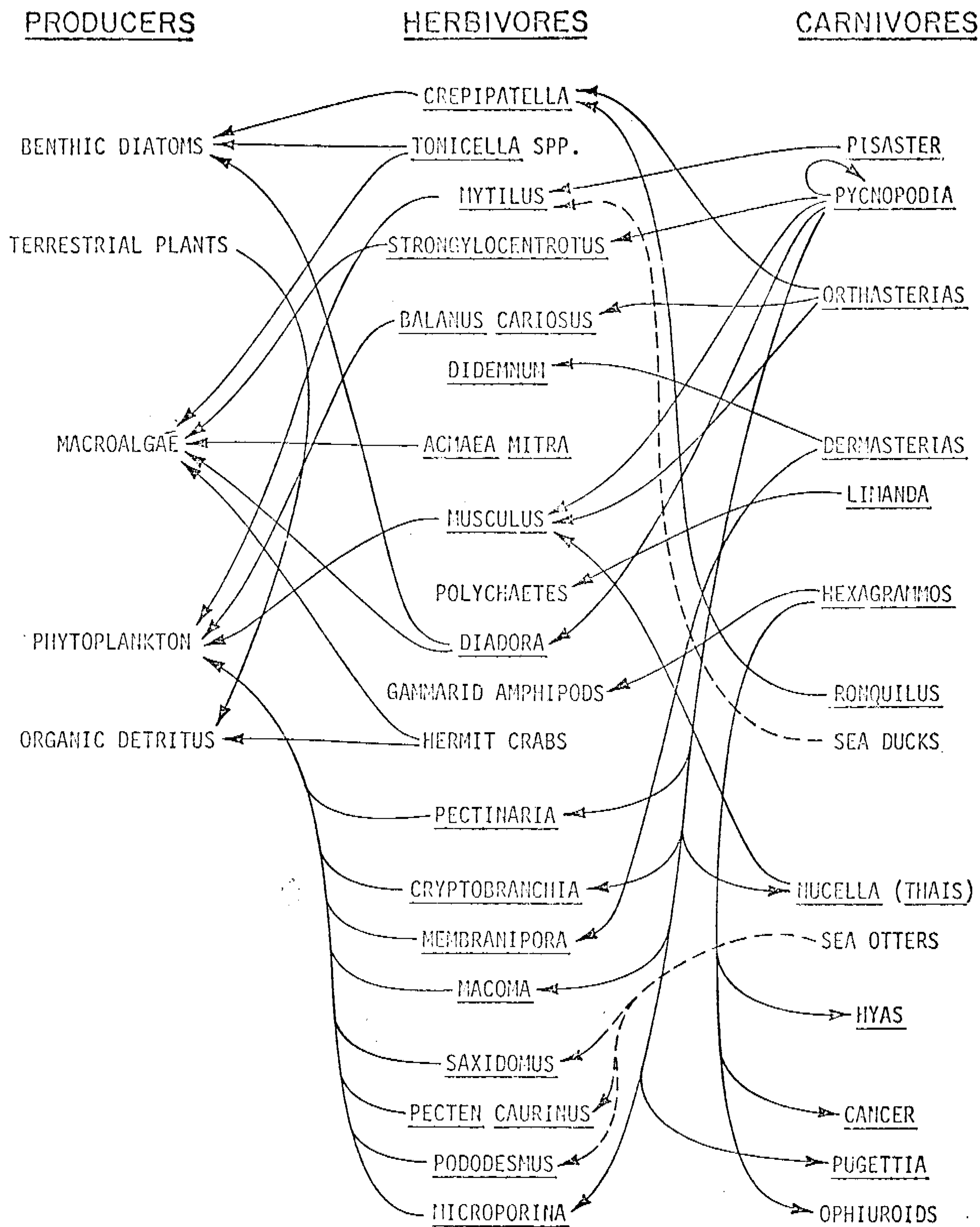
The epifauna was dominated by suspension feeders and species composition was relatively diverse. The suspension feeding assemblage was dominated by the bryozoan *Microporina borealis*; it occurred in 37 of 71 quadrats (Tables 37-50). Estimates of percent cover ranged from 0 to 60 percent; however, the average coverage was 9.37 percent during the one year sample period.

Other common suspension feeders in this location were the filibranch mussels *Musculus discors* and *M. vernicosus*. During the late fall (1975) and winter (1976) surveys heavy sets of juveniles were observed in the shallow subtidal waters; most samples were collected on macrophytes and larger attached macroinvertebrates such as ascidians. Size structures of the population at this time is virtually indistinguishable.

It appeared as though there was little or no growth during the winter months, and this is probably due to the fact that as suspension or filter feeders the food source, i.e. phytoplankton, was extremely scarce during this time of year. Musculus species were encountered in 41 of 71 quadrats during two observation periods. Estimates of percent cover ranged between 0 and 40 percent. An important predator of this age group of Musculus was the muricid snail Thais canaliculata, many of which were observed feeding on dense populations of juvenile Musculus. Maximum densitiies of 16.0/m^2 were observed for Thais in this location during the March (1976) survey.

Hydroids and bryozoans such as Dendrobeania murryani, Sertularella; Tricellaria and Heteropora spp. were moderately common in this site. Other common suspension feeding forms were the ascidians Halocynthia aurantium; Distaplia sp; Synoicum sp.; ? Ritterella rubra and Didemnum or Trididemnum.

Few herbivores were seen at Macleod Harbor, however, others species were no doubt present, but because of their size and/or behavioral traits were not recorded, or listed in the generalized food web (Figure 16). As previously noted for the other two locations, the sea urchins were relatively small and cryptic in behavior. Most were seen beneath rocks, or were found crawling on the undersides of the leaf-like brown algae. Maximum densities of 0.10/m^2 of S. droebachiensis were recorded in the band transects (Tables 51 and 52).



FOOD WEB OF A SUBLITTORAL REEF
AT MACLEOD HARBOR, MONTAGUE ISLAND
Figure 16

TABLE 51

DENSITY ESTIMATES OF SOME COMMON ECHINODERMS AT MACLEOD HARBOR

Taxon	9-14-75	9-14-75	9-14-75	9-14-75	9-15-75	9-15-75	9-15-75	9-15-75	9-15-75
Pycnopodia helianthoides	7 0.14/m^2	3 0.12/m^2	5 0.33/m^2	1 0.06/m^2	1 0.04/m^2	0	13 0.26/m^2	6 0.24/m^2	4 0.16/m^2
Dermasterias imbricata	0	1 0.04/m^2	1 0.06/m^2	0	1 0.04/m^2	0	2 0.04/m^2	0	0
Orthasterias koehleri	0	0	1 0.06/m^2	0	0	0	0	0	0
Crossaster papposus	0	0	0	0	0	0	0	0	0
Henricia spp.	0	0	1 0.06/m^2	0	0	0	1 0.02/m^2	0	0
Pisaster ochraceus	0	0	0	0	0	0	0	0	0
Evasterias troschelii	0	0	0	0	0	0	0	0	0
Strongylocentrotus spp.	0	0	0	0	0	1 0.02/m^2	0	0	0
Area sampled:	25 x 2m	25 x 1m	15 x 1m	15 x 1m	25 x 1m	10 x .5m	50 x 1m	25 x 1m	25 x 1m
Depth:	6-7m	12m	8m	5m	12m	7-8m	7-11m	6m	3-5m
Substate type:	Rock & sand	Sand & rock	Rock out-crop	Rock	Sand & rock	Rock & kelp	Rock & sand	Rock & kelp	Rock & kelp

TABLE 52

DENSITY ESTIMATES OF SOME COMMON ECHINODERMS AT MACLEOD HARBOR

Taxon	11-29-75	11-29-75	11-30-75	11-30-75	11-30-75	3-13-76	3-13-76	3-14-76	3-14-76	3-15-76
Pyncopodia helianthoides	18 $0.72/m^2$	8 $0.80/m^2$	15 $0.38/m^2$	4 $0.40/m^2$	0	12 $0.80/m^2$	1 $0.10/m^2$	10 $0.20/m^2$	5 $0.33/m^2$	10 $0.20/m^2$
Dermasterias imbricata	1 $0.04/m^2$	2 $0.20/m^2$	2 $0.05/m^2$	1 $0.10/m^2$	0	0	0	4 $0.08/m^2$	1 $0.06/m^2$	0
Orthasterias koehleri	0	3 $0.30/m^2$	3 $0.08/m^2$	0	0	0	1 $0.10/m^2$	1 $0.02/m^2$	0	1 $0.02/m^2$
Crossaster papposus	0	0	0	0	0	1 $0.06/m^2$	0	0	0	0
Henricia spp.	0	1 $0.10/m^2$	2 $0.05/m^2$	3 $0.30/m^2$	0	1 $0.60/m^2$	0	1 $0.02/m^2$	0	1 $0.02/m^2$
Pisaster ochraceus	0	0	0	0	12 $1.2/m^2$	0	0	0	0	0
Evasterias troschelii	0	0	1 $0.03/m^2$	1 $0.10/m^2$	0	0	0	0	0	0
Strongylocentrotus spp.	0	0	0	1 $0.10/m^2$	0	0	0	0	0	0
Area sampled:	25 x 1m	10 x 1m	40 x 1m	10 x 1m	10 x 1m	15 x 1m	10 x 1m	50 x 1m	15 x 1m	50 x 1m
Depth:	6-7m	3-4m	9m	6-7m	1-2m	10m	5m	2-7m	10m	3-9m
Substrate type:	Rock & sand	Rock	Rock & sand	Rock	Rock	Rock & sand	Rock	Rock	Rock & sand	Rock

Some of the other conspicuous herbivores are listed in Table 53 of Representative Important Species (RIS). These are the limpet Acmaea mitra, chitons Tonicella lineata and T. insignis, and the occasional herbivore Dermasterias imbricata (sea star). The snail Calliostoma ligatum, Diadora aspera (limpet), Puncturella spp. (snail), Crepipatella spp. (snail), Lacuna carinata (snail) and hermit crabs of the genus Pagurus were also common in this location. Most of these are microherbivores, and none were sufficiently abundant to influence the flora appreciably.

The most numerous predators in the rock habitat were the sea stars. Eight species of predatory starfish were observed in the study area, and of these the sun star Pycnopodia helianthoides was the most abundant species (Tables 51 and 52). Density estimates ranged from 0 to $0.80/m^2$, and averaged 0.28 individuals/m^2 in the 470 square meters of seafloor that was quantitatively sampled during 1975-76. Pycnopodia was observed to feed on Musculus spp.; Diadora aspera; Cryptochiton stelleri (chiton); Thais spp. (snail); Macoma spp. (clam); Microporina (bryozoan); Pectinaria (polychaete worm) and Strongylocentrotus droebachiensis (Figure 16).

The second most common species in this location was the leather star Dermasterias imbricata; density estimates ranged from 0 to $0.20/m^2$, and averaged $0.04/m^2$ in all of the combined transects. Demasterias preyed on Didemnum (ascidian); Membranipora spp. (bryozoan) and the clavate ascidian Synoicum sp. and macroalgae.

TABLE 53

CHARACTERISTIC OR REPRESENTATIVE IMPORTANT SPECIES
FROM THE SHALLOW SUBLITTORAL ZONE AT MACLEOD HARBOR

Species	Occurrence	Major Taxon	Trophic Category
Agarum cribrosum (P)	A	Brown alga	Producer
Laminaria groenlandica (P)	A	Brown alga	Producer
Laminaria yezoensis (P)	C	Brown alga	Producer
Pleurophycus gardneri (P)	C	Brown alga	Producer
Nereocystis luetkeana (A)	C	Brown alga	Producer
Costaria costata (A)	C	Brown alga	Producer
Opuntiella californica (?)	C	Red alga	Producer
Constantinea spp. (P)	C	Red alga	Producer
Callophyllis spp. (?)	C	Red alga	Producer
Rhodymenia spp. (?)	C	Red alga	Producer
Ralfsia spp. (P)	C	Brown alga	Producer
Hildenbrandia ? occidentalis (P)	C	Red alga	Producer
Delesseria decipiens (A)	C	Red alga	Producer
Encrusting coralline (P)	A	Red alga	Producer
Strongylocentrotus spp. (P)	U	Sea urchin	Herbivore
Tonicella spp. (P)	C	Snail	Herbivore
Acmaea mitra (P)	C	Snail	Herbivore
Orthasterias koehleri (P)	C	Sea star	Predator
Pycnopodia helianthoides (P)	C	Sea star	Predator
Dermasterias imbricata (P)	C	Sea star	Predator/Herbivore
Henricia spp. (P)	C	Sea star	Suspension feeder
Fusitriton oregonensis (P)	C	Snail	Predator/Scavenger
Thais canaliculata (P)	C	Snail	Predator
Halocynthia aurantium (P)	C	Ascidian	Suspension feeder
Musculus spp. (A)	C	Mussel	Suspension feeder
Enhydra lutris (P)	C	Sea otter	Predator
Microporina borealis	C	Bryozoan	Suspension feeder

Key: (P) = perennial
(A) = annual
A = abundant
C = common
U = uncommon

The star Orthasterias koehleri was next in abundance; densities of up to $0.03/m^2$ were recorded for Orthasterias, however the average of $0.03/m^2$ is probably a more realistic estimate of density. Orthasterias was seen eating Balanus cariosus (barnacle), Crepipatella (snail), and the mussels Musculus vernicosus and M. discors.

Another common asteroid was the blood star Henricia spp. The predominant blood star in this area was H. leviuscula, although two other species: H. tumida and H. sanquinolenta occurred in the same shallow water habitat. Because of taxonomic difficulities inherent in field identifications the numerical data are presented as combined counts. Estimates of density ranged from 0 to $0.60/m^2$, with a mean density of $0.06/m^2$.

One of the other common sea stars in the littoral zone was the ochre star, Pisaster ochraceus. Pisaster was relatively rare in the rocky subtidal regions of Macleod Harbor, however, around the MLLW mark it was more common. For example, within one 10 x 1m transect we counted 12 P. Ochracens for a mean density of $1.2/m^2$ (Table 52). The only feeding observations that involved P. ochraceus during this time period were with the bay mussel, Mytilus edulis.

A number of other secondary and tertiary consumers were observed in Macleod Harbor, notably sea otters, diving ducks, harbor seals and fin fishes. Density estimates of these species were not made at this time, however in some cases feeding observations were recorded or the occurrence of a particular species present in a certain habitat was noted. A total of 31 species of fishes are listed in Table 19; of these the most conspicuous families in the kelp habitat were the greenlings (Hexagrammidae), sculpins (Cottidae); ronquils (Bathymasteridae) and righteye flounders (Pleuronectidae). Other fishes such as pricklebacks (Stichaeidae), and gunnels (Pholididae) were seen, but because of their small size and secretive nature could not be counted properly by our sampling methodology.

SOFT BOTTOM AND FAUNAL COMPONENTS

The soft bottom directly seaward of the NMFS intertidal station consisted of fine silty sand, with ripple marks and large amounts of shell debris. The upper layer of the shell debris was composed heavily of empty Musculus spp. and clam shells. Organic debris of marine and terrestrial origin was moderate, i.e. alder leaves were common on the seafloor during the November (1975) survey. At slightly deeper depths, beyond the rock/sand interface the sand was siltier, and contained low fecal mounds that were produced by tubicolous polychaetes. A dense layer or film comprised of sessile diatoms covered the surface of the sand during March 1976. Dominant invertebrates observed on the sand were tubicolous polychaetes, the most conspicuous of which was a large maldanid or bamboo worm with a slightly branched, thick walled sandy tube. The estimated density of the maldanid ranged between 0 and 64.0 individual/m^2; the average density in 48 quadrats (.25m^2) was 25.6/m^2. The maldanid bed was best developed at depths of between 5 and 7 meters on a sandy bench west of the shoreline. A less conspicuous, but possibly larger worm was also common in this habitat; the tube did not extend very far above the sand surface. This species was identified as Onuphis iridescens. Non-tubicolous species of worms were common about 15 cm below the surface of the unconsolidated sediment.

There were a number of species observed in this soft bottom habitat including: Pycnopodia helianthoides (sea star); Crangon sp.

(shrimp); Ophuira ? sarsii (brittle star); Olivella baetica (snail); Tellina sp. (bivalve); Chone ? mollis (sabellid worm); Margarites sp. (snail); Nassarius mendicus (snail); Pagurus ochotensis (hermit crab); unid. hermit crabs; Clinocardium spp. (bivalve); Halcampa sp. (sea anemone); unid. nemertean worm and Aglaja ocelligera (opisthobranch snail). A few fishes were also common on the softer substrates, notably the yellow fin sole Limanda aspera, starry flounder Platichthys stellatus; whitespotted greenling, Hexagrammos stelleri, and pacific tomcod, Microgadus proximus.

DISCUSSION

Seaweeds and their associated microflora are important sources of energy in the coastal ecosystems of the northern Gulf of Alaska. Much of the carbon production in the Gulf is undoubtedly derived from within a narrow band of the shoreline where the marine plant life flourishes. Other forms of organic carbon are pumped into the system from terrestrial sources such as freshwater streams, island meadows, forests, and shallow bays or estuaries. Despite the seaward flow of energy, usually in the form of detritus, there is a positive feedback to the terrestrial system. Many of the terrestrial life forms, i.e. waterfowl, deer and land otter, utilize the resources of both major environments. One example of this feedback is the foraging behavior of the blacktail deer (*Odocoileus columbianus*), which utilize seaweed resources of the Prince William Sound Archipelago on a fairly regular, yet seasonal basis. This is especially evident during winter months, when heavy snows push the deer from the high country down to the beaches where they browse on both attached and drift seaweeds. For example, during the March survey (1976) four blacktail deer were sighted in the rocky intertidal zone at Latouche Point, and an equal number were seen browsing at the NMFS intertidal station in Zaikof Bay. Even higher consumer species such as the land otter, *Lutra canadensis* derive a great deal of energy from the sea by foraging in the shallow subtidal waters of the Sound for clams, mussels, chitons and sea urchins. Undoubtedly, however, considerably more energy flows from terrestrial to estuarine and marine systems than is returned through such pathways as described above.

Many commercially valuable species like Pacific salmon pass through the waters of Zaikof Bay, Macleod Harbor and Latouche Point on their way to and from the spawning streams of Prince William Sound. The major species in these areas are pink and chum salmon. Recently Sibert, Brown, Healey and Kask (1977) described a detritus-based food web that involved juvenile chum salmon from coastal waters of southern British Columbia and it appears that they also use some resource associated with kelp beds during their development. Additionally, schools of juvenile salmon were observed in the seaweed beds off Latouche Point during August, 1974, and early September, 1976. Usage of these habitats by salmon has been poorly documented in Alaska.

During the 12 months of this study (1975-76), there was a pronounced oscillation in the appearance and areal dimensions of the subtidal vegetative canopies. Concurrent with these subsurface changes was a physical alteration in the size of the floating canopies of bull kelp (Nereocystis luetkeana) that typically grew above the shorter statured species. These pronounced seasonal changes have been interpreted as characteristic for this part of the Gulf of Alaska. Annual brown algae such as Nereocystis, Cymathere triplicata and Costaria costata germinated in early spring and formed dense canopies by mid to late summer. However, most of these same plants were lost by late fall of the same year. Conversely, the perennial kelps, such as Agarum cribrosum, Laminaria spp. and Pleurophycus gardneri persisted year round, and exhibited maximum growth during late winter and early spring. The rapid growth period usually follows a period of tissue shedding or blade loss. One hypothesis to account for the winter growth strategies of these perennial species is that it results from competition with both understory and taller statured annuals such as bull kelp (Nereocystis). The alternation in peak growth and development between different canopy levels would possibly negate some competitive interactions between kelps (Dames & Moore, 1976a). These factors would lead to the creation of more free space, and light penetration in the rocky subtidal zone. All of these factors could contribute to the high plant diversity and high standing crop and plant production exhibited by the seaweeds of the Gulf.

Many of the same parameters that influenced the seaweed populations in the NEGOA study sites also affected the associated invertebrate fauna. The species composition of the epifauna was reasonably constant throughout the year, however patterns of distribution, frequency of occurrence and relative abundance was effected or altered with variations of the calendar year. The variations in distribution, density and size for the mussel (Musculus vernicosus) population at Latouche Point can be used as an example. This small filibranch is a conspicuous member of the seaweed assemblages of the northeastern Gulf. Shell debris at the base of some rocky reefs and previous field observations by Rosenthal (unpublished data) indicate that these populations have thrived in the vicinity of

Latouche Point and Danger Island for the past 3 years. Heavy sets of juvenile Musculus or spat were attached to algal substrates during the spring and summers of 1974-76. However, by late November, most of the population was drastically reduced in number, and this is probably due in part to algal shedding and fall storms which periodically remove the mussels along with their attachment sites. Several other epifaunal species exhibited substantial seasonal variations in abundance and coverage of the underlying substrate. Among these were the hydroids Campanularia, Grammaria and Abietinaria, which covered substantial portions of the rocky substrate in Zaikof Bay during spring and summer, but typically were reduced in coverage by late fall leading to the conclusion that annual variations in abundance are part of the life history patterns of these hydroids.

The physical oceanographic conditions in the shallow waters of Zaikof Bay, Macleod Harbor and Latouche Point differ somewhat in terms of exposure to ocean swell, velocity of tidal currents and transparency of the sea water. Two of the stations (Macleod Harbor and Zaikof Bay) are generally protected from the power of deep sea swells so conspicuous in the Gulf of Alaska. However, the southwest end of Latouche Island does receive moderate wave activity when storm surf breaks over the reef complex between the Point and Danger Island. The second major difference between stations seemed to be in the degree and/or velocity of the tidal currents. Although no measurements were made in conjunction with the biological surveys, strongest currents observed during this study were at the Latouche Point. The third physical parameter which was measured in the field was water transparency or visibility in sea water. Transparency was determined by making either visual observations while submerged, or estimating water transparency with the aid of a standard white secchi disc. Again, the Latouche Point station generally had the clearest water with a maximum secchi disc reading of 13 meters during the March (1976) survey. Latouche Point was typically bathed in an oceanic environment characteristic of exposed outer coast habitats, whereas the other 2 stations were more typical of embayment or fiord systems in Prince William Sound. At Latouche Point the bottom was usually free of silt, and the subtidal plant life formed a lush submarine forest which covered several square kilometers of the reef complex. Whereas in more protected areas such as Zaikof Bay and Macleod Harbor the hard substrate and bottom vegetation were usually dusted with a thin veneer of silt, and the seaweeds were generally restricted to a narrow girdle along the rocky shoreline.

For the most part, the composition of the subtidal algal assemblage was rather similar in all 3 areas, however, in terms of species composition, frequency and abundance the areas were dissimilar. At all three stations the benthos was dominated by marine plants, with the kelps being visual, numerical and biomass dominants. Recent subtidal surveys in the vicinity of Danger Island have shown algal biomass (wet weight) at between 1,468 and 5,676 grams/m^2 during late summer (Rosenthal, unpublished data). However, these estimates are conservative, and would be much higher if the floating canopies were included.

The underlying invertebrate fauna was dominated by suspension or filter feeders; macroherbivores appeared to be somewhat unimportant on a year-round basis. Tertiary consumers were visually conspicuous with the asteroids appearing to be the most important group in this level of the food chain. However, the importance of finfish, diving birds and marine mammals has not been assessed. For the most part, energy pathways appeared to be basically similar in each of the 3 sites, with the inshore food chain dependent upon a regular flow of plant and animal detritus.

Because circulation appeared to be somewhat restricted in Macleod Harbor and Zaikof Bay, they appear to have a higher probability of prolonged exposure to contaminants drifting on the sea surface than Latouche Point. However, since the latter is strategically situated between two major arteries of Prince William Sound, biological processes are definitely susceptible to man-induced contaminants that would affect species of aesthetic and commercial importance.

LITERATURE CITED

Fager, E. W., 1963. Communities of Organisms. The Sea, Vol. 2, Interscience Publishers, New York, 415-437

Mann, K. H., 1973. Seaweeds: Their Productivity and Strategy for Growth. Science, Vol. 182 (4116): 975-981

Westlake, D. F., 1963. Comparisons of Plant Productivity. Bio. Review, Vol. 38: 385-425

Mann, K. H., 1972. Ecological Energetics of the Seaweed Zone in a Marine Bay on the Atlantic Coast of Canada. II. Productivity of the Seaweeds. Mar. Biol. 14: 199-209

Dawson, E. Y., 1966. Marine Botany. Holt, Rienhart and Winston, Inc., 371 p.

Rosenthal, R. J. and D. C. Barilotti, 1973. Feeding Behavior or Transplanted Sea Otters and Community Interactions off Chichagof Island, Southeast Alaska, p. 74-88. In W. J. North (ed.), Calif. Inst. Tech., Kelp Habitat Improv. Proj., Ann. Rept., July 1, 1972-June 30, 1973

Dayton, P. K., 1975. Experimental Studies of Algal Canopy Interactions in a Sea Otter-Dominated Kelp Community at Amchitka Island, Alaska. U. S. Fishery Bull. 73(2): 230-237

Dames & Moore, 1976a. Marine Plant Community Studies, Kachemak Bay, Alaska. Final Report, Alaska Department of Fish and Game: 288 pp.

Dames & Moore, 1976b. Herring Spawn on Kelp Fishery of Prince William Sound. Final Report, Alaska Department of Fish and Game: 63 pp.

Dames & Moore, 1977. An Ecological Assessment of the Littoral Zone along the Outer Coast of the Kenai Peninsula. Final Report, Alaska Department of Fish and Game: 101 pp.

Rigg, G. B., 1915. Potash from Kelp V. The Kelp Beds of Western Alaska. U. S. Department of Agriculture Report 100: 105-122

Rosenthal, R. J., W. D. Clarke and P. K. Dayton, 1974. Ecology and Natural History of a Stand of Giant Kelp, *Macrocystis pyrifera* off Del Mar, California. Fishery Bull.: Vol. 72(3): 670-684

Johansen, H. W., 1971. Effects of Elevation Changes on Benthic Algae in Prince William Sound. (In). The Great Alaska Earthquake of 1964: Bilogy, NAS. Public 1604, Washington: 35-68

Plafker, G., 1969. Tectonics of the March 27, 1964, Alaska Earthquake. U. S. Geological Survey Professional Paper 543-I. Washington Government Printing Office: 122 pp.

Cameron, F. K., 1915. Potash from Kelp. U. S. Department of Agriculture, Report No. 100, Washington Government Printing Office: 122 pp.

Chapman, A. R. O., 1972. Morphological Variaion and its Taxonomic Implications in the Ligulate Members of the Genus Desmarestia Occurring on the West Coast of North America. Syesis, 5: 1-20

Mauzey, K. P., C. Birkeland, and P. K. Dayton, 1968. Feeding Behavior of Asteroids and Escape Responses of their Prey in the Puget Sound Region. Ecology 49: 603-619

Vadas, R. L., 1972. Ecological Implications of Culture Studies on Nereocystis luetkeana, J. Phycol. 8: 196-203

Markham, J. W., 1969. Vertical Distribution of Epiphytes on the Stipe of Nereocystis luetkeana (Merteus) Postels and Ruprecht. Syesis 2: 277-340

Chapman, A. R. O., 1974. The Ecology of Macroscopic Marine Algae. Annual Sev. of Ecol. and Syst., Vol. 5: 65-80

RU #174

REPORT NOT RECEIVED

Quarterly Report

Contract #03-5-022-69
Research Unit #233
Reporting Period - July through September 1977
2 Pages

Beaufort Sea Estuarine Fishery Study

Principal Investigator:

Terrence N. Bendock
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1300 College Road
Fairbanks, Alaska 99701

29 September 1977

OCS Quarterly Report - September 1977

I. Task objectives

The objectives of the Beaufort Sea Estuarine Fishery Study are as follows:

A. To detmine the seasonal distribution, relative abundance, size and species composition, growth rates, feeding habits and reproductive capabilities of Beaufort Sea nearshore fishes in the area from the Colville to the Canning Rivers and between shore and the barrier islands, including river deltas.

B. To determine migration pattens and timing of these fishes.

C. To identify critical habitats including spawning, over-wintering, feeding, rearing and migration areas.

D. To determine the interrelationship of Arctic fishes to lower food-web organisms.

E. To determine the present rate of exploitation of the anadromou fishes of the area and to monitor changes in this usage as development of the area's petroleum resource progresses.

II. Field or laboratory activities

Field activities during the summer of 1977 were directed toward identifying the migration patterns, timing of movements, and seasonal abundances of Beaufort Sea fish in Prudhoe Bay.

Up to seven trap stations were monitored daily near Prudhoe Bay in July and August. Daily captures were organized by species and enumerated. All salmonids over 200 mm in length were tagged with numbered Floy FD 67 internal anchor tags and released (Table I). Physical parameters monitored daily included: air temperature, water temperature, salinity, bottom type, present weather, cloud amount, sea state, wind direction, and wind force. The fish were captured in fyke traps, and on occasion with gill nets.

Analysis of tagging, capture and movement data is presently underway in Fairbanks. Detailed results are not available at this time, but will be presented in the final report for the project in November, 1977.

Some tag returns are expected in October and early.November.

Table I. Fish species captured, number caught and number tagged during the 1977 summer season at Prudhoe Bay.

Species		Number Captured	Number Tagged
Arctic char	*Salvelinus alpinus*	903	233
Grayling	*Thymallus arcticus*	3	0
Humpback whitefish	*Coregonus pidschian*	16	15
Broad whitefish	*C. nasus*	89	34
Least cisco	*C. sardinella*	1,078	522
Arctic cisco	*C. autumnalis*	238	140
Arctic cod	*Boregadus saida*	647	
Fourhorn sculpin	*Myoxocephalus quadricornis*	2,171	
Arctic flounder	*Liopsetta glacialis*	7	
Boreal smelt	*Osmerus mordax*	7	
Pink salmon	*Oncorhynchus gorbuscha*	1	
Totals		5,160	944

QUARTERLY REPORT

Contract # 03-5-022-56
Task Order # 21
Research Unit # 284
Reporting Period 6/30/77-9/30/77

Food and Feeding Relationships in the Benthic and Demersal Fishes of the Gulf of Alaska and Bering Sea

Ronald L. Smith, Principal Investigator
Alan C. Paulson
John R. Rose

Institute of Marine Science
University of Alaska
Fairbanks, Alaska 99701

October 1, 1977

SUMMARY OF THIS QUARTER'S OPERATIONS

Ship and Laboratory Activities

1. Ship or field work: None

2. Scientific party involved in project:

   R. L. Smith, IMS, Principal Investigator
   A. C. Paulson, IMS
   J. R. Rose, IMS

3. Methods: Same as previous methods.

4. Sample localities: Same as previous, no new samples have been obtained.

5. Data analyzed:

   stomach analyses included
      shortfin eelpout
      capelin

   verification of difficult prey organisms for the following:

      Dover sole
      Rock sole
      shortfin eelpout
      flathead sole

   computer summaries and interpretation of data trends completed on rex sole and flathead sole.

A discussion of the feeding habits of the rex sole and flathead sole are appended below in the form of manuscripts which have been submitted for publication.

Problems Encountered

No new problems have been encountered this quarter. An old problem, lack of necessary funds to complete this project adequately, has resulted in slow progress on the last of the stomach analyses and slow progress on interpreting the results of those analyses. All time spent by project personnel during the last two quarters toward the completion of this project is being donated gratis due to the exhaustion of project funds.

The rex sole, *Glyptocephalus zachirus*, occurs from southern California to the eastern Bering Sea. Needler (1954) reported that this species grows slowly with a lifespan of at least 24 years, and Mineva (1968) noted that 75 percent of fish captured in the Bering Sea were between 12 and 16 years of age. Hart (1973) reports females most abundant in Pacific Ocean catches while Mineva (1968) found males most abundant in the Bering Sea. As juveniles grow, they move out of shallow water down to 150 m, and as adults are most abundant from 200 to 550 m. The rex sole has been reported down to 1100 m (Grinols, 1965). Little is known about the life history of this species. This study provides some insight into the feeding habits of the rex sole from the Gulf of Alaska.

METHODS

Fishes were captured by otter trawl from May through July, 1975. Trawl stations occupied in this study are the same used by the International Pacific Halibut Commission in their yearly surveys (Fig. 1). Abdomens were slit and the whole fishes were packed in 10 percent formalin (per total volume of water and fish), buffered with 20 grams of hexamethylenetetramine per liter. Upon return to the lab, 300 specimens were measured for standard length to the nearest millimeter. Sex and maturity were recorded.

Prey were identified to the most specific taxa permitted by their state of preservation. Counts were made of all items, and volumes were measured for each taxon to the nearest 0.1 ml. The frequency of prey occurrence (F), the percent contribution by volume (V), the percent by number (N), and an index of relative importance (IRI) were calculated for each station and for all stations combined. The index was developed by Pinkas *et al.* (1971) using the formula $IRI = (N + V)F$. It should be noted that values reported for consumption of a prey taxon may be conservative. This is reflected in partially unidentifiable material being assigned to a higher taxon; for example, the importance of the Amphipoda is far greater than suggested by values for amphipods identified to lower taxa.

An index of stomach fullness was recorded for each predator such that 0 = no information, 1 = empty, 2 = trace, 3 = 25 percent, 4 = 50 percent, 5 = 75 percent, 6 = 100 percent, and 7 = distended. Mean stomach fullness was calculated for each prey taxon at a station, for all taxa at a station, for each taxon combining all stations, and for all taxa combining all stations. Mean predator length was calculated in the same fashion. It was hoped that these last two criteria might illucidate possible changes in food preference with stomach fullness (i.e., satiation) or with predator size. The fortran program developed for this study is highly machine specific for the Honeywell 66/40.

RESULTS

Of 300 rex sole stomachs collected in 1975, 7 were empty and 293 contained food (Table 1). Ten families of polychaetes contributed most of the food consumed. Pelecypods, cumaceans, amphipods, euphausiids, and decapods (especially *Pandalus borealis* and postlarval *Chionoecetes bairdi*) were also common in the diet (Table 2; Fig. 2).

Prey availability data came from Best (1964), Feder *et al.* (1976), and R. T. Conney (personal communication). Biologically important taxa (BIT) in terms of prey availability were determined using the method of Feder *et al.* (1976). To qualify as a BIT, a taxon must be distributed in 50 percent or more of total stations sampled, comprise over 10 percent of population numbers or biomass at any one station, or satisfy a population density or biomass criterion. These density and biomass criteria are based upon a percentage calculated for each taxon, with the sum of the population density or biomass of all taxa equaling 100 percent. These percentages are ranked in descending order. The percentages of each taxon are then summed in descending order until a cut-off point of 50 percent is reached. BIT by these population density or biomass criteria are those taxa whose percentages are used to reach the 50 percent cut-off point.

DISCUSSION

De Groot (1971) discussed the interrelationships of alimentary morphology, behavior, and feeding of flatfishes. From the feeding habits of 59 species, he concluded that flatfishes can be classified according to three feeding strategies: (1) fish feeders, (2) crustacean feeders, and (3) polychaete-mollusc feeders. De Groot classified two congenerics of the rex sole, *Glyptocephalus cynoglossus* and *G. stelleri*, as feeding group (3) (polychaete-mollusc feeders). He described their principal prey as polychaetes, crustaceans, and molluscs. Compatible with De Groots polychaete-mollusc strategy are the more detailed discussions of feeding in these species by Rae (1969) and Hayase and Hamai (1974). These studies suggest that polychaetes and crustaceans were the dominant food items, with molluscs far less important.

Mineva (1968) states that feeding data on the rex sole are limited, and suggests that the intensity of feeding is less in the middle of September than at the beginning of the month. There is no information concerning prey composition. Figure 2 portrays the feeding habits of the rex sole. Clearly the rex sole feeds predominantly on polychaetes and crustaceans. Molluscs and other prey taxa contribute much less. Thus, the rex sole feeds much as the two congenerics already discussed, and can also be classified as De Groot's feeding group (3). This feeding strategy was used by 23 of the 49 species of Pleuronectidae investigated by De Groot. Regional variation of diet in the rex sole is suggested by Table 3.

The scope of this study is too limited to permit a detailed discussion of prey selectivity by the rex sole, but several points are worth mentioning. Molluscs consumed were predominantly in the Nuculanidae. Most individuals were only several mm long, suggesting that they had recently settled. Thus postlarval molluscs and crabs (Fig. 2) seem to be important in the early summer diet of the rex sole. Table 2 shows that the Onuphidae contributed most of the polychaetes consumed. Probably most of the unidentified polychaetes that gave the large F, N, V, and IRI values for the Polychaeta were also Onuphidae. Yet the only species identified from this family was *Onuphis iridescens*, which is not a BIT in this area according to Feder *et al.* (1976). They reported *Onuphis geophiliformis* as the only BIT from this family. With this exception, taxa important in the diet of the rex sole tend to be important members of the local community.

ACKNOWLEDGEMENTS

I wish to thank Ronald L. Smith for providing the opportunity to do this study and for reading the manuscript. George Mueller, Ken Coyle, and Nora Foster provided invaluable taxonomic assistance. I also thank Shirley Liss for help with the computer work. This study was supported in part under contract 03-5-022-56 between the University of Alaska (R. L. Smith, Principal Investigator) and NOAA, Department of Commerce to which funds were provided by the Bureau of Land Management through an interagency agreement.

LITERATURE CITED

BEST, E. 1964. Catch records of a trawl survey conducted by the International Pacific Halibut Commission between Unimak Pass and Cape Spencer, Alaska from May 1961 to April 1963. Rept. Int. Pac. Halibut Comm. 36:1-524.

DE GROOT, S. J. 1971. On the interrelationships between morphology of the alimentary tract, food and feeding behaviour in flat fishes (Pisces: Pleuronectiformes). Netherlands J. Sea Res. 5(2):121-196.

FEDER, H.M., G. MUELLER, G. MATHEKE, And S. JEWETT. 1976. The distribution, abundance, diversity, and productivity of benthic organisms in the Gulf of Alaska. Environmental Assessment of the Alaska Continental Shelf, Annual Report 1976(7):263-454.

GRINOLS, R. B. 1965. Check-list of offshore marine fishes occurring in the northeastern Pacific Ocean, principally off the coasts of British Columbia, Washington, and Oregon. M.S. Thesis, Univ. Washington. 217 p.

HART, L. 1973. Pacific fishes of Canada. Fish. Res. Bd. Canada Bull. 180. 740 p.

HAYASE, S., and I. HAMAI. 1974. Studies on feeding habits of three flatfishes, *Cleisthenes pinetorum herzensteini* (Schmidt), *Hippoglossoides dubius* (Schmidt), and *Glyptocephalus stelleri* (Schmidt). Bull. Fac. Fish. Hokkaido Univ. 25(2):82-99.

MINEVA, T. A. 1968. On the biology of some flatfishes in the eastern Bering Sea. *In* Sov. Fish. Inv. N. Pac. Pt. II:227-235. Isr. Prog. Sci. Trans. TT67-51204. 289 p.

NEEDLER, M. 1954. Confidential report. Fish. Res. Bd. Canada Pac. Biol. Sta., Nanaimo 1953:1-128.

PINKAS, L., M.S. OLIPHANT, and I. L. K. IVERSON. 1971. Food habits of albacore, bluefin tuna, and bonito in California waters. Calif. Fish Game, Fish. Bull. 152:3-82.

RAE, B. B. 1969. The food of the witch. Dept. Agr. Fish. Scotland, Marine Research 1969(2):5-23.

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Table 1. Station data for rex sole collections in the Gulf of Alaska.

Variable	STATION 81C	98B	77I	78H	100B	82D	Combined Gulf of Alaska
Latitude (°N)	59.88	59.53	59.55	59.73	59.45	59.88	59.67
Longitude (°W)	144.95	140.73	145.98	145.73	140.23	144.73	143.73
Time of Day (1-24h)	23	1	22	6	22	21	21
Date	7-14	7-4	7-27	5-14	6-3	5-15	-
Depth (m)	111	149	76	89	122	63	102
Number Feeding	106	65	3	36	16	67	293
Number Empty	4	1	1	0	0	1	7
Mean Fullness of Feeding Individuals	60	59	8	46	77	82	63
Mean Length of Predator (mm)	240	267	121	250	251	261	228

Table 2. Prey consumed by rex sole for all Gulf of Alaska stations. Data are expressed as percent frequency of occurrence (F), percent by number (N), percent by volume (V), and by index of relative importance (IRI). Biologically important taxa in terms of prey availability are noted by an asterisk under BIT. Mean predator length in mm (MPL) and mean fullness of stomach in percent (MFS) are given for each prey taxon consumed.

Taxon	MPL	MFS	F	N	V	IRI	BIT
POLYCHAETA	231	68	79.7	42.3	54.6	7722	*
PHYLLODOCIDAE	207	84	3.9	1.1	0.3	5	
Anaitides sp.	250	100	0.7	0.2	0.0	0.2	
Eulalia sp.	174	25	0.4	0.1	0.0	0	
Notophyllum sp.	228	100	0.4	0.1	0.0	0.1	
NEPHTYIDAE	241	100	0.7	0.1	0.8	0.6	*
GONIADIDAE	245	76	6.6	1.3	1.1	16	*
Glycinde picta	182	100	0.4	0.1	0.0	0	
Goniada annulata	247	74	5.9	1.2	1.1	13	*
ONUPHIDAE	231	87	28.7	18.8	21.9	1166	*
Onuphis iridescens	232	89	25.5	18.0	21.0	996	
LUMBRINERIDAE	210	79	6.3	1.4	1.5	18	*
Lumbrinereis sp.	253	38	0.7	0.1	0.2	0.2	
STERNASPIDAE	261	88	5.2	1.0	0.7	9	*
Sternaspis scutata	261	88	5.2	1.0	0.7	9	*
SABELLARIIDAE	222	0	0.4	0.1	0.2	0.1	
PECTINARIDAE	278	100	0.7	0.1	0.1	0.2	
AMPHARETIDAE	217	100	0.7	0.1	0.1	0.1	*
SABELLIDAE	326	100	0.4	0.1	0.1	0	*

Table 2. Continued.

Taxon	MPL	MFS	F	N	V	IRI	BIT
PELECYPODA	265	71	16.8	6.3	3.1	157	*
CRUSTACEA	160	83	95.5	74.3	21.6	9148	*
COPEPODA	214	38	0.7	0.1	0.0	0.1	
Calanus sp.	214	38	0.7	0.1	0.0	0.1	
CUMACEA	196	74	26.6	6.0	0.2	164	*
Eudorella sp.	198	60	4.6	1.5	0.2	8	
Eudorella emarginata	187	56	2.8	1.2	0.2	4	*
Diastylis sp.	174	100	0.4	0.1	0.0	0	
Campylaspis sp.	194	69	3.2	0.4	0.2	2	
AMPHIPODA	190	75	27.3	14.2	0.8	408	*
Haploops tubercula	250	100	0.7	0.3	0.0	0.2	*
AMPITHOIDAE	273	50	0.4	0.1	0.2	0.1	
Neohela sp.	232	100	0.4	0.1	0.0	0	
GAMMARIDAE	251	25	0.4	0.1	0.0	0	
Hyperia sp.	256	100	0.4	0.1	0.0	0	
CAPRELLIDAE	230	88	2.1	0.4	0.0	0.9	
EUPHAUSIACEA	228	78	16.8	3.7	4.3	134	*
Euphausia pacifica	265	81	1.4	0.3	0.6	1.2	*
Thysanoessa sp.	174	80	1.8	0.2	0.2	0.8	
Thysanoessa rashii	205	100	0.4	0.1	0.1	0.1	
DECAPODA	219	70	52.1	20.4	16.7	1933	*
PANDALIDAE	258	84	9.1	3.3	7.5	98	
Pandalus borealis	264	79	4.6	1.9	6.3	37	
HIPPOLYTIDAE	205	88	6.3	1.8	2.1	24	

Table 2. Continued.

Taxon	MPL	MFS	F	N	V	IRI	BIT
DECAPODA (cont'd)							
Spirontocaris sp.	284	50	0.4	0.5	0.4	0.3	
CALLIDNASSIDAE	289	88	0.7	0.1	0.4	0.3	
MAJIIDAE	214	70	39.5	13.9	4.7	734	*
Hyas sp.	139	100	0.7	0.1	0.0	0.1	
Chionoecetes bairdi	214	70	38.8	13.6	4.8	709	*
XANTHIDAE	262	25	0.4	0.1	0.1	0.1	
OPHIUROIDEA	266	82	3.9	0.5	0.4	4	*
TELEOSTEI	258	75	1.4	0.2	1.0	2	*
ZOARCIDAE	225	100	0.4	0.1	0.1	0	
Unidentified animal material			38.8	0.0	15.8	620	

Table 3. Prey consumed by rex sole for each Gulf of Alaska station. Numbers are expressed as IRI (index of relative importance). Biologically important taxa in terms of prey availability are noted by an asterisk under BIT.

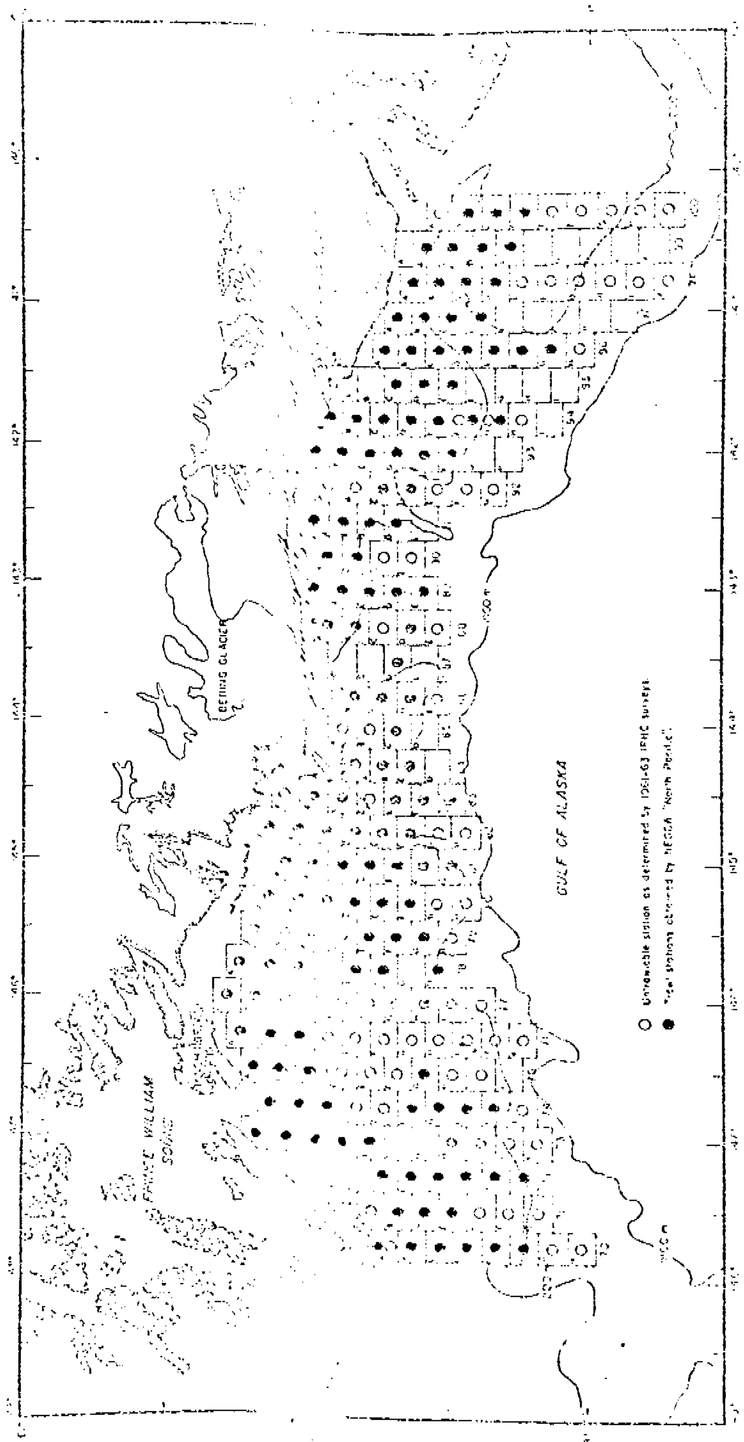
	Index of Relative Importance by Station						
Taxon	81C	98B	77I	78H	100B	82D	BIT
POLYCHAETA	8466	8135	16153	3537	13652	6230	*
PHYLLODOCIDAE	2	16	-	-	-	17	
Anaitides sp.	-	5	-	-	-	-	
Eulalia sp.	0.1	-	-	-	-	-	
Notophyllum sp.	-	2	-	-	-	-	
NEPHTYIDAE	-	3	-	-	-	4	*
GONIADIDAE	25	24	-	-	55	7	*
Glycinde sp.	-	0.4	-	-	-	-	
Goniada annulata	25	11	-	-	55	7	*
ONUPHIDAE	2069	97	-	3	2487	1685	*
Onuphis iridescens	1846	28	-	-	2487	1513	
LUMBRINERIDAE	0.1	44	-	5	18	107	*
Lumbrinereis sp.	0.1	2	-	-	-	-	
STERNASPIDAE	0.2	103	-	-	176	-	*
Sternaspis scutata	0.2	103	-	-	176	-	*
SABELLARIIDAE	-	-	-	12	-	-	
PECTINARIDAE	-	-	-	-	47	-	
AMPHARETIDAE	-	0.8	-	-	-	-	*
SABELLIDAE	-	1	-	-	-	-	*
PELECYPODA	1	2567	-	173	21	0.6	*

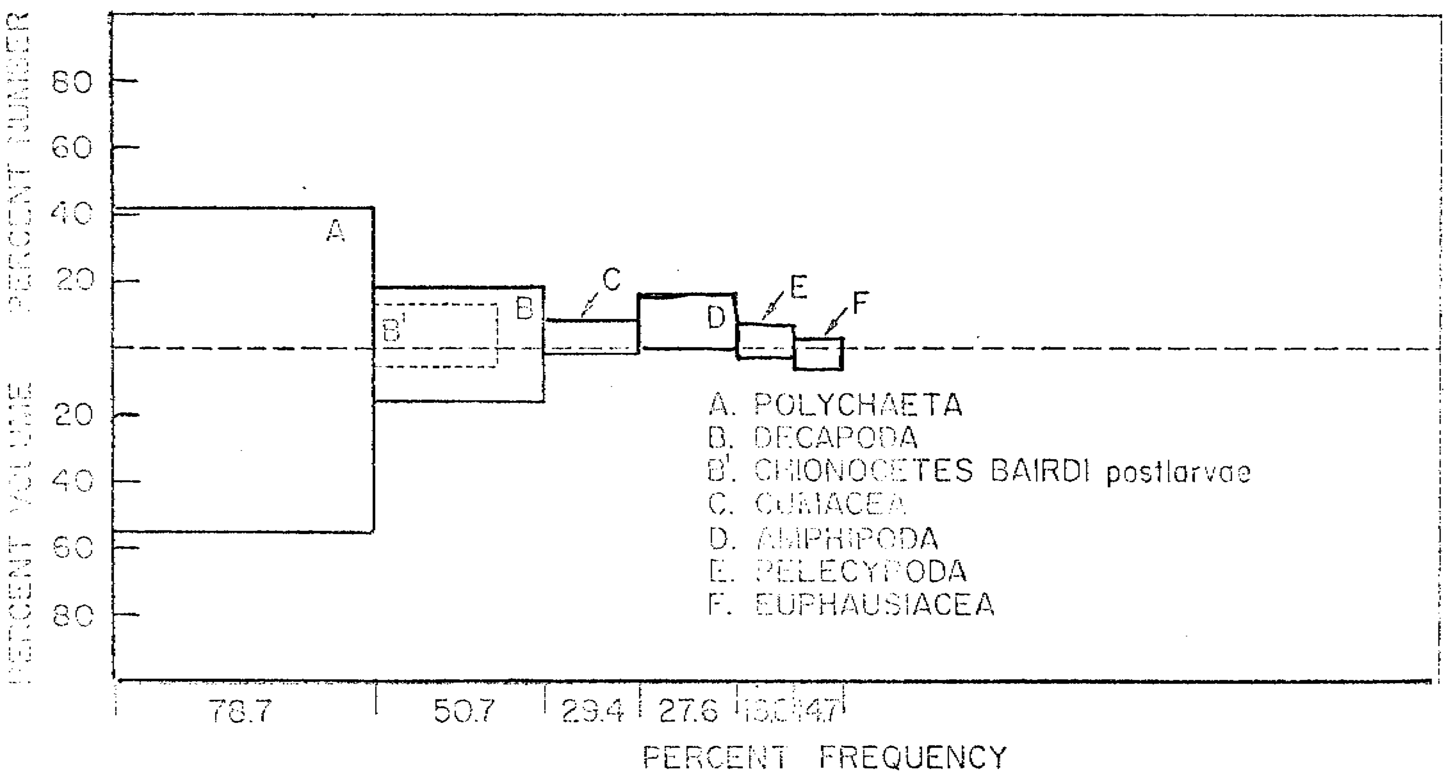
Table 3. Continued.

Taxon	81C	98B	77I	78H	100B	82D	BIT
	Index of Relative Importance by Station						
CRUSTACEA	6963	1577	-	8192	3690	9148	*
COPEPODA	-	-	-	-	-	0	
Calanus sp.	-	-	-	-	-	0	
CUMACEA	263	110	-	190	64	734	*
Eudorella sp.	36	-	-	-	-	-	
Eudorella emarginata	15	-	-	-	-	3	*
Diastilis sp.	-	-	-	-	-	0.5	
Campylaspis sp.	-	4	-	12	-	6	
AMPHIPODA	28	49	-	858	322	2937	*
Haploops tubercula	-	-	-	20	-	-	*
AMPITHOIDAE	0.4	-	-	-	-	-	
Neohela sp.	-	-	-	3	-	-	
GAMMARIDAE	0.1	-	-	-	-	-	
Hyperia sp.	0.1	-	-	-	-	-	
CAPRELLIDAE	0.1	17	-	-	-	-	
EUPHAUSIACEA	222	123	-	-	32	119	*
Euphausia pacifica	2	2	-	-	13	-	*
Thysanoessa sp.	-	4	-	-	-	3	
Thysanoessa rachii	0.4	-	-	-	-	-	
DECAPODA	4431	287	-	20	1817	2070	*
PANDALIDAE	509	1	-	-	-	3	
Pandalus borealis	214	-	-	-	-	-	
HIPPOLYTIDAE	1	8	-	-	29	270	

Table 3. Continued.

Taxon	Index of Relative Importance by Station 81C	98B	77I	78H	100B	82D	BIT
DECAPODA (Cont'd)							
Spirontocaris sp.	-	8	-	-	-	-	
CALLIANASSIDAE	0.2	3	-	-	-	-	
MAJIIDAE	1916	9	-	2	947	820	*
Hyas	-	-	-	-	-	1	
Chionoecetes bairdi	1933	5	-	2	947	778	*
XANTHIDAE	0.5	-	-	-	-	-	
OPHIUROIDEA	0.6	55	-	2	-	-	*
TELEOSTEI	272	42	-	-	-	-	*
ZOARCIDAE	272	-	-	-	-	-	
Unidentified animal material	274	654	1923	1051	614	1611	


PRINCE WILLIAM SOUND
BERING GLACIER
GULF OF ALASKA
Untowable station as determined by 1961-63 IPHC surveys


PERCENT NUMBER
80
60
40
20
20
40
60
80
PERCENT VOLUME
A
B
B'
C
D
E
F
A. POLYCHAETA
B. DECAPODA
B'. CHIONOECETES BAIRDI postlarvae
C. CUMACEA
D. AMPHIPODA
E. PELECYPODA
F. EUPHAUSIACEA
78.7
50.7
29.4
27.6
4.7
PERCENT FREQUENCY

FEEDING HABITS OF THE FLATHEAD SOLE, *HIPPOGLOSSOIDES ELASSODON*, IN ALASKAN WATERS

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Running Head: Feeding of Flathead Sole

ABSTRACT

Prey consumption by the flathead sole, *Hippoglossoides elassodon*, is described for the Gulf of Alaska and the Bering Sea. Data are presented as frequency of prey occurrence (F), percent contribution by volume (V), percent by number (N), and an index of relative importance (IRI) where IRI = (N + V)F. In the Gulf of Alaska, the respective dominance of euphausiids (*Thysanoessa spp.*) in shallow water, and ophiuroids (*Ophiura sarsi*) in deeper water feeding was nearly absolute. Diet was more varied in the Bering Sea, but also exhibited a shift from chiefly benthic to nektonic feeding near the 50 m isobath. Prey availability is discussed.

The flathead sole, *Hippoglossoides elassodon*, occurs from northern California to the Bering Sea, at depths ranging from the surface to 550 m. While maximum abundance tends to occur at depths of 91-181 m in the Gulf of Alaska and 2-90 m in the Bering Sea (Alderdice and Forrester 1974), geographic and bathymetric migrations have been described with respect to season and maturity (Hughes 1974). The possibility of flathead sole rising to the surface at night, and returning to the bottom during the day was proposed by Cooney (1967).

Limited information on feeding in this species has been reported by Suyehiro (1934), Smith (1936), and Skalkin (1968). These studies suggested that the flathead sole feeds on both benthic organisms such as polychaetes, molluscs, and brittle stars, and nektonic organisms such as fishes and shrimps. Mineva (1968) found that the flathead sole feeds in winter, unlike allied species. Miller (1970) discussed changes in the diet of the flathead sole with size and season in Washington waters. This study describes prey consumption by the flathead sole in the Gulf of Alaska and the Bering Sea in terms of four importance criteria. Prey availability is also discussed.

METHODS

Fishes were captured by otter trawl in the Gulf of Alaska from May through July, 1975. The six Gulf of Alaska stations occupied in this study are from among those used by the International Pacific Halibut Commission in their yearly surveys. Five trawls in the Bering Sea were made in August 1975, October 1975, and May 1976 representing summer, autumn, and spring respectively. It was impossible to influence when or where any trawls were made in this study, so collections were opportunistic rather than according to a particular sampling plan. Abdomens were slit and the whole fishes were packed in 10% formalin (per total volume of water and fish) buffered with 20 grams of hexamethylenetetramine per liter. Upon return to the lab, 286 specimens were measured for standard length to the nearest millimeter. Sex and maturity were recorded.

Prey were identified to the most specific taxa permitted by their state of preservation. Counts were made of all items and volumes were measured for each taxon to the nearest 0.1 ml. The frequency of prey occurrence (F), the percent contribution by volume (V), the percent by number (N), and an index of relative importance (IRI) were calculated for each station and for all stations combined. The index was developed by Pinkas *et al* (1971) using the formula IRI = (N + V)F. It should be noted that values reported for consumption of a prey taxon may be conservative. This is reflected in partially unidentifiable material being assigned to a higher taxon. For example, the importance of Euphasiidae (Table 1) is greater than suggested by values for euphausiids identified to lower taxa.

Stomach fullness and mean predator length for each taxon consumed were calculated. It was hoped that these last two criteria might illucidate possible changes in food preference with stomach fullness (i.e. satiation) or with predator size. The fortran program developed for this study is highly machine specific for the Honeywell 66/40.

Prey availability information came from Motoda and Minoda (1974), Feder *et al*. (1976a,b) and Pereyra *et al*. (1976). Biologically important taxa (BIT) in terms of prey availability were determined using the method of Feder *et al* (1976a). To qualify as a BIT, a taxon must be distributed in 50% or more of total stations sampled, comprise over 10% of population numbers or biomass at any one station, or satisfy a population density or biomass criterion. These density and biomass criteria are based upon a percentage calculated for each taxon, with the sum of the population density or biomass of all taxa equally 100 percent. These percentages are ranked in descending order. The percentages of each taxon are then summed in descending order until a cut-off point of 50 percent is reached. BIT by these population density or biomass criteria are those taxa whose percentages are used to reach the 50 percent cut-off point.

RESULTS

Prey consumption by 247 flathead sole in the Gulf of Alaska is listed in Table 1. Euphausiids (probably all *Thysanoessa spp.*) and the brittle star, *Ophiura sarsi*, comprise most of the diet of the 139 feeding individuals. Only 39 flathead sole were collected in the Bering Sea (Table 2). These limited data suggest that the shrimp *Pandalus borealis* is the most important spring prey, while mysids, amphipods, and *Ophiura sarsi* dominated summer feeding. Crangonid shrimps and juvenile pollock were the most important autumn prey in the Bering Sea. Biologically important prey taxa in the local community are noted in Tables 1 and 2.

DISCUSSION

Diet differences with depth in the Gulf of Alaska are pronounced, and therefore the importance of the euphausiids in Table 1 may be somewhat misleading. Five trawls at 66 to 88 m ($\bar{x}$ = 73 m) yielded 176 flathead sole. Empty stomachs occurred in 49 percent of these fishes. The index of relative importance for ophiuroids (IRI = 18,279) far exceeded the value for euphausiids (IRI = 274) for these five trawls. A single trawl south of Hinchinbrook Island at 26 m yeilded 71 fishes, of which 30 percent had empty stomachs. Here the importance of euphausiids (IRI = 17,854) in the diet contrasts with that of the ophiuroids (IRI = 1). The theoretically maximum IRI value is 20,000 (given feeding predators have a particular prey species in every stomach, and this prey comprises 100 percent of the volume and count). Thus the respective dominance of euphausiids in shallow water, and ophiuroids in the deep water feeding is nearly absolute.

The flathead sole diet in the Gulf of Alaska differs from that of a population in East Sound, Orcas Island, a shallow (28 m) embayment in Washington. Miller (1970) found that mysids comprised most of the diet (F = 77) followed by shrimps, fishes, clams, and polychaetes. Miller found 31 percent of the stomachs empty. Feeding intensity of Alaskan populations was greater in shallow areas (above the 50 m isobath), as evidenced by the frequency of empty stomachs and the mean fullness of stomachs. The flathead sole feeding in shallow water had a mean fullness of 57 percent while the deeper individuals had a mean fullness of 29 percent. Miller (1970) discussed how predator size, season, and bottom temperature affected the frequency of empty stomachs in a Washington population of flathead sole. Size and season do not account for the observed frequencies in the Gulf of Alaska population and temperature data are not available. While feeding by Washington and Alaskan flathead sole may always be more intense on nektonic organisms, one would expect from the Van't Hoff rule that the higher metabolic rate induced by warmer shallow waters would require a higher feeding rate than deeper populations.

Mineva (1968) found that in the Bering Sea, flathead sole fed chiefly on ophiuroids, followed by shrimps, amphipods, fishes, and molluscs. The limited sampling of this study tends to support these conclusions. According to Mineva the flathead sole is caught together with yellowfin sole, Alaska plaice and rock sole in the southeast Bering. The present study suggests a similarity in geographic and depth-related feeding patterns of the flathead sole with Skalkin's (1968) study of the yellowfin sole. The flathead sole seems to feed primarily on pink shrimp and fishes from 200 to 100 m, on ophiuroids and pink shrimp just above the 100 m isobath, on crangonid shrimps, fishes and molluscs below the 50 m isobath, and upon nekton such as mysids in more shallow waters. Seasonal differences suggested by Table 2 may simply result from migration-induced changes in prey availability with depth.

This study suggests that taxa important in the diet of the flathead sole tend to be important members of the local community. Both benthic and nektonic prey are consumed. This study plus the data of Mineva (1968) and Skalkin (1968) suggest a depth-related change from predominantly benthic to nektonic feeding somewhere around the 50 m isobath.

ACKNOWLEDGEMENTS

I wish to thank Ronald L. Smith for providing the opportunity to do this study and for commenting on the manuscript. George Mueller, Ken Coyle, and Nora Foster provided invaluable taxonomic assistance. I also thank Shirley Liss for help with the computer work. This study (R. L. Smith, Principal Investigator) was supported in part by the Bureau of Land Management through interagency agreement with the National Oceanic and Atmospheric Administration, under which a multi-year program responding to needs of petroleum development of the Alaskan Continental Shelf is managed by the Outer Continental Shelf Environmental Assessment Program (OCSEAP) Office.

REFERENCES

Alderdice, D. F., and C. R. Forrester. 1974. Early development and distribution of the flathead sole (*Hippoglossoides elassodon*). *J. Fish. Res. Bd. Can.* 31:1879-1918.

Cooney, R. T. 1967. Diet differences in trawl catches of some demersal fishes. M.S. Thesis, Univ. of Wash. 97 p.

Feder, H. M., G. Mueller, G. Matheke, and S. Jewett. 1976a. The distribution, abundance, diversity, and productivity of benthic organisms in the Gulf of Alaska. Environmental Assessment of the Alaska Continental Shelf Annual Report 1976 (7):263-454.

Feder, H. M., G. Mueller, S. Jewett, M. Hoberg, and K. Haflinger. 1976b. Environmental assessment of the Bering Sea: benthic biology. Environmental Assessment of the Alaska Continental Shelf Annual Report 1976 (5):1-218.

Hughes, S. E. 1974. Groundfish and crab resources in the Gulf of Alaska - based on International Pacific Halibut Commission trawl surveys, May 1961-March 1963. U.S. Dept. Commer., NOAA, NMFS, Seattle, WA Processed Rep. 87 p.

Miller, B. S. 1970. Food of flathead sole (*Hippoglossoides elassodon*) in East Sound, Orcas Island, Washington. *J. Fish. Res. Bd. Can.* 27(9): 1661-1665.

Mineva, T. A. 1968. On the biology of some flatfishes in the Bering Sea. *In* Sov. Fish. Inv. N. Pac. Pt. II: 227-235. Isr. Prog. Sci. Trans. TT67-51204. 289 p.

Motoda, S., and T. Minoda. 1974. Plankton of the Bering Sea. *In* D. W. Hood and E. J. Kelley, eds., *Oceanography of the Bering Sea*. Inst. Mar. Sci. Occas. Publ. No. 2, University of Alaska, Fairbanks. pp. 207-242.

Pereyra, W. T., J. E. Reeves, and R. G. Bakkala. 1976. Demersal fish and shellfish resources of the eastern Bering Sea in the baseline year 1975. U.S. Dept. Commer., NOAA, NMFS, Seattle, WA Processed Rep. 619 p.

Pinkas, L., M. S. Oliphant, and I. L. K. Iverson. 1971. Food habits of albacore, bluefin tuna, and bonito in California waters. Calif. Fish Game, Fish. Bull. 152:3-82.

Skalkin, V. A. 1968. Diet of flatfishes in the southeastern Bering Sea. *In* Sov. Fish. Invest. N. Pac. Pt. I: 235-250. Isr. Prog. Sci. Trans. TT67-51203. 333 p.

Smith, R. T. 1936. Report on Puget Sound otter trawl investigations. Wash. Dept. Fish. Biol. Rept. 36B:1-61.

Suyehiro, Y. 1934. Studies on the digestive system and the feeding habits of the important fishes in the North Pacific. II. The plaice, *Lepidopsetta mochigarei* Snyder and the halibut, *Hippoglossoides elassodon* Jordan and Gilbert. *Bull. Jap. Soc. Sci. Fish.* 3:65-72.

TABLE 1. Prey consumed by flathead sole for all Gulf of Alaska stations (n=247). Data are expressed as percent frequency of occurrence (F), percent by number (N), percent by volume (V), and by index of relative importance (IRI). Biologically important taxa in terms of prey availability are noted by an asterisk under BIT. Mean predator length (MPL) in mm and mean fulness of stomach in percent (MFS) are given for each prey taxon consumed.

Taxon	MPL	MFS	F	N	V	IRI	BIT
MOLLUSCA	240	100	1.4	0.1	0.1	0.3	*
PELECYPODA	253	100	0.7	0.0	0.0	0	*
GASTROPODA	227	100	0.7	0.0	0.0	0	*
CEPHALOPODA	227	100	0.7	0.1	0.0	0	
CRUSTACEA	210	77	51.1	73.8	38.2	5718	*
Euphausiidae	209	78	49.6	73.7	37.9	5537	*
Thysanoessa sp.	201	82	20.1	37.6	18.3	1125	*
Thysanoessa spinifera	177	104	13.0	33.4	18.0	665	*
DECAPODA	243	50	2.2	0.1	0.3	0.9	*
Majiidae	263	63	1.4	0.1	0.2	0.4	*
Hyas sp.	248	75	0.7	0.0	0.0	0	
OPHIUROIDEA	263	53	61.9	26.1	59.6	5297	*
Ophiura sarsi	263	57	56.8	26.0	58.4	4793	*
TELEOSTEI	258	50	1.4	0.1	1.8	2.6	*
UNIDENTIFIED ANIMAL MATERIAL			3.6	0.0	0.4	1.4	

TABLE 2. Seasonal prey consumption by flathead sole in the Bering Sea. Data are expressed as index of relative importance (IRI), and biologically important taxa in terms of prey availability are noted by an asterisk under BIT. Probable BIT are noted by a question mark.

Taxon	Spring 1976	Summer 1975	Autumn 1975	BIT
POLYCHAETA	381	--	--	*
PELECYPODA	116	--	108	*
Nuculana fossa	70	--	--	
CRUSTACEA	7936	7645	11651	*
AMPHIPODA	--	2700	69	*
Rhachotropis oculatus	--	2700	--	*
DECAPODA	6561	159	11234	*
Crangon dalli	--	--	11234	?
Majiidae	23	--	--	?
Pandalus borealis	5485	159	--	?
OPHIUROIDEA	68	1946	35	?
Ophiopenia disacantha	35	--	--	
Ophiura sarsi	--	1946	--	?
Ophiuroidae	--	--	35	
TELEOSTEI	235	157	416	*
Theragra chalcogramma	--	--	416	*
UNIDENTIFIED ANIMAL MATERIAL	66	--	1	

Contract 03-5-022-81
Research Unit 356
July 1 to September 30, 1976
8 Pages

QUARTERLY REPORT

Environmental Assessment of Selected Habitats in the Beaufort and Chukchi Sea Littoral System

Principal Investigator

Carter Broad
West Washington State College
Bellingham, Wash.

September 30, 1977

I. TASK OBJECTIVES

The task objectives of this quarter were specified in our proposal/work statement for fiscal 1977 as updated in quarterly reports:

1. To amplify the 1976 sampling of the Chukchi coast by resampling at most of the beach stations.
2. To continue subtidal sampling of the Beaufort Sea (shoreline to 5M depth).
3. To establish permanent shore stations and sample repeatedly during the season at:
   A. Nuvagapak Point in the Beaufort Lagoon region
   B. Barter Island
   C. Prudhoe Bay
   D. Colville River delta
   E. Point Barrow
   F. Wainwright
   G. Cape Thompson
   H. Cape Krusenstern
   I. Kotzebue Sound at Arctic Circle
   J. Wales (Cape Prince of Wales)
4. To establish permanent salt marsh experimental plots at Prudhoe Bay (mouth of Putuligayak River) and on the Baldwin Peninsula (Arctic Circle landing strip) and initiate measurements of productivity, grazing rates and recovery from various perturbations.
5. To initiate experiments designed to help elucidate:
   A. The contributions to the shallow water ecosystem of land-originated aetritus (peat);
   B. The food web and energy pathways in the littoral zone.

II. FIELD OR LABORATORY ACTIVITIES

A. Ship or field trip schedule:

1. June 23 to August 19, 1977: Repetitive sampling of permanent shore stations at Wales, Arctic Circle Landing strip, Cape Krusenstern and Cape Thompson: seven stations sampled three times each. Investigators: Clayton, Basabe

2. July 3 to August 29, 1977: Sampling of Chukchi Sea shore stations at Shishmarif (4 stations); Cape Espenberg (2 stations); south shore of Kotzebue Sound and Eschscholtz Bay (4 stations); Baldwin Peninsula (1 station); Hathom Inlet (3 stations); Kivalina (1 station); Point Hope (2 stations); Cape Lisburne (1 station); Icy Cape (4 stations); and Peard Bay (5 stations). Investigators: Benedict, Henderson, Spawn.

3. August 2 to 26, 1977: Benthic, epibenthic and plankton sampling of 36 stations comprising 17 transects of the littoral zone (shoreline to 10M depth) between Point Barrow and Tapkaurak Entrance in the Beaufort Sea aboard R/V ALUMIAK (NARL, OCS chartered). Investigators: Cordell, Broad.

4. July 7 to August 26, 1977: Repetitive sampling of permanent shore stations at Wainwright (2 stations) and Barrow (2 stations) and establishment of lagoon stations in Wainwright Inlet and the Kuk River (6 stations). Investigators: Stiefel, Koch, Fonda.

5. July 11 to September 6, 1977: Repetitive sampling of shore stations at Colville River delta (1 station); Prudhoe Bay (1 station); Barter Island (2 stations); and Nuvagapak Point (2

stations) and establishment of lagoon or estuarine transects at the Colville River mouth (6 stations); Putuligayak River mouth (2 stations); and Beaufort Lagoon (3 stations). Investigators: Dunton, Maier.

6. June 17 to September 4, 1977. A study of salt marsh ecology, productivity, and recovery from various perturbations at Prudhoe Bay (mouth of Putuligayak River) and on the Baldwin Peninsula (Arctic Circle landing strip). Investigators: Mason, Kiera.
7. July 5 to September 7, 1977. Observations and experiments of: feeding of amphipods and other invertebrates; and the role of peat (of terrestreal origin) as a nutritional source. Investigators: Schneider, Koch, Fonda, Stiefel.
8. July 1 to August 15, 1977. Verification of beach plant identifications and ecological data, Beaufort and Chukchi shore stations. Investigator: Taylor.
9. August 1 to 31, 1977. Macroalgae of the Alaskan Arctic littoral region. Investigator: Dube.

B. Scientific Party:

1. Principal Investigator

   A. C. Broad - July 1 to September 15
2. Associate Investigators:

   Maurice A. Dube, August 1-31

   Richard W. Fonda, July 1 - August 31

   David T. Mason, July 1 - August 31

   David E. Schneider, July 1 - August 31

   Ronald J. Taylor, July 15 - August 31

3. Research Aide II (all July 1 to September 15)

   Alice B. Benedict
   Jeffery R. Cordell
   Cheryl Clayton
   Ken Dunton

4. Research Aide I (all July 1 to September 15)

   Felix A. Basabe
   Richard Henderson
   Eileen Kiera (plus June 15 to 30)
   Bob Maier
   Raymond Steifel

5. Computer Programmer

   Gregg M. Petrie - hourly wages

6. Laboratory Supervisor

   Helmut Koch, July 1 to September 30

7. Laboratory Assistants (all hourly wages)

   Mark Childers
   James Hanes
   Scott Hansen
   Wendy Pounds
   Carl Wheeler
   Marijean Winchell

C. Methods

1. The methods employed in all shore stations were essentially those given on page 5 of the current work statement/proposal for fiscal 1977 and in recent annual reports. In addition to the Ekman grab for benthos sampling, which is ineffective in gravel, a hand-operated scoop of the same dimensions was devised. In a few instances, a Ponar grab of the same size as the hand-operated Ekman was used in deeper stations.

2. For subtidal benthic sampling from R/V ALUMIAK, a 0.1M^2 Smith-McIntyre grab was used instead of the VanVenn or Ekman suggested in the work statement.

3. Methods employed in the salt marsh ecology study include introduction of crude oil, sand overlay, light attenuation, nitrate and phosphate applications, artificial grazing, salt stress, selective transplants, peat overlays and other perturbations. The study has been a measurement of the strain induced in the community by these stresses and includes cover, plant heights, and biomass measurements and descriptive indices (watershed, physiography, profiles, soil salinities, general biologic relationships, wind and temperature profiles). These methods will be amplified in subsequent reports.

4. Laboratory and field experiments on the feeding of amphipods and the introduction of peat into littoral zone food webs included examination of gut contents and fecal pellets of common amphipods and some other animals (15 species), feeding experiments in which various foods were offered to animals of the littoral zone (8 species), choice experiments, experiments designed to test reduction of size of peat particles by animals (5 species), a growth experiment (using _Gammarus setosa_), a field experiment to verify the roles of _Gammarus_ and _Onisimus_ in the breakdown of peat under natural conditions, and observations on respiration of peat (including contained microorganisms). These methods will be amplified in subsequent reports.

5. The method verification of beach plant data and for arctic macroalgae was simply to put experts in the field.
6. Methods of laboratory analyses of samples have been dealt with in previous reports.

D. Sample Localities/Ship Tracklines

1. Shore stations (beach transects): the general locations of beach transects are given above (items IIA1, IIA2, IIA4, and IIA5).
2. Deeper benthic stations: The 17 transects of the Beaufort sea littoral zone and the depths of the stations on each transect are given below:

Transect Location	stations (depth in meters)
Point Barrow	2, 6, 10
Cooper Island	2, 5, 10
Cape Simpson (DEWline site)	5, 10
Smith Bay (Ikpikpuk River)	5, 10
Pitt Point (Lonely)	3, 5, 10
Cape Halkett	2, 5, 10
Kogru River	2, 5, 10
Colville River	2, 5, 10
Pingok Island	5, 10
Prudhoe Bay (west)	2, 5, 10
Heald Point	2, 5, 10
Foggy Island Bay	2, 5, 9
Flaxman Island	3, 5, 10
Simpson Cove	5, 10
Hulahula River	5, 10
Barter Island	5, 10
Tapkaurak Entrance	3.5, 10

3. The salt marsh ecology study was based in marshes in the mouth of the Putuligayak River (at Prudhoe Bay) and at Arctic Circle Landing Strip (Baldwin Peninsula south of Kotzebue).

E. Data Collected or Analyzed

1. Number and types of samples:

a.	sediment samples (for particle size analysis)	214
b.	benthos samples	1,230
c.	epibenthos samples	196
d.	plankton samples	185
e.	other, biological samples	215
f.	plant voucher samples	not counted

2. Sorting of 1976 samples was completed and lab analysis of 1977 samples begun.

F. Milestone Chart Update

1. Unanticipated taxonimic problems (possible undescribed species) have delayed reporting 1976 field season data. It is anticipated that these data can be reported (possibly with only generic identification of some species) this quarter.

III. RESULTS

Except as indicated above (item IIA), none reported.

IV. PRELIMINARY INTERPRETATION OF RESULTS

None given.

V. PROBLEMS ENCOUNTERED

1. There were mechanical problems that caused delays in the schedule and sampling program of R/V ALUMIAK. These delays combined with near shore drift ice in the eastern Beaufort Sea prevented our sampling transects at Nuvagapak Entrance and Demarcation Bay.
2. An experiment (field experiments to verify the role of *Gammarus* and *Onisimus* in the breakdown of peat) was destroyed by a storm.
3. Adverse weather and uncertainty over relationships with native people late in the summer resulted as a decision not to complete the final sampling of shore stations at Wainwright.

VI. ESTIMATE OF FUNDS EXPENDED (September 15, 1977)

	amount budgeted	amount spent	amount remaining
Salary, P.I.	$ 25,000	$ 27,021	$-2,021
Salaries, Associates	56,000	49,512	6,488
Salaries, other	90,000	92,598	-2,598
Fringe	18,000	19,337	-1,337
Travel & Freight	30,500	29,695	805
Chukchi logistics	78,611	39,440	39,171
Supplies	6,000	7,337	-1,337
Equipment	15,765	5,548	10,217
Computer Costs	5,800	3,441	2,359
Overhead	68,000	45,408	22,592
	$393,676	$319,337	$74,339

QUARTERLY REPORT

Contract #:
Research Unit #: 359
Reporting Period: 1 Jul - 30 Sep 1977
Number of Pages: 18

Beaufort Sea Plankton Studies

Rita A. Horner

1 October 1977

I. Abstract - Highlights

This quarter was spent preparing for and going on the USCGC *Glacier* food web cruise in the Chukchi and Beaufort seas.

II. Task Objectives

The objectives of this study are to assess the density distribution and environmental requirements of zooplankton and ichthyoplankton in an array of samples of opportunity, and to make index measurements of phytoplankton activity.

III. Field or Laboratory Activities

A. Ship schedule

1. 01 Aug to 07 Sep 1977

2. USCGC *Glacier*

B. Scientific party

1. Rita A. Horner, Principal Investigator

2. Thomas Kaperak, Assistant Oceanographer

C. Methods - Field Sampling

Zooplankton were collected with bongo nets having a mouth size of 333 and 505 μm. The net was lowered at 40 m per min to a depth approximately 10 m from the bottom at shallow stations or to 200 m at deep stations, allowed to soak for 30 sec, and then hauled to the surface at 20 m per min. A 2 m English umbrella net with a mesh size of 571 μm was used when we were in heavy concentrations of ice or when the ship was stopped on station for long periods of time. This net, designed to fall open after it is in the water beneath the ice, was lowered to a depth near the bottom and then vertically hauled to the surface. The net was closed approximately 1 m below the surface by dropping a messenger.

Acoustic surveys for layers of plankton were made with a Ross 200A Fine Line echo sounder system operated at a frequence of 105 kHz. A 10° transducer mounted in a 0.6 m V-fin depressor was lowered over the side when the ship was stopped on station.

Phytoplankton for standing stock, chlorophyll, and primary productivity measurements were collected with 5 ℓ Niskin bottles. Salinity was measured on water collected by the Niskin bottle.

Temperature was measured with reversing thermometers. Water transparency was measured with a Secchi disc.

Table 1. Station locations, USCGC *Glacier*, 01 Aug to 07 Sep 1977.

Station	Latitude (N)	Longitude (W)	Sonic Depth (m)	Location
01	71°19'	157°59'	102	Chukchi Sea
02	71°22'	160°04'	48	Chukchi Sea
03	71°24'	162°00'	46	Chukchi Sea
04	71°25'	164°00'	42	Chukchi Sea
05	71°12'	158°22'	107	Chukchi Sea
06	71°25'	156°56'	112	Chukchi Sea
07	71°46'	155°51'	123	Beaufort Sea
08	71°57'	154°33'	183	Beaufort Sea
09	72°24'	154°37'	2196	Beaufort Sea
10	71°35'	153°29'	51	Beaufort Sea
11	71°18'	152°43'	55	Beaufort Sea
12	71°10'	151°30'	24	Beaufort Sea
13	71°05'	150°23'	29	Beaufort Sea
14	71°10'	150°04'	45	Beaufort Sea
15	70°38'	148°28'	21	Beaufort Sea
16	70°42'	147°59'	31	Beaufort Sea
16A	70°40'	147°48'	32	Beaufort Sea
17	70°33'	147°24'	28	Beaufort Sea
18	70°25'	146°41'	31	Beaufort Sea
19	70°32'	146°30'	3658	Beaufort Sea
20	72°46'	146°23'	3568	Beaufort Sea
21	72°47'	146°34'	3568	Beaufort Sea
22	72°57'	143°20'	3292	Beaufort Sea
23	72°54'	142°08'	3531	Beaufort Sea
24	70°45'	141°28'	1189	Beaufort Sea
25	70°32'	141°32'	406	Beaufort Sea
26	69°49'	141°31'	28	Beaufort Sea
27	70°04'	142°14'	35	Beaufort Sea
28	70°19'	142°32'	49	Beaufort Sea
29	70°21'	143°29'	38	Beaufort Sea
30	70°14'	144°28'	28	Beaufort Sea
31	70°10'	145°32'	20	Beaufort Sea
32	70°39'	145°34'	51	Beaufort Sea
33	70°23'	146°26'	28	Beaufort Sea
34	71°46'	147°02'	54	Beaufort Sea
35	70°32'	147°35'	18	Beaufort Sea
36	70°36'	148°26'	22	Beaufort Sea
37	70°45'	149°03'	27	Beaufort Sea
38	71°58'	155°43'	150	Beaufort Sea
39	71°30'	155°12'	26	Beaufort Sea
40	71°30'	155°13'	26	Beaufort Sea
41	71°32'	156°30'	160	Chukchi Sea

Table 3. Summary of station locations, sampling depths, temperature and salinity data, Secchi disc depths, and ice cover for USCGC *Glacier* cruise, 01 Aug to 06 Sep 1977.

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/°°)
01	02 Aug	71°19'	157°59'	102		2	000	5.08	30.24
							005	4.43	31.66
							010	4.21	32.09
							015	1.92	32.18
							020	-1.31	32.67
							025	-1.46	32.95
							030	-1.20	32.89
							045	-0.93	33.01
02	02 Aug	71°22'	160°04'	48		0	000	1.77	30.20
							004	1.54	*
							007	-0.62	30.90
							011	-1.15	31.29
							022	-1.41	32.27
							027	-1.48	32.40
							035	-1.66	32.80
							045	-1.72	33.64
03	03 Aug	71°24'	162°00'	46	10	0	000	-0.17	28.09
							004	2.10	30.12
							008	2.28	30.30
							014	4.25	31.60
							020	-1.51	32.57

* No water sample because the Niskin bottle didn't trip.

† Depth discrepancy because ship drifted after fathometer was read.

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/°°)
							027	-1.71	33.09
							035	-1.71	33.16
							045	-1.72	33.17
04	04 Aug	71°25'	164°00'	42†	8	1	000	-0.14	27.14
							005	1.36	30.50
							010	-0.47	31.77
							015	-1.43	32.32
							020	-1.53	32.49
							025	-1.70	32.82
							030	-1.70	33.18
							045	-1.74	33.45
05	06 Aug	71°12'	158°22'	107	9	1	000	1.20	24.26
							010	3.89	31.32
							020	-0.09	31.97
							030	-1.63	32.78
							045	-1.62	32.92
							060	-1.64	32.86
							075	-1.65	32.87
							100	-1.70	32.92
06	06 Aug	71°25'	156°56'	112	11	1	000	2.81	29.38
							010	2.83	30.64
							020	0.13	32.36
							030	-0.21	32.46
							045	1.69	32.47

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/∘∘)
							060	-0.60	32.49
							075	-0.72	32.51
							100	-1.38	32.69
07	07 Aug	71°46'	155°51'	123	16	1	000	0.27	27.94
							010	-0.79	30.85
							020	-0.97	31.19
							030	-1.41	31.55
							045	-1.29	32.04
							060	-1.26	32.44
							075	-1.08	32.95
							100	-1.61	33.20
08	09 Aug	71°57'	154°33'	183	15	1	000	1.12	28.22
							010	1.12	28.27
							020	-0.33	30.27
							030	0.85	31.58
							045	-0.50	32.54
							060	-1.24	33.01
							075	-1.29	33.13
							100	-1.66	33.43
09	10 Aug	72°24'	154°37'	2196		8	000	-0.73	25.20
							010	-0.63	*
							020	0.95	31.80
							030	-1.38	32.29
							045	3.34	32.90

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/₀₀)
							060	2.34	32.86
							075	1.68	32.92
							100	0.16	33.01
10	10 Aug	71°35'	153°29'	51		1	000	1.24	29.45
							010	1.02	29.58
							020	3.90	31.95
							025	5.19	32.24
							030	5.06	32.33
							035	4.81	32.48
							040	5.02	32.58
							045	3.39	32.62
11	11 Aug	71°18'	152°43'	55		0	000	1.39	29.39
							010	1.35	29.41
							015	1.33	29.45
							020	0.77	30.68
							025	0.83	31.99
							035	1.77	32.57
							045	2.57	32.77
							050	1.15	32.78
12	12 Aug	71°10'	151°30'	24		0	000	-0.71	28.80
							005	-0.81	29.35
							010	-1.23	31.18
							015	-1.30	32.84
							020	-1.28	32.87

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/oo)
13	13 Aug	71°05'	150°23'	29		1	000	-1.00	30.29
							005	-1.06	30.35
							010	-1.03	30.31
							015	-1.48	32.67
							020	-1.29	32.81
							025	-1.40	32.82
14	14 Aug	71°10'	150°04'	45	7	4	000	-0.85	30.95
							005	-1.00	31.32
							010	-0.97	31.71
							015	-1.13	31.96
							020	-1.45	32.24
							025	-1.49	32.33
							030	-1.49	32.54
							045	-1.53	32.86
15	16 Aug	70°38'	148°28'	21		0-1	000	0.05	31.25
							003	-0.69	31.80
							006	-0.74	31.83
							009	-0.94	31.90
							012	-0.84	32.13
							015	-1.23	32.13
							018	-1.24	32.13
16	17 Aug	70°42'	147°59'	31		3	000	0.19	31.03
							005	-0.47	31.97
							010	-0.98	32.31

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/oo)
							015	-1.12	32.42
							020	-0.98	32.47
							025	-1.21	32.46
16A	17 Aug	70°40'	147°48'	32	4	2	000	-0.39	30.44
							005	-0.43	32.18
							010	-0.65	32.39
							015	-1.02	32.41
							020	-1.09	32.43
							025	-1.12	32.42
							030	-1.17	32.42
17	18 Aug	70°33'	147°24'	28	4	2-3	000	-0.15	31.48
							003	-0.16	31.51
							006	-0.28	31.55
							009	-0.47	31.61
							012	-0.50	31.65
							015	-0.64	31.85
							020	-0.78	31.98
							025	-0.97	32.09
18	18 Aug	70°25'	146°41'	31		0	000	0.90	32.06
							003	0.86	32.06
							006	0.88	32.06
							009	0.82	32.06
							012	0.90	32.06
							015	1.02	32.06

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/₀₀)
							020	-0.72	32.38
							025	-0.74	32.40
19	19 Aug	70°32'	146°30'	3658	30	0	000	-0.97	26.66
							010	-0.94	28.10
							020	-1.24	30.98
							030	-1.45	31.63
							045	-1.33	31.91
							060	-0.79	32.24
							075	-1.42	32.52
							100	-1.50	32.83
							200	-0.77	34.27
							400	0.47	34.88
							500	0.45	34.90
							600	-0.29	34.91
							700	-0.23	34.91
							800	0.03	34.92
							900	-0.04	34.92
							1000	-0.15	34.93
20	21 Aug	72°46'	146°23'	3568	42	8	000	1.35	05.02
							010	-0.85	29.76
							020	-1.19	30.71
							030	-1.43	31.45
							045	-1.35	31.74
							060	-1.48	32.10
							075	-1.44	32.40
							100	-1.47	32.76

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/oo)
21	22 Aug	72°47'	146°34'	3658	14	1	000	1.41	24.42
							010	2.15	26.30
							020	-1.14	30.60
							030	-1.42	31.54
							045	-1.50	31.88
							060	-1.44	32.18
							075	-1.42	32.37
							100	-1.50	32.81
22	23 Aug	72°57'	143°20'	3292	21	4	000	2.13	17.72
							010	-0.48	27.01
							020	-0.87	30.93
							030	-1.26	31.82
							045	-1.17	31.82
							060	-1.48	32.17
							075	-1.47	32.42
							100	-1.45	32.78
23	23 Aug	72°54'	142°08'	3531	21	5	000	3.34	21.22
							010	1.16	29.20
							020	-0.65	31.17
							035	-1.45	31.71
							050	-1.59	31.95
							075	-1.59	32.43
							100	-1.46	32.76
							3400	-0.28	34.98

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/∘∘)
24	25 Aug	70°45'	141°28'	1189	12	0	000	2.59	30.50
							010	2.39	30.54
							020	-1.10	31.65
							030	-1.49	31.92
							045	-1.59	32.18
							060	-1.56	32.43
							075	-1.51	32.63
							100	-1.50	32.95
25	25 Aug	70°32'	141°32'	406	20	0	000	2.02	30.92
							010	-0.14	31.44
							020	-0.73	31.96
							030	-1.04	32.15
							045	-0.85	32.40
							060	-1.43	32.72
							075	-1.48	32.81
							100	-1.49	32.86
26	26 Aug	69°49'	141°31'	28	5	0	000	2.38	32.52
							003	2.36	32.53
							006	2.41	32.52
							009	2.37	32.53
							012	2.33	32.52
							015	2.36	32.53
							020	0.36	32.76
							025	-0.18	32.79

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/°°)
27	26 Aug	70°04	142°14'	35	4	0	000	1.27	32.34
							003	1.23	32.34
							006	1.26	32.34
							009	1.20	32.34
							012	1.19	32.34
							015	1.21.	32.34
							020	0.20	32.45
							030	-0.33	32.50
28	27 Aug	70°19'	142°32'	49	13	0	000	1.47	31.22
							005	1.45	31.21
							010	1.47	31.21
							015	0.93	32.09
							020	0.55	32.35
							025	-1.03	32.56
							030	-1.08	32.56
							045	-1.20	32.59
29	28 Aug	70°21'	143°29'	38		0	000	1.47	31.71
							005	1.45	31.76
							010	1.38	32.03
							015	1.61	32.16
							020	1.15	32.19
							025	-0.64	32.46
							030	-0.61	32.46
							035	-0.62	32.46

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/∘∘)
30	28 Aug	70°14'	144°28'	28	11	0	000	1.37	32.13
							003	1.36	32.13
							006	1.42	32.14
							009	1.36	32.14
							012	1.33	32.21
							015	1.35	32.14
							020	-0.76	32.37
							025	-0.80	32.38
31	29 Aug	70°10'	145°32'	20	5	0	000	1.04	31.39
							003	1.07	31.39
							006	1.09	31.42
							009	1.09	31.52
							012	1.07	31.61
							015	1.30	31.68
							018	1.36	31.71
32	30 Aug	70°39'	145°34'	51	10	0	000	2.08	29.62
							005	2.08	29.62
							010	2.08	29.65
							015	1.28	31.67
							020	0.56	31.89
							025	-0.84	32.14
							030	-0.83	32.29
							045	-1.45	32.59

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/°°)
33	30 Aug	70°23'	146°26'	28		2	000	-0.20	29.82
							003	0.12	30.24
							006	0.12	30.86
							009	-0.07	31.40
							012	-0.21	31.40
							015	-0.46	31.55
							020	-0.69	31.63
							025	-0.73	31.64
34	31 Aug	71°46'	147°02'	54	24	0	000	1.04	28.02
							005	1.75	28.99
							010	0.70	29.90
							015	0.59	29.91
							020	0.19	30.54
							025	-1.08	31.36
							030	-1.19	31.55
							045	0.12	32.24
35	01 Sep	70°32'	147°35'	18	5	3-4	000	0.55	29.89
							003	0.75	30.00
							006	0.53	30.17
							009	0.27	30.23
							012	0.15	30.67
							015	0.04	30.99
36	01 Sep	70°36'	148°26'	22		1	000	0.66	28.78
							003	1.17	28.87
							006	0.90	28.91

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/oo)
							009	0.40	30.07
							012	0.21	30.81
							015	-0.26	31.22
							018	-0.27	31.22
37	02 Sep	70°45'	149°03'	27	11	3	000	0.67	28.45
							003	0.36	28.78
							006	-0.13	29.79
							009	-0.15	30.04
							012	-0.50	30.47
							015	-1.06	31.29
							018	-1.43	31.83
38	04 Sep	71°58'	155°43'	150		0	000	5.96	29.17
							010	6.21	29.23
							020	-1.16	31.70
							030	-1.38	31.93
							040	-1.40	32.10
							050	-1.10	32.27
							075	-1.06	32.68
							100	-1.46	32.98
39	04 Sep	71°30'	155°12'	26	9	0	000	7.97	28.62
							003	8.07	28.63
							006	8.47	28.98
							009	8.54	28.97
							012	8.37	29.03

Table 3. (continued)

Sta No	Date (1977) (GMT)	Latitude (N)	Longitude (W)	Sonic Depth (m)	Secchi Depth (m)	Ice Cover (oktas)	Sample Depth (m)	Temp (°C)	Salinity (°/oo)
							015	8.42	29.15
							018	8.35	29.21
							021	7.83	29.37
40	04 Sep	71°30'	155°13'	26	6	0	000	8.57	29.03
							003	8.58	29.13
							006	8.59	29.02
							009	8.57	29.02
							012	8.50	29.04
							015	8.48	29.13
							018	8.50	29.18
							021	8.51	29.21
41	05 Sep	71°32'	156°30'	160	9	0	000	3.56	27.67
							010	4.39	31.26
							020	3.01	31.52
							030	1.22	31.98
							040	0.83	32.06
							050	0.63	32.10
							075	0.51	32.13
							100	-0.16	32.28

VIII. Estimate of Funds Expended

Salaries and Wages		$4500.00
Miscellaneous Supplies		500.00
Shipping		1000.00
Travel		900.00
	Total	$6900.00

QUARTERLY REPORT

Contract No.	: R7120824
Research Unit No.	: RU-380
Reporting Period	: 1 July - 30 September 1977
Number of Pages	: 6

ICHTHYOPLANKTON OF THE EASTERN BERING SEA

Co-Principal Investigators

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National Marine Fisheries Service
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PI QUARTERLY PROGRESS REPORT

Reporting Period: 1 July - 30 September 1977

Project Title: Ichthyoplankton of the eastern Bering Sea (RU-380)

I. Abstract

Ichthyoplankton sorted from plankton samples collected during MILLER FREEMAN Cruise RP-4-MF-77B Legs V and VI was received and larvae from the .505 mm mesh bongo samples and from a portion of the neuston samples have been identified.

II. Objectives

Collect and analyze ichthyoplankton samples from a portion of the eastern Bering Sea during the spring of 1976 (completed) and 1977 (in progress).

III. Field or Laboratory Activities

A. Ship or Field Trip Schedules
None

B. Scientific Party

Kenneth D. Waldron	NMFS	Co-Principal Investigator (part-time)
Beverly M. Vinter	NMFS	Ichthyoplankton specialist (part-time)
Donald M. Fisk	NMFS	Technician (part-time)

C. Methods

Ichthyoplankton was removed from the general plankton under contract with the Ecological Services Division of Texas Instruments, Inc., of Dallas, Texas.

Fish larvae were identified by microscopic examination and standard procedures used in larval fish taxonomy.

D. Sample Collection Localities
No samples were collected during the quarter.

E. Data Collected and/or Analyzed

1. Number of samples examined:

.505 mm mesh bongo samples	134
Neuston samples	66

2. Number and type of analyses:

Larval specimens identified (bongo samples)	9,694
Larval specimens identified (neuston samples)	2,959

3. Flowmeters used during the survey were recalibrated at the Corps of Engineers Division Hydraulics Laboratory, Bonneville, Oregon.

IV. Results

Collections made with the .505 mm mesh, 60 cm bongo nets contained 9,694 fish larvae in 134 samples, an average of 71 larvae per sample (range 0-844); only 5 samples did not contain fish larvae. Samples collected during the same months of 1976 contained only 42 fish larvae per sample (range 0-202). Examination of catches of the neuston net has not been completed, but the average catch appears to be greater than for similar samples collected during 1976.

Walleye pollock larvae (Theragra chalcogramma) made up 83% of the bongo catch; only 2% have not yet been identified to at least the family level (most of these are badly damaged specimens), and the remaining 15% were divided among 24 taxa (species, genus, or family) (Table 1). The 1977 collections included all taxa present in the 1976 collections, plus an additional 5 taxa (those marked with an asterisk in Table 1) represented by a few specimens.

Numbers and distribution of pollock larvae in April-May 1977 differed from 1976. Standardized maximum number (No./10 m^2) caught during the 1976 survey was 881 larvae at a single station, while in the 1977 survey maximum number in a single sample was 5,751 larvae, and 13 samples contained more than 1,000 pollock larvae per 10 m^2.

During the 1977 survey, samples were collected more than once at a number off stations -- with 24 stations occupied 3 times, and 39 stations occupied 2 times within a one month period, 16 April - 15 May 1977. We will thus be able to ascertain some indication of short-term variability in catches of fish eggs and fish larvae. Figure 1 shows the difference in abundance of walleye pollock larvae (.505 mm mesh bongo samples) at 39 stations for two periods, 19-26 April and 3-15 May 1977. In the relatively short interval between the two sampling periods, average abundance declined from 727 pollock larvae/station to 245 pollock larvae/station, and centers of high abundance observed during the first period were not apparent during the second period.

Fish eggs collected during the survey have not yet been identified and enumerated. Cursory examination of the 1977 samples indicates that the distribution of eggs will not be the same as that of larvae, and centers of abundance may be expected to differ from those of larvae.

V. Preliminary Interpretation of Results
None

VI. Auxiliary Material

A. Bibliography of References.
None

B. Papers in Preparation or in Print
Waldron, Kenneth D. Ichthyoplankton of the eastern Bering Sea, April-May 1976. Journal: NMFS Special Report, Status of the Environment, 1976 (manuscript).

C. Oral Presentations
None

VII. Problems Encountered and Recommended Changes
Lack of adequate published descriptions has made it difficult to identify certain groups of larvae, especially those in the families Agonidae, Bathymasteridae, Cottidae, Cyclopteridae, Hexagrammidae, Pholidae, and Stichaeidae. Taxonomic status of the Bering Sea members of some of these groups is uncertain and adequate descriptions of adults are lacking in many instances. One solution to this problem would be funding of specific systematic and taxonomic studies by OCSEAP or NMFS.

Table 1.—Larval fish identified in samples collected with a .505 mm mesh bongo net, *Miller Freeman* Cruise RP-4-MF77B, Legs V & VI, eastern Bering Sea, 16 April-15 May 1977.

Taxon	No. of larvae in sample	Percent
Theragra chalcogramma	8,048	83.0
Ammodytes hexapterus	401	4.1
Sebastes sp.	351	3.6
Pleuronectidae (A)1/	157	1.6
Atheresthes sp.	134	1.4
Reinhardtius hippoglossoides	117	1.2
Bathylagus pacificus	78	0.8
Cottidae (non-Hemilepidotinae)	57	0.6
Leuroglossus schmidti	38	0.4
Stichaeidae	32	0.3
Cottidae (Hemilepidotinae)	31	0.3
Mallotus villosus	20	0.2
Cyclopteridae	18	0.2
Bathymasteridae	17	0.2
* *Stenobrachius leucopsarus*2/	17	0.2
Agonidae	14	0.4
Hexagrammos sp.	13	0.1
Hippoglossus stenolepis	8	0.1
* *Nectoliparis pelagicus*	8	0.1
Pleurogrammus monopterygius	7	0.1
Gadidae (non-*Theragra*)	6	0.1
Pholidae	3	--3/
* Macrouridae	1	--
* *Ptilichthys goodei*	1	--
* *Zaprora silenus*	1	--

1/ This pleuronectid has not yet been identified to species.

2/ An asterisk indicates taxa not present in samples collected during April-May, 1976, during a survey in the same general area.

3/ -- Indicates a value less than 0.05%.

VIII. Estimate of Funds Expended
Total for the FY 1977 $50,000.

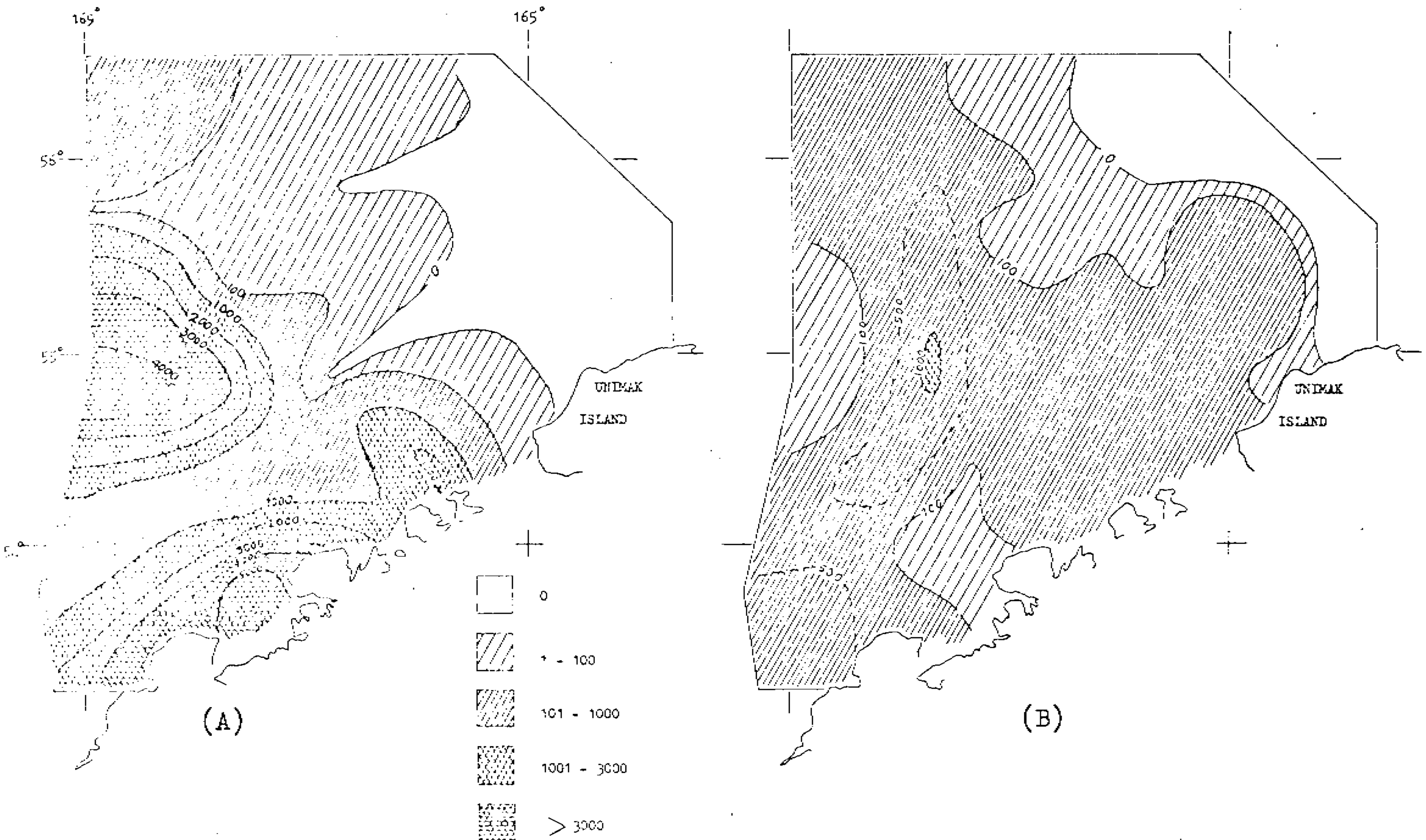
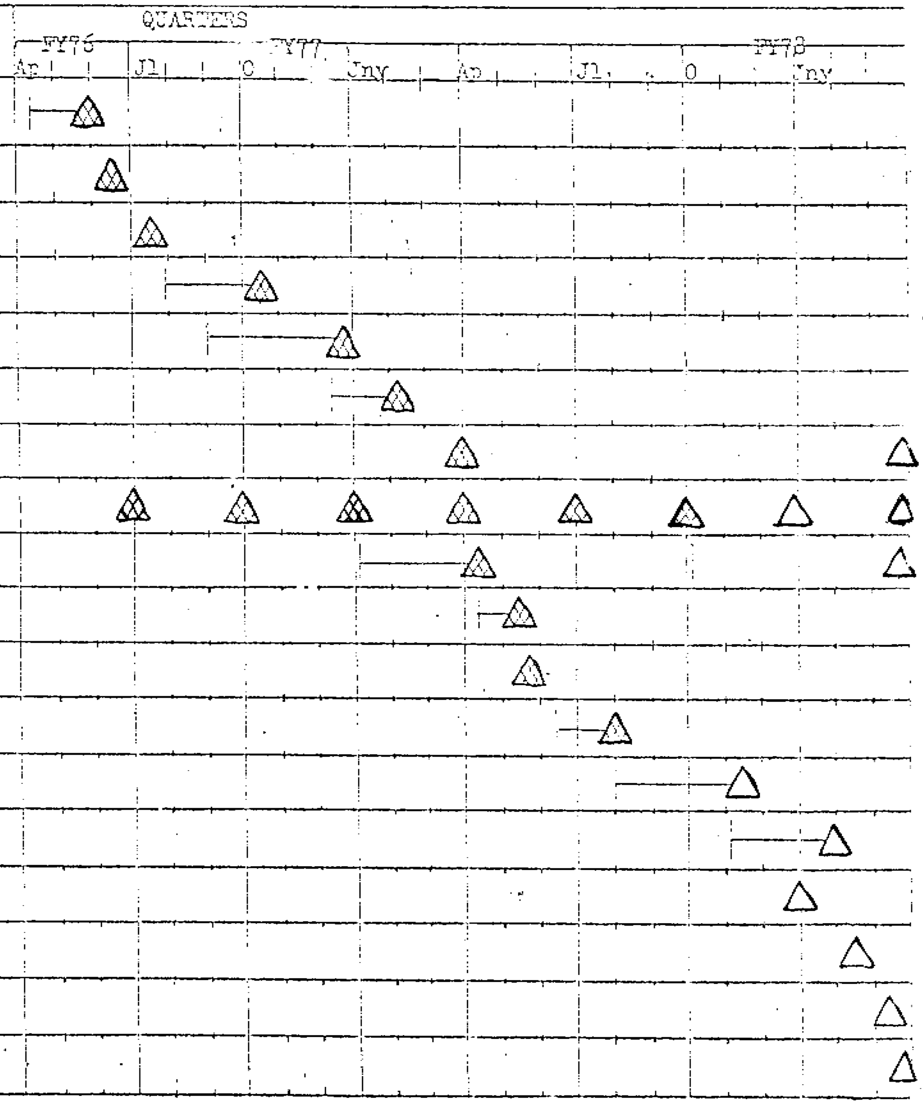


Figure 1. Distribution of larvae of walleye pollock (Theragra chalcogramma), as No./10 m^2, during two sampling periods, (A) 19 - 26 April 1977, and (B) 3 - 15 May 1977. Cruise RP-4-MF77B. (RU-380)

PROJECT RU-380 Ichthyoplankton of the Eastern Bering Sea, NWAFC   DATE 23 Sept. 1977

PRINCIPAL INVESTIGATORS F. Favorite and K. Waldron, NWAFC

	MAJOR MILESTONES/ ACTIVITIES
1	MILLER FREEMAN Cruise 764 Collect Plankton Samples
2	Samples returned to Seattle aboard FREEMAN
3	Award sorting contract
4	Sort plankton for ichthyoplankton and major taxa
5	Identification of ichthyoplankton
6	Analysis of data
7	Annual Report
8	Quarterly Reports
9	Transcription to OCSEAP format & submit mag tapes
10	MILLER FREEMAN Cruise 77B, Collect plankton samples
11	Samples returned to Seattle via commercial carrier
12	Sort samples for ichthyoplankton by contract
13	Identification of ichthyoplankton
14	Analysis of data
15	Final Report (a) Start
16	(b) Submit for internal review
17	(c) Final draft preparation
18	(d) Submit to NOAA



QUARTERLY REPORT

RESEARCH UNIT #: 417
JOB NUMBER: 6797-004-20
REPORTING PERIOD: June 1, 1976 -
September 30, 1977
NUMBER OF PAGES 324

ECOLOGICAL STUDIES OF INTERTIDAL AND SHALLOW SUBTIDAL HABITATS IN LOWER COOK INLET

Dennis C. Lees
Marine Biologist
DAMES & MOORE

October 1, 1977

QUARTERLY REPORT

I. Task Objectives

The main purpose of the study is to describe some of the important features of the principal intertidal and nearshore assemblages in lower Cook Inlet. The overall objectives are to obtain information on patterns of trophic dynamics and succession, and to develop preliminary estimates of primary and secondary production in the assemblages examined. Considerable effort is being placed in obtaining biomass and production estimates for the algai assemblages in the rocky intertidal and subtidal region on the south side of Kachemak Bay.

II. Field and Laboratory Activities

A. Ship or Field Trip Schedule

1. 29, 30 June - Gull Island via Dames & Moore vessel, Sea Star.
2. 2, 3 July - Seldovia Point rocky beach via charter aircraft and inflatable boat.
3. 12, 15, 22, 25 July - Jakolof Bay dive study via Dames & Moore vessel, Sea Star.
4. 28 July - Homer Spit via personal car.
5. 29 July - Deep Creek sand beach via personal car.
6. 30 July - Chinitna Bay mudflat via chartered aircraft.
7. 31 July - Douglas River beach via chartered aircraft.
8. 4, 5 August - Seldovia Point dive study via Dames & Moore vessel, Sea Star.

9. 18 August - Jakolof Bay dive study via Dames & Moore vessel, Sea Star.

10. 27, 30 August - Gull Island via Dames & Moore vessel, Sea Star.

11. 28, 29 August - Seldovia Point rocky beach via Dames & Moore vessel, Sea Star.

12. 13 September - Seldovia Point subtidal survey via Dames & Moore vessel, Sea Star.

B. Scientific Party

1. Deborah Boettcher, Dames & Moore, Assistant Biologist
2. William Driskell, Dames & Moore, Assistant Biologist
3. Dr. Jonathan Houghton, Dames & Moore Project Marine Biologist
4. Dennis Lees, Dames & Moore, Project Manager
5. Richard Rosenthal, Alaska Coastal Research, Consulting Biologist

C. Methods

1. Field sampling

a. Soft Substrates

(1) A profile of beach elevations is established.

(2) A stratified random sample design is being utilized.

(3) Ten cores 10 cm in diameter and about 30 cm long are collected randomly at each of at least four levels of the beach below MLLW.

(4) Samples are individually bagged and labeled.

(5) After sample collection is completed (about one hour), the fresh samples are screened in seawater through a 1 mm sieve to remove the sand. The sample remaining in the screen is rebagged with its label and fixed with a 10% formaldehyde-seawater solution.

b. Rock Substrates

(1) A stratified sampling design is being used.

(2) Levels being occupied at Seldovia Point are about +8 ft., +2 ft., MLLW, -1 ft., -30 ft., -40 ft. and -60 ft. elevations.

(3) Levels being occupied at Gull Island are about +12 ft., +5 ft., MLLW and -1 ft. elevations.

(4) Ten 1/4 m^2 quadrats are placed randomly at each level; within each quadrat the number and/or relative cover of each plant taxon are recorded and all plants attached within the frame are removed and bagged. Additionally, the number and/or relative cover of conspicuous invertebrates and fish are recorded.

(5) Additional quadrats (from 1/16 m^2 to 25 m^2) are utilized at each level to obtain better estimates of density and cover for the plants and animals in the study area.

(6) Feeding observations are recorded.

(7) Samples of many invertebrates are collected to establish size distributions.

(8) At Jakolof Bay, individual plants of *Laminaria groenlandica*, *Agarum cribrosum* and *Alaria fistulosa* were tagged, measured and marked in such a manner as to allow the determination of growth rates.

2. Laboratory Procedures

a. Soft Substrates

(1) In the laboratory, the samples are sorted and the organisms identified to the lowest practical taxon and counted.

(2) Aggregate drained wet weights are measured for each species, where practical, or for major taxa.

(3) Representative specimens are sent to taxonomic specialists for identification or verification.

b. Rock Substrates

(1) Plant samples from each level are handled and recorded individually.

(2) Drained wet weight and length are measured for each laminarian; aggregate drained wet weights are measured for all other algae.

(3) Sizes are measured for various invertebrate species to establish size distributions.

(4) Fish and selected invertebrate species are observed or dissected in order to determine food habits and develop food webs.

D. <u>Sample Localities</u>

1. Soft Substrates

   a. Deep Creek - 1½ mi. south of beach access at beach park (Figure 1); transect based on very large triangular boulder at base of cliff;

   b. Homer Spit - 2½ mi. south of Kachemak Drive, off beach access ramp on west side of spit (Figure 1);

   c. Glacier Spit - at Byer's home site, on the north side of Chinitna Bay (Figure 1); transect based on a solitary intertidal boulder clump near MLLW.

2. Rock Substrates

   a. Gull Island, in Kachemak Bay - Gorilla Rock at west end of island (Figure 1);

   b. Jakolof Bay, in Kachemak Bay - on the reef at the mouth of Jakolof Bay, under the overhead high tension wires (Figure 1);

   c. Seldovia Point, in Kachemak Bay - directly at the point; transect based on a very large boulder, marked by a pointed arrow, at the base of the cliff (Figure 1).

E. <u>Data Collected or Analyzed</u>

1. Soft Substrates (7-28-77)

   a. Homer Spit

      (1) Beach profile

      (2) Forty core samples - sorted and identified

   b. Deep Creek (7-29-77)

      (1) Beach profile

(2) Forty core samples - sorted and identified

(3) Size distribution for four species

c. Chinitna Bay - Glacier Spit (7-30-77)

(1) Forty core samples collected

(2) 1/16 m^2 quadrats for density and dominant invertebrate - 100

d. Douglas River (7-31-77)

(1) Reconnaissance survey

2. Rock Substrate

a. Gull Island (6-29-77 and 6-30-77)

(1) 1/4 m^2 quadrats for plant cover, density and biomass - 26

(2) 1/4 m^2 quadrats for cover and density of plants and invertebrates - 6

(3) Feeding observations - 2

(4) Size distribution for two species

b. Seldovia Point intertidal survey (7-2-77 and 7-3-77)

(1) 1/4 m^2 quadrats for plant cover, density and biomass - 39

(2) 1/4 m^2 quadrats for cover and density of plants and invertebrates - 2

(3) Beach profile

(4) Feeding observations - 2

(5) Size distribution for four species

(6) Reproductive status for one species

c. Jakolof Bay Subtidal Studies (7-12, 15, 22, 25-77)

(1) Large quadrats for plants and large invertebrates:

0.5 x 28m - 1

0.5 x 30m - 8

(2) 1/4 m^2 quadrats for plant density, cover and biomass -

9 + 7 = 16

(3) Tagged plants measured:

Agarum cribrosum - 6

Alaria fistulosa - 9

Laminaria groenlandica - 13

Nereocystis luetkeana - 6

(4) Feeding observations - 35

(5) Size distribution for six species

d. Seldovia Point Subtidal Survey (8-4-77 and 8-5-77)

(1) Large quadrats for plants and large invertebrates

0.5 x 12m - 1

0.5 x 25m - 5

1.0 x 25m - 2

(2) 1/4 m^2 quadrats for plant cover, density and biomass - 30

(3) 1/4 m^2 quadrats for cover and density of dominant plants and animals - 4

(4) Feeding observations - 1

(5) Size distribution for three species

e. Jakolof Bay Subtidal Studies (8-18-77)

(1) Tagged plants measured:

Laminaria groenlandica - 10

(2) Feeding observations - 8

(3) Size distribution for one species

f. Gull Island (8-27-77 and 8-30-77)

(1) 1/4 m^2 quadrats for plant cover, density and biomass - 25

(2) Feeding observations - 1

(3) Size distribution for two species

g. Seldovia Point Intertidal Survey (8-28-77 and 8-29-77)

(1) 1/4 m^2 quadrats for plant cover, density and biomass - 39

(2) Feeding observations - 5

(3) Size distribution for three species

h. Seldovia Point Subtidal Survey (9-13-77)

(1) 1/4 m^2 quadrats for plant cover, density and biomass - 10

(2) Size distribution for three species

F. Milestone Chart and Data Submission Schedule

The scheduling projected in the milestone chart is being met, with two exceptions. Submission of data reports and digital data are lagging because of field schedules, keypunch backlog and delays in taxonomic assistance. However, the situation is better than at last reporting. Taxonomic information has become available and a data report covering through August is in progress. Completion of that report is projected for 30 November 1977.

III. Results

A brief data report will be submitted after laboratory analysis is completed.

IV. Preliminary Interpretation of Results

Plant production was high during the summer at Seldovia Point and Gull Island, except on the horizontal portion of the bench at Gull Island. The disappearance of the thatched barnacle *Balanus cariosus* there resulted in the absence of a usually dense cover of *Alaria ?praelonga* that zone. Causes cannot be determined.

The kelp bed at Seldovia Point was well developed this year and included large numbers of both *Nereocystis luetkeana* and *Alaria fistulosa*. Growth rates for those two species were consistently quite high, but were decreasing to a low rate through the summer for *Laminaria groenlandica* and *Agarum cribrosum*.

V. Estimated Funds Expended

$92,000.00

RECONNAISSANCE OF THE INTERTIDAL AND
SHALLOW SUBTIDAL BIOTIC LOWER COOK INLET

(SUPPLEMENT TO RESEARCH UNIT #417)
WILL BE AVAILABLE AT A LATER DATE.

QUARTERLY REPORT

Contract # 03-5-022-67-TA8 #4
Research Unit # 424
Reporting Period: 1 Apr 76 - 1 Oct 77
Number of Pages: 361

Lower Cook Inlet Meroplankton

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1 October 1977

Departmental Concurrence: G. C. Anderson
George C. Anderson
Associate Chairman for Research

REF: A77-17

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I. Task Objective

Our main objective is to conduct a quantitative survey to determine the seasonal distribution of commercially or ecosystem important species of ichthyoplankton, crab and shrimp larvae in Lower Cook Inlet, Alaska.

II. Field or Laboratory Activities

A. Ship or Field Trip Schedule

None in this quarter.

B. Scientific Party

None in this quarter.

C. Methods

Ten routine sampling locations were established in the Lower Cook Inlet region (Figure 1 and Table 1). Seven seasonal cruises were made from April 1976 through February 1977; bad weather prevented sampling four stations (Table 2).

Plankton samples were obtained by using open bongo nets in double-oblique hauls. The diameter of the nets was 60 cm and the mesh sizes were 333 and 505 μm. The volume of water filtered was estimated as the product of the area of the net opening and the distance of each haul measured by a calibrated flow meter in the mouth of each net. The assumption was implicit that the efficiency of filtration was 100%. If one flow meter failed, the other meter reading was used; in two instances when both meters failed, an estimate was made using the duration relative to other hauls.

The samples were sorted repeatedly to remove fish eggs, fish larvae and juveniles, shrimps, and crabs. In most cases the entire sample was examined; subsamples were taken when organisms in a group were relatively abundant (Table 3). When the first subsample contained too few of the desired organisms, further subsamples were examined.

The organisms were identified to the lowest practicable taxonomic category and life history stage. The concentrations of the organisms were recorded, and reported in data submissions destined for the National Oceanographic Data Center, as abundance per cubic meter, with a minimum concentration of 0.001.

The concentrations taken with paired 333 and 505 μm meshes did not appear to differ as might occur with extrusion of small organisms with escapement of large organisms (Figure 2). Therefore, the catches of the paired nets for each haul were combined as the geometric means of the two

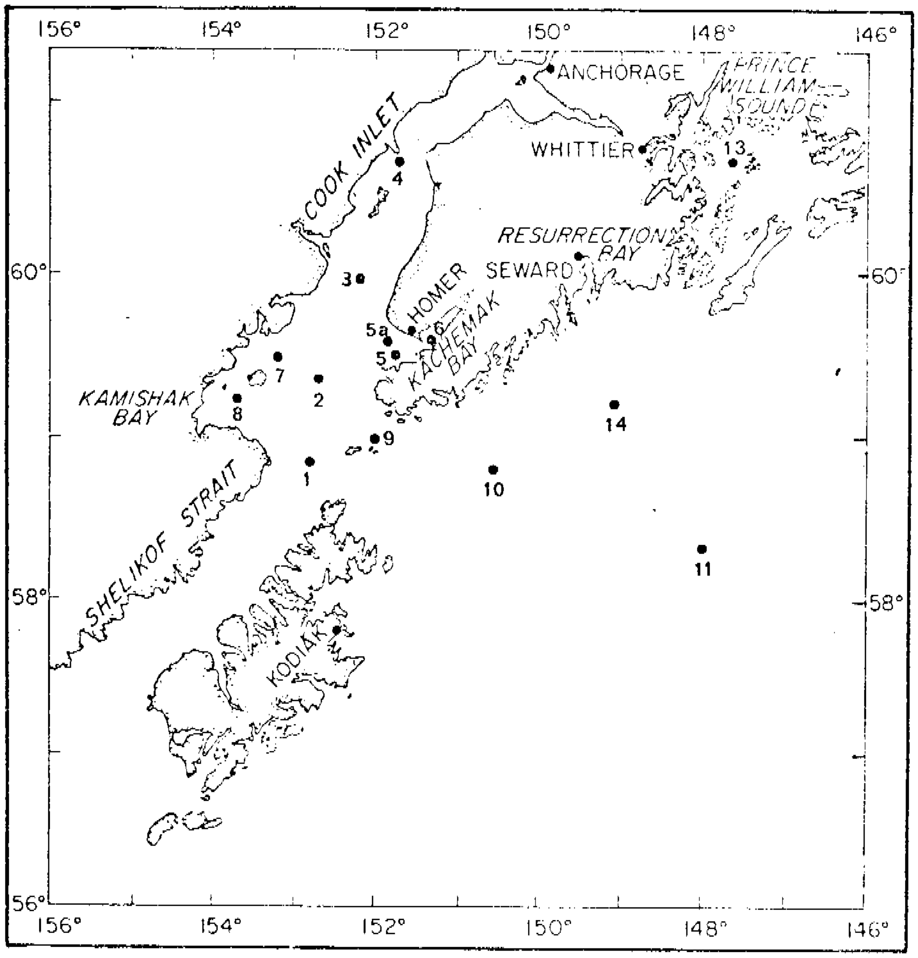


Figure 1. Station locations, Cook Inlet area.

Table 1. Station Locations

Station	Latitude (N)	Longitude (W)	Chart Depth (m)	Location
1	58° 53.0'	152° 48.0'	174	Lower Cook Inlet
2	59° 22.0'	152° 40.0'	62	Lower Cook Inlet
3	60° 00.0'	152° 10.0'	58	Lower Cook Inlet
4	60° 40.0'	151° 40.0'	36	Cook Inlet
5	59° 31.0'	151° 45.0'	80	Outer Kachemak Bay
5a	59° 35.0'	151° 49.0'	36	Outer Kachemak Bay
6	59° 36.0'	151° 18.0'	77	Inner Kachemak Bay
7	59° 30.0'	153° 10.0'	35	Lower Cook Inlet
8	59° 14.0'	153° 40.0'	29	Kamishak Bay
9	59° 02.0'	151° 58.0'	196	Kennedy Entrance
10	58° 52.0'	150° 51.0'	210	Gulf of Alaska
11	58° 23.0'	148° 03.0'	1005	Gulf of Alaska
13	60° 42.0'	147° 41.0'	686	Prince William Sound
14	58° 24.0'	149° 05.0'	214	Gulf of Alaska

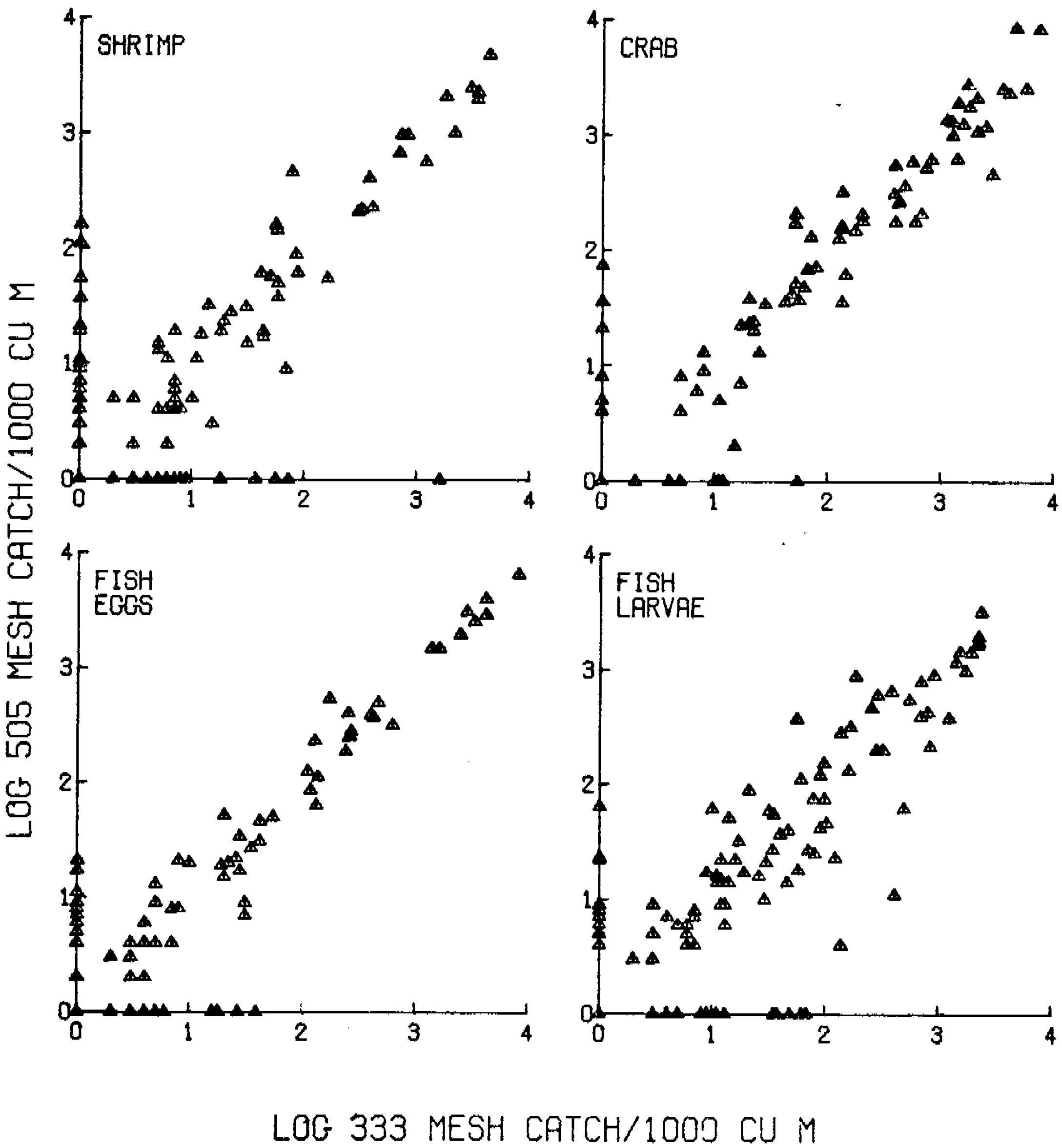
Table 2. Samples taken at ten locations on seven seasonal cruises in Lower Cook Inlet, April 1976 through February 1977.

Station	6-13 Apr	6-9 May	22-30 May	8-15 Jul	24-31 Aug	17-29 Oct	21-26 Feb
1	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X
7	X	X	X	X	X	X	X
8		X	X	X	X	X	X
9	X	X		X	X	X	X
10	X		X	X	X		X

Table 3. Percentage of sample volume examined for four categories of organisms.

Percentage	Crabs	Shrimps	Fish Eggs	Fish Larvae
100	18	51	54	53
50 or more	30	7	7	6
25 or more	7	4	4	4
12 or more	5	1	1	1
6 or more	3	0	0	2
3 or more	3	0	0	0

Figure 2. Comparison of concentrations between 333 and 505 µm mesh nets



concentrations. Those mean concentrations per cubic meter were transformed, based on the depth of each sample, to abundance per 10 square meters for graphical and tabular presentations.

The methods of laboratory analysis are unchanged from earlier reports.

D. Sample Localities

See Figure 1 and Table 1.

E. Data Analyzed

The number and kinds of net hauls analyzed from the *Discoverer* cruise, Leg III, 06-13 April 1976, are reported in Tables 4, 5 and 6. Thirteen replicate samples were collected by standard MARMAP procedures using a 60 centimeter bongo net with 333 and 505 μm mesh sizes. Fifteen samples were collected using a 1-m NIO (National Institute of Oceanography) net with 571 μm mesh. One sample was collected with a Miller net, one sample with a 3-m NIO net and one sample with a 5 x 6-m NIO. The Miller net mesh size was 571 μm; the two NIO nets had 2 inch meshes. Samples were collected at 11 stations, including 2 in the Gulf of Alaska and 1 in Prince William Sound.

The number and kinds of net hauls analyzed from the *Discoverer* cruise, Leg V, 05-09 May 1976, are reported in Tables 7 and 8. Twelve replicate samples were collected by standard MARMAP procedures using a 60 centimeter bongo net with 333 and 505 μm mesh sizes, and one sample was collected with a 1-m NIO (National Institute of Oceanography) net at 11 stations, including 1 station in the Gulf of Alaska.

The number and kinds of net hauls analyzed from the *Discoverer* cruise, Leg VII, 22-30 May 1976, are reported in Tables 9 and 10. Eighteen replicate samples were collected by standard MARMAP procedures using a 60 centimeter bongo net with 333 and 505 μm mesh sizes, and one sample was collected with a 1-m NIO net at twelve stations, including 3 stations in the Gulf of Alaska and one in Prince William Sound.

The number and kinds of net hauls analyzed from the *Acona* cruise, Leg III, 08-15 July 1976, are reported in Table 11. Fifteen replicate samples were collected by standard MARMAP procedures using a 60 centimeter bongo net with 333 and 505 μm mesh sizes at 11 stations, including 2 stations in the Gulf of Alaska.

The number and kinds of net hauls analyzed from the *Surveyor* cruise, Leg II, 24-31 August 1976, are reported in Table 12. Fifteen replicate samples were collected by standard MARMAP procedures using a 60 centimeter bongo net with 333 and 505 μm mesh sizes at 13 stations, including 3 stations in the Gulf of Alaska and 1 in Prince William Sound.

Table 4. UW Haul Summary Sheet, *Discoverer*, Leg III, 06-13 April 1976

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Maximum Sampling Depth (m)	Speed (m/sec)	Duration of Haul (secs)	Volume[a] Filtered (m^3)
7 Apr	0844	1	1	58° 52.7'	152° 42.8'	125	2.2	600	350
7 Apr	1620	2	2	59° 23.2'	152° 41.5'	--[b]	1.1	251	79
7 Apr	2239	3	2	59° 56.5'	152° 11.7'	--[c]	1.4	276	106
8 Apr	0440	4	1	60° 40.5'	151° 35.0'	--[c]	1.4	240	95
8 Apr	1520	5	3	59° 32.0'	151° 39.5'	--[d]	2.2	446	272
8 Apr	1635	6	1	59° 35.9'	151° 21.6'	40	1.8	411	208
9 Apr	0155	6	5	59° 36.3'	151° 19.5'	59	1.8	690	353
10 Apr	0810	7	1	59° 30.7'	153° 06.6'	41	1.2	180	64
10 Apr	1536	9	2	59° 01.7'	151° 54.2'	147	1.9	1143	612
10 Apr	2120	10	1	58° 51.8'	150° 41.4'	110	1.5	840	359
11 Apr	1255	11	2	58° 27.4'	148° 08.3'	130	1.8	720	365
12 Apr	0355	13	2	60° 41.8'	147° 41.7'	190	1.7	1338	657
12 Apr	1448	13	4	60° 41.7'	147° 41.1'	350	1.4	2992	1186

[a] Averaged [b] BKG not used [c] Depth greater than spring maximum [d] BKG not calibrated

Table 5. UW Haul Summary Sheet, *Discoverer*, Leg III, 06-13 April 1976

1-m NIO Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Maximum Sampling Depth (m)	Tow[a] Type	Speed (m/sec)	Duration of Haul (secs)	Volume[b] Filtered (m^3)
7 Apr	0916	1	2	58° 52.7'	152° 46.6'	100[d]	DO	∿1.3[e]	607	∿790[e]
7 Apr	1639	2	3	59° 22.7'	152° 40.2'	--[f]	DO	∿2.0[e]	268	∿536[e]
7 Apr	2217	3	1	59° 56.5'	152° 11.7'	80	DO	0.9	476	413
8 Apr	0456	4	2	60° 40.5'	151° 35.0'	30	DO	2.1	220	456
8 Apr	1507	5	2	59° 31.6'	151° 42.0'	38	DO	2.2	296	659
8 Apr	1650	6	2	59° 36.5'	151° 19.0'	75	DO	1.2	391	481
9 Apr	0115	6	4	59° 36.5'	151° 19.8'	36	DO	1.5	656	975
9 Apr	0610	6	6	59° 36.4'	151° 18.2'	25	HZ	2.0	1420	2920
9 Apr	1457	6	7	59° 36.5'	151° 19.0'	64	HZ	1.5	732	1079
9 Apr	1628	6	8	59° 36.5'	151° 19.1'	27	HZ	∿2.0[e]	741	∿1487[e]
10 Apr	1515	9	1	59° 01.5'	151° 54.2'	29	HZ	2.6	631	167
10 Apr	2243	10	2	58° 51.8'	150° 42.0'	100	DO	1.4	1200	1634
12 Apr	0224	13	1	60° 41.5'	147° 41.0'	20	HZ	∿1.5[e]	732	∿1100[e]
12 Apr	0632	13	3	60° 41.1'	147° 41.1'	--[c]	DO	1.2	600	723
12 Apr	1640	13	5	60° 42.1'	147° 40.7'	10	HZ	1.9	455	877

[a] Tow type: HZ - horizontal
DO - double oblique

[b] Averaged

[c] BKG not used

[d] Depth estimated by wire angle

[e] TSK malfunctioned

[f] BKG not calibrated

Table 6. UW Haul Summary Sheet, *Discoverer*, Leg III, 06-13 April 1976

Miscellaneous Net Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Net	Tow Type	Maximum Sampling Depth (m)	Speed (m/sec)	Duration of Haul (secs)	Volume[a] Filtered (m^3)
7 Apr	2310	3	3	59° 56.5'	152° 11.7'	5 x 6-m NIO	DO	50[b]	1.5	5700	220,077
10 Apr	1607	9	3	59° 01.3'	151° 56.5'	Miller	HZ	0	6.0	1800	80
11 Apr	0631	11	1	58° 25.1'	148° 05.2'	3-m NIO	HZ	35[b]	2.2	4560	90,288

[a] Averaged.

[b] Depth estimated by wire angle.

Table 7. UW Haul Summary Sheet, *Discoverer*, Leg V, 05-09 May 1976

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Depth (m)	Speed (m/sec)	Duration of Haul (secs)	Volume Filtered[b] (m^3)
6 May	1325	1	1	58° 52.5'	152° 49.2'	170	1.8	1200	645
6 May	1552	2	1	59° 21.0'	152° 39.7'	53	1.3	660	242
6 May	2117	3	1	59° 58.5'	152° 11.4'	65	1.7	594	280
7 May	0259	4	1	60° 39.2'	151° 37.1'	65	1.6	600	260
7 May	1030	5	2	59° 34.4'	151° 47.2'	20	2.4	360	244
7 May	1312	6	1	59° 37.0'	151° 18.3'	75	1.4	480	182
7 May	1709	6	2	59° 37.1'	151° 19.0'	70	1.5	656	268
8 May	0020	5a	1	59° 34.6'	151° 47.5'	25[a]	1.7	240	116
8 May	0402	7	1	59° 30.0'	153° 10.4'	35	--[c]	420	--[c]
8 May	0734	8	1	59° 14.2'	153° 40.3'	32[a]	1.3	331	121
8 May	1315	9	1	59° 02.0'	151° 59.1'	130	1.6	1200	546
9 May	0145	11	1	58° 21.8'	148° 01.7'	195[a]	1.6	1740	795

[a] Estimated by wire angle [b] Averaged [c] TSK malfunctioned

Table 8. UW Haul Summary Sheet, *Discoverer*, Leg V, 05-09 May 1976

1-m NIO Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Maximum Sampling Depth (m)	Speed (m/sec)	Duration of Haul (secs)	Volume Filtered[a] (m^3)
7 May	1757	6	3	59° 37.2'	151° 17.6'	40	1.1	619	710

[a] Averaged

Table 9. UW Haul Summary Sheet, *Discoverer*, Leg VII, 22-30 May 1976

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Maximum Sampling Depth (m)	Speed (m/sec)	Duration of Haul (secs)	Volume Filtered[a] (m^3)
25 May	0732	1	1	58° 53.7'	152° 47.5'	105	1.9	1240	652
25 May	1150	2	1	59° 23.9'	152° 37.3'	40	1.6	480	216
25 May	1607	3	1	59° 58.6'	152° 13.4'	58	1.4	420	170
25 May	2217	4	1	60° 41.3'	151° 37.5'	40	1.5	604	252
26 May	0541	5a	2	59° 35.1'	151° 45.9'	45	1.6	311	149
26 May	0835	6	1	59° 36.7'	151° 17.8'	90	1.4	539	221
26 May	1928	6	3	59° 36.6'	151° 18.6'	67	1.8	418	212
27 May	0056	6	4	59° 36.5'	151° 19.5'	51	1.4	420	174
27 May	0708	6	7	59° 36.5'	151° 19.6'	50	1.7	389	193
27 May	1300	7	1	59° 29.4'	153° 09.6'	36	1.1	490	156
27 May	1701	8	1	59° 13.4'	153° 38.5'	32	1.3	240	87
30 May	1813	10	1	58° 52.0'	150° 41.4'	90	1.7	710	348
30 May	0253	11	1	58° 24.1'	148° 06.2'	130	1.8	1581	797
30 May	0813	11	2	58° 21.3'	148° 02.4'	265	1.5	1809	764

[a] averaged

Table 9. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Maximum Sampling Depth (m)	Speed (m/sec)	Duration of Haul (secs)	Volume Filtered[a] (m^3)
28 May	1831	13	1	60° 42.1'	147°40.5'	165	1.9	1735	1055
28 May	2248	13	2	60° 42.5'	147° 40.7'	230	2.0	3960	2244
29 May	1029	13	3	60° 42.6'	147° 40.9'	190	2.3	1680	1114
28 May	0536	14	1	59° 24.6'	149° 05.0'	165	1.8	1378	708

[a] Averaged

Table 10. UW Haul Summary Sheet, *Discoverer*, Leg VII, 22-30 May 1976

1-m NIO Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Maximum Sampling Depth (m)	Speed (m/sec)	Duration of Haul (secs)	Volume Filtered[a] (m^3)
27 May	0120	6	5	59° 36.7'	151° 19.5'	49	1.2	480	581

[a] averaged

Table 11. UW Haul Summary Sheet, *Acona*, Leg II, 08-15 July 1976

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Maximum Sampling Depth (m)	Speed (m/sec)	Duration of Haul (secs)	Volume Filtered[a] (m^3)
13 July	0119	1	1	58° 53.0'	152° 48.0'	150	1.5	1445	616
12 July	1133	2	1	59° 23.0'	152° 40.0'	30	1.8	490	245
10 July	0901	3	1	60° 00.0'	152° 10.0'	83	1.0	720	207
10 July	1556	4	1	60° 38.1'	151° 38.5'	60	2.0	540	297
11 July	0018	5a	1	59° 35.0'	151° 48.0'	28	2.0	300	168
11 July	1009	6	2	59° 37.0'	151° 19.0'	27	1.6	240	108
11 July	1031	6	3	59° 37.0'	151° 19.0'	73	1.9	540	283
11 July	2051	6	4	59° 37.0'	151° 19.0'	17	2.2	435	272
11 July	2113	6	5	59° 37.0'	151° 19.0'	45	2.1	632	373
10 July	0405	7	1	59° 30.0'	153° 10.0'	20	1.8	420	209
10 July	0010	8	1	59° 14.0'	153° 40.0'	23	2.8	275	221
13 July	0548	9	1	59° 02.0'	151° 58.0'	200	1.4	1829	732
13 July	1230	10	1	58° 52.1'	150° 48.7'	104	2.5	1371	958
13 July	2243	11	1	58° 24.0'	148° 02.0'	207	1.7	1805	880
14 July	0835	11	2	58° 24.0'	148° 02.0'	206	1.8	1890	956

[a] averaged

Table 12. UW Haul Summary Sheet, *Surveyor*, Leg II, 24-31 August 1976

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Maximum Sampling Depth (m)	Speed (m/secs)	Duration of Haul (secs)	Volume Filtered[a] (m^3)
25 Aug	0840	1	1	58° 54.6'	152° 45.4'	163	1.2	1391	476
25 Aug	1206	2	1	59° 22.1'	152° 40.0'	70	--[b]	540	--[b]
25 Aug	1952	3	1	59° 59.5'	152° 11.0'	48	1.4	566	217
26 Aug	0400	4	1	60° 41.6'	151° 37.4'	90	2.1	543	322
26 Aug	1040	5a	1	59° 36.5'	151° 50.9'	30	2.7	360	277
26 Aug	2203	6	1	59° 36.5'	151° 17.7'	40	3.2	539	488
27 Aug	1000	6	2	59° 36.8'	151° 16.9'	50	2.0	660	370
28 Aug	0650	7	1	59° 29.8'	153° 09.5'	48	2.0	368	1190
28 Aug	0330	8	1	59° 14.8'	153° 40.8'	34	0.3	152	33
28 Aug	1832	9	1	59° 02.2'	151° 59.0'	100	1.4	620	1387
28 Aug	1919	9	2	59° 01.8'	151° 58.0'	115	0.9	1407	1989
29 Aug	0459	10	1	58° 51.2'	150° 37.8'	135	1.2	1044	1907
29 Aug	1922	11	1	58° 23.1'	148° 06.5'	270	1.4	1631	3645
31 Aug	0641	13	1	60° 41.7'	147° 41.4'	165	1.4	2058	848
30 Aug	0459	14	1	59° 23.5'	149° 04.0'	170	0.8	2145	468

[a] averaged

[b] TSK's malfunctioned

The number and kinds of net hauls analyzed from the *Miller Freeman* cruise, Leg III, 17-29 October 1976, are reported in Table 13. Nine replicate samples were collected by standard MARMAP procedures using a 60 centimeter bongo net with 333 and 505 μm mesh sizes at 9 stations.

The number and kinds of net hauls analyzed from the *Discoverer* cruise, Leg I, 21-26 February 1977, are reported in Table 14. Eighteen replicate samples were collected by standard MARMAP procedures using a 60 centimeter bongo net with 333 and 505 μm mesh sizes at 11 stations, including 2 stations in the Gulf of Alaska.

F. Milestone Chart

The Milestone Chart (Table 15) covers the contract period of this report from October 1976 to October 1977.

III. Results

The summaries of samples analyzed from the *Discoverer* cruise, Leg III, 06-13 April 1976, cover the taxonomic categories of fish eggs, fish larvae, crab and shrimp larvae and adult shrimps (Tables 16-25). These data are complete and correct and correspond to data cards (024 DIS001 DISCOVERER III 76/04/06 - 76/04/13 GOA/ICHTHYOPLANKTON).

The summaries of samples analyzed from the *Discoverer* cruise, Leg V, 05-09 May 1976, cover the same taxonomic categories (Tables 26-31). These data are complete and correct and correspond to data cards (024 DIS002 DISCOVERER V 76/05/05 - 76/05/09 GOA/ICHTHYOPLANKTON).

The summaries of samples analyzed from the *Discoverer* cruise, Leg VII, 22-30 May 1976 cover the same taxonomic categories (Tables 32-37). These data are complete and correct and correspond to data cards (024 DIS003 DISCOVERER VII 76/05/22 - 76/05/30 GOA/ICHTHYOPLANKTON).

The summaries of samples analyzed from the *Acona* cruise, Leg II, 08-15 July 1976 cover the same taxonomic categories (Tables 38-42). Crab larvae were sorted from the 505 μm mesh nets, but not the 333 μm mesh nets. All other data are complete and correct and correspond to data cards (024 ACØ001 ACONA II 76/07/08 - 76/07/15 GOA/MEROPLANKTON).

The summaries of samples analyzed from the *Surveyor* cruise, Leg II, 24-31 August 1976, cover the same taxonomic categories (Tables 43-47). Crab larvae were sorted from the 505 μm mesh nets, but not the 333 μm mesh nets. All other data are complete and correct and correspond to data cards (024 SUR003 SURVEYOR II 76/08/24 - 76/08/31 GOA/MEROPLANKTON).

The summaries of samples analyzed from the *Miller Freeman* cruise, Leg III, 17-29 October 1976, cover the same taxonomic categories (Tables 48-52). Crab larvae were sorted from the 505 μm mesh nets, but only one 333 μm mesh net from station 1, haul 1, was sorted.

Table 13. UW Haul Summary Sheet, *Miller Freeman*, Leg III, 17-29 October 1976

Bongo Tows

(1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Maximum Sampling Depth (m)	Speed (m/sec)	Duration of Haul (secs)	Volume Filtered[a] (m^3)
19 Oct	0400	1	1	58° 54.3'	152° 51.1'	172	1.2	705	244
28 Oct	0845	2	2	59° 22.8'	152° 40.8'	66	1.6	294	130
23 Oct	1935	3	1	60° 00.8'	152° 13.6'	57	1.9	212	115
24 Oct	1004	4	1	60° 38.4'	151° 39.0'	50	1.5	375	162
23 Oct	1006	5a	1	59° 35.1'	151° 49.2'	35	1.9	203	110
22 Oct	1758	6	1	59° 36.7'	151° 16.8'	75	1.6	350	162
21 Oct	0907	7	1	59° 29.9'	153° 10.0'	31	1.0	165	45
22 Oct	0403	8	1	59° 15.9'	153° 41.8'	27	2.2	246	153
28 Oct	1244	9	1	59° 02.6'	151° 59.4'	199	2.5	1000	706

[a] averaged

Table 14. UW Haul Summary Sheet, *Discoverer*, Leg I, 21-26 February 1977

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Latitude (N)	Longitude (W)	Maximum Sampling Depth (m)	Speed (m/sec)	Duration of Haul (secs)	Volume Filtered[a] (m^3)
24 Feb	1331	1	1	58° 52.4'	152° 48.9'	105	2.8	926	737
22 Feb	0736	2	1	59° 23.1'	152° 39.5'	68	1.4	584	223
25 Feb	2340	2	3	59° 22.3'	152° 38.2'	38	1.6	240	106
22 Feb	2180	3	1	59° 59.2'	152° 12.0'	35	1.8	480	241
22 Feb	1723	4	1	60° 41.7'	151° 37.2'	60	1.8	510	261
22 Feb	0447	5a	1	59° 34.4'	151° 49.8'	40	1.6	309	139
23 Feb	0415	5a	2	59° 34.7'	151° 49.2'	22	1.6	218	98
25 Feb	0031	5a	3	59° 34.8'	151° 48.0'	30	1.9	292	158
25 Feb	0745	5a	4	59° 34.6'	151° 48.6'	26	2.2	279	171
22 Feb	0050	6	1	59° 36.6'	151° 17.8'	70	2.0	636	362
23 Feb	0645	6	2	59° 36.8'	151° 16.3'	70	1.4	966	397
25 Feb	0235	6	3	59° 36.7'	151° 15.8'	50	1.7	560	267
25 Feb	1039	6	4	59° 36.7'	151° 17.7'	30	2.2	527	328
24 Feb	1604	7	1	59° 18.3'	153° 07.3	58	1.2	341	119
26 Feb	0429	8	3	59° 15.7'	153° 30.5'	30	1.6	163	75
23 Feb	1055	9	1	59° 00.7'	151° 59.2'	188	1.2	1380	481
23 Feb	1501	10	1	58° 52.2'	150° 40.2'	110	1.5	683	307
23 Feb	2137	11	1	58° 22.0'	148° 02.7'	180	1.6	1366	862

[a] averaged

Table 15. Milestone Chart

RU #: 424 PI: T. Saunders English

Major Milestones: Reporting, data management and other significant contractual requirements; periods of field work; workshops; etc.

MAJOR MILESTONES	1976			1977											
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Autumn Sampling	├▲	—	┤												
Quarterly Report 1			▲												
Submit Summer 76 Cruise Data				△							▲				
Winter-Early Spring Sampling				├	▲	┤									
Quarterly Report 2						△									
Annual Report						▲									
Submit Fall 76 Data							△					▲			
Quarterly Report 3									▲						
Submit Winter-Early Spring 77 Data										△		▲			
Final Report												△			
Quarterly Report 4												▲			

△ Planned Completion Date ▲ Actual Completion Date

Table 16. Number of Fish Eggs and Larvae at each Station

Lower Cook Inlet Bongo Tows, *Discoverer*, Leg III, 6-13 April 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
7 Apr	0844	1	1	333	0	4
7 Apr	0844	1	1	505	1	3
7 Apr	1620	2	2	333	0	0
7 Apr	1620	2	2	505	0	0
7 Apr	2239	3	2	333	1	3
7 Apr	2239	3	2	505	2	1
8 Apr	0440	4	1	333	0	0
8 Apr	0440	4	1	505	0	0
8 Apr	1520	5	3	333	0	1
8 Apr	1520	5	3	505	4	5
8 Apr	1635	6	1	333	5	3
8 Apr	1635	6	1	505	0	3
9 Apr	0155	6	5	333	15	7
9 Apr	0155	6	5	505	12	7
10 Apr	0810	7	1	333	16	1
10 Apr	0810	7	1	505	16	2
10 Apr	1536	9	2	333	1	16
10 Apr	1536	9	2	505	2	13
10 Apr	2120	10	1	333	1	2
10 Apr	2120	10	1	505	1	1
11 Apr	1255	11	2	333	1	13
11 Apr	1255	11	2	505	8	8
12 Apr	0355	13	2	333	512	4156
12 Apr	0355	13	2	505	504	3680
12 Apr	1448	13	4	333	2622	8056
12 Apr	1448	13	4	505	3336	8112

1-m NIO Tows (571 μm mesh size)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Eggs	Fish or Larvae
7 Apr	0916	1	2	0	2
7 Apr	1639	2	3	0	2
7 Apr	2217	3	1	1	9

Table 16. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Eggs	Fish or Larvae
8 Apr	0456	4	2	0	1
8 Apr	1507	5	2	2	13
8 Apr	1650	6	2	7	16
9 Apr	0115	6	4	12	24
9 Apr	0610	6	6	28	107
9 Apr	1457	6	7	6	17
9 Apr	1628	6	8	21	14
10 Apr	1515	9	1	1	10
10 Apr	2243	10	2	2	4
12 Apr	0224	13	1	396	5880
12 Apr	0632	13	3	115,200	69
12 Apr	1640	13	5	456	5040

Miscellaneous Net Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Net	Eggs	Fish or Larvae
7 Apr	2310	3	3	5 x 6-m NIO	--	195
10 Apr	1607	9	3	Miller	0	0
11 Apr	0631	11	1	3-m NIO	--	109

Table 17. Summary of taxonomic categories of fish eggs, larvae, young and adults found in Bongo, 1-m, 3-m, and 5 x 6-m NIO net samples collected on the Lower Cook Inlet *Discoverer* cruise, Leg III, 6-13 April 1976

A total of 44 samples contained 123,192 fish eggs and 35,609 fish and larvae that were examined. The fish were distributed into 11 families, 15 genera and 12 species. The eggs are distributed into 4 size categories.

Family Ammodytidae

189 larvae sandlance[1] *Ammodytes hexapterus* Pallas

Family Bathylagidae

2745 larvae northern smoothtongue *Bathylagus stilbius* (Gilbert)

Family Cottidae

1 adult marbled sculpin *Oligocottus rimensis* (Greeley)
1 larva genus? species?

Family Gadidae

32,083 larvae Alaska pollock *Theragra chalcogramma* (Pallas)
1 young Pacific tomcod *Microgadus proximus* (Girard)
125 larvae genus? species?

Family Liparidae

2 young marbled snailfish *Liparis dennyi* Jordan and Starks

Family Myctophidae

29 larvae smallfin lanternfish *Stenobrachius leucopsarus* (Eigenmann and Eigenmann)
125 young smallfin lanternfish *Stenobrachius leucopsarus* (Eigenmann and Eigenmann)
11 larvae lanternfish genus? species?

Family Osmeridae

17 larvae capelin *Mallotus villosus* Müller
3 larvae longfin smelt *Spirinchus thaleichthys* (Ayres)
189 young longfin smelt *Spirinchus thaleichthys* (Ayres)
1 adult candlefish *Thaleichthys pacificus* (Richardson)
1 young genus? species?

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[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 17. (continued)

Family Pleuronectidae

1 larva Pacific halibut *Hippoglossus stenolepis* Schmidt

Family Scorpaenidae

18 larvae rockfishes *Sebastes* sp.

Family Stichaeidae

2 larvae cockscomb *Anoplarchus* sp.
1 larva prickleback *Lumpenus* sp.

Family Zoarcidae

8 young pallid eelpout *Lycodapus mandibularis* Gilbert

56 larvae unidentified

123,192 eggs categorized (see Table 18, List of Possible Fish for Egg Size Categories):

16	eggs	< 1 mm	(0.74-0.88 mm)
121,419	eggs	∿ 1 mm	(0.90-1.28 mm)
1,635	eggs	∿ 2 mm	(1.30-2.54 mm)
122	eggs	∿ 3 mm	(2.56-3.90 mm)

Table 18. List of Possible Fish for Egg Size Categories

< 1 mm category (0.74-0.88 mm)

Limanda aspera
Limanda proboscidea

∿ 1 mm category (0.90-1.28 mm)

Gadus macrocephalus
Isopsetta isolepis
Parophrys vetulus
Platichthys stellatus
Psettichthys melanostictus

∿ 2 mm category (1.30-2.54 mm)

Bathylagus stilbius
Eopsetta jordani
Glyptocephalus zachirus
Lyopsetta exilis
Microstomus pacificus
Pleuronectes quadrituberculatus
Pleuronichthys coenosus
Pleuronichthys decurrens
Theragra chalcogramma

∿ 3 mm category (2.56-3.90 mm)

Hippoglossoides elassodon
Hippoglossoides robustus
Hippoglossus stenolepis

Table 19. Identification of Fish Eggs and Larvae by Station
Cook Inlet Bongo Tows, *Discoverer*, Leg III, 06-13 April 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 Apr	0844	1	1	333	0[a]	4[a]	1 larva 8.2 mm[b] *Ammodytes hexapterus*
							2 larvae 31, 44 mm *Mallotus villosus*
							1 larva 4.5 mm *Stenobrachius leucopsarus*
7 Apr	0844	1	1	505	1	3	1 egg ∿ 2 mm (1.44 mm)
							2 larvae 6.7, 7.7 mm *Ammodytes hexapterus*
							1 larva 45 mm *Mallotus villosus*
7 Apr	2239	3	2	333	1	3	1 egg ∿ 1 mm (1.14 mm)
							3 larvae 7.0 mm *Ammodytes hexapterus*
7 Apr	2239	3	2	505	2	1	2 eggs ∿ 1 mm (1.10 mm)
							1 larva 7.0 mm *Ammodytes hexapterus*

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

Table 19. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
8 Apr	1520	5	3	333	0	1	1 larva 9.0 mm *Sebastes* sp.
8 Apr	1520	5	3	505	4	5	4 eggs ∿ 1 mm (1.10 mm)
							1 larva 7.0 mm damaged, probably *Ammodytes hexapterus*
							4 larvae 8.0-9.0 mm *Sebastes* sp.
8 Apr	1635	6	1	333	5	3	5 eggs ∿ 1 mm (1.03 mm)
							2 larvae 4.8, 5.6 mm *Ammodytes hexapterus*
							1 larva 14 mm Myctophidae
8 Apr	1635	6	1	505	0	3	2 larvae 4.8, 6.1 mm *Ammodytes hexapterus*
							1 larva 28 mm *Mallotus villosus*
9 Apr	0155	6	5	333	15	7	14 eggs ∿ 1 mm (1.03 mm)
							1 egg ∿ 2 mm (1.36 mm)
							6 larvae 6.0-8.0 mm *Ammodytes hexapterus*
							1 larva 16 mm Myctophidae
9 Apr	0155	6	5	505	12	7	11 eggs ∿ 1 mm (1.10 mm)
							1 egg ∿ 2 mm (1.40 mm)
							6 larvae 4.8-7.5 mm *Ammodytes hexapterus*
							1 larva 18 mm Myctophidae

Table 19. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
10 Apr	0810	7	1	333	16	1	16 eggs ∿ 1 mm (1.03 mm) 1 larva 5.0 mm *Ammodytes hexapterus*
10 Apr	0810	7	1	505	16	2	16 eggs ∿ 1 mm (1.03 mm) 2 larvae 6.0 mm *Ammodytes hexapterus*
10 Apr	1536	9	2	333	1	16	1 egg ∿ 1 mm (1.10 mm) 1 larva 6.0 mm *Ammodytes hexapterus* 3 larvae 35, 42, 45 mm *Mallotus villosus* 7 larvae approximately 4 mm *Theragra chalcogramma* 5 larvae 3.2-7.0 mm elongate, damaged and unidentified
10 Apr	1536	9	2	505	2	13	2 eggs ∿ 2 mm (1.44 mm) 1 larva 9.0 mm *Bathylagus stilbius* 3 larvae 40-43 mm *Mallotus villosus* 5 larvae 4.0-4.4 mm *Theragra chalcogramma* 4 larvae 4.0-6.0 mm unidentified
10 Apr	2134	10	1	333	1	2	1 egg ∿ 1 mm (1.20 mm) 1 larva 5.0 mm Myctophidae 1 larva 5.0 mm with 2 dorsal bands, unidentified

Table 19. (continued)

Date (1976 (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
10 Apr	2120	10	1	505	1	1	1 egg ∿ 1 mm (1.20 mm)
							1 larva 4.0 mm *Ammodytes hexapterus*
11 Apr	1255	11	2	333	1	13	1 egg ∿ 1 mm (egg not measured)
							4 larvae 6.0 mm *Stenobrachius leucopsarus*
							9 young 19-36 mm *Stenobrachius leucopsarus*
11 Apr	1255	11	2	505	8	8	8 eggs < 1 mm (0.70-0.98 mm)
							1 larva 13 mm *Hippoglossus stenolepis*
							7 young 21-50 mm *Stenobrachius leucopsarus*
12 Apr	0355	13	2	333	512[c]	4156[c]	500 eggs ∿ 2 mm (1.24-1.56 mm)
							12 eggs ∿ 3 mm (2.40-3.10 mm)
							748 larvae 7.2-10 mm *Bathylagus stilbius*
							3320 larvae approx. 5-6 mm *Theragra chalcogramma*
							84 larvae 5.0-5.4 mm Gadidae
							4 larvae 10 mm unidentified
12 Apr	0355	13	2	505	504[d]	3680[d]	480 eggs ∿ 1 mm (1.20-1.30 mm)

[c] The sample was split and 1/4 was sorted for fish eggs and larvae; totals given are for the entire sample.

[d] The sample was split and 1/2 was sorted for fish eggs and larvae; totals given are for the entire sample.

Table 19. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
12 Apr	0355	13	2	505	504	3680	18 eggs ∿ 2 mm (1.68-1.80 mm)
							6 eggs ∿ 3 mm (2.44-3.10 mm)
							2 larvae 7.0 mm *Anoplarchus* sp.
							648 larvae 7.0-11 mm *Bathylagus stilbius*
							3030 larvae 4.0-8.0 mm *Theragra chalcogramma*
12 Apr	1448	13	4	333	2622[e]	8056[e]	2546 eggs ∿ 1 mm (1.20-1.30 mm)
							76 eggs ∿ 2 mm (1.90-2.00 mm)
							532 larvae 8.0-10 mm *Bathylagus stilbius*
							7524 larvae 4.0-6.0 mm extensively damaged *Theragra chalcogramma*
12 Apr	1448	13	4	505	3336[f]	8112[f]	3048 eggs ∿ 1 mm (1.20-1.35 mm)
							264 eggs ∿ 2 mm (1.60-1.75 mm)
							24 eggs ∿ 3 mm (2.72-3.00 mm)
							816 larvae 5.6-10 mm *Bathylagus stilbius*
							8 young 115 mm *Lycodapus mandibularis*

[e] The total sample had nine 32 oz. jars; settled volume was 4.8 liters. 126 ml or 1/38 of the sample was sorted for fish eggs and larvae; totals given are for entire sample.

[f] The sample was split and 1/8 was sorted for fish eggs and larvae; totals given are for the entire sample.

Table 19. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
12 Apr	1448	13	4	505	3336	8112	7272 larvae 3.0-5.6 mm *Theragra chalcogramma*
							16 larvae 6.0, 11 mm unidentified

Table 20. Identification of Fish Eggs and Larvae by Station

1-m NIO Tows (571 μm mesh size), *Discoverer*, Leg III

Date (1976) (GMT)	Time (GMT)	Station	Haul	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 Apr	0916	1	2	0	2	2 larvae 5.0, 7.0 mm *Ammodytes hexapterus*
7 Apr	1639	2	3	0	2	1 larva 5.0 mm *Ammodytes hexapterus*
						1 larva 9.0 mm *Sebastes* sp.
7 Apr	2217	3	1	1	9	1 egg ∿ 1 mm (1.10 mm)
						9 larvae 7.0 mm *Ammodytes hexapterus*
8 Apr	0456	4	2	0	1	1 larva 6.0 mm *Ammodytes hexapterus*
8 Apr	1507	5	2	2	13	2 eggs ∿ 1 mm (1.10 mm)
						5 larvae 5.0-6.0 mm *Ammodytes hexapterus*
						2 larvae 28, 31 mm *Mallotus villosus*
						2 larvae 8.0 mm *Sebastes* sp.
						4 larvae 11-14 mm Myctophidae
8 Apr	1650	6	2	7	16	7 eggs ∿ 1 mm (1.03 mm)
						15 larvae 4.4-6.8 mm *Ammodytes hexapterus*
						1 larva 18 mm Myctophidae
9 Apr	0115	6	4	12	24	8 eggs ∿ 1 mm (1.10 mm)
						4 eggs ∿ 2 mm (1.40 mm)

Table 20. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
9 Apr	0115	6	4	12	24	20 larvae 4.0-7.2 mm *Ammodytes hexapterus*
						4 larvae 32-40 mm *Mallotus villosus*
9 Apr	0610	6	6	28	107	28 eggs ∿ 1 mm (1.03-1.10 mm)
						79 larvae 5.0-6.0 mm *Ammodytes hexapterus*, many damaged
						1 larva 17 mm *Lumpenus* sp.
						3 larvae 25, 25, 28 mm *Spirinchus thaleichthys*
						22 larvae 10-16 mm *Stenobrachius leucopsarus*
						1 larva 5.6 mm Cottidae
						1 larva 13 mm unidentified
9 Apr	1457	6	7	6	17	5 eggs ∿ 1 mm (1.03 mm)
						1 egg ∿ 2 mm (1.40 mm)
						15 larvae 5.6-7.2 mm *Ammodytes hexapterus*
						2 larvae 16 mm *Stenobrachius leucopsarus*
9 Apr	1628	6	8	21	14	19 eggs ∿ 1 mm (1.03 mm)
						2 eggs ∿ 2 mm (1.40 mm)
						13 larvae 5.0-6.0 mm *Ammodytes hexapterus*, some badly damaged
						1 larva 30 mm *Mallotus villosus*

Table 20. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
10 Apr	1515	9	1	1	10	1 egg ∿ 1 mm (1.10 mm)
						9 larvae 5.0-10 mm *Sebastes* sp.
						1 larva damaged Myctophidae
10 Apr	2243	10	2	2	4	1 egg ∿ 1 mm (0.96 mm)
						1 egg ∿ 2 mm (1.40 mm)
						1 larva 11 mm *Sebastes* sp.
						1 larva 4.4 mm *Theragra chalcogramma*
						1 larva 3.4 mm Myctophidae
						1 larva 6.0 mm with two dorsal bars unidentified (similar to larva in st. #10, haul 1).
12 Apr	0224	13	1	396[a]	5880[a]	8 eggs < 1 mm (0.80 mm)
						340 eggs ∿ 2 mm (1.32-1.40 mm)
						48 eggs ∿ 3 mm (2.95-3.95 mm)
						5880 larvae 5.0-6.0 mm *Theragra chalcogramma*
12 Apr	0632	13	3	115,200[b]	69	115,200 eggs ∿ 1 mm (1.20-1.30 mm) with one 0.16 mm oil globule

[a] The sample was split and 1/4 was sorted for fish eggs and larvae; totals given are for the entire sample.

[b] The total sample had three 1 gallon jars, two of the three jars were broken in transit. Settled volume for the one jar was 2.4 liters. 116 ml or approximately 1/60 of the sample was sorted for fish eggs; totals given are for entire sample.

Table 20. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
12 Apr	0632	13	3	155,200	69	4 larvae 4.0-5.0 mm *Theragra chalcogramma*
						41 larvae 4.8-5.8 mm Gadidae (some damaged larvae)
						1 larva 4.5 mm unidentified (non-elongate)
						1 larva 2.1 mm unidentified (very early embryo that escaped from a ruptured egg)
						22 larvae unidentified due to extensive damage (non-elongate)
12 Apr	1640	13	5	456[c]	5040[c]	424 eggs ∿ 2 mm (1.28-1.36 mm)
						32 eggs ∿ 3 mm (3.00-3.60 mm)
						5040 larvae 4.8-5.5 mm *Theragra chalcogramma*

[c] The sample was split and 1/8 was sorted for fish eggs and larvae; totals given are for the entire sample.

Table 21. Identification of Fish and Larvae by Station

Gulf of Alaska Miscellaneous Net Tows, *Discoverer*, Leg III

Date (1976) (GMT)	Time (GMT)	Station	Haul	Depth (m)	Net	Fish or Larvae	Identification of Fish or Larvae
7 Apr	2310	3	3	50	5 x 6-m NIO	195	2 young 65 mm *Liparis dennyi*
							1 young 90 mm *Microgadus proximus*
							1 adult 65 mm *Oligocottus rimensis*
							189 young 46-106 mm *Spirinchus thaleichthys*
							1 adult 185 mm *Thaleichthys pacificus*
							1 young 53 mm Osmeridae
11 Apr	0631	11	1	35	3-m NIO	109	109 young *Stenobrachius leucopsarus*

Table 22. Summary of taxonomic categories of commercially important crab and shrimp larvae found in bongo, 1-m, 3-m, and 5 x 6-m NIO net samples collected on the Lower Cook Inlet *Discoverer* cruise, Leg III, 6-13 April 1976

A total of 44 samples contained 576 crab zoeae and 28 megalopae. The commercially important crabs were distributed into 3 families, 2 genera, and 2 species. The 44 samples contained 1200 shrimp zoeae and 1702 adults. The commercially important shrimp were distributed into 1 family, 2 genera, and 5 species.

Section Anomura

Family Lithodidae

47 zoeae king crab[1] *Paralithodes camtschatica* (Tilesius)

131 zoeae unidentified, non-commercially important anomurans

Section Brachyura

Family Cancridae

267 zoeae non-commercially important *Cancer* spp.

Family Majidae

25 zoeae tanner crab *Chionoecetes bairdi* (Rathbun)
28 megalopae *Chionoecetes* spp.

106 zoeae unidentified, non-commercially important brachyurans

Section Caridea

Family Pandalidae

40 zoeae sidestripe shrimp *Pandalopsis dispar* Rathbun
402 zoeae northern pink shrimp *Pandalus borealis* Kröyer
15 zoeae humpy shrimp *Pandalus goniurus* Stimpson
1 adult *Pandalus goniurus*
2 zoeae *Pandalus montagui tridens* Rathbun
1 zoeae *Pandalus stenolepis* Rathbun
3 zoeae *Pandalus* spp., damaged

737 zoeae unidentified hippolytids
1701 adult non-commercially important shrimp

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[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 23. Identification of Shrimp and Crab Larvae by Station
Lower Cook Inlet Bongo Tows, *Discoverer*, Leg III, 06-13 April 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
7 Apr	0844	1	1	333		6	unidentified anomurans
7 Apr	0844	1	1	505		2	unidentified anomurans
7 Apr	1620	2	2	333		0	
7 Apr	1620	2	2	505		0	
7 Apr	2239	3	2	333		0	
7 Apr	2239	3	2	505		0	
8 Apr	0440	4	1	333		0	
8 Apr	0440	4	1	505		0	
8 Apr	1520	5	3	333		0	
8 Apr	1520	5	3	505	IV	1	*Cancer oregonensis*
8 Apr	1635	6	1	333	I zoea	3 2	*Paralithodes camtschatica* unidentified anomurans
8 Apr	1635	6	1	505	I zoea	1 1	*Paralithodes camtschatica* unidentified anomuran
9 Apr	0155	6	5	333	I	3	*Paralithodes camtschatica*

Table 23. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
9 Apr	0155	6	5	333	zoea	14	unidentified anomurans
					I	2	*Pandalus borealis*
					I	1	*P. goniurus*
9 Apr	0155	6	5	505	II	1	*Paralithodes camtschatica*
					zoea	13	unidentified anomurans
					I	1	*Pandalopsis dispar*
10 Apr	0810	7	1	333		0	
10 Apr	0810	7	1	505	adult	1	*Pandalus goniurus*
10 Apr	1536	9	2	333	megalopa	2	*Chionoecetes* sp.
					I	1	*Pandalopsis dispar*
10 Apr	1536	9	2	505	I	1	*Pandalus montagui tridens*
10 Apr	2134	10	1	333	megalopa	1	*Chionoecetes* sp.
10 Apr	2134	10	1	505		0	
11 Apr	1307	11	2	333	megalopa	5	*Chionoecetes* sp.
					zoea	1	unidentified brachyuran
					adult	1	*Sergestes* sp.
11 Apr	1307	11	2	505	megalopa	2	*Chionoecetes* sp.
12 Apr	0355	13	2	333	I	10	*Chionoecetes bairdi*
					megalopa	1	*Chionoecetes* sp.
					zoea	28	unidentified anomurans

Table 23. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
12 Apr	0355	13	2	333	zoea	5	unidentified brachyurans
					I	4	*Pandalopsis dispar*
					I	79	*Pandalus borealis*
					II	2	*P. borealis*
					I	1	*P. goniurus*
					I	1	*P. stenolepis*
					zoea	36	unidentified hippolytids
12 Apr	0355	13	2	505	zoea	12	unidentified anomurans
					zoea	3	unidentified brachyurans
					I	3	*Pandalopsis dispar*
					I	53	*Pandalus borealis*
					II	4	*P. borealis*
					I	3	*P. goniurus*
					zoea	111	unidentified hippolytids
12 Apr	1448	13	4	333	I	9	*Chionoecetes bairdi*
					zoea	14	unidentified anomurans
					zoea	4	unidentified brachyurans
					I	15	*Pandalopsis dispar*
					I	22	*Pandalus borealis*
					II	2	*P. borealis*
					zoea	205	unidentified hippolytids
					adult	7	*Pasiphaea* sp.
12 Apr	1448	13	4	505	zoea	5	unidentified anomurans
					zoea	5	unidentified brachyurans
					I	9	*Pandalopsis dispar*

Table 23. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
12 Apr	1448	13	4	505	I	18	*Pandalus borealis*
					II	5	*P. borealis*
					zoea	147	unidentified hippolytids
					adult	9	*Pasiphaea* sp.

Table 24. Identification of Shrimp and Crab Larvae by Station
Lower Cook Inlet 1-m NIO Net Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Stage	Total	Identification of Larvae
7 Apr	0916	1	2		0	
7 Apr	1639	2	3		0	
7 Apr	2217	3	1	adult	7	*Crangon franciscorum angustimana* (2 gravid females)
8 Apr	0456	4	2		0	
8 Apr	1507	5	2	I	1	*Pandalopsis dispar*
				I	9	*Pandalus borealis*
8 Apr	1650	6	2	zoea	2	unidentified anomurans
				zoea	19	unidentified brachyurans
				I	2	*Pandalus borealis*
				I	1	*P. goniurus*
				zoea	6	unidentified hippolytids
9 Apr	0115	6	4	I	19	*Paralithodes camtschatica*
				zoea	6	unidentified anomuran
				zoea	38	unidentified brachyurans
				I	3	*Pandalus goniurus*
				zoea	9	unidentified hippolytids
9 Apr	0210	6	6	megalopa	1	*Chionoecetes* sp.
				I	21	*Paralithodes camtschatica*
				zoea	4	unidentified anomurans

Table 24. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Stage	Total	Identification of Larvae
9 Apr	0210	6	6	zoea	14	unidentified brachyurans
9 Apr	1657	6	7		0	
9 Apr	1828	6	8	zoea	9	unidentified brachyrans
				I	1	*Pandalus borealis*
				I	2	*P. goniurus*
				zoea	5	unidentified hippolytids
10 Apr	1515	9	1	megalopa	11	*Chionoecetes* sp.
					1	unidentified hippolytids
10 Apr	2243	10	2	megalopa	5	*Chionoecetes* sp.
					1	unidentified anomuran
12 Apr	0224	13	1	II	1	unidentified *Cancer* sp.
				I	6	*Chionoecetes bairdi*
				I	2	*Paralithodes camtschatica*
				zoea	20	unidentified anomurans
				zoea	8	unidentified brachyurans
				I	3	*Pandalopsis dispar*
				I	154	*Pandalus borealis*
				II	4	*P. borealis*
				I	1	*P. goniurus*
				I	1	*P. montagui tridens*
				zoea	121	unidentified hippolytids

Table 24. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Stage	Total	Identification of Larvae
12 Apr	0632	13	3	zoea	1	unidentified anomuran
				I	2	*Pandalopsis dispar*
				I	33	*Pandalus borealis*
				I	3	unidentified *Pandalus* sp., damaged
				zoea	15	unidentified hippolytids
12 Apr	1640	13	5	I	1	*Pandalopsis dispar*
				I	12	*Pandalus borealis*
				I	3	*P. goniurus*
				zoea	81	unidentified hippolytids

Table 25. Identification of Shrimp and Crab Larvae by Station

Lower Cook Inlet Misc. Net Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Net	Stage	Total	Identification of Larvae
7 Apr	2310	3	3	5 x 6-m NIO	adult	1	*Crangon alaskensis*
					adult	1629	*Crangon franciscorum angustimana*
					adult	1	*Eualus suckleyi*
					adult	777	*Boreomysis* sp.
10 Apr	1607	9	3	miller		0	
11 Apr	0631	11	1	3-m NIO	adult	46	*Sergestes* sp.

Table 26. Number of fish eggs and larvae at each station Lower Cook Inlet, *Discoverer*, Leg V, 05-09 May 1976

Bongo Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
6 May	1325	1	1	333	42	34
6 May	1325	1	1	505	32	40
6 May	1552	2	1	333	0	26
6 May	1552	2	1	505	3	13
6 May	2117	3	1	333	41	12
6 May	2117	3	1	505	37	18
7 May	0259	4	1	333	0	3
7 May	0259	4	1	505	0	2
7 May	1030	5	2	333	40	119
7 May	1030	5	2	505	136	852
7 May	1312	6	1	333	992	290
7 May	1312	6	1	505	1616	326
7 May	1709	6	2	333	1296	352
7 May	1709	6	2	505	364	236
8 May	0020	5a	1	333	48	182
8 May	0020	5a	1	505	50	162
8 May	0402	7	1	333	54	4
8 May	0402	7	1	505	60	8
8 May	0734	8	1	333	360	17
8 May	0734	8	1	505	353	20
8 May	1315	9	1	333	25	22
8 May	1315	9	1	505	24	18
9 May	0145	11	1	333	11	44
9 May	0145	11	1	505	11	24

1-m NIO Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
7 May	1757	6	3	571	1096	352

Table 27. Summary of taxonomic categories of fish eggs, larvae, young and adults found in Bongo and 1-m NIO net samples collected on Lower Cook Inlet, *Discoverer* cruise, Leg V, 05-09 May 1976.

A total of 25 samples were collected. The fish are distributed into 15 families, 16 genera and 11 species. The eggs are distributed into 4 size categories.

Family Agonidae

24 larvae genus? species?

Family Ammodytidae

1373 larvae sandlance[1] *Ammodytes hexapterus* Pallas

Family Bathylagidae

4 larvae smoothtongue *Bathylagus stilbius* (Gilbert)

Family Bathymasteridae

18 larvae genus? species?

Family Cottidae

3 larvae cabezon *Scorpaenichthys marmoratus* (Ayres)
120 larvae genus? species?

Family Cyclopteridae

12 larvae genus? species?

Family Gadidae

20 larvae Alaska pollock *Theragra chalcogramma* (Pallas)
77 larvae genus? species?

Family Liparidae

1 larva snailfish *Liparis* sp.

Family Myctophidae

23 larvae northern lampfish *Stenobrachius leucopsarus* (Eigenmann and Eigenmann)
6 larvae genus? species?

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[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 27. (continued)

Family Osmeridae

11 larvae capelin *Mallotus villosus* (Müller)
4 larvae longfin smelt *Spirinchus thaleichthys* (Ayres)
11 larvae genus? species?

Family Pholidae

4 larvae penpoint gunnel *Apodichthys flavidus* Girard
4 larvae gunnel *Pholis* sp.
96 larvae genus? species?

Family Pleuronectidae

11 larvae butter sole *Isopsetta isolepis* (Lockington)
4 larvae rock sole *Lepidopsetta bilineata* (Ayres)?

Family Scorpaenidae

16 larvae rockfish *Sebastes* sp.
3 larvae genus? species?

Family Stichaeidae

10 larvae cockscomb *Anoplarchus* sp.
1137 larvae prickleback *Lumpenus* spp.
2 larvae rock prickleback *Xiphister mucosus* (Girard)

Family Tetragonuridae

1 larva genus? species?

181 larvae unidentified

6691 eggs categorized (see Table 18, List of possible fish for egg size categories):

12 eggs < 1 mm (0.74-0.88 mm)
6510 eggs ∿ 1 mm (0.90-1.28 mm)
78 eggs ∿ 2 mm (1.30-2.54 mm)
89 eggs ∿ 3 mm (2.56-3.90 mm)
2 eggs unidentified, damaged

Table 28. Identification of Fish Eggs and Larvae by Station
Lower Cook Inlet Bongo Tows, *Discoverer*, Leg V, 05-09 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
6 May	1325	1	1	333	42[a]	34[a]	2 eggs ∿ 2 mm (1.60 mm)[b]
							38 eggs ∿ 3 mm (2.90-3.20 mm)
							2 eggs damaged unidentified
							4 larvae 32, 42 mm *Mallotus villosus*
							2 larvae 9.7 mm *Sebastes* sp.
							8 larvae 4.4 mm *Stenobrachius leucopsarus*
							8 larvae 3.6-5.2 mm *Theragra chalcogramma*
							6 larvae 5.5 mm Myctophidae
							2 larvae 10 mm unidentified (elongate)
							4 larvae unidentified due to extensive damage

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature. The sample was split and 1/2 was sorted for fish eggs and larvae; totals given are for the entire sample.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
6 May	1325	1	1	505	32	40	3 eggs ∿ 1 mm (1.28 mm)
							29 eggs ∿ 3 mm (2.97-3.52 mm) (27 whole eggs, 2 yolksac embryos without membrane)
							4 larvae 7.2-54 mm *Mallotus villosus*
							9 larvae 4.0-5.2 mm *Stenobrachius leucopsarus*
							4 larvae 3.6-5.2 mm *Theragra chalcogramma*
							8 larvae 6.0-7.0 mm Bathymasteridae
							8 larvae 3.1-11 mm Gadidae
							1 larva 8.0 mm Scorpaenidae
							6 larvae 5.0 mm damaged, unidentified
6 May	1552	2	1	333	0	26	4 larvae 7.7-18 mm *Sebastes* sp.
							2 larvae 6.0 mm *Stenobrachius leucopsarus*
							2 larvae 3.8 mm *Theragra chalcogramma*
							2 larvae 5.6, 18 mm Bathymasteridae
							1 larva 5.6 mm Cottidae
							5 larvae 3.8-5.0 mm Gadidae
							9 larvae 7.7-8.1 mm Osmeridae
							1 larva 6.0 mm Scorpaenidae

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
6 May	1552	2	1	505	3	13	1 egg < 1 mm (0.93 mm)
							2 eggs ∿ 2 mm (1.68 mm)
							5 larvae 7.0-9.0 mm *Ammodytes hexapterus*
							2 larvae 4.8 mm *Sebastes* sp.
							2 larvae 3.8, 4.0 mm *Theragra chalcogramma*
							3 larvae 4.0 mm Gadidae
							1 larva 5.6 mm Scorpaenidae
6 May	2117	3	1	333	41	12	36 eggs ∿ 1 mm (0.97-1.10 mm)
							5 eggs ∿ 2 mm (1.33-1.50 mm)
							9 larvae 4.8-6.0 mm *Ammodytes hexapterus*
							2 larvae 3.6, 4.0 mm Cottidae
							1 larva 4.8 mm damaged, unidentified
6 May	2117	3	1	505	37	18	33 eggs ∿ 1 mm (0.93-1.10 mm)
							4 eggs ∿ 2 mm (1.30-1.40 mm)
							16 larvae 4.4-7.7 mm *Ammodytes hexapterus*
							2 larva 4.0 mm Cottidae
7 May	0259	4	1	333	0	3	1 larva 4.4 mm Cottidae
							1 larva ∿ 5 mm damaged Gadidae
							1 larva > 6 mm extensively damaged, elongate, unidentified

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 May	0259	4	1	505	0	2	2 larvae 5.2 mm *Ammodytes hexapterus*
7 May	1030	5	2	333	40	119	36 eggs ∿ 1 mm (0.96-1.20 mm)
							4 eggs ∿ 2 mm (1.76-1.91 mm)
							63 larvae 5.0-10 mm *Ammodytes hexapterus*
							1 larva 9.0 mm *Liparis* sp.
							24 larvae 12-23 mm *Lumpenus* spp.
							1 larva 40 mm *Mallotus villosus*
							1 larva 10 mm *Scorpaenichthys marmoratus*
							3 larvae 9.0 mm Agonidae
							2 larvae 9.0, 10 mm Cottidae
							1 larva 10 mm Cottidae
							20 larvae 10-15 mm Pholidae
							1 larva 10 mm Tetragonuridae
							2 larvae 5.0 mm unidentified
7 May	1030	5	2	505	136[c]	852[c]	124 eggs ∿ 1 mm (0.96-1.20 mm)
							12 eggs ∿ 2 mm (1.52-1.92 mm)
							486 larvae 6.0-10 mm *Ammodytes hexapterus*
							134 larvae 12-24 mm *Lumpenus* spp.
							2 larvae 43 mm *Mallotus villosus*

[c] The sample was split and 1/2 was sorted for fish eggs and larvae; totals given are for entire sample.

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 May	1030	5	2	505	136	852	2 larvae 10 mm *Scorpaenichthys marmoratus*
							4 larvae 9.3 mm *Sebastes* sp.
							4 larvae ∿ 29 mm *Spirinchus thaleichthys*
							4 larvae 4.8 mm *Theragra chalcogramma*
							16 larvae 8.1-10 mm Agonidae
							8 larvae Bathymasteridae
							10 larvae 9.0-12 mm Cottidae
							18 larvae 3.7-5.1 mm Cottidae
							18 larvae 4.0-8.5 mm Cottidae
							38 larvae 4.8-6.2 mm Cottidae
							8 larvae 8.0-12 mm Cottidae
							12 larvae 3.2-4.0 mm Gadidae
							76 larvae 9.0-11 mm Pholidae
							4 larvae 9.0, 10 mm unidentified
							8 larvae unidentified
8 May	0020	5a	1	333	48	182	45 eggs ∿ 1 mm (0.96-1.03 mm)
							3 eggs ∿ 2 mm (1.28-1.36)
							159 larvae 7.0-10 mm *Ammodytes hexapterus*
							12 larvae 12-24 mm *Lumpenus* spp.

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
8 May	0020	5a	1	333	48	182	3 larvae 3.7, 3.8, 4.8 mm *Isopsetta isolepis*
							1 larva 8.2 mm Agonidae
							5 larvae 4.7-9.6 mm Cottidae
							1 larva 7.9 mm Cottidae
							1 larva unidentified due to extensive damage (elongate)
8 May	0020	5a	1	505	50	162	48 eggs ∿ 1 mm (0.91-1.10 mm)
							2 eggs ∿ 2 mm (1.30, 1.69 mm)
							143 larvae 5.7-8.5 mm *Ammodytes hexapterus*
							6 larvae 4.0-5.9 mm *Isopsetta isolepis*
							6 larvae 12-21 mm *Lumpenus* spp.
							6 larvae 5.0-8.4 mm Cottidae
							1 larva 7.4 mm Cottidae
7 May	1312	6	1	333	992[d]	290[d]	992 eggs ∿ 1 mm (0.96-1.10 mm)
							84 larvae 4.0-6.3 mm *Ammodytes hexapterus*
							184 larvae 9.0-14 mm *Lumpenus* spp.

[d] The sample was split and 1/2 was sorted for fish eggs and larvae; totals given are for the entire sample.

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 May	1312	6	1	333	992	290	2 larvae 4.4 mm *Sebastes* sp.
							2 larvae 20 mm *Xiphister mucosus*
							18 larvae unidentified due to extensive damage (elongate)
7 May	1312	6	1	505	1616[e]	326[e]	1616 eggs ∿ 1 mm (0.98-1.10 mm)
							96 larvae 4.3-7.7 mm *Ammodytes hexapterus*
							184 larvae 9.0-18 mm *Lumpenus* spp.
							4 larvae 8.1-9.5 mm *Pholis* sp.
							2 larvae 30 mm Osmeridae
							40 larvae unidentified due to extensive damage (elongate)
7 May	1709	6	2	333	1296[f]	352[f]	1280 eggs ∿ 1 mm (0.96-1.08 mm)
							16 eggs ∿ 2 mm (1.40-1.83 mm)
							92 larvae 5.1-8.3 mm *Ammodytes hexapterus*
							220 larvae 9.7-17 mm *Lumpenus* spp.
							4 larvae 4.2 mm Cottidae

[e] The sample was split and 1/2 was sorted for fish eggs and larvae; totals given are for the entire sample.

[f] The sample was split and 1/8 was sorted for fish eggs and 1/4 was sorted for larvae; totals given are for entire sample.

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 May	1709	6	2	333	1296	352	12 larvae 3.3-3.7 mm Cyclopteridae
							24 larvae unidentified due to extensive damage (elongate)
7 May	1709	6	2	505	364[g]	236[g]	362 eggs ∿ 1 mm (0.96-1.10 mm)
							2 eggs ∿ 2 mm (1.95 mm)
							44 larvae 4.4-7.3 mm *Ammodytes hexapterus*
							4 larvae 8.2-9.5 mm *Apodichthys flavidus*
							154 larvae 9.6-21 mm *Lumpenus* spp.
							34 larvae unidentified due to extensive damage (elongate)
8 May	0402	7	1	333	54[g]	4[g]	54 eggs ∿ 1 mm (1.00-1.20 mm)
							2 larvae 8.4 mm *Ammodytes hexapterus*
							2 larvae 10 mm *Lumpenus* sp.
8 May	0402	7	1	505	60[h]	8[h]	56 eggs ∿ 1 mm (1.06-1.24 mm)
							4 eggs ∿ 2 mm (1.36 mm)
							8 larvae unidentified due to extensive damage (1 elongate and 1 non-elongate)

[g] The sample was split and 1/2 was sorted for fish eggs and larvae; totals given are for the entire sample.

[h] The sample was split and 1/4 was sorted for fish eggs and larvae; totals given are for the entire sample.

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
8 May	0734	8	1	333	360[i]	17	358 eggs ∿ 1 mm (0.92-1.30 mm)
							2 eggs ∿ 2 mm (1.36 mm)
							17 larvae 6.9-9.0 mm *Ammodytes hexapterus*
8 May	0734	8	1	505	353	20	346 eggs ∿ 1 mm (0.94-1.24 mm)
							7 eggs ∿ 2 mm (1.34-1.64 mm)
							18 larvae 3.4-4.5 mm *Ammodytes hexapterus*
							1 larva 3.7 mm *Lepidopsetta bilineata* ?
							1 larva 9.7 mm *Lumpenus* sp.
8 May	1315	9	1	333	25	22	13 eggs ∿ 1 mm (0.94-1.16 mm)
							1 egg ∿ 2mm (1.40 mm)
							11 eggs ∿ 3 mm (2.80-3.84 mm)
							4 larvae 5.8-6.0 mm *Anoplarchus* sp.
							1 larva 5.3 mm *Isopsetta isolepis* ?
							2 larvae 3.3, 3.9 mm *Lepidopsetta bilineata*
							2 larvae 5.1, 6.3 mm Cottidae
							1 larva 4.4 mm Gadidae
							1 larva 5.3 mm unidentified (intense body pigment)

[i] The sample was split for fish eggs and 1/2 was sorted; totals given are for entire sample.

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
8 May	1315	9	1	333	25	22	1 larva 5.2 mm unidentified (elongate) 10 larvae unidentified due to extensive damage (all elongate)
8 May	1315	9	1	505	24	18	12 eggs ∿ 1 mm (0.94-1.20 mm) 1 egg ∿ 2 mm (1.60 mm) 11 eggs ∿ 3 mm (2.97-3.56) 3 larvae 4.6, 5.5, 9.5 mm *Ammodytes hexapterus* 6 larvae 5.0-6.2 mm *Anoplarchus* sp. 1 larva 3.5 mm *Isopsetta isolepis* 1 larva 11 mm *Lumpenus* sp. 2 larvae 4.0 mm, one damaged, Gadidae 5 larvae unidentified due to extensive damage (all elongate)
9 May	0145	11	1	333	11	44	11 eggs < 1 mm (0.67-0.83 mm) 3 larvae 7.9, 11, 21 mm *Bathylagus stilbius* 1 larva 29 mm *Lumpenus* sp. 4 larvae 3.4-4.1 mm *Stenobrachius leucopsarus* 32 larvae 3.4-4.4 mm Gadidae

Table 28. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
9 May	0145	11	1	333	11	44	1 larva 8.8 mm unidentified (elongate)
							2 larvae 3.7, 6.0 mm unidentified (non-elongate)
							1 larva 12 mm unidentified (w/large ellipsoidal eyes extending to the articulation of the jaws)
9 May	0145	11	1	505	11	24	11 eggs ∿ 2 mm (1.36-2.56 mm)
							1 larva 7.4 mm *Bathylagus stilbius*
							1 larva 3.3 mm *Lepidopsetta bilineata* ?
							2 larvae 5.5, 6.1 mm *Sebastes* sp.
							13 larvae 3.5-4.6 mm Gadidae
							7 larvae unidentified due to extensive damage (all elongate)

Table 29. Identification of Fish Eggs and Larvae by Station
Lower Cook Inlet 1-m NIO Tows, *Discoverer*, Leg V, 05-09 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
7 May	1757	6	3	571	1096[j]	352[k]	1096 eggs ∿ 1 mm (0.96-1.10 mm)
							134 larvae 5.6-9.4 mm *Ammodytes hexapterus*
							214 larvae 12-22 mm *Lumpenus* spp.
							4 larvae 7.1-8.3 mm Agonidae

[j] The sample was split for fish eggs and 1/8 was sorted; totals given are for entire sample.

[k] The sample was split for fish larvae and 1/2 was sorted; totals given are for entire sample.

Table 30. Summary of taxonomic categories of commercially important crab and shrimp larvae found in bongo and 1-m NIO net samples collected on the Lower Cook Inlet *Discoverer* cruise, Leg V, 05-09 May 1976.

A total of 25 samples contained 14,327 crab zoeae and 69 megalopae. The commercially important crabs were distributed into 3 families, 2 genera and 2 species. The 25 samples contained 15,962 shrimp zoeae and 43 adult shrimp. The commercially important shrimp were distributed into 1 family, 2 genera and 6 species.

Section Anomura

Family Lithodidae

5,675 zoeae king crab[1] *Paralithodes camtschatica* (Tilesius)
86 zoeae damaged *Paralithodes* spp.

4,377 zoeae unidentified, non-commercially important anomurans.

Section Brachyura

Family Cancridae

8 zoeae non-commercially important *Cancer* spp.

Family Majidae

743 zoeae tanner crab *Chionoecetes bairdi* (Rathbun)
69 Megalopae *Chionoecetes* spp.

3,438 zoeae unidentified, non-commercially important brachyurans

Section Caridea

Family Pandalidae

11 zoeae sidestripe shrimp *Pandalopsis dispar* Rathbun
2544 zoeae northern pink shrimp *Pandalus borealis* Kröyer
8962 zoeae humpy shrimp *Pandalus goniurus* Stimpson
562 zoea *Pandalus montagui tridens* Rathbun
43 zoeae *Pandalus stenolepis* Rathbun
18 zoeae coonstripe shrimp *Pandalus hypsinotus* Brandt
4 zoeae *Pandalus* spp., damaged
2 adult *Pandalus borealis*
5 adult *Pandalus goniurus*

3,818 zoeae unidentified hippolytids
36 adult non-commercially important shrimp

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[1] The common name is presented for the first time for each species; thereafter, only the scientific name is recorded.

Table 31. Identification of Crab and Shrimp Larvae by Station

Lower Cook Inlet Bongo and 1-m NIO Net Tows, *Discoverer*, Leg V, 05-09 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
6 May	1325	1	1	333	zoea	140	unidentified anomurans
					I	3	*Cancer productus*
					I	1	*Chionoecetes bairdi*
					zoea	122	unidentified brachyurans
					I	9	*Pandalus borealis*
					II	8	*P. borealis*
					I	39	*P. montagui tridens*
					I	4	*P. stenolepis*
					zoea	247	unidentified hippolytids
6 May	1325	1	1	505	zoea	122	unidentified anomurans
					I	4	*Cancer productus*
					megalopa	2	*Chionoecetes* sp.
					zoea	88	unidentified brachyurans
					I	18	*Pandalus borealis*
					II	10	*P. borealis*
					I	85	*P. montagui tridens*
					I	3	*P. stenolepis*
					zoea	295	unidentified hippolytids
6 May	1552	2	1[a]	333	zoea	64	unidentified anomurans
					megalopa	4	*Chionoecetes* sp.
					zoea	180	unidentified brachyurans
					zoea	82	unidentified hippolytids

[a] The sample was split for crab larvae and 1/4 was sorted; totals given are for entire sample.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
6 May	1552	2	1	505	zoea	50	unidentified anomurans
					I	1	*Cancer productus*
					megalopa	5	*Chionoecetes* sp.
					zoea	126	unidentified brachyurans
					I	1	*Pandalus borealis*
					II	1	*P. borealis*
					I	1	*P. montagui tridens*
					I	2	*P. stenolepis*
6 May	2117	3	1	333	I	1	*Paralithodes camtschatica*
					megalopa	3	*Chionoecetes* sp.
					zoea	16	unidentified brachyurans
					I	2	*Pandalus goniurus*
					zoea	51	unidentified hippolytids
					adult	12	*Crangon franciscorum angustimana* (1 gravid female)
6 May	2117	3	1	505	I	1	*Paralithodes camtschatica*
					I	1	*Chionoecetes bairdi*
					zoea	14	unidentified brachyurans
					zoea	50	unidentified hippolytids
					adult	1	*Crangon alaskensis*
					adult	13	*C. franciscorum angustimana* (4 gravid females)
7 May	0259	4	1	333	zoea	1	unidentified anomuran
					I	1	*Chionoecetes bairdi*
					I	1	*Pandalus goniurus*
					zoea	4	unidentified hippolytids

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
7 May	0259	4	1	505	zoea	2	unidentified hippolytids
7 May	1030	5	2[b]	333	I	880	*Paralithodes camtschatica*
					II	384	*P. camtschatica*
					zoea	944	unidentified anomurans
					zoea	208	unidentified brachyurans
					I	440	*Pandalus borealis*
					II	104	*P. borealis*
					I	1416	*P. goniurus*
					II	152	*P. goniurus*
					I	8	*P. hypsinotus*
					zoea	696	unidentified hippolytids
7 May	1030	5	2[c]	505	I	1792	*Paralithodes camtschatica*
					II	544	*P. camtschatica*
					zoea	1696	unidentified anomurans
					megalopa	32	*Chionoecetes* sp.
					zoea	608	unidentified brachyurans
					I	752	*Pandalus borealis*
					II	192	*P. borealis*
					I	2984	*P. goniurus*
					II	640	*P. goniurus*
					zoea	1168	unidentified hippolytids

[b] The sample was split and 1/16 was sorted for crab larvae and 1/8 was sorted for shrimp larvae; totals given are for entire sample.

[c] The sample was split and 1/32 was sorted for crab larvae and 1/8 was sorted for shrimp larvae; totals given are for entire sample.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
8 May	0020	5a	1[d]	333	I	192	*Paralithodes camtschatica*
					II	140	*P. camtschatica*
					zoea	628	unidentified anomurans
					I	444	*Chionoecetes bairdi*
					zoea	316	unidentified brachyurans
					I	80	*Pandalus borealis*
					II	44	*P. borealis*
					I	480	*P. goniurus*
					II	76	*P. goniurus*
					I	4	*P. hypsinotus*
					I	4	*P. montagui tridens*
8 May	0020	5a	1[d]	505	I	336	*Paralithodes camtschatica*
					II	160	*P. camtschatica*
					zoea	312	unidentified anomurans
					I	284	*Chionoecetes bairdi*
					zoea	56	unidentified brachyurans
					I	120	*Pandalus borealis*
					II	28	*P. borealis*
					I	592	*P. goniurus*
					II	84	*P. goniurus*
7 May	1312	6	1[e]	333	I	46	*Paralithodes camtschatica*
					II	24	*P. camtschatica*
					zoea	50	unidentified anomurans

[d] The sample was split and 1/4 was sorted for crab and shrimp larvae; totals given are for the entire sample.

[e] The sample was split and 1/2 was sorted for crab and shrimp larvae; totals given are for the entire sample.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
7 May	1312	6	1	333	zoea	252	unidentified brachyurans
					II	2	*Pandalopsis dispar*
					I	142	*Pandalus borealis*
					II	8	*P. borealis*
					I	412	*P. goniurus*
7 May	1312	6	1[f]	505	I	76	*Paralithodes camtschatica*
					II	44	*P. camtschatica*
					zoea	64	unidentified anomurans
					zoea	264	unidentified brachyurans
					I	140	*Pandalus borealis*
					II	2	*P. borealis*
					I	562	*P. goniurus*
					I	2	*P. hypsinotus*
7 May	1709	6	2[g]	333	I	92	*Paralithodes camtschatica*
					zoea	110	unidentified anomurans
					I	4	*Chionoecetes bairdi*
					zoea	430	unidentified brachyurans
					I	156	*Pandalus borealis*
					I	256	*P. goniurus*
					II	4	*P. goniurus*
					I	2	*P. hypsinotus*
					zoea	178	unidentified hippolytids

[f] The sample was split and 1/4 was sorted for crab larvae and 1/2 was sorted for shrimp larvae; totals given are for entire sample.

[g] The sample was split and 1/2 was sorted for crab and shrimp larvae; totals given are for entire sample.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
7 May	1709	6	2	505	I	42	*Paralithodes camtschatica*
					II	2	*P. camtschatica*
					zoea	24	unidentified anomurans
					megalopa	2	*Chionoecetes* sp.
					zoea	190	unidentified brachyurans
					I	70	*Pandalus borealis*
					I	148	*P. goniurus*
					I	2	*P. hypsinotus*
					I	2	damaged *Pandalus* sp.
					zoea	78	unidentified hippolytids
7 May	1757	6	3[h]	571	I	100	*Paralithodes camtschatica*
					II	8	*P. camtschatica*
					zoea	24	unidentified anomurans
					I	4	*Chionoecetes bairdi*
					zoea	400	unidentified brachyurans
					II	4	*Pandalopsis dispar*
					I	108	*Pandalus borealis*
					I	352	*P. goniurus*
						168	unidentified hippolytid larvae
8 May	0402	7	1[i]	333	I	226	*Paralithodes camtschatica*
					I	52	damaged *Paralithodes* sp.
					zoea	14	unidentified anomurans
					megalopa	2	*Chionoecetes* sp.

[h] The sample was split and 1/4 was sorted for crab and shrimp larvae; totals given are for entire sample.

[i] The sample was split and 1/2 was sorted for crab and shrimp larvae; totals given are for entire sample.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
8 May	0402	7	1	333	zoea	10	unidentified brachyurans
					I	8	*Pandalus borealis*
					I	60	*P. goniurus*
					zoea	120	unidentified hippolytids
					adult	2	*Crangon dalli*
8 May	0402	7	1[j]	505	I	272	*Paralithodes camtschatica*
					II	4	*P. camtschatica*
					I	28	damaged *Paralithodes* sp.
					zoea	26	unidentified anomurans
					zoea	34	unidentified brachyurans
					I	12	*Pandalus borealis*
					I	42	*P. goniurus*
					zoea	116	unidentified hippolytids
					adult	2	*Crangon alaskensis*
					adult	2	*Crangon dalli*
8 May	0734	8	1	333	I	136	*Paralithodes camtschatica*
					II	2	*P. camtschatica*
					I	3	damaged *Paralithodes* sp.
					zoea	14	unidentified anomurans
					zoea	2	unidentified brachyurans
					I	316	*Pandalus goniurus*
					II	6	*P. goniurus*
					zoea	94	unidentified hippolytids
					adult	3	*Crangon alaskensis*
					adult	1	*Pandalus borealis*
					adult	2	*P. goniurus*

[j] The sample was split and 1/2 was sorted for crab and shrimp larvae; totals given are for the entire sample.

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
8 May	0734	8	1	505	I	135	*Paralithodes camtschatica*
					II	3	*P. camtschatica*
					I	3	damaged *Paralithodes* sp.
					zoea	22	unidentified anomurans
					megalopa	1	*Chionoecetes* sp.
					zoea	5	unidentified brachyurans
					I	340	*Pandalus goniurus*
					II	5	*P. goniurus*
					zoea	94	unidentified hippolytids
					adult	1	*Crangon alaskensis*
					adult	1	*Pandalus borealis*
					adult	2	*P. goniurus*
8 May	1315	9	1	333	I	14	*Paralithodes camtschatica*
					zoea	34	unidentified anomurans
					zoea	75	unidentified brachyurans
					I	30	*Pandalus borealis*
					II	22	*P. borealis*
					I	15	*P. goniurus*
					I	197	*P. montagui tridens*
					I	22	*P. stenolepis*
					zoea	227	unidentified hippolytids
					adult	1	*Pandalus goniurus*
8 May	1315	9	1	505	I	19	*Paralithodes camtschatica*
					zoea	38	unidentified anomurans
					megalopa	4	*Chionoecetes* sp.
					zoea	35	unidentified brachyurans
					I	28	*Pandalus borealis*

Table 31. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (m)	Stage	Total	Identification of Larvae
8 May	1315	9	1	505	II	9	*P. borealis*
					I	17	*P. goniurus*
					I	233	*P. montagui tridens*
					I	10	*P. stenolepis*
					II	2	*P. stenolepis*
					II	2	damaged *Pandalus* sp.
					zoea	132	unidentified hippolytids
9 May	0145	11	1	333	megalopa	7	*Chionoecetes* sp.
					II	2	*Pandalopsis dispar*
					zoea	6	unidentified hippolytids
9 May	0145	11	1	505	I	4	*Chionoecetes bairdi*
					megalopa	7	*Chionoecetes* sp.
					zoea	7	unidentified brachyurans
					I	2	*Pandalopsis dispar*
					IV	1	*P. dispar*
					I	2	*Pandalus borealis*
					I	3	*P. montagui tridens*
					zoea	10	unidentified hippolytids

Table 32. Number of fish eggs and larvae at each station

Lower Cook Inlet Bongo Tows, *Discoverer*, Leg VII, 22-30 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
24 May	0732	1	1	333	76	138
24 May	0732	1	1	505	47	107
25 May	1150	2	1	333	11	59
25 May	1150	2	1	505	6	58
25 May	1607	3	1	333	85	7
25 May	1607	3	1	505	86	8
25 May	2217	4	1	333	3	4
25 May	2217	4	1	505	1	2
26 May	0541	5a	2	333	28	70
26 May	0541	5a	2	505	85	167
26 May	0835	6	1	333	648	27
26 May	0835	6	1	505	684	29
26 May	1928	6	3	333	380	36
26 May	1928	6	3	505	242	29
27 May	0056	6	4	333	169	84
27 May	0056	6	4	505	181	79
27 May	0708	6	7	333	17	70
27 May	0708	6	7	505	37	76
27 May	1300	7	1	333	692	67
27 May	1300	7	1	505	656	52
27 May	1701	8	1	333	190	33
27 May	1701	8	1	505	258	26
30 May	1813	10	1	333	22	121
30 May	1813	10	1	505	18	57
30 May	0253	11	1	333	1	55
30 May	0253	11	1	505	0	40
30 May	0813	11	2	333	2	31
30 May	0813	11	2	505	1	51
28 May	1831	13	1	333	13	940
28 May	1831	13	1	505	8	876
28 May	2248	13	2	333	99	2992
28 May	2248	13	2	505	100	2384

Table 32. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
29 May	1029	13	3	333	1	800
29 May	1029	13	3	505	0	700
28 May	0536	14	1	333	74	11
28 May	0536	14	1	505	74	13

1-m NIO Tows

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
27 May	0120	6	5	571	248	162

Table 33. Summary of taxonomic categories of fish eggs, larvae, young, and adults found in Bongo net samples and 1-m NIO net sample collected in Lower Cook Inlet and Prince William Sound, *Discoverer* cruise, Leg VII, 22-30 May 1976.

A total of 38 samples were collected. All samples were sorted for fish larvae and identified or sized for fish eggs and summarized below. The fish are distributed into families, genera, and species. The eggs are distributed into 4 size categories.

Family Agonidae

17 larvae genus? species?

Family Ammodytidae

376 larvae Pacific sandlance[1] *Ammodytes hexapterus* Pallas
1 adult *Ammodytes hexapterus*

Family Bathylagidae

4434 larvae smoothtongue *Bathylagus stilbius* (Gilbert)
32 young *Bathylagus stilbius*

Family Bathymasteridae

4 larvae genus? species?

Family Clupeidae

138 larvae Pacific herring *Clupea harengus pallasi* Valenciennes

Family Cottidae

1 larva northern sculpin *Icelinus borealis* Gilbert ?
3 larvae sculpin *Myoxocephalus* sp. (2 uncertain)
187 larvae genus? species?
2 young genus? species?

Family Cyclopteridae

58 larvae genus? species?
68 young genus? species?

Family Gadidae

390 larvae cod *Gadus* sp.
3 larvae Alaska pollock *Theragra chalcogramma* (Pallas)
317 larvae genus? species?

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[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 33. (continued)

Family Hexagrammidae

2 young greenling *Hexagrammos* sp.
19 young genus? species?

Family Myctophidae

1 young bigeye lanternfish *Protomyctophum thompsoni* (Chapman)
104 larvae smallfin lanternfish *Stenobrachius leucopsarus* (Eigenmann and Eigenmann)
3 young *Stenobrachius leucopsarus*

Family Osmeridae

6 larvae capelin *Mallotus villosus* (Müller)
2 larvae genus? species?

Family Pholidae

3 larvae penpoint gunnel *Apodichthys flavidus* Girard
21 larvae genus? species?

Family Pleuronectidae

64 larvae sole *Hippoglossoides* sp.
33 larvae butter sole *Isopsetta isolepis* (Lockington)
12 larvae rock sole *Lepidopsetta bilineata* (Ayres) (8 uncertain)
3 larvae slender sole *Lyopsetta exilis* (Jordan and Gilbert)

Family Ptilichthyidae

1 larva quillfish *Ptilichthys goodei* Bean

Family Scorpaenidae

2328 larvae rockfish *Sebastes* spp.

Family Stichaeidae

30 larvae cockscomb *Anoplarchus* sp.
157 larvae prickleback *Lumpenus* spp.
1 young *Lumpenus* sp.

1040 larvae unidentified, many badly damaged.

5243 eggs categorized (see Table 18, List of possible fish for egg size categories):

146 eggs < 1 mm (0.74-0.88 mm)
4539 eggs ∿ 1 mm (0.90-1.28 mm)
302 eggs ∿ 2 mm (1.30-2.54 mm)
256 eggs ∿ 3 mm (2.56-3.90 mm)

Table 34. Identification of Fish Eggs and Larvae by Station

Lower Cook Inlet Bongo Tows, *Discoverer*, Leg VII, 22-30 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
24 May	0732	1	1	333	76[a]	138[a]	1 egg ∿ 2 mm (2.16 mm)[b]
							75 eggs ∿ 3 mm (2.74-3.60 mm)
							7 larvae 4.7-6.5 mm *Ammodytes hexapterus*
							2 larvae 8.1, 8.7 mm *Anoplarchus* sp.
							40 larvae 4.3-6.9 *Hippoglossoides* sp.
							1 larva 3.3 mm *Icelinus borealis* ?
							6 larvae 6.8-8.7 mm *Lepidopsetta bilineata* ?
							3 larvae 3.6, 4.2, 5.2 mm *Lyopsetta exilis*
							2 larvae 8.9, 9.9 mm *Myoxocephalus* sp.
							1 larva 36 mm *Ptilichthys goodei*
							2 larva 3.8, 5.4 mm *Stenobrachius leucopsarus*

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
24 May	0732	1	1	333	76	138	1 larva 7.7 mm Cottidae
							2 larvae 4.4, 4.2 mm Gadidae
							65 larvae 3.6-6.7 mm unidentified (elongate)
							1 larva 5.8 mm unidentified (non-elongate)
							5 larvae unidentified due to extensive damage (1 elongate and 1 non-elongate)
24 May	0732	1	1	505	47	107	1 egg ∿ 2 mm (2.08 mm)
							46 eggs ∿ 3 mm (2.74-3.60 mm)
							4 larvae 8.8-14 mm *Ammodytes hexapterus*
							2 larvae 8.0, 8.5 mm *Anoplarchus* sp.
							3 larvae 5.3, 7.4, 9.0 mm *Gadus* sp.
							19 larvae 4.0-5.6 mm *Hippoglossoides* sp.
							2 larvae 3.2, 8.0 mm *Lepidopsetta bilineata* ?
							1 larva 4.1 mm *Myoxocephalus* sp. ?
							2 larvae 4.3 mm *Stenobrachius leucopsarus*
							1 larva 6.4 mm Cottidae ("Cottid 2" from Blackburn 1973)
							3 larvae 3.8, 3.9, 5.0 mm Cottidae

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
24 May	0732	1	1	505	47	107	1 larva 4.8 mm Cyclopteridae
							1 larva 5.5 mm Gadidae
							62 larvae 5.5-6.4 unidentified (elongate)
							1 larva 8.9 mm unidentified (non-elongate)
							5 larvae unidentified due to extensive damage
25 May	1150	2	1	333	11	59	7 eggs ∿ 1 mm (0.94-1.02 mm)
							3 eggs ∿ 2 mm (1.34, 1.34, 1.40 mm)
							1 egg ∿ 3 mm (3.12 mm)
							16 larvae 7.4-13 mm *Ammodytes hexapterus*
							5 larvae 5.5-11 mm *Anoplarchus* sp.
							3 larvae 14, 17, 18 mm *Apodichthys flavidus*
							8 larvae 4.9-6.5 mm *Isopsetta isolepis*
							1 larva 6.5 mm *Theragra chalcogramma*
							1 larva 6.7 mm Bathymasteridae
							17 larvae 4.1-9.1 mm Cyclopteridae
							8 larvae unidentified due to extensive damage (elongate)

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
25 May	1150	2	1	505	6	58	6 eggs ∿ 1 mm (0.93-1.00 mm)
							17 larvae 6.8-13 mm *Ammodytes hexapterus*
							3 larvae 5.5, 9.3, 9.5 mm *Anoplarchus* sp.
							1 larva 4.4 mm *Hippoglossoides* sp.
							2 larvae 5.2, 5.5 mm *Isopsetta isolepis*
							2 larvae 5.6, 18 mm *Lumpenus* spp.
							1 larva 5.9 mm *Sebastes* sp.
							1 larva 9.4 mm *Theragra chalcogramma*
							3 larvae 6.6, 6.7, 7.2 mm Bathymasteridae
							2 larvae 6.9, 7.1 mm Cottidae
							2 larvae 5.8, 6.4 mm Cottidae
							1 larva 8.3 mm Cottidae
							14 larvae 4.8-7.8 mm Cyclopteridae
							1 larva 4.7 mm unidentified (very intensely pigmented larva)
							8 larvae unidentified due to extensive damage
25 May	1607	3	1	333	85	7	80 eggs ∿ 1 mm (0.96-1.24 mm)
							5 eggs ∿ 2 mm (1.30-1.50 mm)

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
25 May	1607	3	1	333	85	7	1 larva 13 mm *Ammodytes hexapterus*
							5 larvae 3.4-4.0 mm Cottidae
							1 larva unidentified due to extensive damage
25 May	1607	3	1	505	86	8	85 eggs ∿ 1 mm (0.90-1.20 mm)
							1 egg ∿ 2 mm (1.54 mm)
							1 larva 6.2 mm *Ammodytes hexapterus*
							1 larva 5.9 mm *Theragra chalcogramma*
							5 larvae 3.4-4.0 mm Cottidae
							1 larva 5.5 mm unidentified (non-elongate)
25 May	2217	4	1	333	3	4	2 eggs ∿ 1 mm (1.10-1.16 mm)
							1 egg ∿ 2 mm (1.70 mm)
							4 larvae 3.8-4.1 mm *Ammodytes hexapterus*
25 May	2217	4	1	505	1	2	1 egg ∿ 1 mm (1.10 mm)
							2 larvae 5.1, 6.3 mm *Ammodytes hexapterus*
26 May	0541	5a	2	333	28	70	26 eggs ∿ 1 mm (0.93-1.02 mm)
							1 egg ∿ 2 mm (1.36 mm)
							1 egg ∿ 3 mm (3.28 mm)

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
26 May	0541	5a	2	333	28	70	38 larvae 5.2-11 mm *Ammodytes hexapterus*
							5 larvae 4.7-5.9 mm *Anoplarchus* sp.
							2 larvae 4.4, 4.5 mm *Hippoglossoides* sp.
							5 larvae 2.8-5.5 mm *Isopsetta isolepis*
							2 larvae 15, 24 mm *Lumpenus* sp.
							1 larva 3.4 mm Cottidae
							3 larvae 3.7, 4.3, 5.4 mm Cyclopteridae
							6 larvae 10-17 mm Pholidae
							2 larvae 1.9, 2.3 mm unidentified (yolk sac absorption has already occurred)
							6 larvae unidentified due to extensive damage (5 elongate, 1 other)
26 May	0541	5a	2	505	85	167	1 egg < 1 mm (0.79 mm)
							80 eggs ∿ 1 mm (0.91-1.06 mm)
							3 eggs ∿ 2 mm (1.34-1.38 mm)
							1 egg ∿ 3 mm (2.56 mm)
							69 larvae 5.5-17 mm *Ammodytes hexapterus*
							8 larvae 4.7-7.0 mm *Anoplarchus* sp.
							2 larvae 5.3, 6.1 mm *Hippoglossoides* sp.

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
26 May	0541	5a	2	505	85	167	18 larvae 2.1-6.7 mm *Isopsetta isolepis*
							4 larvae 19-24 mm *Lumpenus* sp.
							1 larva 6.8 mm *Agonidae*
							1 larva 7.1 mm Cottidae
							3 larvae 3.0, 4.3, 4.7 mm Cyclopteridae
							8 larvae 9.6-18 mm Pholidae
							2 larvae 2.3, 3.4 mm unidentified
							51 larvae unidentified due to extensive damage (45 elongate, 6 others)
26 May	0835	6	1	333	648[c]	27	4 eggs < 1 mm (0.86 mm)
							644 eggs ∿ 1 mm (0.94-1.10 mm)
							1 adult 73 mm *Ammodytes hexapterus*
							2 larvae 29, 30 mm *Lumpenus* sp.
							1 larva 13 mm Agonidae
							23 larvae unidentified due to extensive damage (22 elongate, 1 non-elongate)

[c] The sample was split for fish eggs and 1/4 was sorted; totals given are for entire sample.

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
26 May	0835	6	1	505	684[d]	29	4 eggs < 1 mm (0.86 mm)
							680 eggs ∿ 1 mm (0.90-1.06 mm)
							1 larva 7.3 mm *Anoplarchus* sp.
							8 larvae 15-29 mm *Lumpenus* spp.
							1 larva 18 mm Pholidae
							1 larva 19 mm unidentified (non-elongate)
							18 larvae unidentified due to extensive damage (elongate)
26 May	1928	6	3	333	380[e]	36	378 eggs ∿ 1 mm (0.90-1.06 mm)
							2 eggs ∿ 2 mm (1.34 mm)
							13 larvae 5.1-9.0 mm *Ammodytes hexapterus*
							13 larvae 20-28 mm *Lumpenus* sp.
							1 larva 35 mm *Mallotus villosus*
							1 larva 8.0 mm Cottidae
							2 larvae 4.2, 6.3 mm Cyclopteridae
							6 larvae unidentified due to extensive damage (elongate)

[d] The sample was split for fish eggs and 1/4 was sorted; totals given are for the entire sample.

[e] The sample was split for fish eggs and 1/2 was sorted; totals given are for the entire sample.

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
26 May	1928	6	3	505	242[f]	29	2 eggs < 1 mm (0.84 mm)
							238 eggs ∿ 1 mm (0.94-1.06 mm)
							2 eggs ∿ 2 mm (1.36 mm)
							13 larvae 5.9-13 mm *Ammodytes hexapterus*
							7 larvae 13-23 mm *Lumpenus* spp.
							2 larvae 5.5, 6.3 mm *Mallotus villosus*
							3 larvae 3.8, 4.8, 5.8 mm Cyclopteridae
							1 larva 6.7 mm Osmeridae
							2 larvae 2.9, 3.2 mm unidentified (non-elongate)
							1 larva unidentified due to extensive damage (elongate)
27 May	0056	6	4	333	169	84	168 eggs ∿ 1 mm (0.94-1.16 mm)
							1 egg ∿ 2 mm (1.40 mm)
							42 larvae 6.5-12 mm *Ammodytes hexapterus*
							1 larva 6.7 mm *Anoplarchus* sp.
							11 larvae 17-30 mm *Lumpenus* spp.
							3 larvae 5.3, 5.9, 6.4 mm *Mallotus villosus*

[f] The sample was split for fish eggs and 1/2 was sorted; totals given are for the entire sample.

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
27 May	0056	6	4	333	169	84	2 larvae 4.7, 5.5 mm Cottidae ("Cottid 6" from Blackburn 1973) 3 larvae 3.4, 4.4, 5.2 mm Cyclopteridae 7 larvae 2.5-3.3 mm unidentified (non-elongate) 15 larvae unidentified due to extensive damage (elongate)
27 May	0056	6	4	505	181	79	180 eggs ∿ 1 mm (0.94-1.10 mm) 1 egg ∿ 2 mm (1.40 mm) 49 larvae 6.2-14 mm *Ammodytes hexapterus* 11 larvae 16-23 mm *Lumpenus* spp. 1 larva 6.1 mm Cottidae 1 larva 3.9 mm Cyclopteridae 1 larva 3.8 mm Gadidae 6 larvae 2.0-3.3 mm unidentified (non-elongate) 10 larvae unidentified due to extensive damage (elongate)
27 May	0708	6	7	333	17	70	16 eggs ∿ 1 mm (0.94-1.10 mm) 1 egg ∿ 2 mm (1.40 mm)

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
27 May	0708	6	7	333	17	70	18 larvae 2.9-4.9 mm *Ammodytes hexapterus*
							37 larvae 15-29 mm *Lumpenus* spp.
							1 young 58 mm *Lumpenus* sp.
							2 larvae 6.5, 6.7 mm Cottidae ("Cottid 6" from Blackburn 1973)
							1 young 21 mm Cottidae
							1 larva 7.5 mm Cyclopteridae
							1 larva 19 mm Pholidae
							1 larva 5.6 mm unidentified (non-elongate)
							8 larvae unidentified due to extensive damage (elongate)
27 May	0708	6	7	505	37	76	36 eggs ∿ 1 mm (0.94-1.16 mm)
							1 egg ∿ 2 mm (1.40 mm)
							36 larvae 4.4-13 mm *Ammodytes hexapterus*
							2 larvae 3.2 mm *Lepidopsetta bilineata*
							28 larvae 16-29 mm *Lumpenus* spp.
							4 larvae 5.1-5.8 mm Cottidae ("Cottid 6" from Blackburn 1973)
							1 larva 2.8 mm unidentified (non-elongate)
							5 larvae unidentified due to extensive damage (elongate)

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
27 May	1300	7	1	333	692[g]	67	20 eggs < 1 mm (0.84-0.86 mm)
							668 eggs ∿ 1 mm (0.90-1.10 mm)
							4 eggs ∿ 2 mm (1.30 mm)
							16 larvae 5.9-10 mm *Ammodytes hexapterus*
							1 larva 8.0 mm *Anoplarchus* sp.
							2 young 33, 36 mm *Hexagrammos* sp.
							17 larvae 10-17 mm *Lumpenus* spp.
							8 larvae 6.4-8.4 mm Agonidae
							1 larva 4.7 mm Cyclopteridae
							22 larvae unidentified due to extensive damage (elongate)
27 May	1300	7	1	505	656[g]	52	36 eggs < 1 mm (0.82-0.86 mm)
							620 eggs ∿ 1 mm (0.90-1.10 mm)
							7 larvae 6.3-7.9 mm *Ammodytes hexapterus*
							7 larvae 10-20 mm *Lumpenus* spp.
							5 larvae 7.2-8.1 mm Agonidae
							2 larvae 4.0, 5.5 mm Cyclopteridae
							31 larvae unidentified due to extensive damage (elongate)

[g] The sample was split and 1/4 was sorted for fish eggs; totals given are for the entire sample.

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
27 May	1701	8	1	333	190	33	38 eggs < 1 mm (0.80-0.88 mm)
							151 eggs ∿ 1 mm (0.90-1.14 mm)
							1 egg ∿ 2 mm (1.40 mm)
							2 larvae 9.6, 10 mm *Ammodytes hexapterus*
							1 larva 8.3 mm *Lepidopsetta bilineata*
							1 larva 9.6 mm *Lumpenus* sp.
							4 larvae 5.6-5.9 mm Cottidae ("Cottid 6" from Blackburn 1973)
							1 larva 4.9 mm Cyclopteridae
							7 larvae 2.5-3.2 mm unidentified (non-elongate)
							17 larvae unidentified due to extensive damage (7 elongate, 6 non-elongate)
27 May	1701	8	1	505	258[h]	26	36 eggs < 1 mm (0.80-0.86 mm)
							222 eggs ∿ 1 mm (0.90-1.14 mm)
							3 larvae 11, 11, 13 mm *Ammodytes hexapterus*
							1 larva 6.7 mm *Anoplarchus* sp.
							6 larvae 5.0-5.4 mm Cottidae ("Cottid 6" from Blackburn 1973)

[h] The sample was split for fish eggs and 1/2 was sorted; totals given are for the entire sample.

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
27 May	1701	8	1	505	258	26	1 larva 9.3 mm Cottidae
							1 larva 3.2 mm unidentified (non-elongate)
							14 larvae unidentified due to extensive damage (9 elongate, 1 non-elongate)
30 May	1813	10	1	333	22	121	1 egg < 1 mm (0.84 mm)
							2 eggs ∿ 1 mm (0.90-0.94 mm)
							9 eggs ∿ 2 mm (1.26-2.26 mm)
							10 eggs ∿ 3 mm (3.06-3.80 mm)
							1 larva 14 mm *Bathylagus* sp.
							1 larva 4.3 mm *Sebastes* sp.
							8 larvae 3.7-5.5 mm *Stenobrachius leucopsarus*
							101 larvae 4.2-6.1 mm unidentified (elongate)
							10 larvae unidentified due to extensive damage (elongate)
30 May	1813	10	1	505	18	57	2 eggs < 1 mm (0.74-0.84 mm)
							1 egg ∿ 1 mm (0.96 mm)
							12 eggs ∿ 2 mm (1.50-2.54 mm)
							3 eggs ∿ 3 mm (2.70-3.90 mm)

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
30 May	1813	10	1	505	18	57	1 larva 3.7 mm *Sebastes* sp.
							3 larvae 3.7, 4.2, 5.2 mm *Stenobrachius leucopsarus*
							44 larvae 4.4-6.5 mm unidentified (elongate)
							9 larvae unidentified due to extensive damage (7 elongate, 2 non-elongate)
30 May	0253	11	1	333	1	55	1 egg ∿ 2 mm (1.37 mm)
							26 larvae 3.2-17 mm *Bathylagus stilbius*
							10 larvae 3.4-6.1 mm *Sebastes* spp.
							11 larvae 3.2-5.6 mm *Stenobrachius leucopsarus*
							2 larvae 5.3, 6.4 mm Cottidae
							2 larvae 10, 10 mm Gadidae (both larvae are quite damaged)
							4 larvae unidentified due to extensive damage (3 elongate, 1 non-elongate)
30 May	0253	11	1	505	0	40	3 larvae 6.4, 8.2, 9.8 mm *Bathylagus stilbius*
							6 larvae 3.4-5.5 mm *Sebastes* spp.
							24 larvae 3.6-6.9 mm *Stenobrachius leucopsarus*

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
30 May	0253	11	1	505	0	40	1 young 19 mm Cottidae
							2 larvae 10, 11 mm Gadidae (both larvae are quite damaged)
							4 larvae unidentified due to extensive damage (2 elongate, 2 non-elongate)
30 May	0813	11	2	333	2	31	1 egg < 1 mm (0.89 mm)
							1 egg ∿ 1 mm (1.04 mm)
							1 larva 8.2 mm *Bathylagus stilbius*
							4 larvae 3.0-4.9 mm *Sebastes* spp.
							22 larvae 3.5-5.5 mm *Stenobrachius leucopsarus*
							3 young 21, 25, 39 mm *Stenobrachius leucopsarus*
							1 larva unidentified due to extensive damage (non-elongate)
30 May	0813	11	2	505	1	51	1 egg < 1 mm (0.85 mm)
							2 larvae 19, 28 mm *Bathylagus stilbius*
							1 young 21 mm *Protomyctophym thompsoni*
							3 larvae 4.0, 5.3, 7.2 mm *Sebastes* sp.
							24 larvae 3.9-4.8 mm *Stenobrachius leucopsarus*
							19 young 14-30 mm Hexagrammidae
							2 larvae unidentified due to extensive damage (1 elongate, 1 non-elongate)

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
28 May	1831	13	1	333	13	940[i]	3 eggs ∿ 1 mm (1.02, 1.21, 1.24 mm)
							10 eggs ∿ 2 mm (1.29-1.72 mm)
							704 larvae 7.0-17 mm *Bathylagus stilbius*
							88 larvae 8.8-13 mm *Clupea harengus pallasi*
							8 larvae 13 mm *Gadus* sp.
							92 larvae 4.6-4.8 mm *Sebastes* sp.
							4 larvae 4.8 mm *Stenobrachius leucopsarus*
							16 larvae 4.4-5.5 mm Cottidae
							4 larvae 8.4 mm Gadidae
							24 larvae unidentified due to extensive damage (elongate)
28 May	1831	13	1	505	8	876[i]	8 eggs ∿ 2 mm (1.26-2.17 mm)
							632 larvae 8.0-16 mm *Bathylagus stilbius*
							32 larvae 11-14 mm *Clupea harengus pallasi*
							20 larvae 8.5-11 mm *Gadus* sp.
							76 larvae 4.2-4.7 mm *Sebastes* sp.
							4 larvae 4.5 mm *Stenobrachius leucopsarus*
							8 larvae 6.0-7.6 mm Cottidae

[i] The sample was split for fish larvae and 1/4 was sorted; totals given are for the entire sample.

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
28 May	1831	13	1	505	8	876	20 larvae 5.8-10 mm Gadidae
							84 larvae unidentified due to extensive damage (elongate)
28 May	2248	13	2	333	99	2992[j]	99 eggs ∿ 2 mm (1.25-1.92 mm)
							1424 larvae 6.3-17 mm *Bathylagus stilbius*
							16 young 37 mm *Bathylagus stilbius*
							16 larvae 13 mm *Clupea harengus pallasi*
							192 larvae 9.0-13 mm *Gadus* sp.
							1104 larvae 3.9-5.1 *Sebastes* sp.
							32 larvae 5.9-7.3 mm Cottidae
							16 young 26 mm Cyclopteridae
							80 larvae 6.0-9.1 mm Gadidae
							112 larvae unidentified due to extensive damage (elongate)
28 May	2248	13	2	505	100	2384[j]	100 eggs ∿ 2 mm (1.29-2.17 mm)
							1056 larvae 7.4-15 mm *Bathylagus stilbius*
							16 young 30 mm *Bathylagus stilbius*

[j] The sample was split for fish larvae and 1/16 was sorted; totals given are for the entire sample.

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
28 May	2248	13	2	505	100	2384	80 larvae 10-13 mm *Gadus* sp.
							880 larvae 4.3-5.0 mm *Sebastes* sp.
							64 larvae 6.3-6.9 mm Cottidae
							32 young 15, 71 mm Cyclopteridae
							16 young 25 mm Cyclopteridae
							160 larvae 7.3-12 mm Gadidae
							80 larvae unidentified due to extensive damage (elongate)
29 May	1029	13	3	333	1	800[k]	1 egg ∿ 2 mm (1.71 mm)
							8 larvae 9.5-10 mm *Ammodytes hexapterus*
							580 larvae 7.7-18 mm *Bathylagus stilbius*
							8 larvae 13, 14 mm *Clupea harengus pallasi*
							44 larvae 9.0-14 mm *Gadus* sp.
							116 larvae 4.4-5.3 mm *Sebastes* sp.
							4 larva 6.3 mm Cottidae
							32 larvae 5.5-13 mm Gadidae
							8 larvae unidentified due to extensive damage (non-elongate)

[k] The sample was split for fish larvae and 1/4 was sorted; totals given are for the entire sample.

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
29 May	1029	13	3	505	0	700	4 larvae 20 mm *Ammodytes hexapterus*
							440 larvae 8.1-15 mm *Bathylagus stilbius*
							76 larvae 9.4-16 mm *Gadus* sp.
							120 larvae 4.7-5.5 mm *Sebastes* sp.
							16 larvae 5.6-6.8 mm Cottidae
							4 young 96 mm Cyclopteridae
							32 larvae 5.1-9.7 mm Gadidae
							4 larvae 6.1 mm unidentified (elongate)
							4 larvae unidentified due to extensive damage (non-elongate)
28 May	0536	14	1	333	74	11	14 eggs ∿ 2 mm (2.00-2.40 mm)
							60 eggs ∿ 3 mm (2.80-3.77 mm)
							4 larvae 13 mm *Lumpenus* sp.
							2 larvae 5.7, 6.7 mm Gadidae
							5 larvae 5.2-6.6 mm unidentified (elongate)

Table 34. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
28 May	0536	14	1	505	74	13	15 eggs ∿ 2 mm (2.00-2.48 mm)
							59 eggs ∿ 3 mm (2.97-3.52 mm)
							1 larva 4.6 mm *Sebastes* sp.
							3 larvae 4.0-5.5 mm Gadidae
							9 larvae 5.2-6.1 mm unidentified (elongate)

Table 35. Identification of Fish Eggs and Larvae by Station

1-m NIO Tow, *Discoverer*, Leg VII, 22-30 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
27 May	0120	6	5	571	248[a]	162	244 eggs ∿ 1 mm (0.93-1.05 mm)
							4 eggs ∿ 2 mm (1.29-1.37 mm)
							12 larvae 5.0-14 mm *Ammodytes hexapterus*
							1 larva 7.7 mm *Anoplarchus* sp.
							1 larva 3.9 mm *Lepidopsetta bilineata* ?
							3 larvae 10, 17, 18 mm *Lumpenus* sp.
							2 larvae 10, 13 mm Agonidae
							5 larvae 6.9-9.0 mm Cottidae ["Cottid 6" from Blackburn 1973]
							6 larvae 4.7-6.3 mm Cyclopteridae
							1 larva 8.0 mm Osmeridae
							5 larvae 13-19 mm Pholidae
							126 larvae unidentified due to extensive damage (123 elongate, 3 non-elongate)

[a] The sample was split for fish eggs and 1/2 was sorted; totals given are for the entire sample.

Table 36. Summary of taxonomic categories of commercially important crab and shrimp larvae found in bongo and 1-m net samples collected on the Lower Cook Inlet *Discoverer* cruise, Leg VII, 22-30 May 1976.

A total of 37 samples contained 29,582 crab zoeae and 120 megalopae. The commercially important crabs were distributed into 3 families, 2 genera and 2 species. The 37 samples contained 16,834 shrimp zoeae and 798 adult shrimp. The commercially important shrimp were distributed into 1 family, 2 genera and 6 species.

Section Anomura

Family Lithodidae

1010 zoeae king crab[1] *Paralithodes camtschatica* (Tilesius)

5,969 zoeae unidentified, non-commercially important anomurans

Section Brachyura

Family Cancridae

18 zoeae non-commercially important *Cancer* spp.

Family Majidae

3469 zoeae tanner crab *Chionoecetes bairdi* (Rathbun)
1070 zoeae damaged *Chionoecetes* spp.
120 megalopae *Chionoecetes* spp.

18,046 zoeae unidentified, non-commercially important brachyurans

Section Caridea

Family Pandalidae

42 zoeae sidestripe shrimp *Pandalopsis dispar* Rathbun
1421 zoeae northern pink shrimp *Pandalus borealis* Kröyer
5710 zoeae humpy shrimp *Pandalus goniurus* Stimpson
280 zoeae *Pandalus montagui tridens* Rathbun
18 zoeae *Pandalus stenolepis* Rathbun
472 zoeae coonstripe shrimp *Pandalus hypsinotus* Brandt
41 zoeae *Pandalus* spp., damaged
594 adult *Pandalus borealis*
83 adult *Pandalus goniurus*

8850 zoeae unidentified hippolytids
121 adult non-commercially important shrimp

[1] The common name is presented for the first time for each species; thereafter, only the scientific name is recorded.

Table 37. Identification of Crab and Shrimp Larvae by Station

Lower Cook Inlet Bongo and 1-m NIO Net Tows, *Discoverer*, Leg VII, 22-30 May 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
25 May	0732	1	1[a]	333	I	6	*Paralithodes camtschatica*
					II	2	*P. camtschatica*
					III	8	*P. camtschatica*
					zoea	274	unidentified anomurans
					I	4	*Cancer productus*
					I	12	*Chionoecetes bairdi*
					megalopa	4	*Chionoecetes* sp.
					zoea	906	unidentified brachyurans
					II	6	*Pandalus borealis*
					III	28	*P. borealis*
					IV	4	*P. borealis*
					I	2	*P. montagui tridens*
					II	49	*P. montagui tridens*
					III	4	*P. montagui tridens*
					I	5	*P. stenolepis*
					II	1	*P. stenolepis*
					zoea	590	unidentified hippolytids
					adult	1	*Eualus* sp.
25 May	0732	1	1	505	I	3	*Paralithodes camtschatica*
					II	5	*P. camtschatica*
					III	1	*P. camtschatica*
					zoea	265	unidentified anomurans
					I	6	*Cancer productus*

[a] The sample was split for crab larvae and 1/2 was sorted; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
25 May	0732	1	1	505	I	17	*Chionoecetes bairdi*
					megalopa	9	*Chionoecetes* sp.
					zoea	917	unidentified brachyurans
					II	1	*Pandalopsis dispar*
					II	7	*Pandalus borealis*
					III	41	*P. borealis*
					II	1	*P. goniuris*
					I	9	*P. montagui tridens*
					II	45	*P. montagui tridens*
					III	2	*P. montagui tridens*
					I	3	*P. stenolepis*
					II	3	*P. stenolepis*
					zoea	567	unidentified hippolytids
					adult	1	*Eualus* sp.
25 May	1150	2	1[b]	333	II	16	*Paralithodes camtschatica*
					zoea	2432	unidentified anomurans
					I	288	*Chionoecetes bairdi*
					zoea	2272	unidentified brachyurans
					I	1	*Pandalus borealis*
					III	1	*P. borealis*
					III	1	*P. goniurus*
					zoea	239	unidentified hippolytids

[b] The sample was split for crab larvae and 1/8 was sorted; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
25 May	1150	2	1[c]	505	I	8	*Paralithodes camtschatica*
					II	16	*P. camtschatica*
					zoea	1352	unidentified anomurans
					I	144	*Chionoecetes bairdi*
					zoea	1816	unidentified brachyurans
					III	1	*Pandalopsis dispar*
					II	1	*Pandalus montagui tridens*
					II	1	*P. stenolepis*
					III	1	*P. stenolepis*
					zoea	291	unidentified hippolytids
25 May	1607	3	1	333	zoea	8	unidentified anomurans
					I	4	*Chionoecetes bairdi*
					zoea	304	unidentified brachyurans
					I	1	*Pandalus goniurus*
					zoea	67	unidentified hippolytids
25 May	1607	3	1	505	zoea	7	unidentified anomurans
					I	2	*Chionoecetes bairdi*
					zoea	300	unidentified brachyurans
					I	3	*Pandalus goniurus*
					zoea	93	unidentified hippolytids
					adult	1	*Crangon franciscorum angustimana*
25 May	2217	4	1	333	megalopa	1	*Chionoecetes* sp.
					zoea	48	unidentified brachyurans
					zoea	16	unidentified hippolytids

[c] The sample was split for crab larvae and 1/8 was sorted; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
25 May	2217	4	1	505	zoea	1	unidentified anomuran
					zoea	46	unidentified brachyurans
					zoea	9	unidentified hippolytids
26 May	0541	5a	2[d]	333	II	64	*Paralithodes camtschatica*
					zoea	376	unidentified anomurans
					V	8	*Cancer oregonensis*
					I	312	*Chionoecetes bairdi*
					zoea	1112	unidentified brachyurans
					I	240	*Pandalus borealis*
					III	24	*P. borealis*
					I	8	*P. goniurus*
					II	512	*P. goniurus*
					III	320	*P. goniurus*
					zoea	1984	unidentified hippolytids
26 May	0541	5a	2[d]	505	II	40	*Paralithodes camtschatica*
					zoea	176	unidentified anomurans
					I	312	*Chionoecetes bairdi*
					zoea	1232	unidentified brachyurans
					II	24	*Pandalus borealis*
					III	8	*P. borealis*
					IV	24	*P. borealis*
					I	24	*P. goniurus*
					II	296	*P. goniurus*
					III	152	*P. goniurus*
					I	8	*P. hypsinotus*
					zoea	1816	unidentified hippolytids

[d] The sample was split and 1/8 was sorted for crab and shrimp larvae; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
26 May	0835	6	1[e]	333	I	88	*Chionoecetes bairdi*
					I	320	damaged *Chionoecetes* sp.
					zoea	1024	unidentified brachyurans (many damaged)
					IV	16	*Pandalus goniurus*
					adult	235	*P. borealis*
					adult	26	*P. goniurus*
26 May	0835	6	1[e]	505	zoea	16	unidentified anomurans
					I	120	*Chionoecetes bairdi*
					I	416	damaged *Chionoecetes* sp.
					zoea	1864	unidentified brachyurans (many damaged)
					II	8	*Pandalus borealis*
					I	24	*P. goniurus*
					II	24	*P. goniurus*
					adult	211	*P. borealis*
					adult	44	*P. goniurus*
					adult	1	*Crangon communis*
26 May	1928	6	3[e]	333	III	8	*Paralithodes camtschatica*
					zoea	8	unidentified anomurans
					I	128	*Chionoecetes bairdi*
					I	96	damaged *Chionoecetes* sp.
					zoea	552	unidentified brachyurans (many damaged)
					III	24	*Pandalus borealis*

[e] The sample was split and 1/8 was sorted for crab and shrimp larvae; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
26 May	1928	6	3	333	I	24	*P. goniurus*
					zoea	24	unidentified hippolytids
					adult	20	*P. borealis*
					adult	4	*P. goniurus*
26 May	1928	6	3[f]	505	III	8	*Paralithodes camtschatica*
					IV	4	*P. camtschatica*
					I	88	*Chionoecetes bairdi*
					I	52	damaged *Chionoecetes* sp.
					zoea	308	unidentified brachyurans (many damaged)
					I	4	*Pandalus borealis*
					II	4	*P. borealis*
					I	16	*P. goniurus*
					II	16	*P. goniurus*
					III	4	*P. goniurus*
					zoea	68	unidentified hippolytids
					adult	20	*P. borealis*
27 May	0056	6	4[g]	333	II	32	*Paralithodes camtschatica*
					III	32	*P. camtschatica*
					zoea	48	unidentified anomurans
					I	264	*Chionoecetes bairdi*
					I	104	damaged *Chionoecetes* sp.
					zoea	584	unidentified brachyurans (some damaged)

[f] Adult shrimp were sorted from the entire sample. The sample was split and 1/4 was sorted for crab and shrimp larvae; totals given are for the entire sample.

[g] Adult shrimp were sorted from the entire sample. The sample was split and 1/8 was sorted for crab and shrimp larvae; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
27 May	0056	6	4	333	I	32	*Pandalus borealis*
					II	8	*P. borealis*
					III	8	*P. borealis*
					I	16	*P. goniurus*
					II	8	*P. goniurus*
					III	16	*P. goniurus*
					I	72	*P. hypsinotus*
					II	24	*P. hypsinotus*
					zoea	272	unidentified hippolytids
					adult	6	*P. borealis*
					adult	1	*P. goniurus*
27 May	0056	6	4[h]	505	II	32	*Paralithodes camtschatica*
					III	56	*P. camtschatica*
					zoea	48	unidentified anomurans
					I	248	*Chionoecetes bairdi*
					I	80	damaged *Chionoecetes* sp.
					zoea	496	unidentified brachyurans (some damaged)
					III	8	*Pandalus borealis*
					IV	8	*P. borealis*
					I	8	*P. goniuris*
					III	8	*P. goniuris*
					I	112	*P. hypsinotus*
					II	48	*P. hypsinotus*
					III	16	*P. hypsinotus*
					zoea	208	unidentified hippolytids
					adult	8	*P. borealis*
					adult	1	*P. goniuris*

[h] Adult shrimp were sorted from the entire sample. The sample was split and 1/8 was sorted for crab and shrimp larvae; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
27 May	0120	6	5[i]	571	II	24	*Paralithodes camtschatica*
					III	28	*P. camtschatica*
					IV	8	*P. camtschatica*
					zoea	104	unidentified anomurans
					I	24	*Chionoecetes bairdi*
					zoea	544	unidentified brachyurans
					I	28	*Pandalus borealis*
					II	16	*P. borealis*
					III	20	*P. borealis*
					I	16	*P. goniurus*
					II	36	*P. goniurus*
					III	8	*P. goniurus*
					II	12	damaged *Pandalus* sp.
					zoea	728	unidentified hippolytids
27 May	0708	6	7[j]	333	II	8	*Paralithodes camtschatica*
					III	8	*P. camtschatica*
					zoea	56	unidentified anomurans
					I	288	*Chionoecetes bairdi*
					zoea	552	unidentified brachyurans
					III	8	*Pandalus borealis*
					I	8	*P. goniurus*
					III	16	*P. goniurus*
					I	120	*P. hypsinotus*
					II	64	*P. hypsinotus*

[i] Adult shrimp were sorted from the entire sample. The sample was split and 1/4 was sorted for crab and shrimp larvae; totals given are for the entire sample.

[j] Adult shrimp were sorted from the entire sample. The sample was split and 1/8 was sorted for crab and shrimp larvae; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
27 May	0708	6	7	333	zoea	16	damaged *Pandalus* sp.
					adult	56	*P. borealis*
					adult	3	*P. goniurus*
					adult	1	*Crangon franciscorum angustimana*
27 May	0708	6	7[j]	505	II	8	*Paralithodes camtschatica*
					zoea	56	unidentified anomurans
					I	304	*Chionoecetes bairdi*
					zoea	616	unidentified brachyurans
					III	8	*Pandalus goniurus*
					III	8	*P. hypsinotus*
					adult	36	*P. borealis*
					adult	4	*P. goniurus*
					adult	1	*Crangon franciscorum angustimana*
27 May	1300	7	1[k]	333	I	8	*Paralithodes camtschatica*
					II	196	*P. camtschatica*
					III	20	*P. camtschatica*
					zoea	88	unidentified anomurans
					I	8	*Chionoecetes bairdi*
					zoea	128	unidentified brachyurans
					I	280	*Pandalus goniurus*
					II	1440	*P. goniurus*
					III	128	*P. goniurus*
					zoea	20	damaged *Pandalus goniurus* ?
					zoea	544	unidentified hippolytids

[k] The sample was split and 1/4 was sorted for crab and shrimp larvae; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
27 May	1300	7	1[l]	505	I	32	*Paralithodes camtschatica*
					II	204	*P. camtschatica*
					III	24	*P. camtschatica*
					zoea	92	unidentified anomurans
					I	8	*Chionoecetes bairdi*
					zoea	96	unidentified brachyurans
					I	328	*Pandalus goniurus*
					II	1752	*P. goniurus*
					III	152	*P. goniurus*
					zoea	8	damaged *Pandalus* sp.
					zoea	544	unidentified hippolytids
27 May	1701	8	1[m]	333	II	24	*Paralithodes camtschatica*
					III	36	*P. camtschatica*
					zoea	212	unidentified anomurans
					I	8	*Chionoecetes bairdi*
					zoea	976	unidentified brachyurans
					II	5	*Pandalus goniurus*
					III	1	*P. goniurus*
					zoea	122	unidentified hippolytids
27 May	1701	8	1[m]	505	II	20	*Paralithodes camtschatica*
					III	20	*P. camtschatica*
					zoea	284	unidentified anomurans
					I	4	*Chionoecetes bairdi*

[l] The sample was split and 1/4 was sorted for crab larvae and 1/8 was sorted for shrimp larvae; totals given are for the entire sample.

[m] The sample was split and 1/4 was sorted for crab larvae; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (µm)	Stage	Total	Identification of Larvae
27 May	1701	8	1	505	megalopa	4	*Chionoecetes* sp.
					zoea	892	unidentified brachyurans
					I	1	*Pandalus borealis*
					II	2	*P. borealis*
					I	1	*P. goniurus*
					II	10	*P. goniurus*
					III	2	*P. goniurus*
					zoea	3	damaged *Pandalus* sp.
					zoea	152	unidentified hippolytids
30 May	1813	10	1	333	zoea	7	unidentified anomurans
					I	18	*Chionoecetes bairdi*
					megalopa	2	*Chionoecetes* sp.
					zoea	41	unidentified brachyurans
					III	1	*Pandalopsis dispar*
					III	2	*Pandalus borealis*
					IV ?	1	damaged *P. borealis* ?
					II	1	*P. goniurus*
					I	7	*P. montagui tridens*
					II	6	*P. montagui tridens*
					III	2	*P. montagui tridens*
					zoea	2	unidentified hippolytids
30 May	1813	10	1	505	zoea	7	unidentified anomurans
					I	13	*Chionoecetes bairdi*
					megalopa	2	*Chionoecetes* sp.
					zoea	46	unidentified brachyurans
					I	1	*Pandalopsis dispar*
					II	2	*Pandalus borealis*

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
30 May	1813	10	1	505	III	2	*P. borealis*
					IV	3	*P. borealis*
					I	10	*P. montagui tridens*
					II	8	*P. montagui tridens*
					III	1	*P. montagui tridens*
					IV	1	damaged *Pandalus* sp.
					zoea	14	unidentified hippolytids
30 May	0253	11	1	333	zoea	1	unidentified anomuran
					I	6	*Chionoecetes bairdi*
					megalopa	6	*Chionoecetes* sp.
					zoea	33	unidentified brachyurans
					I	1	*Pandalus montagui tridens*
					II	1	damaged *Pandalus* sp.
					zoea	11	unidentified hippolytids
					adult	1	*Pasiphaea* sp.
30 May	0253	11	1	505	I	1	*Chionoecetes bairdi*
					megalopa	2	*Chionoecetes* sp.
					zoea	4	unidentified brachyurans
					IV ?	1	*Pandalopsis dispar*
					zoea	6	unidentified hippolytids
30 May	0813	11	2	333	megalopa	3	*Chionoecetes* sp.
					zoea	7	unidentified brachyurans
					zoea	4	unidentified hippolytids

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (µm)	Stage	Total	Identification of Larvae
30 May	0813	11	2	505	megalopa	5	*Chionoecetes* sp.
					zoea	24	unidentified brachyurans
					IV	1	*Pandalopsis dispar*
					III	1	*Pandalus montagui tridens*
					zoea	4	unidentified hippolytids
28 May	1831	13	1[n]	333	zoea	4	unidentified anomurans
					I	140	*Chionoecetes bairdi*
					megalopa	4	*Chionoecetes* sp.
					zoea	96	unidentified brachyurans
					I	4	*Pandalopsis dispar*
					II	2	*P. dispar*
					III	2	*P. dispar*
					II	2	*Pandalus borealis*
					III	48	*P. borealis*
					IV	60	*P. borealis*
					V	6	*P. borealis*
					I	2	*P. montagui tridens*
					II	6	*P. montagui tridens*
					III	6	*P. montagui tridens*
					zoea	72	unidentified hippolytids
28 May	1831	13	1[n]	505	zoea	8	unidentified anomurans
					I	122	*Chionoecetes bairdi*
					megalopa	2	*Chionoecetes* sp.

[n] The sample was split and 1/2 was sorted for crab and shrimp larvae; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
28 May	1831	13	1	505	zoea	102	unidentified brachyurans
					I	2	*Pandalopsis dispar*
					II	2	*P. dispar*
					II	4	*Pandalus borealis*
					III	46	*P. borealis*
					IV	40	*P. borealis*
					V	10	*P. borealis*
					I	6	*P. montagui tridens*
					II	14	*P. montagui tridens*
					III	2	*P. montagui tridens*
					I	2	*P. stenolepis*
					zoea	62	unidentified hippolytids
28 May	2248	13	2	333	zoea	2	unidentified anomurans
					I	88	*Chionoecetes bairdi*
					II	1	*Chionoecetes* sp.
					megalopa	1	*Chionoecetes* sp.
					zoea	23	unidentified brachyurans
					I	8	*Pandalopsis dispar*
					II	3	*P. dispar*
					III	2	*P. dispar*
					III	60	*Pandalus borealis*
					IV	66	*P. borealis*
					V	3	*P. borealis*
					II	8	*P. montagui tridens*
					III	1	*P. montagui tridens*
					zoea	64	unidentified hippolytids
					adult	34	*Pasiphaea* sp.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (um)	Stage	Total	Identification of Larvae
28 May	2248	13	2[o]	505	zoea	2	unidentified anomurans
					I	59	*Chionoecetes bairdi*
					megalopa	2	*Chionoecetes* sp.
					zoea	10	unidentified brachyurans
					II	2	*Pandalopsis dispar*
					III	96	*Pandalus borealis*
					IV	55	*P. borealis*
					V	7	*P. borealis*
					I	2	*P. montagui tridens*
					II	9	*P. montagui tridens*
					zoea	94	unidentified hippolytids
					adult	2	*Pandalus borealis*
					adult	39	*Pasiphaea* sp.
29 May	1029	13	3[o]	333	zoea	3	unidentified anomurans
					I	104	*Chionoecetes bairdi*
					II	1	*Chionoecetes* sp.
					megalopa	2	*Chionoecetes* sp.
					zoea	9	unidentified brachyurans
					II	2	*Pandalopsis dispar*
					III	2	*P. dispar*
					II	4	*Pandalus borealis*
					III	46	*P. borealis*
					IV	78	*P. borealis*
					V	16	*P. borealis*
					II	9	*P. montagui tridens*
					III	2	*P. montagui tridens*
					IV	2	*P. montagui tridens*
					zoea	66	unidentified hippolytids
					adult	25	*Pasiphaea* sp.

[o] The sample was split and 7/16 was sorted for shrimp larvae and adult shrimp; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
29 May	1029	13	3[p]	505	zoea	8	unidentified anomurans
					I	168	*Chionoecetes bairdi*
					zoea	6	unidentified brachyurans
					III	2	*Pandalopsis dispar*
					II	2	*Pandalus borealis*
					III	53	*P. borealis*
					IV	96	*P. borealis*
					V	18	*P. borealis*
					II	2	*P. montagui tridens*
					III	4	*P. montagui tridens*
					zoea	82	unidentified hippolytids
					adult	16	*Pasiphaea* sp.
28 May	0536	14	1	333	III	1	*Paralithodes camtschatica*
					zoea	10	unidentified anomurans
					I	44	*Chionoecetes bairdi*
					megalopa	39	*Chionoecetes* sp.
					zoea	33	unidentified brachyurans
					I	1	*Pandalopsis dispar*
					II	1	*P. dispar*
					II	1	*Pandalus borealis*
					I	16	*P. montagui tridens*
					II	3	*P. montagui tridens*
					III	1	*P. montagui tridens*
					zoea	12	unidentified hippolytids

[p] The sample was split and 5/8 was sorted for crab larvae and 7/16 was sorted for shrimp larvae; totals given are for the entire sample.

Table 37. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
28 May	0536	14	1	505	zoea	14	unidentified anomurans
					I	35	*Chionoecetes bairdi*
					megalopa	32	*Chionoecetes* sp.
					zoea	27	unidentified brachyurans
					I	1	*Pandalopsis dispar*
					I	1	*Pandalus borealis*
					II	1	*P. borealis*
					III	5	*P. borealis*
					IV	1	*P. borealis*
					I	28	*P. montagui tridens*
					II	6	*P. montagui tridens*
					III	3	*P. montagui tridens*
					I	1	*P. stenolepis*
					III	1	*P. stenolepis*
					zoea	23	unidentified hippolytids

Table 38. Number of fish eggs and larvae at each station

Lower Cook Inlet Bongo Tows, *Acona*, Leg II, 08-15 July 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
13 July	0119	1	1	333	1	1116
13 July	0119	1	1	505	3	1584
12 July	1133	2	1	333	28	1272
12 July	1133	2	1	505	35	1312
10 July	0901	3	1	333	1	150
10 July	0901	3	1	505	1	101
10 July	1556	4	1	333	5	304
10 July	1556	4	1	505	0	422
11 July	0018	5	1	333	299	744
11 July	0018	5	1	505	338	668
11 July	1009	6	2	333	123	33
11 July	1009	6	2	505	92	45
11 July	1031	6	3	333	104	37
11 July	1031	6	3	505	122	38
11 July	2051	6	4	333	656	64
11 July	2051	6	4	505	816	99
11 July	2113	6	5	333	1176	79
11 July	2113	6	5	505	740	131
10 July	0405	7	1	333	330	532
10 July	0405	7	1	505	386	484
10 July	0010	8	1	333	660	214
10 July	0010	8	1	505	920	31
13 July	0548	9	1	333	2	119
13 July	0548	9	1	505	7	217
13 July	1230	10	1	333	5	318
13 July	1230	10	1	505	3	413
13 July	2243	11	1	333	0	1
13 July	2243	11	1	505	1	3
14 July	0835	11	2	333	0	39
14 July	0835	11	2	505	0	47

Table 39. Summary of taxonomic categories of fish eggs, larvae, young and adults found in bongo net samples collected on Lower Cook Inlet, *Acona* Cruise, Leg II, 08-15 July 1976.

A total of 30 samples were collected. All samples were sorted for fish eggs and larvae and the results are summarized below. The fish are distributed into 15 families, 18 genera, and 11 species. Eggs are distributed into 4 size categories.

Family Agonidae

1 young sturgeon poacher[1] *Agonus acipenserinus* (Tilesius)

Family Bathylagidae

3 larvae smoothtongue *Bathylagus stilbius* Gilbert
3 larvae deepsea smelt *Bathylagus* spp.

Family Bathymasteridae

124 larvae genus? species?

Family Clupeidae

48 larvae Pacific herring *Clupea harengus pallasi* Valenciennes

Family Cottidae

1 larva northern sculpin *Icelinus borealis* Gilbert
1 young *Icelinus borealis*
83 larvae genus? species?

Family Cyclopteridae

96 larvae genus? species?
1 young genus? species?

Family Gadidae

4 larvae cod *Gadus*
3 larvae genus? species?

Family Myctophidae

23 larvae northern lampfish *Stenobrachius leucopsarus* Eigenmann & Eigenmann
68 young *Stenobrachius leucopsarus*
1 adult *Stenobrachius leucopsarus*
3 larvae genus? species?

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1 The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 39. (continued)

Family Osmeridae

5363 larvae capelin *Mallotus villosus* (Müller)
3122 larvae genus? species?

Family Pholidae

89 larvae genus? species?

Family Pleuronectidae

19 larvae Rex sole *Glyptocephalus zachirus* Lockington
240 larvae sole *Hippoglossoides* sp.
8 larvae rock sole *Lepidopsetta bilineata* (Ayres)
45 larvae yellowfin sole *Limanda aspera* (Pallas) (1 uncertain)
1 young starry flounder *Platichthys stellatus?*
3 larvae sand sole *Psettichthys melanostictus*
3 larvae genus? species

Family Salmonidae

2 young salmon *Onchorhynchus* sp.

Family Scorpaenidae

26 larvae rockfish *Sebastes* sp.
25 larvae thornyhead *Sebastolobus* sp.

Family Stichaeidae

21 larvae cockscomb *Anoplarchus* sp.
52 larvae prickleback *Lumpenus* sp.

1135 larvae unidentified (many badly damaged)

6854 eggs categorized (see Table 18, List of possible fish for egg size categories)

6450	eggs	<1 mm	(0.71-0.90 mm)
394	eggs	~ 1 mm	(0.90-1.20 mm)
4	eggs	~ 2 mm	(1.34-2.00 mm)
6	eggs	~ 3 mm	(2.64-3.24 mm)

Table 40. Identification of Fish Eggs and Larvae by Station

Lower Cook Inlet Bongo Tows, *Acona*, Leg II, 08-15 July 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
13 Jul	0119	1	1	333	1[a]	1116[a]	1 egg < 1 mm (0.71 mm)[b]
							16 larvae 8.4-14 mm *Hippoglossoides* sp.
							912 larvae 3.1-12 mm *Mallotus villosus*
							4 larvae 6.7 mm Cottidae ("Cottid 2" from Blackburn 1973)
							180 larvae 3.4-16 mm Osmeridae
							4 larvae 3.0 mm unidentified (non-elongate)
13 Jul	0119	1	1	505	3	1584[c]	2 eggs < 1 mm (0.71, 0.87 mm)
							1 egg ∿ 1 mm (0.93 mm)

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature. The sample was sorted for fish eggs. Then it was split and 1/4 of the sample was sorted for fish larvae; totals are given for the entire sample.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

[c] The sample was split and 1/8 of the sample was sorted for fish larvae; totals are given for the entire sample.

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
13 Jul	0119	1	1	505	3	1584	1088 larvae 3.7-12 mm *Mallotus villosus*
							496 larvae 3.2-15 mm Osmeridae
12 Jul	1133	2	1	333	28	1272[d]	1 egg < 1 mm (0.85 mm)
							26 eggs ∿ 1 mm (0.91-1.02 mm)
							1 egg ∿ 2 mm (1.34 mm)
							8 larvae 7.1 mm *Lepidopsetta bilinea.*
							536 larvae 6.2-11 mm *Mallotus villosus*
							8 larvae 8.6 mm Cottidae
							16 larvae 6.5-6.7 mm Cyclopteridae
							520 larvae 6.4-14 mm Osmeridae
							24 larvae 10-17 mm Pholidae
							160 larvae unidentified due to extensive damage (elongate)
12 Jul	1133	2	1	505	35	1312[e]	3 eggs < 1 mm (0.85-0.89)
							32 eggs ∿ 1 mm (0.91-1.00 mm)
							16 larvae 5.9 mm *Hippoglossoides* sp.

[d] The sample was split and 1/8 of the sample was sorted for fish larvae; totals are given for the entire sample.

[e] The sample was split and 1/16 of the sample was sorted for fish larvae; totals are given for the entire sample.

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
12 Jul	1133	2	1	505	35	1312	496 larvae 7.5-11 mm *Mallotus villosus*
							32 larvae 6.7-7.6 mm Cottidae
							48 larvae 9.1-10 mm Cyclopteridae
							416 larvae 6.9-11 mm Osmeridae
							32 larvae 11-23 mm Pholidae
							16 larvae 3.8 mm unidentified (non-elongate)
							16 larvae 3.8 mm unidentified (non-elongate)
							240 larvae unidentified due to extensive damage (elongate)
10 Jul	0901	3	1	333	1	150	1 egg ∿ 2 mm (1.40 mm)
							1 larva 42 mm *Lumpenus* sp.
							91 larvae 4.9-11 mm *Mallotus villosus*
							6 larvae 13-14 mm Cyclopteridae
							3 larvae 11, 13, 15 mm Cyclopteridae
							4 larvae 7.1-10 mm Osmeridae
							5 larvae 20-30 mm Pholidae
							40 larvae unidentified due to extensive damage (elongate)

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
10 Jul	0901	3	1	505	1	101	1 egg < 1 mm (0.84 mm)
							1 young 20 mm *Agonus acipenserinus*
							2 larvae 48, 51 mm *Lumpenus* sp.
							60 larvae 5.3-12 mm *Mallotus villosus*
							1 larva 8.7 mm Cottidae ("Cottid 5" from Blackburn 1973)
							2 larvae 13, 15 mm Cyclopteridae
							5 larvae 6.7-8.1 mm Osmeridae
							2 larvae 18, 22 mm Pholidae
							3 larvae 4.4, 4.5, 4.9 mm unidentified (elongate)
							25 larvae unidentified due to extensive damage (elongate)
10 Jul	1556	4	1	333	5	304[f]	5 eggs < 1 mm (0.81-0.85 mm)[b]
							16 larvae 8.9-11 mm *Clupea harengus pallasi*
							164 larvae 5.9-9.4 mm *Mallotus villosus*
							2 young 42 mm *Onchorhynchus* sp.?
							4 larvae 13-21 mm Cyclopteridae

[f] The sample was split and 1/2 of the sample was sorted for fish larvae; totals are given for the entire sample.

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (µm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
10 Jul	1556	4	1	333	5	304	106 larvae 6.6-7.2 mm Osmeridae
							12 larvae unidentified due to extensive damage (elongate)
10 Jul	1556	4	1	505	0	422[g]	2 larvae 8.1 mm *Bathylagus stilbius*
							10 larvae 9.0-10 mm *Clupea harengus pallasi*
							174 larvae 6.7-9.1 mm *Mallotus villosus*
							2 larvae 5.6 mm Cottidae ("Cottid 5" from Blackburn 1973)
							8 larvae 3.4-15 mm Cyclopteridae
							196 larvae 5.8-10 mm Osmeridae
							30 larvae unidentified due to extensive damage (elongate)
11 Jul	0018	5a	1	333	299[h]	744[h]	259 eggs < 1 mm (0.71-0.89 mm)
							40 eggs ∿ 1 mm (0.90-0.94 mm)
							12 larvae 11-13 mm *Anoplarchus* sp.
							360 larvae 4.7-12 mm *Mallotus villosus*
							4 larvae 4.4 mm Cottidae ("Cottid 6" from Blackburn 1973)

[g] The sample was split and 1/2 was sorted for fish larvae; totals given are for the entire sample.

[h] The sample was split and 5/8 was sorted for fish eggs and 1/4 was sorted for larvae; totals given are for the entire sample.

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
11 Jul	0018	5a	1	333	299	744	276 larvae 4.6-13 mm Osmeridae
							12 larvae 14-27 mm Pholidae
							12 larvae 4.5-8.5 mm unidentified (elongate)
							24 larvae 3.5-5.2 mm unidentified (non-elongate)
							8 larvae 6.9 mm unidentified (non-elongate)
							36 larvae unidentified due to extensive damage (elongate)
11 Jul	0018	5a	1	505	338[i]	668[i]	266 eggs < 1 mm (0.74-0.88 mm)
							72 eggs ∿ 1 mm (0.90-1.00 mm)
							8 larvae 11-12 mm *Anoplarchus* sp.
							4 larvae 5.9 mm *Gadus* sp.
							4 larvae 8.8 mm *Hippoglossoides* sp.
							312 larvae 5.9-12 mm *Mallotus villosus*
							4 larvae 6.0 mm Cottidae ("Cottid 5" from Blackburn 1973)
							4 larvae 3.5 mm Cyclopteridae
							176 larvae 5.2-13 mm Osmeridae

[i] The sample was split and 1/2 of the sample was sorted for fish eggs and 1/4 sorted for larvae; totals are given for the entire sample.

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
11 Jul	0018	5a	1	505	338	668	8 larvae 16-19 mm Pholidae
							24 larvae 4.8-7.7 mm unidentified (elongate)
							12 larvae 3.8-5.4 mm unidentified (non-elongate)
							4 larvae 6.8 mm unidentified (non-elongate)
							108 larvae unidentified due to extensive damage (elongate)
11 Jul	1009	6	2	333	123	33	123 eggs < 1 mm (0.74-0.86 mm)
							2 larvae 7.0, 8.0 mm *Hippoglossoides* sp.
							13 larvae 38-52 mm *Lumpenus* spp.
							2 larvae 4.2, 9.5 mm *Mallotus villosus*
							1 larva 9.2 mm Cottidae ("Cottid 5" from Blackburn 1973)
							11 larvae 4.4-8.9 mm unidentified (elongate)
							1 larva 2.0 mm unidentified (appears to be a very early embryo that escaped from a ruptured egg)
							3 larvae unidentified due to extensive damage (all elongate)

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
11 Jul	1009	6	2	505	92	45	91 eggs < 1 mm (0.75-0.87 mm)
							1 egg ∿ 1 mm (1.14 mm)
							1 larva 17 mm *Clupea harengus pallasi*
							15 larvae 36-42 mm *Lumpenus* sp.
							4 larvae 5.6-9.3 mm *Mallotus villosus*
							1 young 17 mm *Platichthys stellatus* ?
							1 larva 4.1 mm *Psettichthys melanostictus* ?
							3 larvae 5.2, 6.3, 6.8 mm Cottidae ("Cottid 5" from Blackburn 1973)
							1 larvae 32 mm Pholidae
							16 larvae 4.5-8.2 mm unidentified (elongate)
							3 larvae unidentified due to extensive damage (elongate)
11 Jul	1031	6	3	333	104	37	103 eggs < 1 mm (0.74-0.86 mm)
							1 egg ∿ 1 mm (1.04 mm)
							3 larvae 7.1, 7.2, 10 mm *Hippoglossoides* sp.
							11 larvae 37-45 mm *Lumpenus* spp.
							6 larvae 5.2-15 mm *Mallotus villosus*
							1 larva 8.6 mm *Psettichthys melanostictus*

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
11 Jul	1031	6	3	333	104	37	1 larva 8.0 mm Cottidae ("Cottid 5" from Blackburn 1973)
							1 larva 6.3 mm Cottidae
							12 larvae 4.9-9.1 mm unidentified (elongate)
							1 larva 3.5 mm unidentified (non-elongate)
							1 larva 2.2 mm unidentified (non-elongate)
11 Jul	1031	6	3	505	122	38	121 eggs < 1 mm (0.76-0.90 mm)
							1 egg ∿ 1 mm (1.00 mm)
							1 larva 14 mm *Anoplarchus* sp.
							10 larvae 37-41 mm *Lumpenus* sp.
							5 larvae 6.9-14 mm *Mallotus villosus*
							1 larva 8.8 mm Cottidae ("Cottid 5" from Blackburn 1973)
							1 larva 4.5 mm Cottidae ("Cottid 6" from Blackburn 1973)
							1 larva 10 mm Cottidae
							14 larvae 5.7-9.4 mm unidentified (elongate)
							5 larvae unidentified due to extensive damage (elongate)

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
11 Jul	2051	6	4	333	656[j]	64	656 eggs < 1 mm (0.76-0.90 mm)
							4 larvae 3.5-9.0 mm *Hippoglossoides* sp.
							28 larvae 5.8-16 mm *Mallotus villosus*
							17 larvae 5.2-11 mm Bathymasteridae
							3 larvae 5.0, 5.3, 6.7 mm Cottidae ("Cottid 5" from Blackburn 1973)
							1 larva 3.4 mm Cottidae ("Cottid 6" from Blackburn 1973)
							2 larvae 8.9, 9.6 mm Osmeridae
							1 larva 3.0 mm unidentified (non-elongate)
							8 larvae unidentified due to extensive damage (7 elongate, 1 non-elongate)
11 Jul	2051	6	4	505	816[j]	99	808 eggs < 1 mm (0.76-0.86 mm)
							8 eggs ∿ 1 mm (1.00 mm)
							1 larva 3.7 mm *Hippoglossoides* sp.
							1 larva 3.6 mm *Limanda aspera* ?
							33 larvae 4.7-15 mm *Mallotus villosus*
							16 larvae 4.4-8.8 mm Bathymasteridae

[j] The sample was split and 1/4 of the sample was sorted for fish eggs; totals are given for the entire sample.

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
11 Jul	2051	6	4	505	816	99	1 larva 5.8 mm Cottidae ("Cottid 5" from Blackburn 1973)
							1 larva 7.8 mm Cottidae ("Cottid 6" from Blackburn 1973)
							1 larva 4.5 mm Cyclopteridae
							3 larvae 6.0, 6.4, 6.7 mm Osmeridae
							42 larvae unidentified due to extensive damage (40 elongate, 2 non-elongate)
11 Jul	2113	6	5	333	1176[k]	79	1176 eggs < 1 mm (0.71-0.89 mm)
							45 larvae 5.2-18 mm *Mallotus villosus*
							9 larvae 5.0-8.7 mm Bathymasteridae
							1 larva 5.0 mm Cottidae ("Cottid 5" from Blackburn 1973)
							12 larvae 6.5-16 mm Osmeridae
							1 larva 29 mm Pholidae
							11 larvae unidentified due to extensive damage (elongate)

[k] The sample was split and 1/8 of the sample was sorted for fish eggs; totals are given for the entire sample.

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
11 Jul	2113	6	5	505	740[1]	131	736 eggs < 1 mm (0.71-0.89 mm)
							4 eggs ∿ 1 mm (0.91 mm)
							1 larva 10 mm *Hippoglossoides* sp.
							56 larvae 5.7-18 mm *Mallotus villosus*
							21 larvae 4.8-9.4 mm Bathymasteridae
							1 larva 4.9 mm Cottidae ("Cottid 2" from Blackburn 1973)
							1 larva 5.1 mm Cottidae ("Cottid 5" from Blackburn 1973)
							17 larvae 6.5-18 mm Osmeridae
							1 larva 14 mm unidentified (elongate)
							1 larva 3.2 mm unidentified (non-elongate)
							32 larvae unidentified due to extensive damage (elongate)
10 Jul	0405	7	1	333	330	532[m]	278 eggs < 1 mm (0.74-0.87 mm)
							52 eggs ∿ 1 mm (0.90-1.04 mm)
							56 larvae 4.1-7.0 mm *Hippoglossoides* sp.

[1] The sample was split and 1/4 of the sample was sorted for fish eggs; totals are given for the entire sample.

[m] The sample was split and 1/4 of the sample was sorted for fish larvae; totals are given for the entire sample.

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
10 Jul	0405	7	1	333	330	532	36 larvae 2.6-5.1 mm *Limanda aspera*
							308 larvae 4.5-13 mm *Mallotus villosus*
							24 larvae 4.4-4.5 mm Bathymasteridae
							4 larvae 5.0 mm Cottidae ("Cottid 6" from Blackburn 1973)
							64 larvae 8.4-15 mm Osmeridae
							40 larvae unidentified due to extensive damage (20 elongate, 20 non-elongate)
10 Jul	0405	7	1	505	386[n]	484[n]	330 eggs < 1 mm (0.67-0.89 mm)
							56 eggs ∿ 1 mm (0.91-1.02 mm)
							44 larvae 3.1-8.1 mm *Hippoglossoides* sp.
							316 larvae 7.7-13 mm *Mallotus villosus*
							16 larvae 4.5-4.9 mm Bathymasteridae
							44 larvae 8.1-11 mm Osmeridae
							4 larvae 24 mm Pholidae
							60 larvae unidentified due to extensive damage (56 elongate, 4 non-elongate)

[n] The sample was split and 1/2 of the sample was sorted for fish eggs and 1/4 sorted for larvae; totals are given for the entire sample.

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
10 Jul	0010	8	1	333	660[o]	214[o]	624 eggs < 1 mm (0.71-0.87 mm)
							36 eggs ∿ 1 mm (0.91-1.00 mm)
							20 larvae 11-18 mm *Clupea harengus pallasi*
							60 larvae 3.4-5.1 mm *Hippoglossoides* sp.
							6 larvae 5.1, 5.2, 5.5 mm *Limanda aspera*
							72 larvae 6.1-11 mm *Mallotus villosus*
							16 larvae 4.0-4.5 mm Bathymasteridae
							4 larvae 4.2-6.2 mm Cottidae ("Cottid 6" from Blackburn 1973)
							10 larvae 5.2-8.4 mm Osmeridae
							26 larvae unidentified due to extensive damage (22 elongate, 4 non-elongate)
10 Jul	0010	8	1	505	920[p]	31	864 eggs < 1 mm (0.76-0.86 mm)
							56 eggs ∿ 1 mm (0.90-1.04 mm)
							1 larva 20 mm *Clupea harengus pallasi*
							3 larvae 3.8, 4.1, 4.7 mm *Hippoglossoides* sp.

[o] The sample was split and 1/4 of the sample was sorted for fish eggs and 1/2 sorted for fish larvae; totals are given for the entire sample.

[p] The sample was split and 1/8 of the sample was sorted for fish eggs; totals are given for the entire sample.

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
10 Jul	0010	8	1	505	920	31	2 larvae 4.9, 5.3 mm *Limanda aspera*
							18 larvae 5.5-8.6 mm *Mallotus villosus*
							7 larvae unidentified due to extensive damage (elongate)
13 Jul	0548	9	1	333	2	119	1 egg < 1 mm (0.73 mm)
							1 egg ∿ 2 mm (1.97 mm)
							1 larva 9.6 mm *Glyptocephalus zachirus*
							1 larva 13 mm *Hippoglossoides* sp.
							1 larva 3.0 mm *Icelinus borealis*
							57 larvae 4.2-13 mm *Mallotus villosus*
							1 larva 4.6 mm *Sebastes* sp.
							1 larva 3.6 mm Cottidae ("Cottid 6" from Blackburn 1973)
							1 larva 8.7 mm Cyclopteridae
							1 larva 21 mm Gadidae
							52 larvae 4.1-16 mm Osmeridae
							3 larvae unidentified due to extensive damage (elongate)

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
13 Jul	0548	9	1	505	7	217	1 egg < 1 mm (0.77 mm)
							5 eggs ∿ 1 mm (1.00–1.20 mm)
							1 egg ∿ 3 mm (lost)
							1 larva 12 mm *Glyptocephalus zachirus*
							7 larvae 8.2–15 mm *Hippoglossoides* sp.
							1 young 12 mm *Icelinus borealis*
							65 larvae 5.3–16 mm *Mallotus villosus*
							1 larva 12 mm Bathymasteridae
							1 larva 7.7 mm Cottidae ("Cottid 6" from Blackburn 1973)
							2 larvae 6.4, 9.7 mm Cyclopteridae
							2 larvae 22, 29 mm Gadidae
							106 larvae 5.9–18 mm Osmeridae
							31 larvae unidentified due to extensive damage (elongate)
13 Jul	1230	10	1	333	5	318	1 egg ∿ 1 mm (0.94 mm)
							1 egg ∿ 2 mm (2.00 mm)
							3 eggs ∿ 3 mm (2.84, 3.04, 3.24 mm)

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
13 Jul	1230	10	1	333	5	318	6 larvae 9.5-19 mm *Glyptocephalus zachirus*
							9 larvae 7.2-18 mm *Hippoglossoides* sp.
							67 larvae 6.1-15 mm *Mallotus villosus*
							1 larva 8.8 mm *Psettichthys melanostictus*
							11 larvae 6.6-9.7 mm *Sebastes* sp.
							18 larvae 2.4-3.4 mm *Sebastolobus* sp.
							10 larvae 5.1-6.1 mm *Stenobrachius leucopsarus*
							1 larva 9.1 mm Myctophidae
							186 larvae 7.6-19 mm Osmeridae
							2 larvae 6.6, 6.7 mm Pleuronectidae
							5 larvae 5.7-10 mm unidentified (elongate)
							2 larvae unidentified due to extensive damage (elongate)
13 Jul	1230	10	1	505	3	413	2 eggs ∿ 1 mm (lost)
							1 egg ∿ 3 mm (3.23 mm)
							10 larvae 5.1-17 mm *Glyptocephalus zachirus*
							13 larvae 5.9-20 mm *Hippoglossoides* sp.
							88 larvae 8.1-18 mm *Mallotus villosus*

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
13 Jul	1230	10	1	505	3	413	14 larvae 3.3-7.0 mm *Sebastes* sp.
							7 larvae 2.2-3.1 mm *Sebastolobus* sp.
							7 larvae 5.1-7.1 mm *Stenobrachius leucopsarus*
							251 larvae 9.1-19 mm Osmeridae
							1 larva 8.1 mm Pleuronectidae
							6 larvae 6.0-8.9 mm unidentified (elongate)
							16 larvae unidentified due to extensive damage (elongate)
13 Jul	2243	11	1	333	0	1	1 larva unidentified due to extensive damage (elongate)
13 Jul	2243	11	1	505	1	3	1 egg ∿ 3 mm (2.64 mm)
							1 larva 10 mm *Bathylagus stilbius*
							1 larva 7.6 mm Cyclopteridae
							1 larva unidentified due to extensive damage (elongate)
14 Jul	0835	11	2	333	0	39	2 larvae 13, 15 mm *Bathylagus* spp.
							4 larvae 5.5-7.7 mm *Stenobrachius leucopsarus*

Table 40. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
14 Jul	0835	11	2	333	0	39	28 young 22-39 mm *Stenobrachius leucopsarus*
							1 adult 78 mm *Stenobrachius leucopsarus*
							3 larvae 11, 12, 12 mm Bathymasteridae
							1 young 36 mm Cyclopteridae
14 Jul	0835	11	2	505	0	47	1 larva 13 mm *Bathylagus* sp.
							1 larva 21 mm *Glyptocephalus zachirus*
							2 larvae 5.5, 6.8 mm *Stenobrachius leucopsarus*
							40 young 23-53 mm *Stenobrachius leucopsarus*
							1 larva 11 mm Bathymasteridae
							2 larvae 8.2, 15 mm Myctophidae

Table 41. Summary of taxonomic categories of commercially important crab and shrimp larvae found in bongo net samples collected on the Lower Cook Inlet, *Acona* cruise, Leg II, 8-15 July, 1977.

A total of 30 samples contained 20462 crab zoeae and 2081 megalopae. The commercially important crabs were distributed into 3 families, 3 genera, and 3 species. The 30 samples contained 14180 shrimp zoeae, 6 juveniles and 98 adults. The commercially important shrimp were distributed into 1 family, 2 genera, and 7 species.

Section Anomura

Family Lithodidae

8 megalopae blue king crab[1] *Paralithodes platypus* (Brandt)

2773 zoeae unidentified, non-commercially important anomurans
84 megalopae unidentified, non-commercially important anomurans

Section Brachyura

Family Cancridae

59 zoeae dungeness crab *Cancer magister* (Dana)
9957 zoeae non-commercially important *Cancer* sp.
95 megalopae non-commercially important *Cancer* sp.

Family Majidae

152 zoeae tanner crab *Chionoecetes bairdi* Rathbun
65 megalopae *Chionoecetes* sp.

7521 zoeae unidentified, non-commercially important brachyurans
1829 megalopae unidentified, non-commercially important brachyurans

Section Caridea

Family Pandalidae

4 zoeae sidestripe shrimp *Pandalopsis dispar* Rathbun
234 zoeae northern pink shrimp *Pandalus borealis* Kröyer
23 zoeae dock shrimp *Pandalus danae* Stimpson
1 zoea coonstripe shrimp *Pandalus hypsinotus* Brandt
1 zoea *Pandalus montagui tridens* Rathbun
43 zoeae *Pandalus stenolepis* Rathbun
20 zoeae *Pandalus* spp., damaged

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1 The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 41. (continued)

Family Pandalidae (continued)

6 juvenile humpy shrimp *Pandalus goniurus*
1 adult *Pandalopsis dispar*
63 adult *Pandalus borealis*
7 adult *Pandalus goniurus*

13854 zoeae unidentified hippolytids
27 adult non-commercially important shrimp

Table 42. Identification of crab and shrimp larvae by station

Lower Cook Inlet bongo net tows, *Acona*, Leg II, 8-15 July 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
13 Jul	0119	1	1	333[a]	V	1	*Pandalus borealis*
					II	2	*P. stenolepis*
					III	3	*P. stenolepis*
					IV	3	*P. stenolepis*
					V	2	*P. stenolepis*
					VI	1	*P. stenolepis*
					zoea	206	unidentified hippolytids
13 Jul	0119	1	1[b]	505	zoea	256	unidentified anomurans
					I	1824	*Cancer oregonensis*
					II	576	*C. oregonensis*
					III	80	*C. oregonensis*
					IV	8	*C. oregonensis*
					I	8	*Chionoecetes bairdi*
					II	88	*C. bairdi*
					zoea	664	unidentified brachyurans
					megalopa	176	unidentified brachyurans
					IV	2	*Pandalus borealis*
					V	1	*P. borealis*
					I	1	*P. stenolepis*
					II	2	*P. stenolepis*
					III	5	*P. stenolepis*
					IV	3	*P. stenolepis*
					zoea	308	unidentified hippolytids

[a] 333 μm samples were not sorted for crab larvae.

[b] The sample was split and 1/8 of the sample was sorted for crab larvae and the entire sample was sorted for shrimp larvae; totals are given for the entire sample.

Table 42. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
12 Jul	1133	2	1[c]	333	IV	2	*Pandalus* sp.
					zoea	837	unidentified hippolytids
12 Jul	1133	2	1[d]	505	zoea	165	unidentified anomurans
					megalopa	20	unidentified anomurans
					I	293	*Cancer oregonensis*
					II	320	*C. oregonensis*
					III	10	*C. oregonensis*
					zoea	384	unidentified brachyurans
					megalopa	71	unidentified brachyurans
					zoea	1301	unidentified hippolytids
10 Jul	0901	3	1[e]	333	IV	24	*Pandalus borealis*
					zoea	64	unidentified hippolytids
					adult	1	*Crangon alaskensis elongata*
					adult	1	*C. franciscorum angustimana*
					adult	1	*C. stylirostris*
10 Jul	0901	3[f]	1	505	zoea	152	unidentified anomurans
					megalopa	8	*Paralithodes platypus*
					I	1568	*Cancer oregonensis*

[c] The sample was split and 19/32 of the sample was sorted for shrimp larvae; totals are given for the entire sample.

[d] The sample was split and 19/64 of the sample was sorted for crabs and shrimp larvae; totals are given for the entire sample.

[e] The sample was split and 1/8 of the sample was sorted for shrimp larvae; the entire sample was sorted for adult shrimp; totals are given for the entire sample.

[f] The sample was split and 1/8 of the sample was sorted for crab larvae and the entire sample was sorted for shrimp larvae and adults; totals are given for the entire sample.

Table 42. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
10 Jul	0901	3	1	505	II	192	*C. oregonensis*
					III	8	*C. oregonensis*
					zoea	200	unidentified brachyurans
					megalopa	24	unidentified brachyurans
					III	2	*Pandalopsis dispar*
					IV	46	*Pandalus borealis*
					V	1	*P. danae*
					zoea	137	unidentified hippolytids
					adult	1	*Crangon alaskensis*
					adult	2	*Pandalus goniurus*
10 Jul	1556	4	1	333	IV	1	*Pandalus borealis*
					zoea	62	unidentified hippolytids
10 Jul	1556	4	1	505	zoea	3	unidentified anomurans
					zoea	3	unidentified brachyurans
					megalopa	1	unidentified brachyurans
					zoea	3	unidentified hippolytids
					adult	10	*Crangon* sp.
					adult	1	*Heptacarpus brevirostris*
11 Jul	0018	5	1	333		0	
11 Jul	0018	5[g]	1	505	zoea	752	unidentified anomurans
					II	32	*Cancer magister*
					I	3776	*C. oregonensis*
					II	240	*C. oregonensis*

[g] The sample was split and 1/16 of the sample was sorted for crab and shrimp larvae; totals are given for the entire sample.

Table 42. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
11 Jul	0018	5	1	505	zoea	1008	unidentified brachyurans
					megalopa	16	unidentified brachyurans
					zoea	1728	unidentified hippolytids
11 Jul	1009	6	2[h]	333	IV	8	*Pandalus borealis*
					V	4	*P. borealis*
					adult	36	*P. borealis*
11 Jul	1009	6	2	505	zoea	61	unidentified anomurans
					megalopa	2	unidentified anomurans
					I	5	*Cancer magister*
					II	1	*C. magister*
					I	146	*C. oregonensis*
					II	8	*C. oregonensis*
					zoea	352	unidentified brachyurans
					megalopa	2	unidentified brachyurans
					IV	12	*Pandalus borealis*
					III	1	*Pandalus* sp. (damaged)
					zoea	180	unidentified hippolytids
					adult	7	*Pandalus borealis*
					adult	2	*P. goniurus*
					adult	1	*Eualus townsendi*

[h] The sample was split and 1/4 of the sample was sorted for shrimp larvae and adults; totals are given for the entire sample.

Table 42. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
11 Jul	1031	6	3[i]	333	III	4	*Pandalus stenolepis*
					zoea	120	unidentified hippolytids
					adult	1	*Pandalopsis dispar*
					adult	8	*Pandalus borealis*
					adult	2	*P. goniurus*
11 Jul	1031	6	3[j]	505	zoea	180	unidentified anomurans
					megalopa	12	unidentified anomurans
					I	4	*Cancer magister*
					I	124	*C. oregonensis*
					II	10	*C. oregonensis*
					zoea	522	unidentified brachyurans
					IV	1	*Pandalus borealis*
					V	1	*P. borealis*
					juvenile	6	*P. goniurus* ?
					I	1	*Pandalus* sp. (damaged)
					zoea	141	unidentified hippolytids
					adult	12	*Pandalus borealis*
					adult	1	*Crangon alaskensis*
11 Jul	2051	6	4[k]	333	II	4	*Pandalus danae*
					zoea	168	unidentified hippolytids

[i] The sample was split and 1/4 of the sample was sorted for shrimp larvae and the entire sample was sorted for adult shrimp; totals are given for the entire sample.

[j] The sample was split and 1/2 of the sample was sorted for crab larvae and the entire sample was sorted for shrimp larvae and adults; totals are given for the entire sample.

[k] The sample was split and 1/4 of the sample was sorted for shrimp larvae; totals are given for the entire sample.

Table 42. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
11 Jul	2051	6	4	505	zoea	82	unidentified anomurans
					I	12	*Cancer magister*
					II	4	*C. magister*
					I	296	*C. oregonensis*
					II	4	*C. oregonensis*
					zoea	104	unidentified brachyurans
					I	1	*Pandalus danae* ?
					II	1	*P. danae*
					zoea	130	unidentified hippolytids
11 Jul	2113	6	5[1]	333	IV	8	*Pandalus borealis*
					II	8	*P. danae*
					zoea	856	unidentified hippolytids
11 Jul	2113	6	5	505	zoea	97	unidentified anomurans
					megalopa	2	unidentified anomurans
					I	1	*Cancer magister*
					I	62	*C. oregonensis*
					zoea	166	unidentified brachyurans
					IV	11	*Pandalus borealis*
					II	1	*P. hypsinotus*
					zoea	544	unidentified hippolytids
					adult	3	*Pandalus goniurus*

[1] The sample was split and 1/8 of the sample was sorted for shrimp larvae; totals are given for the entire sample.

Table 42. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
10 Jul	0405	7	1[m]	333	IV	64	*Pandalus borealis*
					?	16	*Pandalus* sp. (damaged)
					zoea	3072	unidentified hippolytids
10 Jul	0405	7	1[n]	505	zoea	528	unidentified anomurans
					I	16	*Cancer oregonensis*
					zoea	2768	unidentified brachyurans
					megalopa	80	unidentified brachyurans
					III	8	*Pandalus borealis*
					IV	48	*P. borealis*
					V	8	*P. borealis*
					II	8	*P. danae*
					zoea	3280	unidentified hippolytids
10 Jul	0010	8	1[o]	333	IV	8	*Pandalus borealis*
					zoea	58	unidentified hippolytids
10 Jul	0010	8	1	505	zoea	9	unidentified anomurans
					zoea	22	unidentified brachyurans
					megalopa	4	unidentified brachyurans
					II	1	*Pandalus stenolepis*
					zoea	39	unidentified hippolytids

[m] The sample was split and 1/16 of the sample was sorted for shrimp larvae; totals are given for the entire sample.

[n] The sample was split and 1/16 of the sample was sorted for crab larvae, and 1/8 of the sample was sorted for shrimp larvae; totals are given for the entire sample.

[o] The sample was split and 1/2 of the sample was sorted for shrimp larvae; totals are given for the entire sample.

Table 42. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (um)	Stage	Total	Identification of Larvae
13 Jul	0548	9	1	333	IV	3	*Pandalus borealis*
					III	1	*P. montagui tridens*
					I	8	*P. stenolepis*
					zoea	248	unidentified hippolytids
13 Jul	0548	9	1[p]	505	zoea	480	unidentified anomurans
					megalopa	48	unidentified anomurans
					I	112	*Cancer oregonensis*
					II	64	*C. oregonensis*
					III	144	*C. oregonensis*
					zoea	1312	unidentified brachyurans
					megalopa	1440	unidentified brachyurans
					III	2	*Pandalopsis dispar*
					IV	1	*Pandalus borealis*
					I	2	*P. stenolepis*
					IV	1	*P. stenolepis*
					zoea	311	unidentified hippolytids
13 Jul	1230	10	1	333	III	6	*Pandalus borealis*
					IV	4	*P. borealis*
					V	1	*P. borealis*
					III	2	*P. stenolepis*
					zoea	30	unidentified hippolytids

[p] The sample was split and 1/16 of the sample was sorted for crab larvae and the entire sample was sorted for shrimp larvae; totals are given for the entire sample.

Table 42. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
13 Jul	1230	10	1[q]	505	zoea	8	unidentified anomurans
					I	2	*Cancer oregonensis*
					II	54	*C. oregonensis*
					III	18	*C. oregonensis*
					IV	2	*C. oregonensis*
					II	32	*Chionoecetes bairdi*
					zoea	14	unidentified brachyurans
					megalopa	102	unidentified brachyurans
					III	8	*Pandalus borealis*
					IV	11	*P. borealis*
					V	3	*P. borealis*
					IV	2	*P. stenolepis*
					V	1	*P. stenolepis*
					zoea	22	unidentified hippolytids
13 Jul	2243	11	1	333		0	
13 Jul	2243	11	1	505	II	11	*Chionoecetes bairdi*
					megalopa	45	*Chionoecetes* sp.
					zoea	2	unidentified brachyurans
					megalopa	8	unidentified brachyurans
14 Jul	0835	11	2	333	adult	5	*Sergestes* sp.
14 Jul	0835	11	2	505	II	13	*Chionoecetes bairdi*
					megalopa	20	*Chionoecetes* sp.
					IV	1	*Pandalus borealis*
					adult	3	*Pasiphaea* sp.

[q] The sample was split and 1/2 of the sample was sorted for crab larvae and the entire sample was sorted for shrimp larvae; totals are given for the entire sample.

Table 43. Number of fish eggs and larvae at each station

Lower Cook Inlet Bongo Tows, *Surveyor*, Leg II, 24-31 August 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
25 Aug	0840	1	1	333	0	125
25 Aug	0840	1	1	505	0	772
25 Aug	1206	2	1	333	0	102
25 Aug	1206	2	1	505	0	127
25 Aug	1952	3	1	333	0	4
25 Aug	1952	3	1	505	0	24
26 Aug	0400	4	1	333	0	460
26 Aug	0400	4	1	505	0	50
26 Aug	1040	5	1	333	34	504
26 Aug	1040	5	1	505	24	528
26 Aug	2203	6	1	333	21	852
26 Aug	2203	6	1	505	19	270
27 Aug	1000	6	2	333	16	1384
27 Aug	1000	6	2	505	17	1584
28 Aug	0650	7	1	333	0	107
28 Aug	0650	7	1	505	1	90
28 Aug	0330	8	1	333	0	83
28 Aug	0330	8	1	505	0	50
28 Aug	1832	9	1	333	2	21
28 Aug	1832	9	1	505	1	17
28 Aug	1919	9	2	333	0	219
28 Aug	1919	9	2	505	1	207
29 Aug	0459	10	1	333	0	39
29 Aug	0459	10	1	505	1	55
29 Aug	1922	11	1	333	5	5
29 Aug	1922	11	1	505	23	4
31 Aug	0641	13	1	333	5	131
31 Aug	0641	13	1	505	1	107
30 Aug	0459	14	1	333	0	0
30 Aug	0459	14	1	505	1	4

Table 44. Summary of taxonomic categories of fish eggs, larvae, young and adults found in bongo net samples collected on Lower Cook Inlet, *Surveyor* cruise, Leg II, 24-31 August 1976.

A total of 30 samples were collected. All samples were sorted for fish eggs and larvae and the results are summarized below. The fish are distributed into 15 families, 17 genera, and 11 species. Eggs are distributed into 4 size categories.

Family Ammodytidae

2 young Pacific sandlance[1] *Ammodytes hexapterus* Pallas

Family Bathylagidae

96 larvae deepsea smelt *Bathylagus* spp. (4 uncertain)

Family Bathymasteridae

4 larvae genus? species?

Family Clupeidae

3 larvae Pacific herring *Clupea harengus pallasi* Valenciennes

Family Cottidae

12 larvae genus? species?

Family Cyclopteridae

1 larva genus? species?
3 young genus? species?

Family Gadidae

4 young walleye pollock *Theragra chalcogramma* (Pallas)

Family Gasterosteidae

502 young threespine stickleback *Gasterosteus aculeatus* Linnaeus
1 young ninespine stickleback *Pungitius pungitius* (Linnaeus)

Family Hexagrammidae

8 larvae greenling *Hexagrammos* sp.

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[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 44. (continued)

Family Myctophidae

6 larvae northern lampfish *Stenobrachius leucopsarus* Eigenmann and Eigenmann
2 young *Stenobrachius leucopsarus*
1 adult *Stenobrachius leucopsarus*

Family Osmeridae

3456 larvae capelin *Mallotus villosus* (Müller)
1 young *Mallotus villosus*
1750 larvae genus? species?

Family Pleuronectidae

1 larva Rex sole *Glyptocephalus zachirus* Lockington
10 larvae sole *Hippoglossoides* sp. (1 uncertain)
1 young *Hippoglossoides* sp.
18 larvae yellowfin sole *Limanda aspera* (Pallas)
1 young *Limanda aspera*
2 larvae sand sole *Psettichthys melanostictus* Girard

Family Ptilichthyidae

2 young quillfish *Ptilichthys goodei* Bean

Family Scorpaenidae

60 larvae rockfish *Sebastes* sp.
1 larva thornyhead *Sebastolobus* sp.

Family Stichaeidae

1 young prickleback *Lumpenus* sp.

1976 larvae unidentified (many badly damaged)

172 eggs categorized (see Table 18, List of possible fish for egg size categories).

134	eggs	<1 mm (0.73–0.90 mm)
4	eggs	∿1 mm (0.90–1.00 mm)
31	eggs	∿2 mm (1.34–2.12 mm)
3	eggs	∿3 mm (2.88, 3.39, 3.59 mm)

Table 45. Identification of Fish Eggs and Larvae by Station

Lower Cook Inlet Bongo Tows, *Surveyor*, Leg II, 24-31 August 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
25 Aug	0840	1	1	333	0[a]	125[a]	26 larvae 4.7-12 mm[b] *Mallotus villosus*
							2 larvae 3.4, 4.0 mm *Sebastes* sp.
							88 larvae 4.7-31 mm Osmeridae
							9 larvae unidentified due to extensive damage (elongate)
25 Aug	0840	1	1	505	0	772[c]	176 larvae 4.7-11 mm *Mallotus villosus*
							12 larvae 3.6-4.1 mm *Sebastes* sp.
							4 larvae 8.2 mm Cottidae ("Cottid 6" from Blackburn 1973)
							420 larvae 5.8-22 mm Osmeridae
							4 larvae 8.4 mm unidentified (elongate)
							156 larvae unidentified due to extensive damage (elongate)

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

[c] The sample was split and 1/4 of the sample was sorted for larvae; totals are given for the entire sample.

Table 45. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
25 Aug	1206	2	1	333	0	102	24 larvae 6.5-22 mm *Mallotus villosus*
							34 larvae 7.0-31 mm Osmeridae
							44 larvae unidentified due to extensive damage (43 elongate, 1 non-elongate)
25 Aug	1206	2	1	505	0	127	1 larva 14 mm *Hippoglossoides* sp.
							1 larva 20 mm *Hippoglossoides* sp. ?
							38 larvae 6.3-20 mm *Mallotus villosus*
							1 young 63 mm *Mallotus villosus*
							1 larva 18 mm *Psettichthys melanostictus*
							1 young 123 mm *Ptilichthys goodei*
							70 larvae 7.3-20 mm Osmeridae
							14 larvae unidentified due to extensive damage (elongate)
25 Aug	1952	3	1	333	0	4	2 larvae 5.2, 9.3 mm *Mallotus villosus*
							2 larvae 3.0, 20 mm Osmeridae
25 Aug	1952	3	1	505	0	24	13 larvae 3.7-21 mm *Mallotus villosus*
							9 larvae 7.7-21 mm Osmeridae
							2 larvae unidentified due to extensive damage (elongate)

Table 45. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
26 Aug	0400	4	1	333	0	460	2 larva 23, 30 mm *Clupea harengus pallasi*
							453 young 15-27 mm *Gasterosteus aculeatus*
							1 larva 29 mm *Hippoglossoides* sp.
							3 larvae 24, 25, 31 mm *Mallotus villosus*
							1 young 30 mm *Pungitius pungitius*
26 Aug	0400	4	1	505	0	50	1 larva 27 mm *Clupea harengus pallasi*
							48 young 18-24 mm *Gasterosteus aculeatus*
							1 larva 7.5 mm *Hexagrammos* sp.
26 Aug	1040	5	1	333	34	504[d]	33 eggs < 1 mm (0.74-0.90 mm)[b]
							1 egg ∿ 1 mm (0.94 mm)
							260 larvae 6.4-18 mm *Mallotus villosus*
							4 young 48 mm *Theragra chalcogramma*
							200 larvae 7.6-30 mm Osmeridae
							40 larvae unidentified due to extensive damage (elongate)

[d] The sample was split and 1/4 of the sample was sorted for fish larvae; totals are given for the entire sample.

Table 45. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
26 Aug	1040	5	1	505	24	528[e]	22 eggs < 1 mm (0.75-0.89 mm)
							2 eggs ∿ 1 mm (0.91-0.93 mm)
							4 larvae 28 mm *Bathylagus* sp. ?
							232 larvae 8.0-15 mm *Mallotus villosus*
							204 larvae 8.3-31 mm Osmeridae
							88 larvae unidentified due to extensive damage (elongate)
26 Aug	2203	6	1	333	21	852[e]	21 eggs < 1 mm (0.77-0.81 mm)
							148 larvae 4.2-20 mm *Mallotus villosus*
							8 larvae 18, 25 mm Osmeridae
							696 larvae unidentified due to extensive damage (692 elongate, 4 non-elongate)
26 Aug	2203	6	1	505	19	270[f]	19 eggs < 1 mm (0.73-0.85 mm)
							38 larvae 5.9-23 mm *Mallotus villosus*
							2 larvae 7.2 mm Cottidae ("Cottid 6" from Blackburn 1973)

[e] The sample was split and 1/4 of the sample was sorted for fish larvae; totals are given for the entire sample.

[f] The sample was split and 1/2 of the sample was sorted for fish larvae; totals are given for the entire sample.

Table 45. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
26 Aug	2203	6	1	505	19	270	10 larvae 10-25 mm Osmeridae
							220 larvae unidentified due to extensive damage (elongate)
27 Aug	1000	6	2	333	16	1384[g]	16 eggs < 1 mm (0.75-0.83 mm)
							936 larvae 8.2-26 mm *Mallotus villosus*
							216 larvae 7.3-27 mm Osmeridae
							232 larvae unidentified due to extensive damage (elongate)
27 Aug	1000	6	2	505	17	1584[h]	16 eggs < 1 mm (0.76-0.80 mm)
							1 egg ~ 1 mm (1.00 mm)
							16 larvae 6.9 mm *Limanda aspera*
							1120 larvae 8.7-21 mm *Mallotus villosus*
							192 larvae 8.7-13 mm Osmeridae
							256 larvae unidentified due to extensive damage (elongate)

[g] The sample was split and 1/8 of the sample was sorted for fish larvae; totals are given for the entire sample.

[h] The sample was split and 1/16 of the sample was sorted for fish larvae; totals are given for the entire sample.

Table 45. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
28 Aug	0650	7	1	333	0	107	1 young 19 mm *Gasterosteus aculeatus*
							73 larvae 5.5-21 mm *Mallotus villosus*
							16 larvae 4.7-23 mm Osmeridae
							17 larvae unidentified due to extensive damage (elongate)
28 Aug	0650	7	1	505	1	90	1 egg ∿ 2 mm (1.38 mm)
							1 young 31 mm *Hippoglossoides* sp.
							35 larvae 4.7-20 mm *Mallotus villosus*
							1 larva 5.1 mm Bathymasteridae
							23 larvae 5.0-21 mm Osmeridae
							30 larvae unidentified due to extensive damage (elongate)
28 Aug	0330	8	1	333	0	83	7 larvae 5.9-8.9 mm *Hexagrammos* sp.
							28 larvae 6.3-18 mm *Mallotus villosus*
							2 larvae 9.6, 10 mm Osmeridae
							46 larvae unidentified due to extensive damage (elongate)
28 Aug	0330	8	1	505	0	50	7 larvae 5.3-11 mm *Mallotus villosus*
							43 larvae unidentified due to extensive damage (elongate)

Table 45. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
28 Aug	1832	9	1	333	2	21	2 eggs ∿ 3 mm (2.88, 3.59 mm)
							6 larvae 5.1-15 mm *Mallotos villosus*
							3 larvae 3.5, 3.8, 3.9 mm *Sebastes* sp.
							3 larvae 9.1, 11, 15 mm Bathymasteridae
							9 larvae 10-26 mm Osmeridae
28 Aug	1832	9	1	505	1	17	1 egg < 1 mm (0.87 mm)
							1 larva 4.8 mm *Hippoglossoides* sp.
							5 larvae 6.1-14 mm *Mallotus villosus*
							3 larvae 3.7, 3.8, 4.0 mm *Sebastes* sp.
							1 larva 3.2 mm Cottidae ("Cottid 6" from Blackburn 1973)
							2 larvae 5.1, 11 mm Osmeridae
							1 larva 7.9 mm unidentified (non-elongate)
							4 larvae unidentified due to extensive damage (elongate)
28 Aug	1919	9	2	333	0	219	1 larva 19 mm *Bathylagus* sp.
							3 larvae 4.3, 5.8, 21 mm *Hippoglossoides* sp.
							1 young 58 mm *Lumpenus* sp.
							55 larvae 3.9-14 mm *Mallotus villosus*

Table 45. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
28 Aug	1919	9	2	333	0	219	1 young 152 mm *Ptilichthys goodei*
							18 larvae 3.0-3.9 mm *Sebastes* sp.
							1 larva 7.1 mm Cottidae ("Cottid 6" from Blackburn 1973)
							84 larvae 4.2-24 mm Osmeridae
							1 larva 7.0 mm unidentified (elongate)
							54 larvae unidentified due to extensive damage (elongate)
28 Aug	1919	9	2	505	1	207	1 egg ∿ 3 mm (3.39 mm)
							3 larvae 3.2, 4.8, 5.6 mm *Hippoglossoides* sp.
							108 larvae 4.2-18 mm *Mallotus villosus*
							1 larva 9.4 mm *Psettichthys melanostictus*
							19 larvae 3.0-4.1 mm *Sebastes* sp.
							1 larva 5.2 mm *Sebastolobus* sp.
							2 larvae 4.4, 7.0 mm Cottidae ("Cottid 6" from Blackburn 1973)
							71 larvae 4.5-28 mm Osmeridae
							1 larva 4.2 mm unidentified (non-elongate)
							1 larva unidentified due to extensive damage (elongate)

Table 45. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
29 Aug	0459	10	1	333	0	39	19 larvae 9.1-13 mm *Mallotus villosus*
							1 larva 8.5 mm Cottidae ("Cottid 6" from Blackburn 1973)
							19 larvae 7.0-19 mm Osmeridae
29 Aug	0459	10	1	505	1	55	1 egg < 1 mm (0.74 mm)
							25 larvae 8.7-12 mm *Mallotus villosus*
							28 larvae 8.3-23 mm Osmeridae
							2 larvae unidentified due to extensive damage (elongate)
29 Aug	1922	11	1	333	5	5	5 eggs ∿ 2 mm (1.76-1.80 mm)
							2 larvae 3.5, 4.4 mm *Sebastes* sp.
							3 larvae 6.1, 7.0, 8.1 mm *Stenobrachius leucopsarus*
29 Aug	1922	11	1	505	23	4	23 eggs ∿ 2 mm (1.80-2.12 mm)
							1 larva 47 mm *Glyptocephalus zachirus*
							2 larvae 6.7, 14 mm *Stenobrachius leucopsarus*
							1 young 23 mm *Stenobrachius leucopsarus*

Table 45. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
31 Aug	0641	13	1	333	5	131	5 eggs < 1 mm (0.77-0.87 mm)
							2 young 52, 70 mm *Ammodytes hexapterus*
							48 larvae 12-30 mm *Bathylagus* spp.
							1 larva 6.6 mm *Limanda aspera*
							50 larvae 9.1-23 mm *Mallotus villosus*
							1 young 85 mm *Stenobrachius leucopsarus*
							1 larva 4.2 mm Cottidae ("Cottid 6" from Blackburn 1973)
							1 young 97 mm Cyclopteridae
							22 larvae 7.4-38 mm Osmeridae
							5 larvae unidentified due to extensive damage (4 elongate, 1 non-elongate)
31 Aug	0641	13	1	505	1	107	1 egg ∿ 2 mm (1.34 mm)
							43 larvae 14-27 mm *Bathylagus* spp.
							1 larva 7.9 mm *Limanda aspera*
							1 young 13 mm *Limanda aspera*
							29 larvae 8.2-27 mm *Mallotus villosus*
							1 adult 89 mm *Stenobrachius leucopsarus*
							2 young 102, 128 mm Cyclopteridae

Table 45. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
31 Aug	0641	13	1	505	1	107	20 larvae 17-34 mm Osmeridae 10 larvae unidentified due to extensive damage (elongate)
30 Aug	0459	14	1	333	0	0	
30 Aug	0459	14	1	505	1	4	1 egg ∿ 2 mm (2.08 mm) 1 larva 3.7 mm *Sebastes* sp. 1 larva 5.6 mm *Stenobrachius leucopsarus* 1 larva 4.8 mm Cyclopteridae 1 larva 18 mm Osmeridae

Table 46. Summary of taxonomic categories of commercially important crab and shrimp larvae found in bongo net samples collected on the Lower Cook Inlet, *Surveyor* cruise, Leg II, 24-31 August 1976

A total of 30 samples contained 5609 crab zoeae, 1128 megalopae and 2 adults. The commercially important crabs were distributed into 2 families, 2 genera, and 1 species. The 30 samples contained 3025 shrimp zoea, 13 juveniles and 51 adults. The commercially important shrimp were distributed into 1 family, 2 genera and 5 species.

Section Anomura

1705 zoeae unidentified, non-commercially important anomurans
59 megalopae unidentified, non-commercially important anomurans

Section Brachyura

Family Cancridae

57 zoeae dungeness crab[1] *Cancer magister* (Dana)
2460 zoeae non-commercially important *Cancer* spp.
950 megalopae non-commercially important *Cancer* spp.

Family Majidae

60 megalopae *Chionoecetes* sp.

1387 zoeae unidentified, non-commercially important brachyurans
59 megalopae unidentified, non-commercially important brachyurans
2 adult unidentified, non-commercially important brachyurans

Section Caridea

Family Pandalidae

3 zoeae sidestripe shrimp *Pandalopsis dispar* Rathbun
5 zoeae northern pink shrimp *Pandalus borealis* Kröyer
1 zoeae dock shrimp *Pandalus danae* Stimpson
2 zoeae *Pandalus stenolepis* Rathbun
6 juvenile *Pandalus borealis*
8 adult *Pandalus borealis*
14 adult humpy shrimp *Pandalus goniurus* Stimpson

3014 zoeae unidentified hippolytids
7 juvenile non-commercially important shrimp
29 adult non-commercially important shrimp

[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 47. Identification of crab and shrimp larvae by station

Lower Cook Inlet bongo net tows, *Surveyor*, Leg II, 24-31 August 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
25 Aug	0840	1	1	333[a]	V	1	*Pandalus borealis*
					juvenile	1	*Pandalus borealis* ?
					zoea	37	unidentified hippolytids
25 Aug	0840	1	1	505	zoea	342	unidentified anomurans
					megalopa	16	unidentified anomurans
					II	1	*Cancer magister*
					III	19	*C. oregonensis*
					IV	53	*C. oregonensis*
					V	74	*C. oregonensis*
					megalopa	9	*C. oregonensis*
					megalopa	4	*Chionoecetes* sp.
					zoea	20	unidentified brachyurans
					megalopa	2	unidentified brachyurans
					V	1	*Pandalus danae*
					juvenile	2	*P. borealis* ?
					zoea	202	unidentified hippolytids
25 Aug	1206	2	1	333	zoea	98	unidentified hippolytids
25 Aug	1206	2	1[b]	505	zoea	36	unidentified anomurans
					megalopa	12	unidentified anomurans
					I	12	*Cancer oregonensis*
					II	8	*C. oregonensis*

[a] 333 μm samples were not sorted for crab larvae.

[b] The sample was split and 1/4 of the sample was sorted for crab larvae and the entire sample was sorted for shrimp larvae and adults; totals are given for the entire sample.

Table 47. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (µm)	Stage	Total	Identification of Larvae
25 Aug	1206	2	1[b]	505	III	128	*C. oregonensis*
					IV	396	*C. oregonensis*
					V	132	*C. oregonensis*
					megalopa	8	*C. oregonensis*
					megalopa	36	*Chionoecetes* sp.
					zoea	68	unidentified brachyurans
					megalopa	24	unidentified brachyurans
					zoea	204	unidentified hippolytids
					adult	1	*Crangon alaskensis*
					adult	1	*C. dalli*
					adult	4	*C. nigricauda*
25 Aug	1952	3	1	333	juvenile	1	*Pandalus borealis* ?
25 Aug	1952	3	1	505	zoea	6	unidentified anomurans
					megalopa	2	unidentified anomurans
					I	2	*Cancer oregonensis*
					II	3	*C. oregonensis*
					III	10	*C. oregonensis*
					IV	44	*C. oregonensis*
					V	21	*C. oregonensis*
					megalopa	2	*C. oregonensis*
					megalopa	2	*Chionoecetes* sp.
					zoea	64	unidentified brachyurans
					megalopa	4	unidentified brachyurans
					zoea	15	unidentified hippolytids
					adult	1	*Pandalopsis dispar*

Table 47. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
26 Aug	0400	4	1	333	zoea	1	unidentified hippolytids
					adult	1	*Crangon alaskensis elongata*
					adult	1	*Crangon dalli*
26 Aug	0400	4	1	505	zoea	6	unidentified anomurans
					megalopa	2	unidentified anomurans
					II	5	*Cancer oregonensis*
					III	21	*C. oregonensis*
					IV	24	*C. oregonensis*
					V	5	*C. oregonensis*
					zoea	92	unidentified brachyurans
					megalopa	1	unidentified brachyuran
					juvenile	2	*Pandalus borealis* ?
					adult	1	*Crangon nigricauda*
26 Aug	1040	5a	1	333	zoea	228	unidentified hippolytids
26 Aug	1040	5a	1[c]	505	zoea	1024	unidentified anomurans
					I	8	*Cancer oregonensis*
					II	8	*C. oregonensis*
					III	24	*C. oregonensis*
					IV	248	*C. oregonensis*
					V	72	*C. oregonensis*
					megalopa	32	*C. oregonensis*

[c] The sample was split and 1/8 of the sample was sorted for crabs and 1/4 of the sample was sorted for shrimp larvae; totals are given for the entire sample.

Table 47. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
26 Aug	1040	5a	1[c]	505	zoea	712	unidentified brachyurans
					megalopa	8	unidentified brachyurans
					zoea	728	unidentified hippolytids
26 Aug	2203	6	1	333	zoea	91	unidentified hippolytids
26 Aug	2203	6	1	505	zoea	50	unidentified anomurans
					megalopa	3	unidentified anomurans
					II	2	*Cancer magister*
					II	1	*C. oregonensis*
					III	13	*C. oregonensis*
					IV	117	*C. oregonensis*
					V	89	*C. oregonensis*
					megalopa	11	*C. oregonensis*
					zoea	68	unidentified brachyurans
					megalopa	3	unidentified brachyurans
					zoea	37	unidentified hippolytids

Table 47. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
27 Aug	1000	6	2[d]	333	IV	2	*Pandalus borealis*
					zoea	542	unidentified hippolytids
					adult	6	*Pandalus borealis*
					adult	4	*Pandalus goniurus*
					adult	2	*Crangon alaskensis elongata*
					adult	2	*Eualus fabricii*
					adult	2	*Eualus townsendi*
27 Aug	1000	6	2[e]	505	zoea	132	unidentified anomurans
					megalopa	2	unidentified anomurans
					III	12	*Cancer oregonensis*
					IV	78	*C. oregonensis*
					V	86	*C. oregonensis*
					megalopa	24	*C. oregonensis*
					megalopa	2	*Chionoecetes* sp.
					zoea	202	unidentified brachyurans
					megalopa	2	unidentified brachyurans
					III	1	*Pandalopsis dispar*
					IV	1	*Pandalus borealis*
					zoea	50	unidentified hippolytids
					adult	2	*Pandalus borealis*
					adult	1	*P. goniurus*
					adult	1	*P. goniurus* ? (damaged)

[d] The sample was split and 1/2 of the sample was sorted for shrimp larvae and adults; totals are given for the entire sample.

[e] The sample was split and 1/2 of the sample was sorted for crab larvae and the entire sample was sorted for shrimp larvae and adults; totals are given for the entire sample.

Table 47. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
28 Aug	0650	7	1	333	zoea	24	unidentified hippolytids
					adult	6	*Pandalus goniurus*
28 Aug	0650	7	1	505	zoea	38	unidentified anomurans
					megalopa	16	unidentified anomurans
					II	8	*Cancer oregonensis*
					III	29	*C. oregonensis*
					IV	38	*C. oregonensis*
					V	19	*C. oregonensis*
					megalopa	1	*C. oregonensis*
					zoea	18	unidentified brachyurans
					adult	2	unidentified demersal brachyurans
					zoea	20	unidentified hippolytids
					adult	2	*Pandalus goniurus*
28 Aug	0330	8	1	333	zoea	40	unidentified hippolytids
28 Aug	0330	8	1	505	zoea	16	unidentified anomurans
					megalopa	1	unidentified anomurans
					III	5	*Cancer oregonensis*
					IV	25	*C. oregonensis*
					V	14	*C. oregonensis*
					zoea	33	unidentified brachyurans
					megalopa	1	unidentified brachyurans
					zoea	32	unidentified hippolytids

Table 47. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
28 Aug	1832	9	1	333	zoea	48	unidentified hippolytids
28 Aug	1832	9	1	505	zoea	9	unidentified anomurans
					megalopa	1	unidentified anomurans
					V	1	*Cancer magister*
					III	4	*C. oregonensis*
					IV	17	*C. oregonensis*
					V	67	*C. oregonensis*
					megalopa	18	*C. oregonensis*
					V	5	*Cancer* sp.
					zoea	8	unidentified brachyurans
					megalopa	1	unidentified brachyurans
					zoea	46	unidentified hippolytids
28 Aug	1919	9	2	333	zoea	203	unidentified hippolytids
28 Aug	1919	9	2[f]	505	zoea	38	unidentified anomurans
					III	12	*Cancer oregonensis*
					IV	52	*C. oregonensis*
					V	336	*C. oregonensis*
					megalopa	140	*C. oregonensis*
					megalopa	6	*Chionoecetes* sp.
					zoea	32	unidentified brachyurans
					IV ?	1	*Pandalopsis dispar*
					VI	1	*Pandalus stenolepis*
					zoea	169	unidentified hippolytids

[f] The sample was split and 1/2 of the sample was sorted for crab larvae and the entire sample was sorted for shrimp larvae; totals are given for the entire sample.

Table 47. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
29 Aug	0459	10	1	333	VI	1	*Pandalus stenolepis*
					zoea	8	unidentified hippolytids
29 Aug	0459	10	1	505	IV	3	*Cancer oregonensis*
					V	23	*C. oregonensis*
					megalopa	2	*C. oregonensis*
					zoea	4	unidentified brachyurans
					zoea	10	unidentified hippolytids
29 Aug	1922	11	1	333	V	1	*Pandalus borealis* ? (damaged)
					zoea	5	unidentified hippolytids
29 Aug	1922	11	1	505	V	4	*Cancer magister*
					IV	2	*C. oregonensis*
					V	3	*C. oregonensis*
					megalopa	15	*C. oregonensis*
					megalopa	1	unidentified brachyuran
					zoea	6	unidentified hippolytids
					adult	1	*Eualus townsendi*
31 Aug	0641	13	1	333	zoea	183	unidentified hippolytids
					juvenile	1	*Pasiphaea* sp.
					adult	12	*Pasiphaea* sp.
31 Aug	0641	13	1[g]	505	zoea	8	unidentified anomurans
					megalopa	4	unidentified anomurans
					III	4	*Cancer magister*

[g] The sample was split and 1/4 of the sample was sorted for crab larvae and the entire sample was sorted for shrimp larvae and adults; totals are given for the entire sample.

Table 47. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (µm)	Stage	Total	Identification of Larvae
31 Aug	0641	13	1[g]	505	V	44	*C. magister*
					IV	12	*C. oregonensis*
					V	44	*C. oregonensis*
					megalopa	548	*C. oregonensis*
					megalopa	116	*Cancer* sp.
					megalopa	4	*Chionoecetes* sp.
					zoea	64	unidentified brachyurans
					megalopa	12	unidentified brachyurans
					zoea	61	unidentified hippolytids
					juvenile	6	*Pasiphaea* sp.
					adult	1	*Pasiphaea* sp.
30 Aug	0459	14	1	333	zoea	10	unidentified hippolytids
30 Aug	0459	14	1	505	V	1	*Cancer magister*
					V	29	*C. oregonensis*
					megalopa	22	*C. oregonensis*
					megalopa	2	*Cancer* sp.
					megalopa	6	*Chionoecetes* sp.
					zoea	1	unidentified brachyuran
					megalopa	1	unidentified brachyuran
					zoea	7	unidentified hippolytids

Table 48 . Number of Fish Eggs and Larvae at each Station

Lower Cook Inlet Bongo Tows, *Miller Freeman*, Leg III
17-29 October 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
19 Oct.	0400	1	1	333	0	13
19 Oct.	0400	1	1	505	0	15
28 Oct.	0845	2	2	333	No sample:	cod end of net broke
28 Oct.	0845	2	2	505	0	6
23 Oct.	1935	3	1	333	0	0
23 Oct.	1935	3	1	505	0	1
24 Oct.	1004	4	1	333	0	1
24 Oct.	1004	4	1	505	0	0
23 Oct.	1006	5	1	333	0	3
23 Oct.	1006	5	1	505	0	5
22 Oct.	1758	6	1	333	0	0
22 Oct.	1758	6	1	505	0	1
21 Oct.	0907	7	1	333	0	1
21 Oct.	0907	7	1	505	0	0
22 Oct.	0403	8	1	333	0	9
22 Oct.	0403	8	1	505	0	2
28 Oct.	1244	9	1	333	0	0
28 Oct.	1244	9	1	505	0	12

Table 49. Summary of taxonomic categories of fish eggs, larvae, young and adults found in bongo net samples collected on Lower Cook Inlet, *Miller Freeman* cruise, Leg III, 17-29 October 1976.

A total of 18 samples were collected. All samples were sorted for fish eggs and larvae and the results are summarized below. The fish are distributed into 5 families, 4 genera, and 3 species. No eggs were found in any of the samples.

Family Clupeidae

1 young Pacific herring[1] *Clupea harengus pallasi* Valenciennes

Family Cyclopteridae

1 larva genus? species?

Family Gasterosteidae

1 young threespine stickleback *Gasterosteus aculeatus* Linnaeus

Family Hexagrammidae

43 larvae greenling *Hexagrammos* sp.

Family Osmeridae

5 larvae genus? species?
17 larvae capelin *Mallotus villosus* (Müller)

1 larva unidentified due to extensive damage

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[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 50. Identification of Fish Eggs and Larvae by Station

Lower Cook Inlet Bongo Tows, *Miller Freeman*, Leg III, 17-29 October 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
19 Oct	0400	1	1	333	0[a]	13[a]	3 larvae 5.9, 13, 23 mm[b] *Mallotus villosus* 10 larvae 5.0-5.9 mm *Hexagrammos* sp.
19 Oct	0400	1	1	505	0	15	1 young 28 mm *Gasterosteus aculeatus* 2 larvae 15, 24 mm *Mallotus villosus* 10 larvae 5.0-5.6 mm *Hexagrammos* sp. 1 larva 4.5 mm Cyclopteridae 1 larva 18 mm Osmeridae

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

Table 50. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
28 Oct	0845	2	2	505	0	6	3 larvae 5.1, 5.7, 6.3 mm *Hexagrammos* sp. 2 larvae 16, 27 mm *Mallotus villosus* 1 larva unidentified due to extensive damage (elongate)
23 Oct	1935	3	1	505	0	1	1 larva 12 mm *Hexagrammos* sp.
24 Oct	1004	4	1	333	0	1	1 young 59 mm *Clupea harengus pallasi*
23 Oct	1006	5	1	333	0	3	3 larvae 7.3, 8.5, 11 mm *Hexagrammos* sp.
23 Oct	1006	5	1	505	0	5	5 larvae 8.6-11 mm *Hexagrammos* sp.
22 Oct	1758	6	1	505	0	1	1 larva 16 mm *Mallotus villosus*
21 Oct	0907	7	1	333	0	1	1 larva 27 mm Osmeridae
22 Oct	0403	8	1	333	0	9	2 larvae 11, 12 mm *Hexagrammos* sp. 7 larvae 28-36 mm *Mallotus villosus*
22 Oct	0403	8	1	505	0	2	2 larvae 31, 34 mm *Mallotus villosus*
28 Oct	1244	9	1	505	0	12	9 larvae 4.3-6.4 mm *Hexagrammos* sp. 3 larvae 15, 18, 23 mm Osmeridae

Table 51. Summary of taxonomic categories of commercially important crab and shrimp larvae found in bongo net samples collected on the Lower Cook Inlet, *Miller Freeman* cruise, Leg III, 17-29 October 1976

A total of 17 samples contained 15 crab zoeae and 27 megalopae. The commercially important crabs were distributed into 2 families, 2 genera and 1 species. The 17 samples contained 11 shrimp zoeae and 63 adults. The commercially important shrimp were distributed into 1 family, 1 genus and 2 species.

Section Anomura

10 zoeae unidentified, non-commercially important anomurans
4 megalopae unidentified, non-commercially important anomurans

Section Brachyura

Family Cancridae

1 zoea dungeness crab[1] *Cancer magister* Dana
18 megalopae *Cancer magister*
4 zoeae non-commercially important *Cancer* sp.
4 megalopae non-commercially important *Cancer* sp.

Family Majidae

1 megalopa tanner crab *Chionoecetes* sp.

Section Caridea

Family Pandalidae

1 adult northern pink shrimp *Pandalus borealis* Kröyer
13 adult humpy shrimp *Pandalus goniurus* Stimpson

11 zoeae unidentified hippolytids
49 adult non-commercially important shrimp

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[1] The common name if presented for the first time for each species; thereafter only the scientific name is recorded.

Table 52. Identification of crab and shrimp larvae by station

Lower Cook Inlet bongo net tows, *Miller Freeman*, Leg III, 17-29 October 1976

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
19 Oct	0400	1	1	333[a]	megalopa	10	*Cancer magister*
					megalopa	1	*Chionoecetes* sp.
					zoea	4	unidentified hippolytids
					adult	7	*Crangon communis*
					adult	2	*C. nigricauda*
					adult	1	*Eualus avinus*
					adult	1	*Eualus* sp.
19 Oct	0400	1	1	505	V	1	*Cancer magister*
					megalopa	8	*C. magister*
					adult	9	*Crangon communis*
					adult	3	*Eualus avinus*
28 Oct	0845	2	2	333		0	cod end broke; no sample
28 Oct	0845	2	2	505	zoea	4	unidentified anomurans
					megalopa	3	*Cancer oregonensis*
					zoea	2	unidentified hippolytids
					adult	4	*Crangon alaskensis*
23 Oct	1935	3	1	333		0	
23 Oct	1935	3	1	505		0	
24 Oct	1004	4	1	333	adult	1	*Crangon franciscorum angustimana*

[a] 333 μm samples were not sorted for crab larvae except Station 1, Haul 1.

Table 52. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
24 Oct	1004	4	1	505	adult	3	*Crangon franciscorum angustimana*
23 Oct	1006	5a	1	333	zoea	5	unidentified hippolytids
23 Oct	1006	5a	1	505	zoea	5	unidentified anomurans
					megalopa	3	unidentified anomurans
					megalopa	2	*Cancer oregonensis*
22 Oct	1758	6	1	333	adult	1	*Pandalus borealis*
22 Oct	1758	6	1	505		0	
21 Oct	0907	7	1	333	adult	2	*Pandalus goniurus*
					adult	6	*Crangon alaskensis*
21 Oct	0907	7	1	505	zoea	1	unidentified anomurans
					megalopa	1	unidentified anomurans
					megalopa	1	*Cancer oregonensis*
					adult	2	*Pandalus goniurus*
					adult	4	*Crangon alaskensis*
22 Oct	0403	8	1	333	adult	1	*Pandalus goniurus*
					adult	4	*Crangon alaskensis*
					adult	1	*Crangon dalli*
22 Oct	0403	8	1	505	megalopa	1	*Cancer oregonensis*
					adult	8	*Pandalus goniurus*
					adult	3	*Crangon alaskensis*
28 Oct	1244	9	1	333		0	
28 Oct	0344	9	1	505	V	1	*Cancer oregonensis*

All other data are complete and correct and correspond to data cards (024 MFR001 M. FREEMAN III 76/10/17 - 76/10/29 LCI/MEROPLANKTON).

The summaries of samples analyzed from the *Discoverer* cruise, Leg I, 21-26 February 1977, cover the same taxonomic categories (Tables 53-57). Crab larvae were sorted from the 505 μm mesh nets, but not the 333 μm mesh nets. All other data are complete and correct and correspond to data cards (024 DIS004 DISCOVERER I 77/02/21 - 77/02/26 LCI/MEROPLANKTON).

Many species of fishes, shrimps, and crabs of commercial, sport, and ecosystem importance were identified from the bongo net samples on seven seasonal cruises in the Lower Cook Inlet region (Tables 58, 59, and 60). In some cases the early life history stages could not be identified to species reliably and have, therefore, been reported in more inclusive categories. The more abundant and important categories were selected for further analysis (Tables 61, 62, 63, and 64).

The seasonal quantitative density distributions of early life history stages of the selected categories are presented, as abundance per 10 square meters, on maps of the Lower Cook Inlet region (Figures 3 to 106).

The planktonic fish eggs are considered in four nominal size categories based on the diameter of the chorion: less than 1 mm, about 1 mm, about 2 mm, and about 3 mm (Table 18).

The fish eggs in the category less than 1 mm are between 0.74 and 0.88 mm in diameter. The fish eggs in this category are probably *Limanda aspera*, the yellowfin sole. The fish eggs in this category were caught from May through August (Figure 3). These fish eggs were most abundant in the July samples near Kachemak Bay and Kamishak Bay.

The fish eggs in the category about 1 mm are between 0.90 and 1.28 mm in diameter. The fish eggs in this category are probably a complex of four fishes: *Isopsetta isolepis*, the butter sole; *Parophrys vetulus*, the English sole; *Platichthys stellatus*, the starry founder; and *Psettichthys melanostictus*, the sand sole. The fish eggs in this category were caught from April through August (Figure 4). These fish eggs were most abundant in the May samples near Kachemak Bay and Kamishak Bay.

The fish eggs in the category about 2 mm are between 1.30 and 2.54 mm in diameter. The fish eggs in this category are probably *Theragra chalcogramma*, the walleye pollock, and three flatfishes, *Atheresthes stomias*, the arrowtooth flounder, *Glyptocephalus zachirus*, the rex sole, and *Lyopsetta exilis*, the slender sole. The fish eggs in this category were caught from April through August (Figure 5). These fish eggs were most abundant in the May samples at scattered locations in the Lower Cook Inlet region.

Table 53. Number of Fish Eggs and Larvae at each Station

Lower Cook Inlet Bongo Tows, *Discoverer*, Leg I

21-26 February 1977

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
24 Feb	1331	1	1	333	0	0
24 Feb	1331	1	1	505	0	0
22 Feb	0736	2	1	333	0	17
22 Feb	0736	2	1	505	0	14
25 Feb	2340	2	3	333	0	0
25 Feb	2340	2	3	505	0	0
22 Feb	2108	3	1	333	0	12
22 Feb	2108	3	1	505	0	10
22 Feb	1723	4	1	333	0	0
22 Feb	1723	4	1	505	0	0
22 Feb	0447	5	1	333	0	4
22 Feb	0447	5	1	505	0	11
23 Feb	0415	5	2	333	0	10
23 Feb	0415	5	2	505	0	4
25 Feb	0031	5	3	333	0	2
25 Feb	0031	5	3	505	0	4
25 Feb	0745	5	4	333	0	14
25 Feb	0745	5	4	505	0	17
22 Feb	0050	6	1	333	0	16
22 Feb	0050	6	1	505	0	98
23 Feb	0645	6	2	333	0	29
23 Feb	0645	6	2	505	0	12
25 Feb	0235	6	3	333	0	70
25 Feb	0235	6	3	505	0	34
25 Feb	1039	6	4	333	0	12
25 Feb	1039	6	4	505	1	11
24 Feb	1604	7	1	333	0	3
24 Feb	1604	7	1	505	0	0
26 Feb	0429	8	3	333	0	0
26 Feb	0429	8	3	505	0	0

Table 53. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae
23 Feb	1055	9	1	333	0	2
23 Feb	1055	9	1	505	0	2
23 Feb	1501	10	1	333	0	3
23 Feb	1501	10	1	505	0	1
23 Feb	2137	11	1	333	0	1
23 Feb	2137	11	1	505	0	8

Table 54. Summary of taxonomic categories of fish eggs, larvae, young and adults found in bongo net samples collected on Lower Cook Inlet, *Discoverer* cruise, Leg I, 21-26 February 1977.

A total of 36 samples were collected. All samples were sorted for fish eggs and larvae and the results are summarized below. The fish are distributed into 9 families, 12 genera, and 10 species. One egg was found in all of the samples.

Family Ammodytidae

251 larvae Pacific sandlance[1] *Ammodytes hexapterus* Pallas

Family Cottidae

6 larvae genus? species?

Family Cyclopteridae

19 larvae genus? species?

Family Hexagrammidae

5 larvae greenling *Hexagrammos* sp.

Family Macrouridae

2 larvae genus? species?

Family Osmeridae

45 larvae genus? species?
2 larvae capelin *Mallotus villosus* (Müller)
2 young *Mallotus villosus*
1 young eulachon *Thaleichthys pacificus* (Richardson)

Family Pholidae

1 larva genus? species?
1 larva penpoint gunnel *Apodichthys flavidus* Girard

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[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 54. (continued)

Family Pleuronectidae

5 larvae arrowtooth flounder *Atheresthes stomias* (Jordan and Gilbert)?
2 young rock sole *Lepidopsetta bilineata* (Ayres)
2 larvae yellowfin sole *Limanda aspera* (Pallas)
1 larva slender sole *Lyopsetta exilis* (Jordan and Gilbert)

Family Stichaeidae

2 larvae warbonnet *Chirolophis* sp.
44 larvae prickleback *Lumpenus* sp.
4 larvae black prickleback *Xiphister atropurpureus*
7 larvae rock prickleback *Xiphister mucosus*

19 larvae unidentified, most badly damaged.

1 egg categorized (see Table 18, List of possible fish for egg size categories):

1 egg ∿ 1 mm (1.10 mm)

Table 55. Identification of Fish Eggs and Larvae by Station

Lower Cook Inlet Bongo Tows, *Discoverer*, Leg I, 21-26 February 1977

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
24 Feb	1331	1	1	333	0	0	
24 Feb	1331	1	1	505	0	0	
22 Feb	0736	2	1	333	0	17[a]	1 young 40 mm[b] *Lepidopsetta bilineata*
							2 larvae 14, 14 mm *Limanda aspera*
							2 larvae 15, 16 mm *Lumpenus* sp.
							1 larva 3.7 mm Cyclopteridae
							10 larvae 28-39 mm Osmeridae
							1 larva unidentified due to extensive damage (elongate)

[a] All specimens are classified into four main categories: eggs include all stages of eggs prior to hatching; larvae include newly hatched and all stages prior to metamorphosis; young include fish after metamorphosis to acquisition of adult fin rays and adult body configuration; adults include fish that are sexually mature.

[b] Eggs are measured to the nearest hundredths of a millimeter in diameter. Fish or larvae, if less than 10 mm in length, are measured to the nearest tenth of a millimeter under a microscope using a calibrated micrometer eye piece. If 10 mm or greater in length, the fish or larvae are measured by a metric ruler to the nearest millimeter. When there are more than three eggs, fish or larvae, the largest and the smallest are measured. Larvae are measured by standard length.

Table 55. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
22 Feb	0736	2	1	505	0	14	1 young 40 mm *Lepidopsetta bilineata*
							2 larvae 15, 16 mm *Lumpenus* sp.
							2 larvae 3.9, 4.0 mm Cyclopteridae
							9 larvae 28-34 mm Osmeridae
25 Feb	2340	2	3	333	0	0	
25 Feb	2340	2	3	505	0	0	
22 Feb	2108	3	1	333	0	12	9 larvae 5.4-5.8 mm *Ammodytes hexapterus*
							1 young 53 mm *Thaleichthys pacificus*
							2 larvae 3.6, 3.7 mm Cycloperidae
22 Feb	2108	3	1	505	0	10	9 larva 4.0-5.3 mm *Ammodytes hexapterus*
							1 larva 3.9 mm Cyclopteridae
22 Feb	1723	4	1	333	0	0	
22 Feb	1723	4	1	505	0	0	
22 Feb	0447	5	1	333	0	4	2 larvae 4.1, 5.4 mm *Ammodytes hexapterus*
							1 larva 9.3 mm *Hexagrammos* sp.
							1 larva 33 mm *Mallotus villosus*

Table 55. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
22 Feb	0447	5	1	505	0	11	3 larvae 4.7, 4.8, 5.5 mm *Ammodytes hexapterus*
							1 larva 16 mm *Lumpenus* sp.
							2 larvae 3.8, 4.2 mm Cyclopteridae
							1 larva 31 mm Osmeridae
							4 larvae unidentified due to extensive damage (elongate)
23 Feb	0415	5	2	333	0	10	3 larvae 5.1, 5.2, 5.7 mm *Ammodytes hexapterus*
							1 larva 11 mm *Apodichthys flavidus*
							2 larvae 18, 19 mm *Lumpenus* sp.
							2 larvae 14, 15 mm *Xiphister atropurpureus*
							2 larvae 4.4, 4.6 mm Cyclopteridae
23 Feb	0415	5	2	505	0	4	1 larva 17 mm *Lumpenus* sp.
							2 larvae 12, 14 mm *Xiphister atropurpureus*
							1 larva 11 mm Pholidae
25 Feb	0031	5	3	333	0	2	1 larva 8.6 mm *Hexagrammos* sp.
							1 larva 17 mm *Xiphister mucosus*

Table 55. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
25 Feb	0031	5	3	505	0	4	3 larva 16, 17, 18 mm *Xiphister mucosus* 1 larva unidentified due to extensive damage (elongate)
25 Feb	0745	5	4	333	0	14	1 larva 5.8 mm *Ammodytes hexapterus* 1 larva 14 mm *Chirolophis* sp. 1 larva 8.1 mm *Hexagrammos* sp. 1 larva 30 mm *Mallotus villosus* 1 larva 3.9 mm Cyclopteridae 9 larvae 30-38 Osmeridae
25 Feb	0745	5	4	505	0	17	2 larvae 5.2, 6.0 mm *Ammodytes hexcpterus* 2 larvae 16, 17 mm *Xiphister mucosus* 2 larvae 12, 12 mm Cottidae 11 larvae 30-34 mm Osmeridae
22 Feb	0050	6	1	333	0	16	15 larvae 4.7-6.2 mm *Ammodytes hexapterus* 1 larva 3.4 mm Cyclopteridae
22 Feb	0050	6	1	505	0	98	94 larvae 4.4-5.5 mm *Ammodytes hexapterus* 1 larva 14 mm *Lumpenus* sp.

Table 55. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
22 Feb	0050	6	1	505	0	98	2 larvae 3.4, 3.5 mm Cyclopteridae 1 larva 7.9 mm unidentified, elongate
23 Feb	0645	6	2	333	0	29	22 larvae 4.7-6.6 mm *Ammodytes hexapterus* 6 larvae 12-13 mm *Lumpenus* sp. 1 larva 40 mm Osmeridae
23 Feb	0645	6	2	505	0	12	7 larvae 4.7-5.1 mm *Ammodytes hexapterus* 3 larvae 10, 11, 11 mm *Lumpenus* sp. 2 young 63, 90 mm *Mallotus villosus*
25 Feb	0235	6	3	333	0	70	56 larvae 4.6-5.7 mm *Ammodytes hexapterus* 12 larvae 10-12 mm *Lumpenus* sp. 2 larvae 3.2, 3.4 mm Cyclopteridae
25 Feb	0235	6	3	505	0	34	21 larvae 4.7-5.8 mm *Ammodytes hexapterus* 10 larvae 11-16 mm *Lumpenus* sp. 2 larvae 3.5, 3.6 mm Cyclopteridae 1 larva unidentified due to extensive damage (elongate)

Table 55. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
25 Feb	1039	6	4	333	0	12	1 larva 5.4 mm *Ammodytes hexapterus* 1 larva 13 mm *Chirolophis* sp. 2 larvae 12, 12 mm *Lumpenus* sp. 8 larvae unidentified due to extensive damage (elongate)
25 Feb	1039	6	4	505	1	11	1 egg ∿ 1 mm (1.10 mm) 6 larvae 4.4-5.1 mm *Ammodytes hexapterus* 1 larva 11 mm *Lumpenus* sp. 1 larva 17 mm *Xiphister mucosus* 1 larva 41 mm Osmeridae 2 larvae unidentified due to extensive damage (elongate)
24 Feb	1604	7	1	333	0	3	1 larva 18 mm *Lumpenus* sp. 1 larva 4.4 mm Cyclopteridae 1 larva 28 mm Osmeridae
24 Feb	1604	7	1	505	0	0	
26 Feb	0429	8	3	333	0	0	
26 Feb	0429	8	3	505	0	0	

Table 55. (continued)

Date (1976) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Eggs	Fish or Larvae	Identification of Fish Eggs and Larvae
23 Feb	1055	9	1	333	0	2	1 larva 10 mm *Hexagrammos* sp.
							1 larva 49 mm Osmeridae
23 Feb	1055	9	1	505	0	2	1 larva 9.8 mm *Hexagrammos* sp.
							1 larva 41 mm Osmeridae
23 Feb	1501	10	1	333	0	3	3 larvae 9.3, 10, 10 mm Cottidae
23 Feb	1501	10	1	505	0	1	1 larva 7.5 mm *Atheresthes stomias* ?
23 Feb	2137	11	1	333	0	1	1 larva 11 mm Macrouridae
23 Feb	2137	11	1	505	0	8	4 larvae 7.1-7.6 *Atheresthes stomias* ?
							1 larva 13 mm *Lyopsetta exilis*
							1 larva 9.6 mm Cottidae
							1 larva 10 mm Macrouridae
							1 larva 8.4 mm unidentified, non-elongate

Table 56. Summary of taxonomic categories of commercially important crab and shrimp larvae found in bongo net samples collected on the Lower Cook Inlet, *Discoverer* Cruise, Leg I, 21-26 February 1977

A total of 36 samples contained 464 crab zoeae. The commercially important crabs were distributed into 1 family, 1 genus, and 1 species. The 36 samples contained 549 shrimp zoeae and 39 adults. The commercially important shrimp were distributed into 1 family, 2 genera, and 4 species.

Section Anomura

Family Lithodidae

20 zoeae king crab[1] *Paralithodes camtschatica* (Tilesius)

70 zoeae unidentified, non-commercially important anomurans

Section Brachyura

Family Cancridae

58 zoeae non-commercially important *Cancer* sp.

316 zoeae unidentified, non-commercially important brachyurans

Section Caridea

Family Pandalidae

20 zoeae sidestripe shrimp *Pandalopsis dispar* Rathbun
1 zoea spot shrimp *Pandalus platyceros* Brandt
18 adult northern pink shrimp *Pandalus borealis* Kröyer
3 adult humpy shrimp *Pandalus goniurus* Stimpson

528 zoeae unidentified hippolytids
18 adult non-commercially important shrimp

[1] The common name is presented for the first time for each species; thereafter only the scientific name is recorded.

Table 57. Identification of crab and shrimp larvae by station

Lower Cook Inlet bongo net tows, *Discoverer*, Leg I, 21-26 February 1977

Date (1977) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
24 Feb	1331	1	1	333[a]		0	
24 Feb	1331	1	1	505		0	
22 Feb	0736	2	1	333	adult	2	*Crangon alaskensis elongata*
22 Feb	0736	2	1	505	adult	1	*Crangon alaskensis*
					adult	1	*C. alaskensis elongata*
25 Feb	2340	2	3	333	zoea	1	unidentified hippolytid
25 Feb	2340	2	3	505	zoea	1	unidentified anomuran
					II	1	*Pandalus platyceros*
22 Feb	2108	3	1	333	adult	1	*Crangon alaskensis elongata*
22 Feb	2108	3	1	505	zoea	6	unidentified anomurans
					I	1	*Cancer oregonensis*
					zoea	1	unidentified brachyuran
					adult	1	*Crangon alaskensis*
22 Feb	1723	4	1	333		0	
22 Feb	1723	4	1	505		0	

[a] 333 μm samples were not sorted for crab larvae.

Table 57. (continued)

Date (1977) (GMT)	Time (GMT)	Station	Haul	Mesh Size (um)	Stage	Total	Identification of Larvae
22 Feb	0447	5	1	333	I	4	*Pandalopsis dispar*
					zoea	1	unidentified hippolytids
					adult	1	*Crangon dalli*
22 Feb	0447	5	1	505	I	4	*Paralithodes camtschatica*
					zoea	1	unidentified anomurans
					I	2	*Pandalopsis dispar*
					zoea	3	unidentified hippolytids
23 Feb	0415	5	2	333	I	2	*Pandalopsis dispar*
23 Feb	0415	5	2	505	I	3	*Paralithodes camtschatica*
					zoea	12	unidentified anomurans
					I	23	*Cancer oregonensis*
					I	1	*Pandalopsis dispar*
					zoea	8	unidentified hippolytids
25 Feb	0031	5	3	333	I	4	*Pandalopsis dispar*
25 Feb	0031	5	3	505	I	6	*Paralithodes camtschatica*
					zoea	5	unidentified anomurans
					I	5	*Cancer oregonensis*
					I	1	*Pandalopsis dispar*
25 Feb	0745	5	4	333	I	1	*Pandalopsis dispar*
					zoea	4	unidentified hippolytids

Table 57. (continued)

Date (1977) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
25 Feb	0745	5	4	505	I	1	*Paralithodes camtschatica*
					zoea	25	unidentified anomurans
					I	1	*Cancer oregonensis*
					zoea	1	unidentified brachyuran
					I	5	*Pandalopsis dispar*
					zoea	6	unidentified hippolytids
22 Feb	0050	6	1	333	zoea	139	unidentified hippolytids
22 Feb	0050	6	1	505	I	2	*Paralithodes camtschatica*
					zoea	29	unidentified anomurans
					I	28	*Cancer oregonensis*
					zoea	168	unidentified brachyurans
					zoea	203	unidentified hippolytids
23 Feb	0645	6	2	333	zoea	16	unidentified hippolytids
					adult	11	*Pandalus borealis*
					adult	1	*Crangon franciscorum angustimana*
					adult	1	*Eualus suckleyi*
23 Feb	0645	6	2	505	I	1	*Paralithodes camtschatica*
					zoea	1	unidentified anomuran
					zoea	38	unidentified brachyurans
					zoea	9	unidentified hippolytids
					adult	6	*Pandalus borealis*
					adult	2	*P. goniurus*
					adult	1	*Crangon franciscorum angustimana*

Table 57. (continued)

Date (1977) (GMT)	Time (GMT)	Station	Haul	Mesh Size (μm)	Stage	Total	Identification of Larvae
25 Feb	0235	6	3	333	zoea	84	unidentified hippolytids
25 Feb	0235	6	3	505	I	3	*Paralithodes camtschatica*
					zoea	2	unidentified anomurans
					zoea	98	unidentified brachyurans
					zoea	40	unidentified hippolytids
25 Feb	1039	6	4	333	adult	1	*Crangon franciscorum angustimana*
25 Feb	1039	6	4	505	zoea	9	unidentified brachyurans
					zoea	2	unidentified hippolytids
					adult	4	*Crangon franciscorum angustimana*
24 Feb	1604	7	1	333	adult	1	*Crangon dalli*
24 Feb	1604	7	1	505	adult	1	*Argis alaskensis*
26 Feb	0429	8	3	333	adult	1	*Crangon dalli*
26 Feb	0429	8	3	505		0	
23 Feb	1055	9	1	333		0	
23 Feb	1055	9	1	505	zoea	1	unidentified brachyuran
					adult	1	*Pandalus goniurus*

Table 57. (continued)

Date (1977) (GMT)	Time (GMT)	Station	Haul	Mesh Size (µm)	Stage	Total	Identification of Larvae
23 Feb	1501	10	1	333		0	
23 Feb	1501	10	1	505	adult	1	*Pandalus borealis*
23 Feb	2137	11	1	333		0	
23 Feb	2137	11	1	505		0	

Table 58. Fishes collected in the Lower Cook Inlet region, April 1976 through February 1977.

Family Clupeidae - herrings

Clupea harengus pallasi Pacific herring

Family Salmonidae - trouts

Oncorhynchus sp. salmon

Family Osmeridae - smelts

Mallotus villosus capelin
Spirinchus thaleichthys longfin smelt
Thaleichthys pacificus eulachon

Family Bathylagidae - deepsea smelt

Bathylagus sp. blacksmelt
Leuroglossus schmidti northern smoothtongue

Family Myctophidae - lanternfishes

Stenobrachius leucopsarus northern lampfish

Family Gadidae - codfishes

Gadus sp. Pacific cod
Theragra chalcogramma walleye pollock

Family Gasterosteidae - sticklebacks

Gasterosteus aculeatus threespine stickleback
Pungitius pungitius ninespine stickleback

Family Bathymasteridae - ronquils

Family Stichaeidae - pricklebacks

Anoplarchus sp. cockscomb
Chirolophis sp. warbonnet
Lumpenus spp. prickleback
Xiphister atropurpureus black prickleback
Xiphister mucosus red prickleback

Family Pholidae - gunnels

Apodichthys flavidus penpoint gunnel
Pholis sp. gunnel

Table 58. (continued)

Family Ptilichthyidae - quillfishes

Ptilichthyidae goodei quillfish

Family Ammodytidae - sand lances

Ammodytes hexapterus Pacific sand lance

Family Tetragonuridae - squaretails

Family Scorpaenidae - scorpionfishes

Sebastes sp. rockfish
Sebastolobus thornyhead

Family Hexagrammidae - greenlings

Hexagrammos sp. greenling

Family Cottidae - sculpins

Icelinus borealis northern sculpin
Myoxocephalus sculpin
Scorpaenichthys marmoratus cabezon

Family Agonidae - poachers

Agonus acipenserinus sturgeon poacher

Family Cyclopteridae - lumpfishes and snailfishes

Liparis sp. snailfish

Family Pleuronectidae - righteye flounders

Atheresthes stomias arrowtooth flounder
Glyptocephalus zachirus rex sole
Hippoglossoides sp. (probably flathead sole)
Isopsetta isolepis butter sole
Lepidopsetta bilineata rock sole
Limanda aspera yellowfin sole
Lyopsetta exilis slender sole
Platichthys stellatus starry flounder
Psettichthys melanostictus sand sole

Table 59. Pandalid shrimp collected in the Lower Cook Inlet region, April 1976 through February 1977.

Order Decapoda

Suborder Natantia

Section Caridea

Family Pandalidae

Pandalopsis dispar Rathbun side-stripe shrimp (larvae and adults)
Pandalus borealis Kröyer northern pink shrimp (larvae and adults)
Pandalus danae Stimpson dock shrimp (larvae)
Pandalus goniurus Stimpson humpy shrimp (larvae and adults)
Pandalus hypsinotus Brandt coonstripe shrimp (larvae)
Pandalus montagui tridens Rathbun no common name (larvae)
Pandalus platyceros Brandt spot shrimp (larvae)
Pandalus stenolepis Rathbun no common name (larvae)

Table 60. Commercially important species of crab larvae collected in Lower Cook Inlet region, April 1976 through February 1977.

Order Decapoda

Suborder Reptantia

Section Anomura

Family Lithodidae

Paralithodes camtschatica (Tilesius) king crab
Paralithodes platypus (Brandt) blue king crab

Section Brachyura

Superfamily Brachyrhyncha

Family Cancridae

Cancer magister Dana Dungeness crab

Superfamily Oxyrhyncha

Family Majidae

Subfamily Oregoniinae

Chionoecetes bairdi Rathbun tanner or snow crab

Table 61.

FISH EGGS/10 SQ M

STATION	SIZE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	<1 MM	0	0	0	4	0	0	0
	1 MM	0	2	0	1	0	0	0
	2 MM	1	2	2	0	0	0	0
	3 MM	0	87	96	0	0	0	0
2	<1 MM	0	1	0	2	0	0	0
	1 MM	0	0	12	35	0	0	0
	2 MM	0	1	1	1	0	0	0
	3 MM	0	0	1	0	0	0	0
3	<1 MM	0	0	0	2	0	0	0
	1 MM	11	80	281	0	0	0	0
	2 MM	0	11	8	1	0	0	0
	3 MM	0	0	0	0	0	0	0
4	<1 MM	0	0	0	3	0	0	0
	1 MM	0	0	3	0	0	0	0
	2 MM	0	0	1	0	0	0	0
	3 MM	0	0	0	0	0	0	0
5	<1 MM	0	0	1	438	30	0	0
	1 MM	1	100	138	90	2	0	0
	2 MM	0	5	5	0	0	0	0
	3 MM	0	0	3	0	0	0	0
6	<1 MM	0	0	16	291	21	0	0
	1 MM	21	5550	2701	3	1	0	0
	2 MM	2	0	0	0	0	0	0
	3 MM	0	0	0	0	0	0	0
7	<1 MM	0	0	62	290	0	0	0
	1 MM	101	96	1485	52	0	0	0
	2 MM	0	1	2	0	1	0	0
	3 MM	0	0	0	0	0	0	0
8	<1 MM		0	144	811	0	0	0
	1 MM		938	712	49	0	0	0
	2 MM		10	1	0	0	0	0
	3 MM		0	0	0	0	0	0

Table 61 (continued).

CONTINUATION-FISH EGGS/10 SQ M

9	<1 MM	0	0		3	0	0	0
	1 MM	1	30		3	0	0	0
	2 MM	1	3		1	0	0	0
	3 MM	0	26		1	1	0	0
10	<1 MM	0		4	0	1		0
	1 MM	3		4	2	0		0
	2 MM	0		27	1	0		0
	3 MM	0		14	2	0		0

Table 62.

HIPPOGLOSSOIDES SP./10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	0	0	45	7	0	0	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	0	1	2	1	0	0
	JUV	0	0	0	0	0	0	0
3	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	LAR	0	0	0	0	1	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	0	0	6	1	0	0	0
	JUV	0	0	0	0	0	0	0
6	LAR	0	0	0	2	0	0	0
	JUV	0	0	0	0	0	0	0
7	LAR	0	0	0	48	0	0	0
	JUV	0	0	0	0	1	0	0
8	LAR		0	0	15	0	0	0
	JUV		0	0	0	0	0	0
9	LAR	0	0		8	2	0	0
	JUV	0	0		0	0	0	0
10	LAR	0		0	12	0		0
	JUV	0		0	0	0		0

GADIDAE/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	0	26	5	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	13	2	0	0	0	0
	JUV	0	0	0	0	0	0	0

Table 62 (continued).

CONTINUATION-GADIDAE/10 SQ M

3	LAR	0	0	1	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	LAR	0	1	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	0	0	0	1	0	0	0
	JUV	0	0	0	0	1	0	0
6	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	LAR		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	LAR	14	4		4	0	0	0
	JUV	0	0		0	0	0	0
10	LAR	0		0	0	0		0
	JUV	0		0	0	0		0

OSMERIDAE/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	0	0	0	752	659	2	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	3	0	571	137	0	29
	JUV	0	0	0	0	0	0	0
3	LAR	0	0	0	21	29	0	0
	JUV	0	0	0	0	0	0	1
4	LAR	0	0	0	351	0	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	0	0	0	368	224	0	1
	JUV	0	0	0	0	0	0	0
6	LAR	0	1	0	0	275	0	1
	JUV	0	0	0	0	0	0	0

Table 62 (continued).

CONTINUATION-OSMERIDAE/10 SQ M

7	LAR	0	0	0	51	8	2	1
	JUV	0	0	0	0	0	0	0
8	LAR		0	0	2	2	0	0
	JUV		0	0	0	0	0	0
9	LAR	0	0		207	49	2	4
	JUV	0	0		0	0	0	0
10	LAR	0		0	238	17		0
	JUV	0		0	0	0		0

MALLOTUS VILLOSUS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	5	11	0	2505	233	17	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	0	0	633	85	9	0
	JUV	0	0	0	0	1	0	0
3	LAR	0	0	0	346	11	0	0
	JUV	0	0	0	0	0	0	0
4	LAR	0	0	0	412	2	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	0	0	0	560	272	0	1
	JUV	0	0	0	0	0	0	0
6	LAR	0	0	0	14	1383	1	0
	JUV	0	0	0	0	0	0	1
7	LAR	0	0	0	299	21	0	0
	JUV	0	0	0	0	0	0	0
8	LAR		0	0	40	144	7	0
	JUV		0	0	0	0	0	0
9	LAR	7	0		170	49	0	0
	JUV	0	0		0	0	0	0
10	LAR	0		0	85	15		0
	JUV	0		0	0	0		0

Table 62 (continued).

CLUPEA HARENGUS PALLASI/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	LAR	0	0	0	31	4	0	0
	JUV	0	0	0	0	0	1	0
5	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	LAR	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	LAR		0	0	5	0	0	0
	JUV		0	0	0	0	0	0
9	LAR	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	LAR	0		0	0	0		0
	JUV	0		0	0	0		0

AMMODYTES HEXAPTERUS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	LAR	5	0	8	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	LAR	0	2	30	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	LAR	13	28	3	0	0	0	13
	JUV	0	0	0	0	0	0	0

Table 62 (continued).

CONTINUATION-AMMODYTES HEXAPTERUS/10 SQ M

4	LAR	0	1	5	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	LAR	1	324	155	0	0	0	7
	JUV	0	0	0	0	0	0	0
6	LAR	10	394	1	0	0	0	22
	JUV	0	0	0	0	0	0	0
7	LAR	9	1	24	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	LAR		47	9	0	0	0	0
	JUV		0	0	0	0	0	0
9	LAR	1	2		0	0	0	0
	JUV	0	0		0	0	0	0
10	LAR	1		0	0	0		0
	JUV	0		0	0	0		0

Table 63.

ANOMURA/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	ZOE	12	346	438	501	1170	0	0
	MEG	0	0	0	0	55	0	0
2	ZOE	0	199	3363	194	101	17	0
	MEG	0	0	0	23	34	0	0
3	ZOE	0	0	25	1262	13	0	0
	MEG	0	0	0	0	4	0	0
4	ZOE	0	1	1	4	16	0	0
	MEG	0	0	0	0	5	0	0
5	ZOE	0	951	777	1176	1186	14	3
	MEG	0	0	0	0	0	8	0
6	ZOE	22	248	7	403	157	0	54
	MEG	0	0	0	27	3	0	0
7	ZOE	0	33	208	476	12	4	0
	MEG	0	0	0	0	5	4	0
8	ZOE		47	953	7	165	0	0
	MEG		0	0	0	10	0	0
9	ZOE	0	86		1090	36	0	0
	MEG	0	0		108	0	0	0
10	ZOE	0		18	10	0		0
	MEG	0		0	0	0		0

BRACHYURA/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	ZOE	0	274	1479	1299	68	0	0
	MEG	0	0	0	343	7	0	0
2	ZOE	0	330	3767	452	190	0	0
	MEG	0	0	0	83	67	0	0

Table 63 (continued).

CONTINUATION-BRACHYURA/10 SQ M

3	ZOE	0	35	1030	1660	142	0	1
	MEG	0	0	0	199	9	0	0
4	ZOE	0	0	83	4	248	0	0
	MEG	0	0	0	1	3	0	0
5	ZOE	0	286	3535	1577	625	0	0
	MEG	0	0	0	25	9	0	0
6	ZOE	0	1131	5639	1169	286	0	313
	MEG	0	0	0	0	3	0	0
7	ZOE	0	32	256	2505	6	0	0
	MEG	0	0	0	72	0	0	0
8	ZOE		9	3626	17	340	0	0
	MEG		0	0	3	10	0	0
9	ZOE	0	122		2978	30	0	4
	MEG	0	0		3268	0	0	0
10	ZOE	0		113	19	3		0
	MEG	0		0	133	0		0

PARALITHODES CAMTSCHATICA/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	7	0	0	0	0
	II	0	0	6	0	0	0	0
	III	0	0	5	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
2	I	0	0	2	0	0	0	0
	II	0	0	30	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
3	I	0	2	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0

Table 63 (continued).

CONTINUATION-PARALITHODES CAMTSCHATICA/10 SQ M

4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
5	I	0	546	0	0	0	0	11
	II	0	322	153	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
6	I	1	259	0	0	0	0	3
	II	1	143	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
7	I	0	434	37	0	0	0	0
	II	0	1	461	0	0	0	0
	III	0	0	51	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
8	I		361	0	0	0	0	0
	II		7	85	0	0	0	0
	III		0	104	0	0	0	0
	IV		0	0	0	0	0	0
	MEG		0	0	0	0	0	0
9	I	0	39		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	MEG	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	MEG	0		0	0	0		0

Table 63 (continued).

PARALITHODES PLATYPUS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	60	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0

Table 63 (continued).

CONTINUATION-PARALITHODES PLATYPUS/10 SQ M

8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	MEG		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	MEG	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	MEG	0		0	0	0		0

CANCER MAGISTER/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	3	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	7	0
	MEG	0	0	0	0	0	58	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0

Table 63 (continued).

CONTINUATION-CANCER MAGISTER/10 SQ M

4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	50	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
6	I	0	0	0	9	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	MEG		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	MEG	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	MEG	0		0	0	0		0

Table 63 (continued).

CANCER OREGONENSIS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	3567	0	0	0
	II	0	0	0	1126	0	0	0
	III	0	0	0	156	65	0	0
	IV	0	0	0	15	181	0	0
	V	0	0	0	0	253	0	0
	MEG	0	0	0	0	31	0	0
2	I	0	0	0	345	34	0	0
	II	0	0	0	376	22	0	0
	III	0	0	0	12	358	0	0
	IV	0	0	0	0	1109	0	0
	V	0	0	0	0	370	0	0
	MEG	0	0	0	0	22	13	0
3	I	0	0	0	13014	4	0	1
	II	0	0	0	1594	7	0	0
	III	0	0	0	66	22	0	0
	IV	0	0	0	0	97	0	0
	V	0	0	0	0	47	0	0
	MEG	0	0	0	0	4	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	13	0	0
	III	0	0	0	0	57	0	0
	IV	0	0	0	0	65	0	0
	V	0	0	0	0	13	0	0
	MEG	0	0	0	0	0	0	0
5	I	0	0	0	8147	9	0	0
	II	0	0	0	375	9	0	0
	III	0	0	0	0	28	0	0
	IV	1	0	0	0	287	0	0
	V	0	0	3	0	83	0	0
	MEG	0	0	0	0	37	6	0
6	I	0	0	0	277	0	0	52
	II	0	0	0	23	0	0	0
	III	0	0	0	0	17	0	0
	IV	0	0	0	0	110	0	0
	V	0	0	0	0	122	0	0
	MEG	0	0	0	0	34	0	0

Table 63 (continued).

CONTINUATION-CANCER OREGONENSIS/10 SQ M

7	I	0	0	0	14	0	0	0
	II	0	0	0	0	2	0	0
	III	0	0	0	0	10	0	0
	IV	0	0	0	0	12	0	0
	V	0	0	0	0	6	0	0
	MEG	0	0	0	0	1	4	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	52	0	0
	IV		0	0	0	258	0	0
	V		0	0	0	144	0	0
	MEG		0	0	0	0	2	0
9	I	0	0		254	0	0	0
	II	0	0		146	0	0	0
	III	0	0		326	11	0	0
	IV	0	0		0	48	0	0
	V	0	0		0	315	2	0
	MEG	0	0		0	131	0	0
10	I	0		0	2	0		0
	II	0		0	71	0		0
	III	0		0	24	0		0
	IV	0		0	2	3		0
	V	0		0	0	16		0
	MEG	0		0	0	1		0

CANCER PRODUCTUS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	9	8	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
2	I	0	1	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0

Table 63 (continued).

CONTINUATION-<u>CANCER PRODUCTUS/10 SQ M</u>

3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	MEG	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	MEG		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	MEG	0	0		0	0	0	0

Table 63 (continued).

CONTINUATION-CANCER PRODUCTUS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-26
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	MEG	0		0	0	0		0

CHIONOECETES BAIRDI/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	1	23	15	0	0	0
	II	0	0	0	172	0	0	0
2	I	0	0	376	0	0	0	0
	II	0	0	0	0	0	0	0
3	I	0	1	10	0	0	0	0
	II	0	0	0	0	0	0	0
4	I	0	1	0	0	0	0	0
	II	0	0	0	0	0	0	0
5	I	0	763	942	0	0	0	0
	II	0	0	0	0	0	0	0
6	I	0	0	419	0	0	0	0
	II	0	0	0	0	0	0	0
7	I	0	0	16	0	0	0	0
	II	0	0	0	0	0	0	0
8	I		0	22	0	0	0	0
	II		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
10	I	0		40	0	0		0
	II	0		0	42	0		0

Table 63 (continued).

CHIONOECETES SP./10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	MEG	0	2	10	0	13	0	0
2	MEG	0	10	0	0	101	0	0
3	MEG	0	2	0	0	4	0	0
4	MEG	0	0	1	0	0	0	0
5	MEG	0	0	0	0	0	0	0
6	MEG	0	0	0	0	3	0	0
7	MEG	0	1	0	0	0	0	0
8	MEG		1	2	0	0	0	0
9	MEG	1	2		0	6	0	0
10	MEG	1		5	0	0		0

Table 64.

PANDALOPSIS DISPAR/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	1	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	1	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	3	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	6
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	I	1	0	0	0	0	0	0
	II	0	2	0	0	0	0	0
	III	0	0	0	0	1	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

Table 64 (continued).

CONTINUATION-PANDALOPSIS DISPAR/10 SQ M

7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	1	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		1	0	0	0
	IV	0	0		0	1	0	0
	V	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		1	0	0		0
	II	0		0	0	0		0
	III	0		1	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS BOREALIS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-2[illegible]
1	I	0	34	0	0	0	0	0
	II	0	23	10	0	0	0	0
	III	0	0	55	0	0	0	0
	IV	0	0	2	1	0	0	0
	V	0	0	0	2	1	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	5	0	0

Table 64 (continued).

CONTINUATION-PANDALUS BOREALIS/10 SQ M

2	I	0	1	1	0	0	0	0
	II	0	1	0	0	0	0	0
	III	0	0	1	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	156	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	1	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	1	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	1	0	0
5	I	0	211	18	0	0	0	0
	II	0	76	5	0	0	0	0
	III	0	0	42	0	0	0	0
	IV	0	0	5	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	I	1	618	0	0	0	0	0
	II	0	18	5	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	1	2	0	0
	V	0	0	0	1	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

Table 64 (continued).

CONTINUATION-PANDALUS BOREALIS/10 SQ M

7	I	0	17	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	1	0	0	0
	IV	0	0	0	53	0	0	0
	V	0	0	0	1	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	1	0	0	0	0
	II		0	1	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	1	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	VII		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	69		0	0	0	0
	II	0	34		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		5	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	0	0	0
	VII	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		1	0	0		0
	III	0		5	7	0		0
	IV	0		2	8	0		0
	V	0		0	2	0		0
	VI	0		0	0	0		0
	VII	0		0	0	0		0
	JUV	0		0	0	0		0

Table 64 (continued).

PANDALUS DANAE/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	1	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	2	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

Table 64 (continued).

CONTINUATION-PANDALUS DANAE/10 SQ M

6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	1	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	VI	0		0	0	0		0
	JUV	0		0	0	0		0

Table 64 (continued).

PANDALUS GONIURUS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	1	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	1	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	1	6	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	1	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	1146	42	0	0	0	0
	II	0	172	1176	0	0	0	0
	III	0	0	666	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

Table 64 (continued).

CONTINUATION-PANDALUS GONIURUS/10 SC M

6	I	1	2109	9	0	0	0	0
	II	0	0	9	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	7	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	1	0	0	0
7	I	0	88	699	0	0	0	0
	II	0	0	3666	0	0	0	0
	III	0	0	322	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	VII	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		874	1	0	0	0	0
	II		15	27	0	0	0	0
	III		0	6	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	VII		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	38		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	0	0	0
	VII	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		1	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	VI	0		0	0	0		0
	VII	0		0	0	0		0
	JUV	0		0	0	0		0

Table 64 (continued).

PANDALUS HYPSINOTUS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	1	3	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

Table 64 (continued).

CONTINUATION-PANDALUS HYPSINOTUS/10 SQ M

6	I	0	1	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	V	0		0	0	0		0
	VI	0		0	0	0		0
	JUV	0		0	0	0		0

Table 64 (continued).

PANDALUS PLATYCEROS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	1
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-PANDALUS PLATYCEROS/10 SQ M

8	I		0	0	0	0	0	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	0		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	0	0		0
	IV	0		0	0	0		0
	JUV	0		0	0	0		0

PANDALUS STENOLEPIS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 6-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	9	6	1	0	0	0
	II	0	0	3	5	0	0	0
	III	0	0	0	9	0	0	0
	IV	0	0	0	7	0	0	0
	V	0	0	0	2	0	0	0
	VI	0	0	0	1	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	1	0	0	0	0	0
	II	0	0	1	0	0	0	0
	III	0	0	1	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

CONTINUATION-*PANDALUS STENOLEPIS*/10 SQ M)

5	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	2	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	V	0	0	0	0	0	0	0
	VI	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	0	0
	II		0	0	1	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	V		0	0	0	0	0	0
	VI		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	0	36		11	0	0	0
	II	0	2		0	0	0	0
	III	0	0		0	0	0	0
	IV	0	0		1	0	0	0
	V	0	0		0	0	0	0
	VI	0	0		0	1	0	0
	JUV	0	0		0	0	0	0

Table 64 (continued).

CONTINUATION-PANDALUS STENOLEPIS/10 SQ M

10	I	0		0	0	0		0
	II	0		0	0	0		0
	III	0		0	1	0		0
	IV	0		0	1	0		0
	V	0		0	1	0		0
	VI	0		0	0	1		0
	JUV	0		0	0	0		0

PANDALUS MONTAGUI TRIDENS/10 SQ M

STATION	STAGE	APR 6-13	MAY 6-9	MAY 22-30	JUL 8-15	AUG 24-31	OCT 17-29	FEB 21-26
1	I	0	153	7	0	0	0	0
	II	0	0	76	0	0	0	0
	III	0	0	5	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
2	I	0	1	0	0	0	0	0
	II	0	0	1	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
3	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
4	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
5	I	0	1	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0

Table 64 (continued).

CONTINUATION-PANDALUS MONTAGUI TRIDENS/10 SQ M

6	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
7	I	0	0	0	0	0	0	0
	II	0	0	0	0	0	0	0
	III	0	0	0	0	0	0	0
	IV	0	0	0	0	0	0	0
	JUV	0	0	0	0	0	0	0
8	I		0	0	0	0	[illegible]	0
	II		0	0	0	0	0	0
	III		0	0	0	0	0	0
	IV		0	0	0	0	0	0
	JUV		0	0	0	0	0	0
9	I	1	510		0	0	0	0
	II	0	0		0	0	0	0
	III	0	0		1	0	0	0
	IV	0	0		0	0	0	0
	JUV	0	0		0	0	0	0
10	I	0		21	0	0		0
	II	0		18	0	0		0
	III	0		4	0	0		0
	IV	0		0	0	0		0
	JUV	0		0	0	0		0

Figures 3 - 106. Seasonal quantitative density distributions of early life history stages.

Relative abundance of organisms of commercial, sport, and ecosystem importance from under 10 m^2 surface area taken at 10 stations on 7 cruises in the Lower Cook Inlet region.

Figure 3.

FISH EGGS
<1MM DIAM/10 SQ M

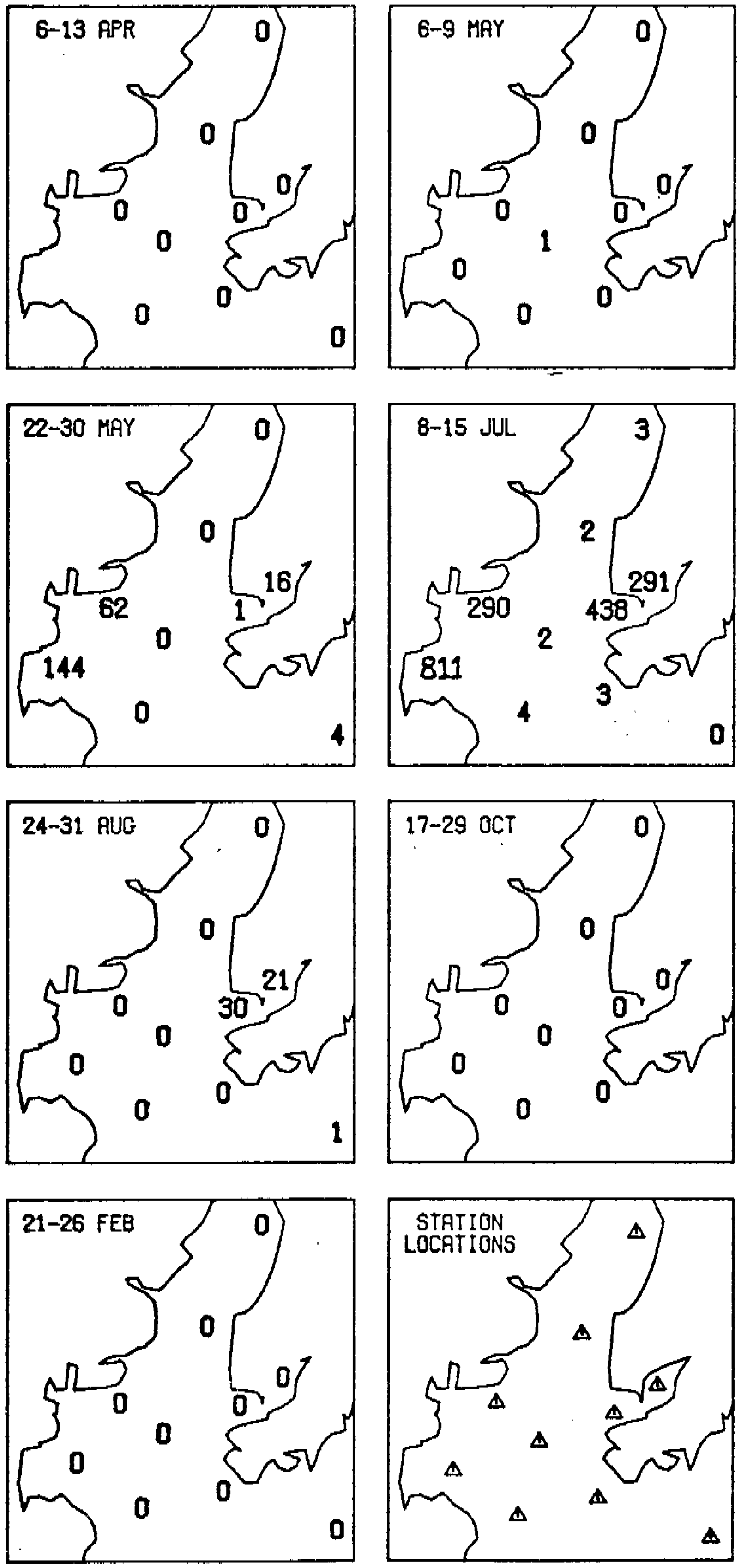


Figure 4.

FISH EGGS
~1MM DIAM/10 SQ M

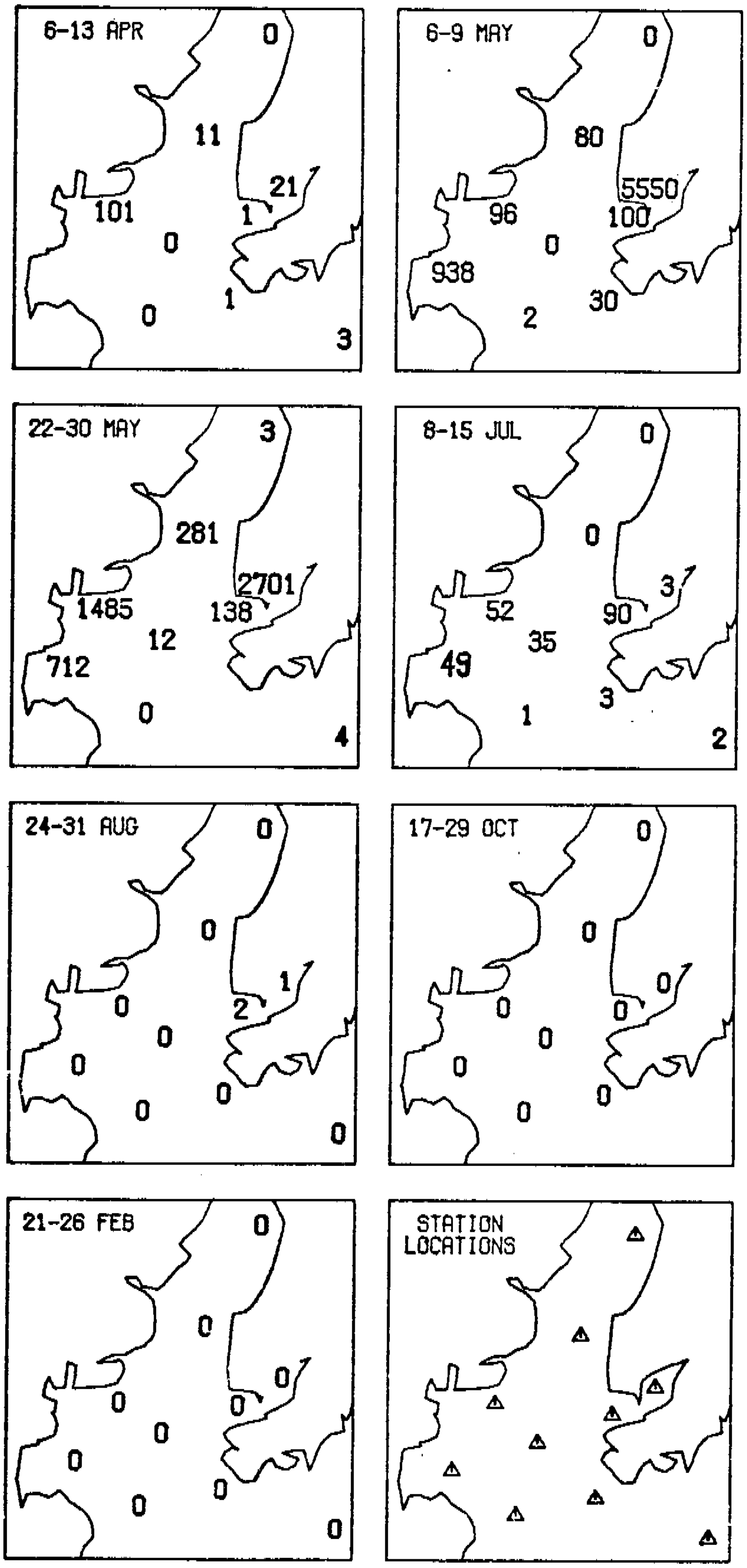


Figure 5.

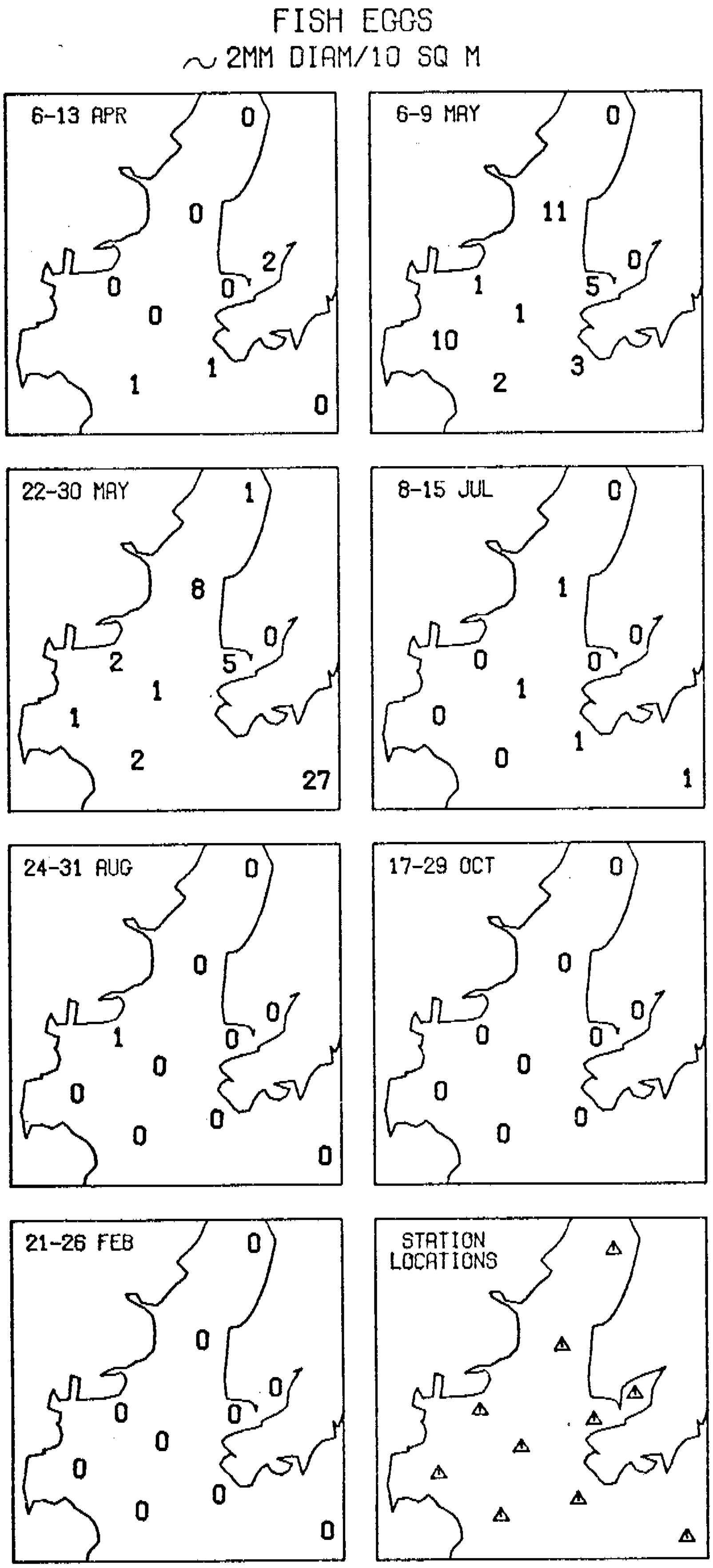

FISH EGGS
~2MM DIAM/10 SQ M
6-13 APR
0
0
2
0
0
0
1
1
0
6-9 MAY
0
11
0
1
5
1
10
3
2
22-30 MAY
1
8
0
2
5
1
1
2
27
8-15 JUL
0
1
0
0
0
1
0
1
0
1
24-31 AUG
0
0
0
1
0
0
0
0
0
0
17-29 OCT
0
0
0
0
0
0
0
0
0
21-26 FEB
0
0
0
0
0
0
0
0
0
0
STATION LOCATIONS

Figure 6.

FISH EGGS
~ 3MM DIAM/10 SQ M

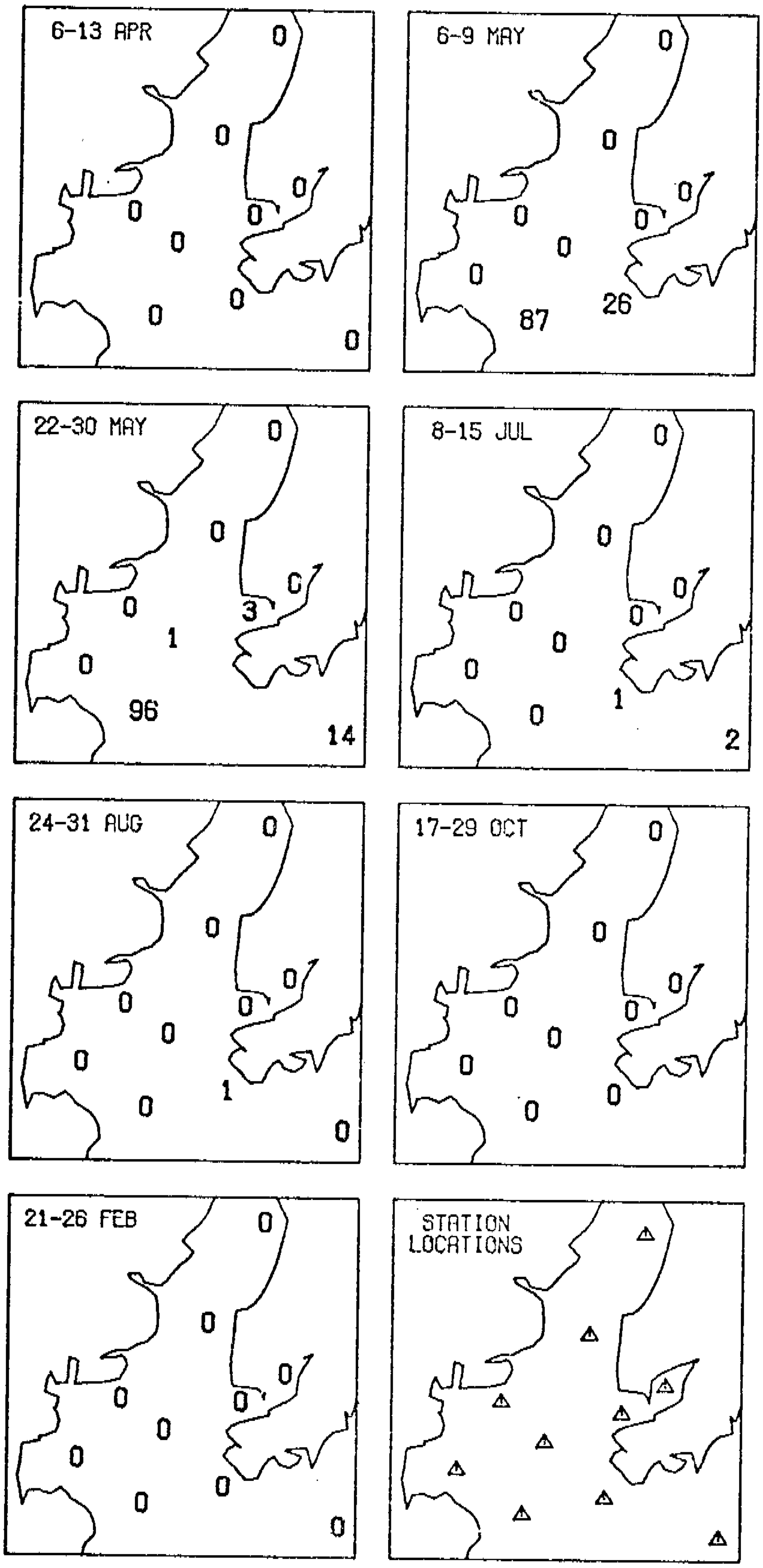


Figure 7.

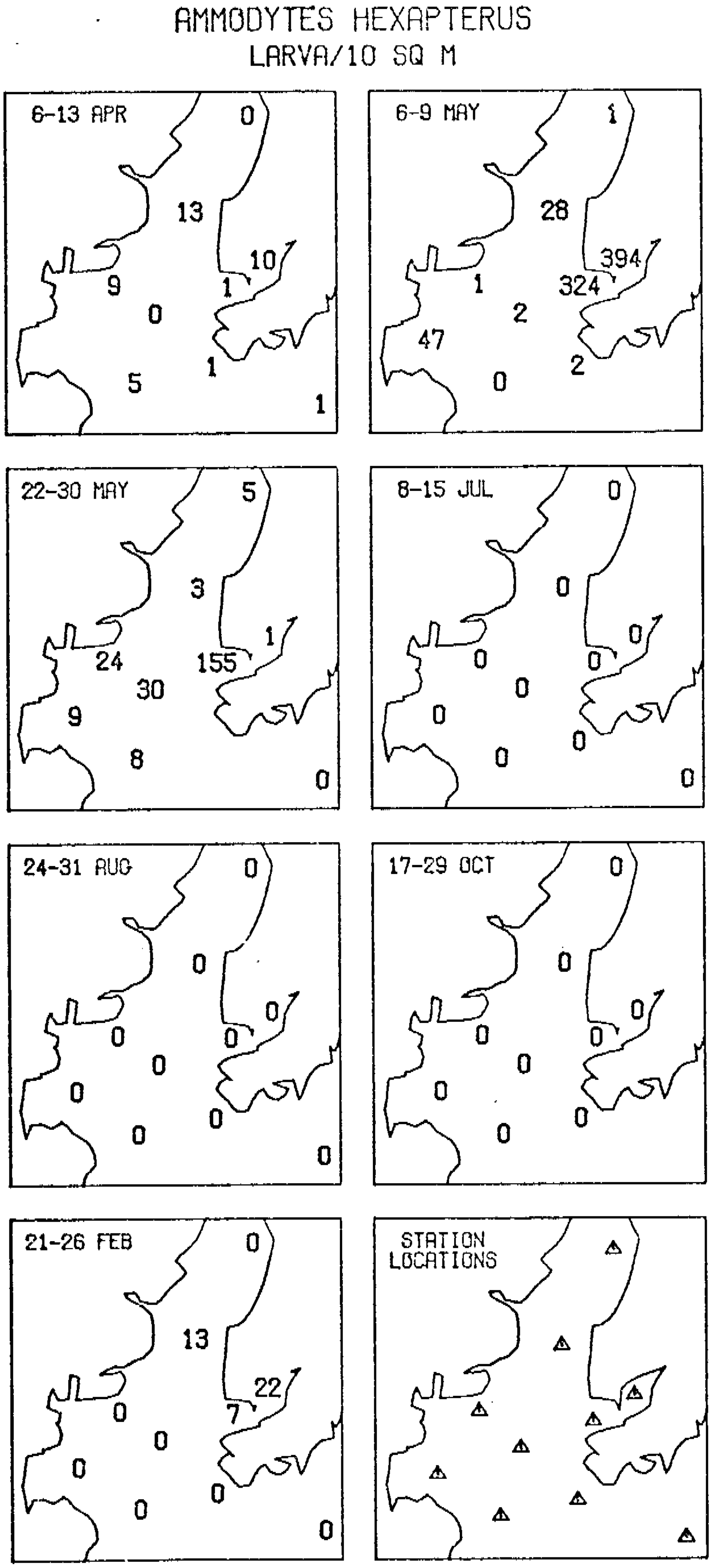

AMMODYTES HEXAPTERUS
LARVA/10 SQ M
6-13 APR
0
13
10
9
1
0
5
1
1
6-9 MAY
1
28
394
1
324
2
47
0
2
22-30 MAY
5
3
1
24
155
30
9
8
0
8-15 JUL
0
0
0
0
0
0
0
0
0
0
24-31 AUG
0
0
0
0
0
0
0
0
0
0
17-29 OCT
0
0
0
0
0
0
0
0
0
21-26 FEB
0
13
22
0
7
0
0
0
0
0
STATION
LOCATIONS

Figure 8.

AMMODYTES HEXAPTERUS
JUVENILE/10 SQ M

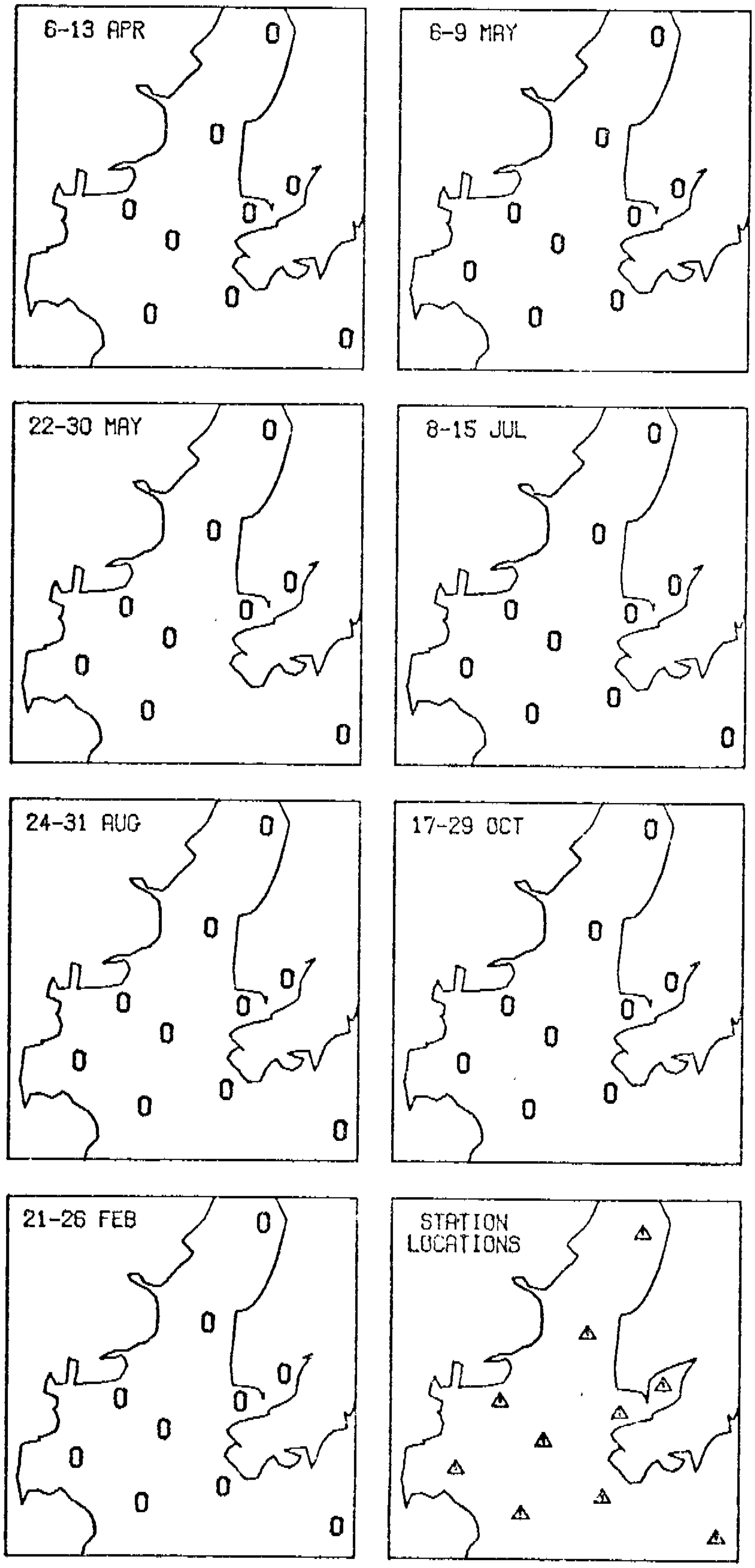


Figure 9.

CLUPEA HARENGUS PALLASI
LARVA/10 SQ M

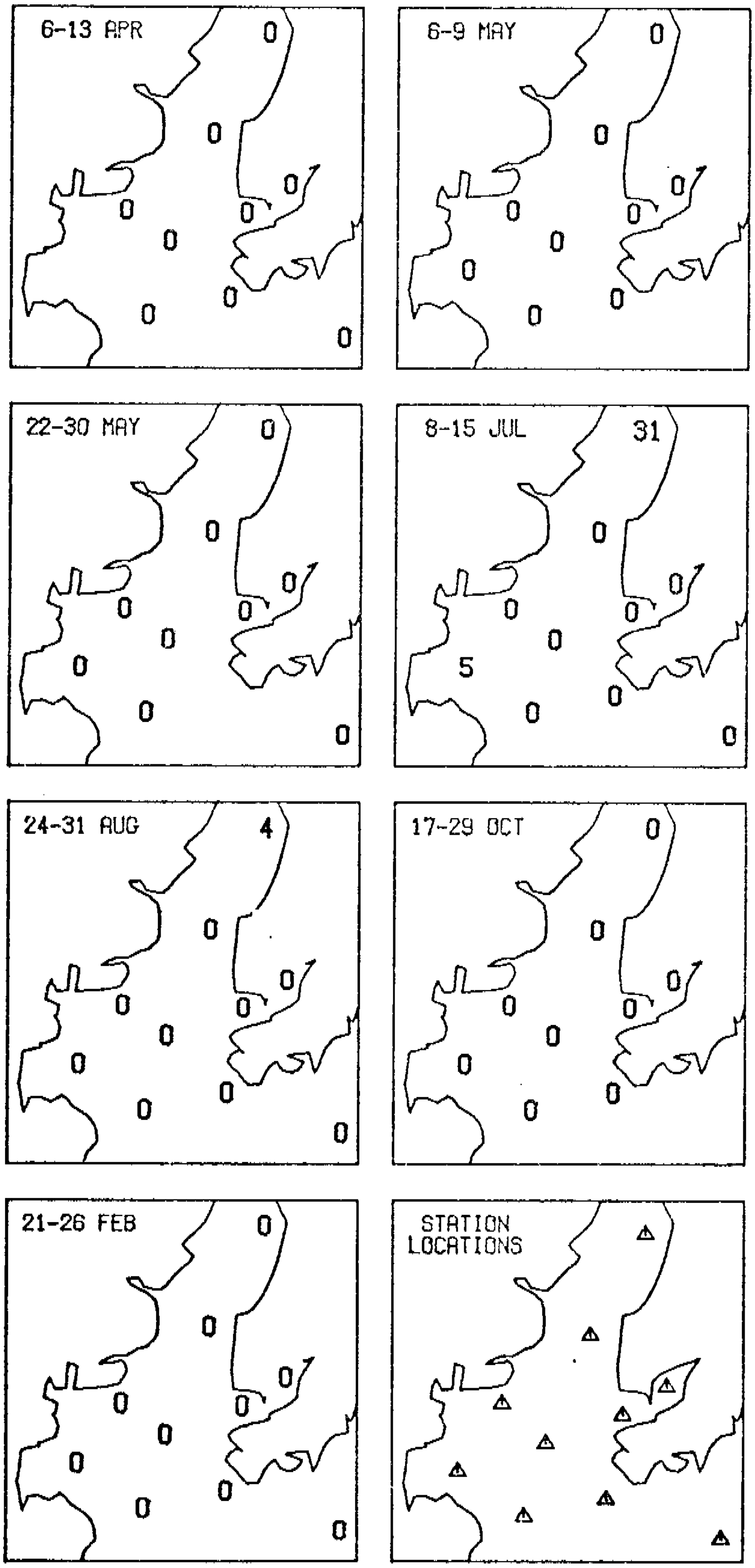


Figure 10.

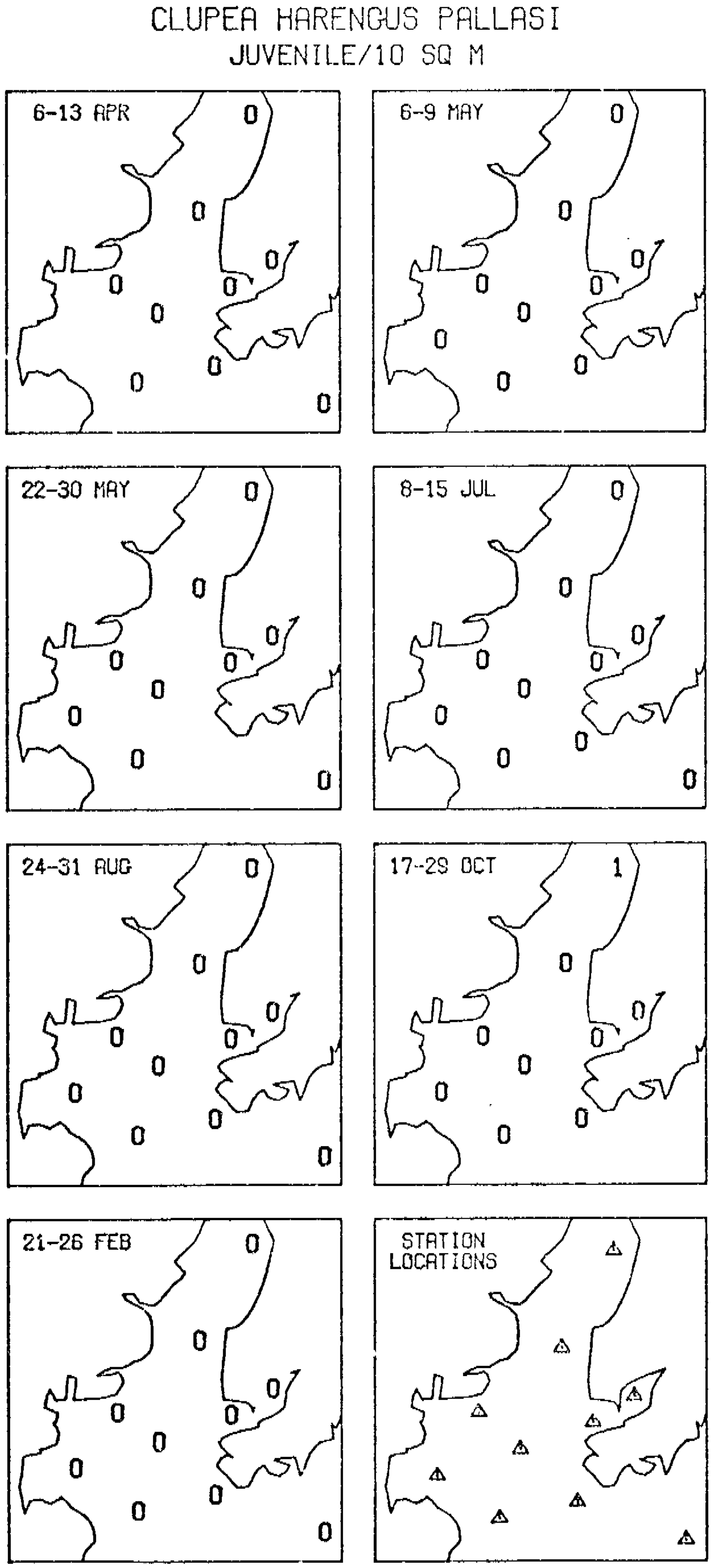

CLUPEA HARENGUS PALLASI
JUVENILE/10 SQ M
6-13 APR
0
0
0
0
0
0
0
0
0
6-9 MAY
0
0
0
0
0
0
0
0
0
22-30 MAY
0
0
0
0
0
0
0
0
0
8-15 JUL
0
0
0
0
0
0
0
0
0
0
24-31 AUG
0
0
0
0
0
0
0
0
0
0
17-29 OCT
1
0
0
0
0
0
0
0
0
21-26 FEB
0
0
0
0
0
0
0
0
0
0
STATION
LOCATIONS

Figure 11.

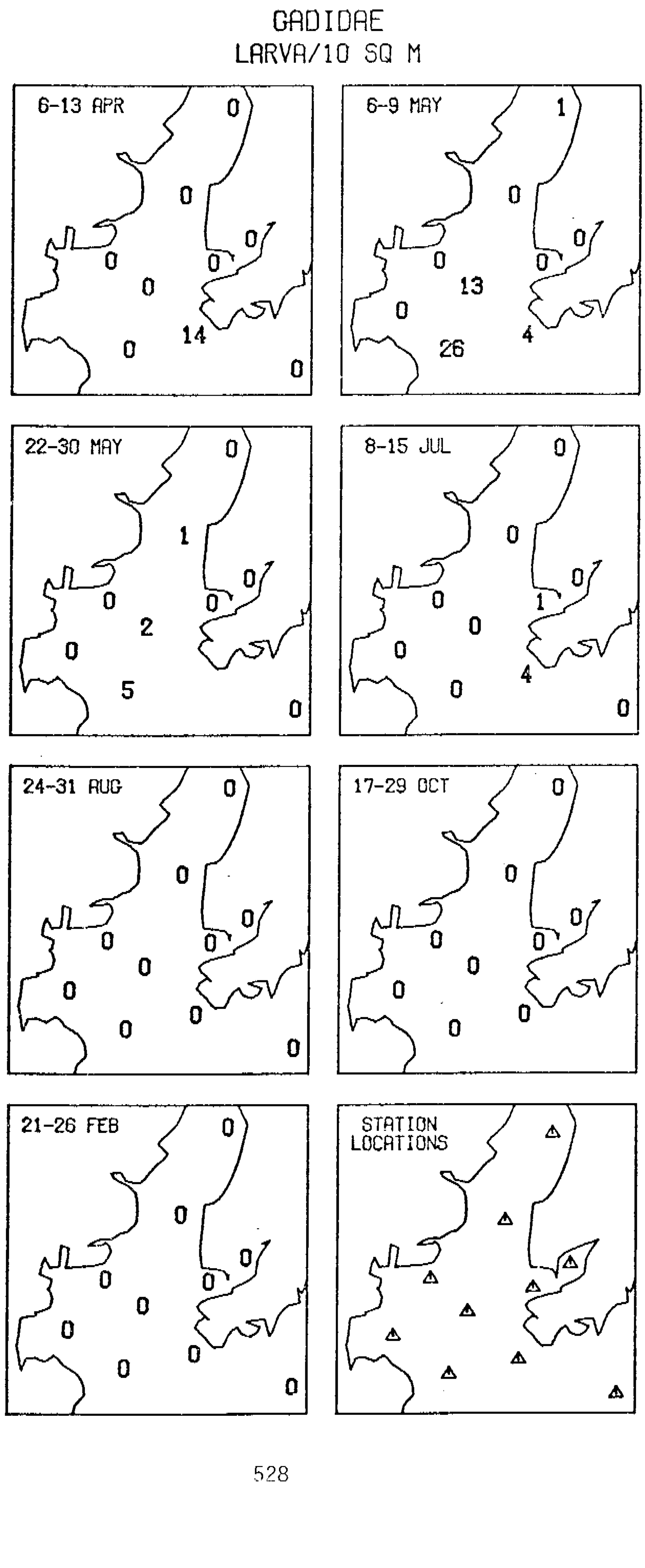

GADIDAE
LARVA/10 SQ M
6-13 APR
0
0
0
0
0
0
0
14
0
0
6-9 MAY
1
0
0
0
0
13
0
26
4
22-30 MAY
0
1
0
0
0
2
0
5
0
8-15 JUL
0
0
0
0
1
0
0
4
0
0
24-31 AUG
0
0
0
0
0
0
0
0
0
0
17-29 OCT
0
0
0
0
0
0
0
0
0
0
21-26 FEB
0
0
0
0
0
0
0
0
0
0
STATION
LOCATIONS

Figure 12.

GADIDAE
JUVENILE/10 SQ M

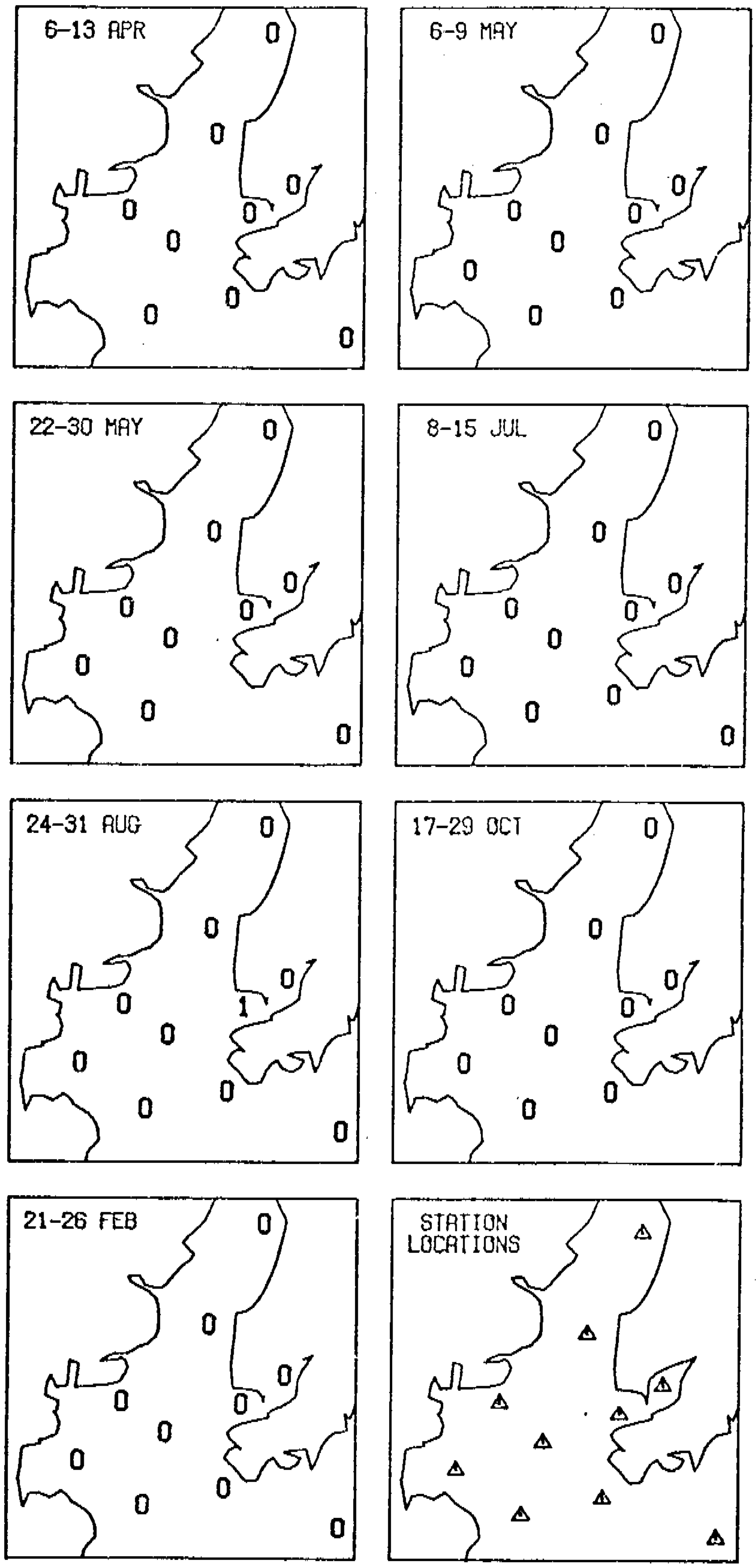
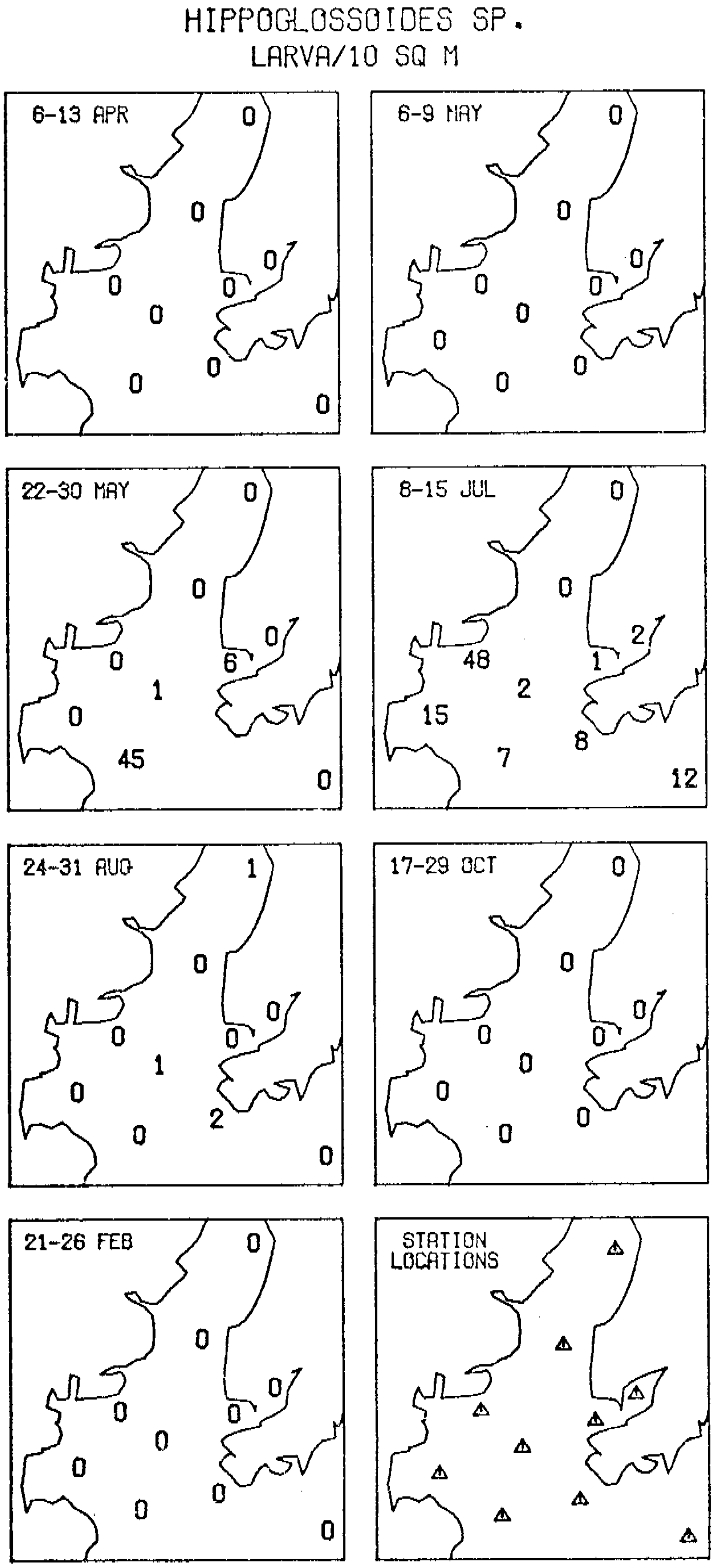


Figure 13.



HIPPOGLOSSOIDES SP.
LARVA/10 SQ M
6-13 APR
0
0
0
0
0
0
0
0
0
0
6-9 MAY
0
0
0
0
0
0
0
0
0
0
22-30 MAY
0
0
0
6
0
1
0
45
0
8-15 JUL
0
0
2
48
1
2
15
8
7
12
24-31 AUG
1
0
0
0
0
1
0
2
0
0
17-29 OCT
0
0
0
0
0
0
0
0
0
21-26 FEB
0
0
0
0
0
0
0
0
0
0
STATION
LOCATIONS

Figure 14.

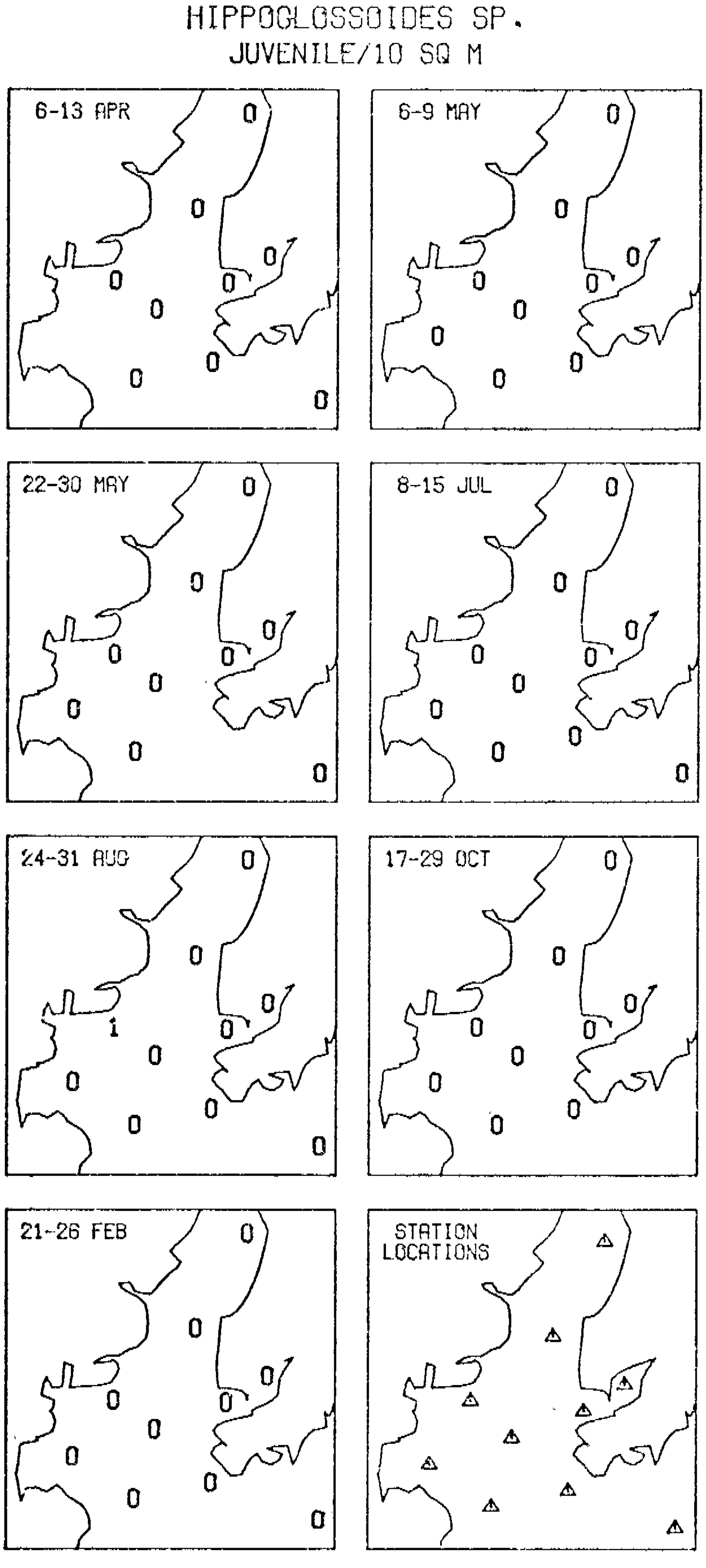
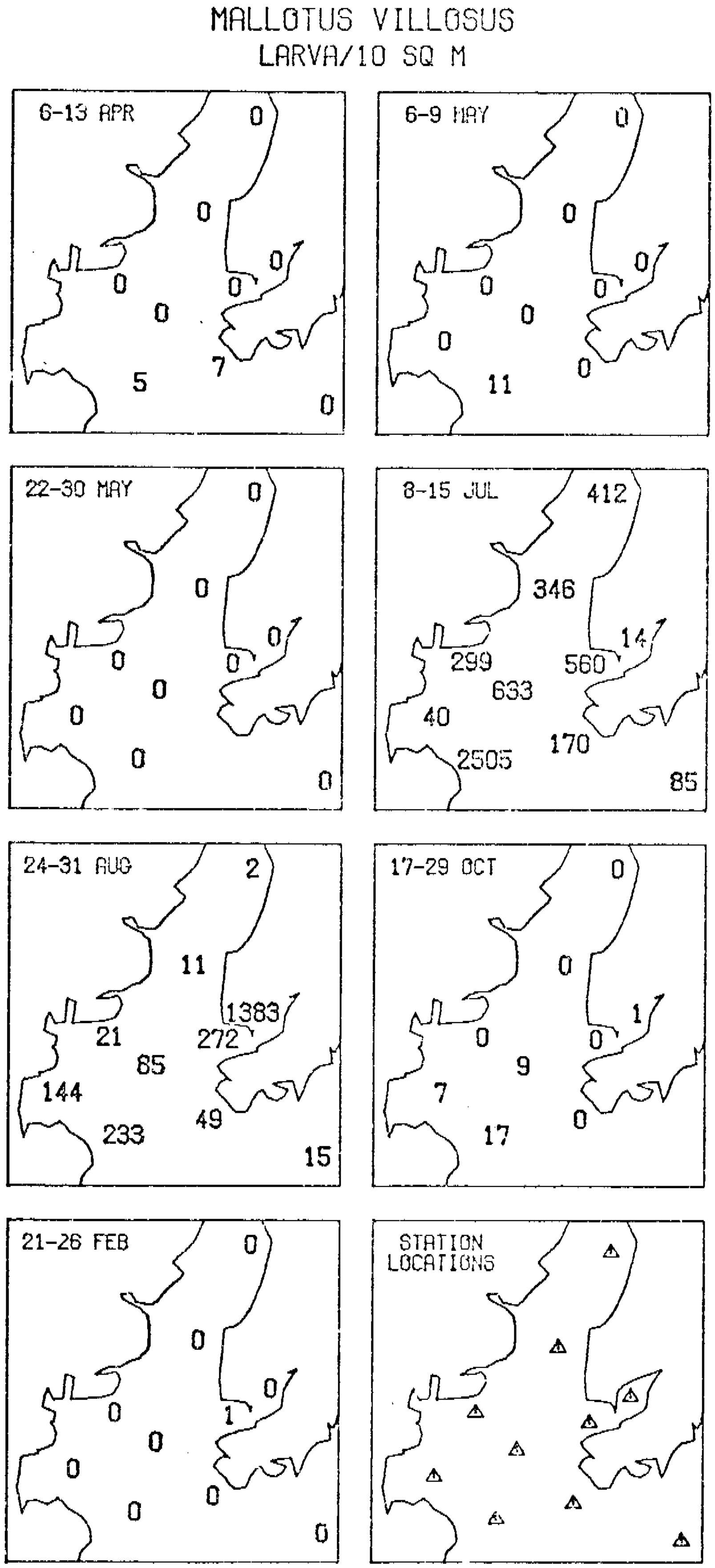

HIPPOGLOSSOIDES SP.
JUVENILE/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 15.



MALLOTUS VILLOSUS
LARVA/10 SQ M
6-13 APR
0
0
0
0
0
0
5
7
0
6-9 MAY
0
0
0
0
0
0
11
0
22-30 MAY
0
0
0
0
0
0
0
0
0
8-15 JUL
412
346
14
299
560
633
40
170
2505
85
24-31 AUG
2
11
1383
21
272
85
144
49
233
15
17-29 OCT
0
0
1
0
0
9
7
0
17
21-26 FEB
0
0
0
0
1
0
0
0
0
0
STATION LOCATIONS

Figure 16.

MALLOTUS VILLOSUS
JUVENILE/10 SQ M

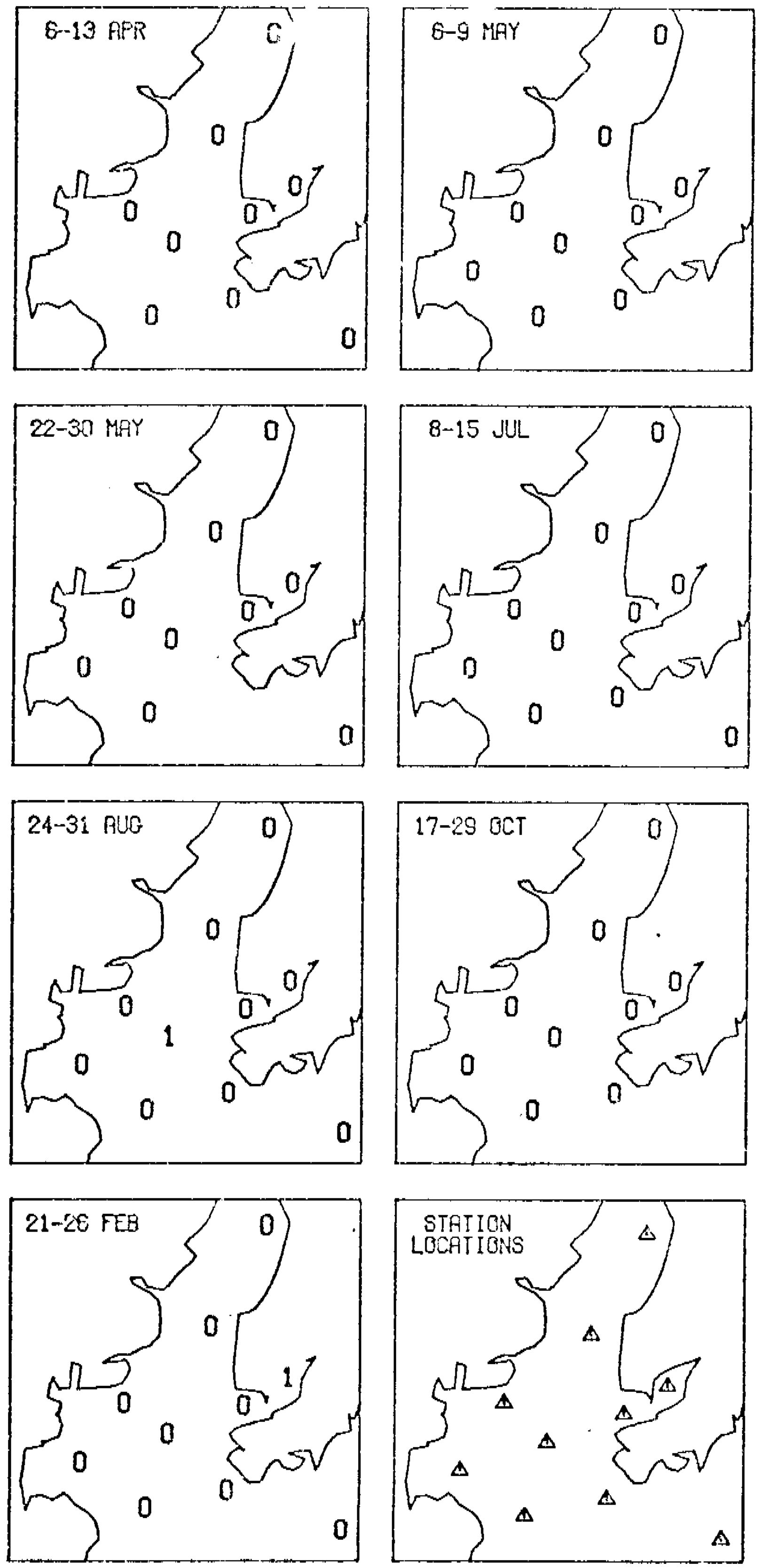


Figure 17.

OSMERIDAE
LARVA/10 SQ M

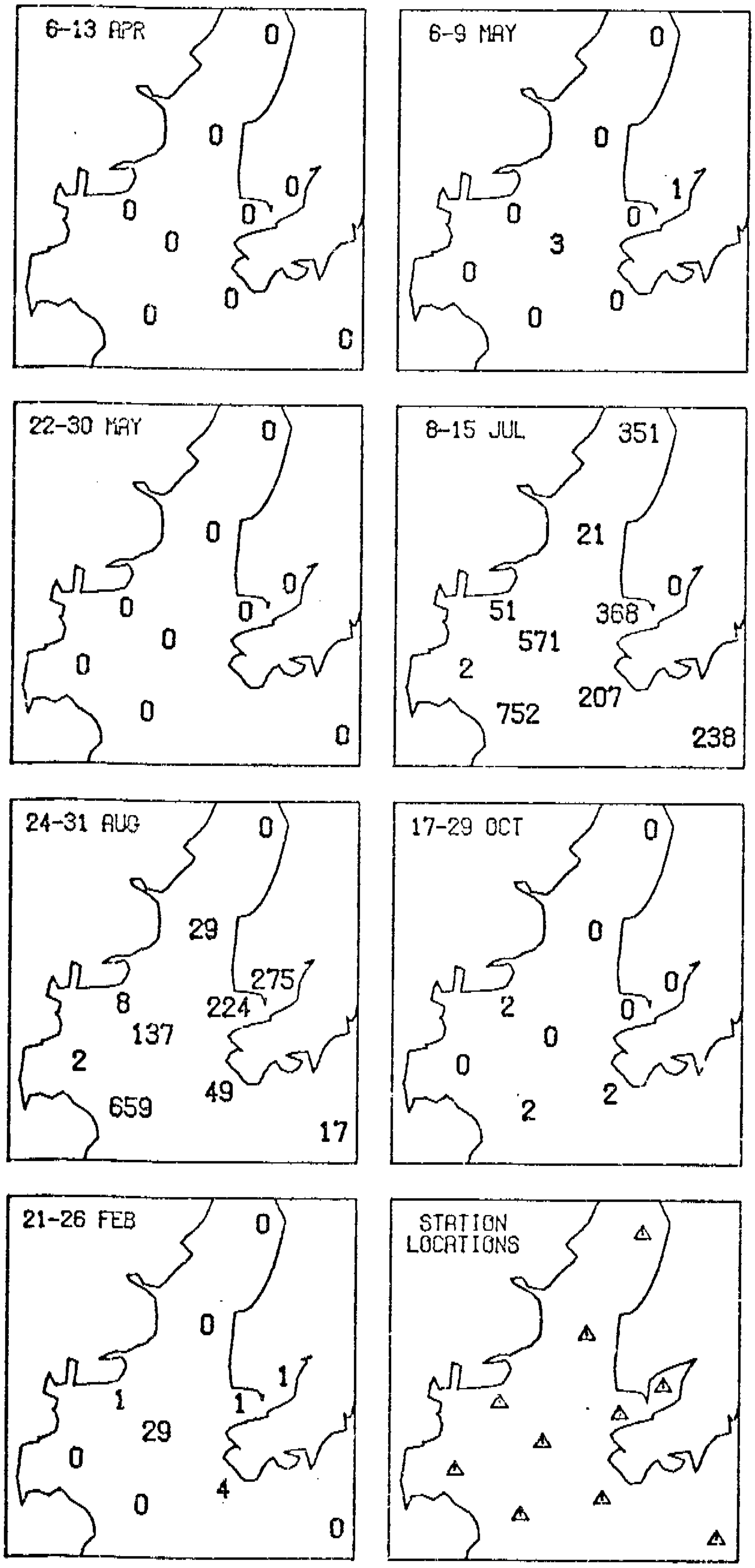


Figure 18.

OSMERIDAE
JUVENILE/10 SQ M

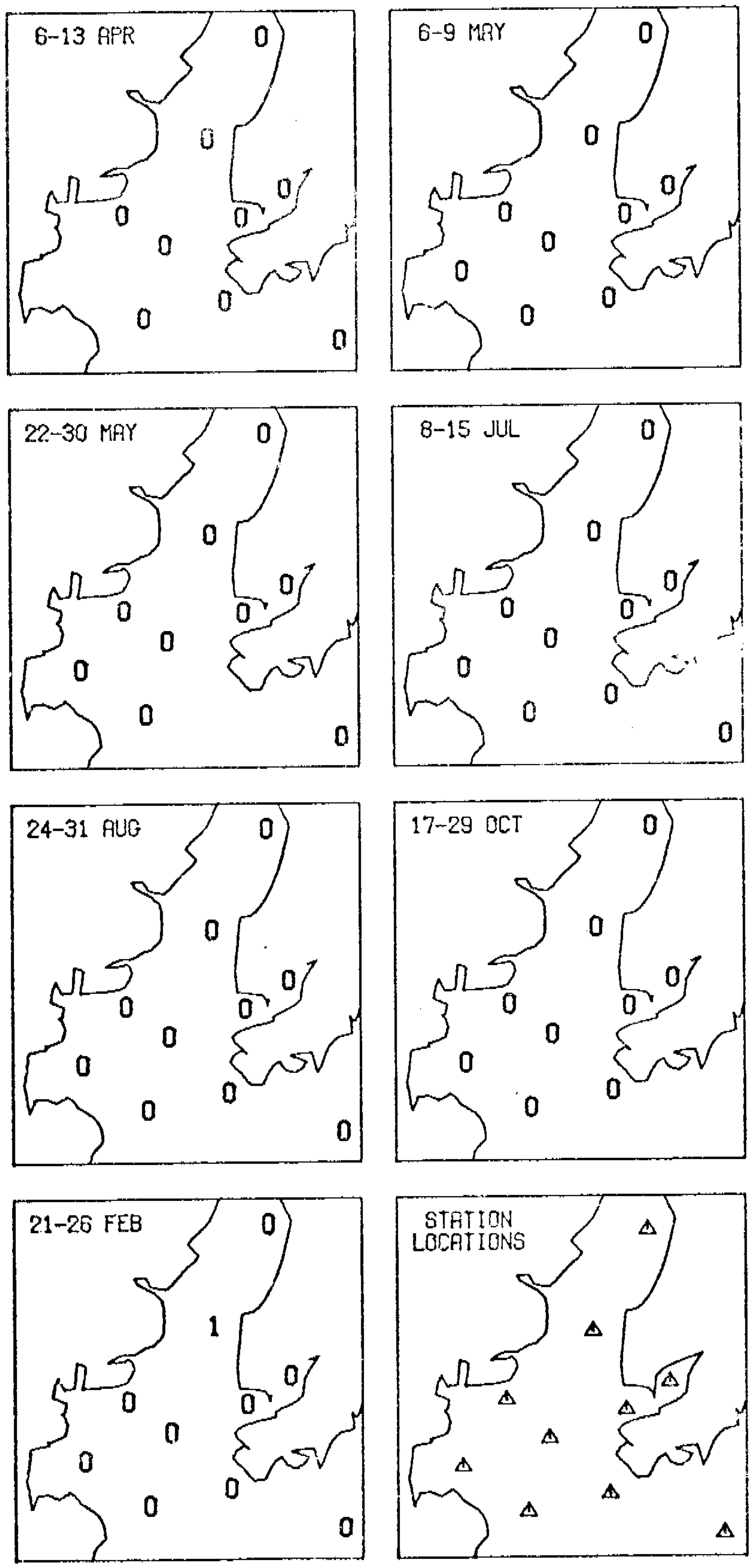


Figure 19.

PANDALOPSIS DISPAR
STAGE I/10 SQ M

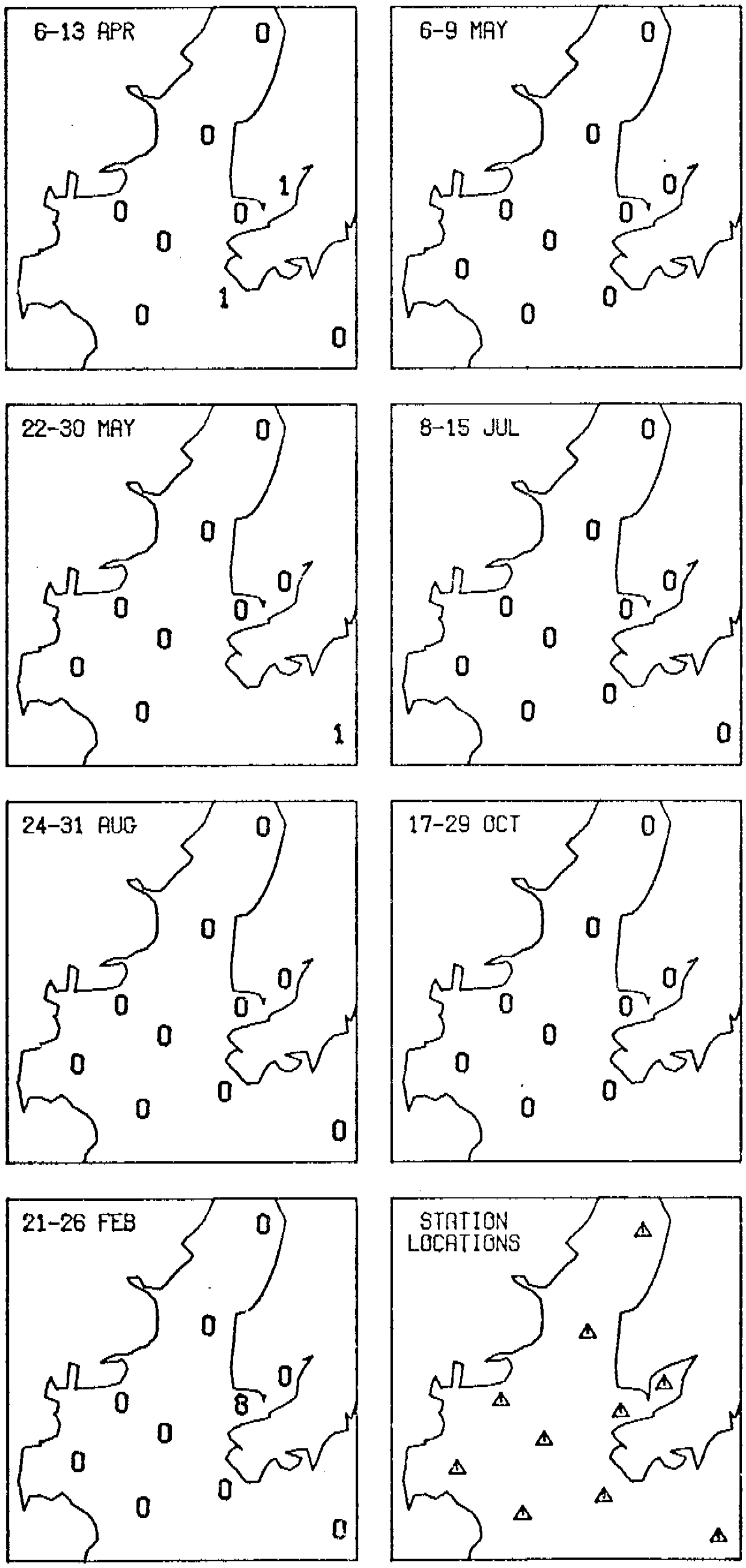


Figure 20.

PANDALOPSIS DISPAR
STAGE II/10 SQ M

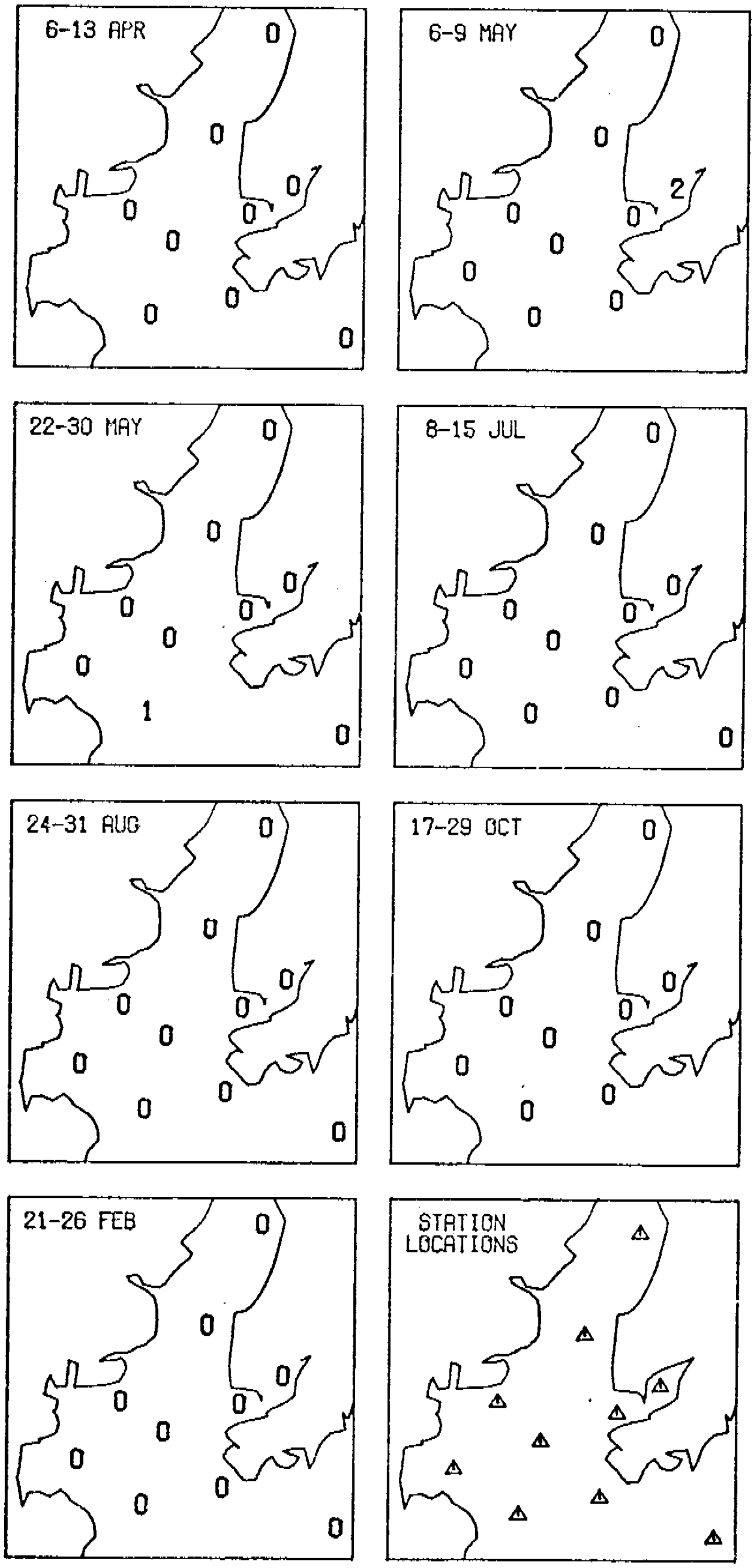


Figure 21.

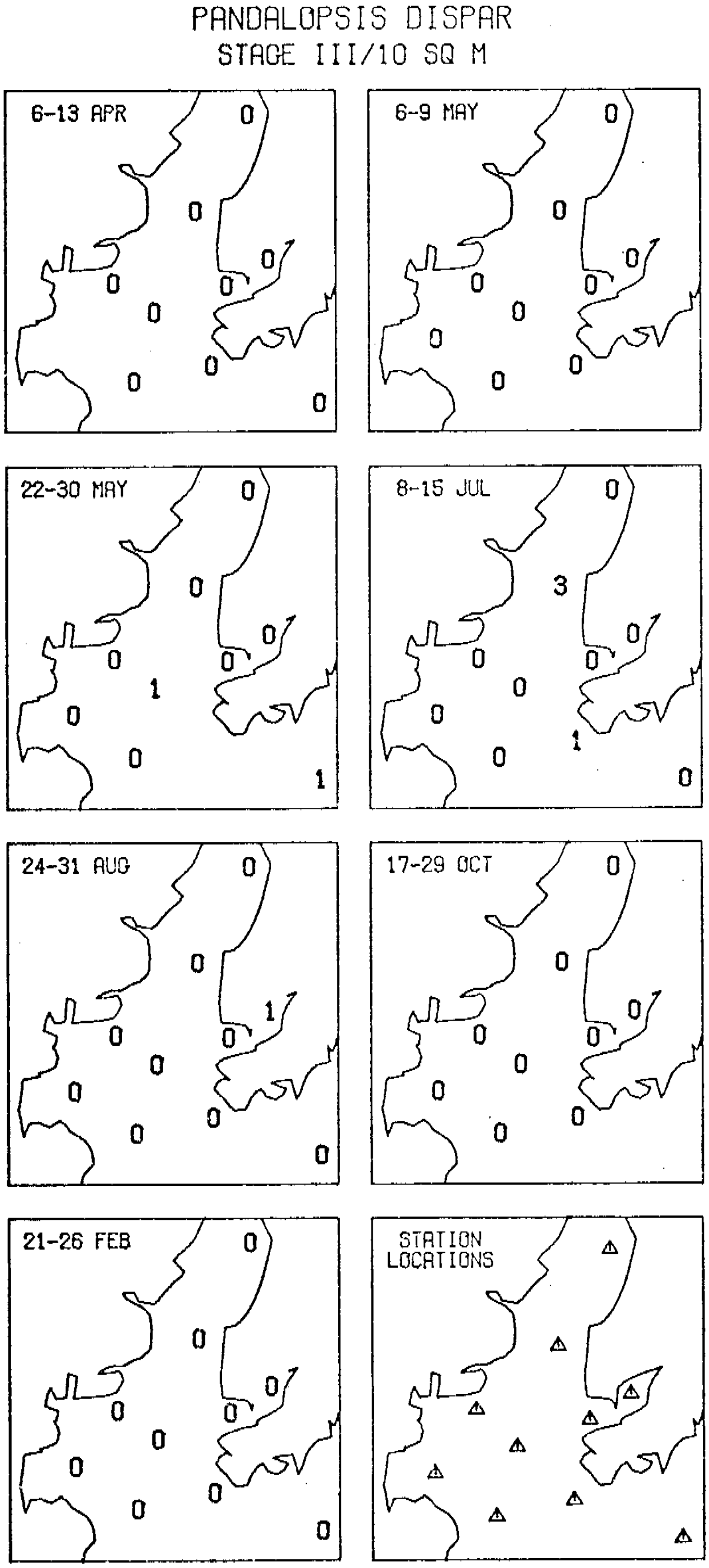

PANDALOPSIS DISPAR
STAGE III/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 22.

PANDALOPSIS DISPAR
STAGE IV/10 SQ M

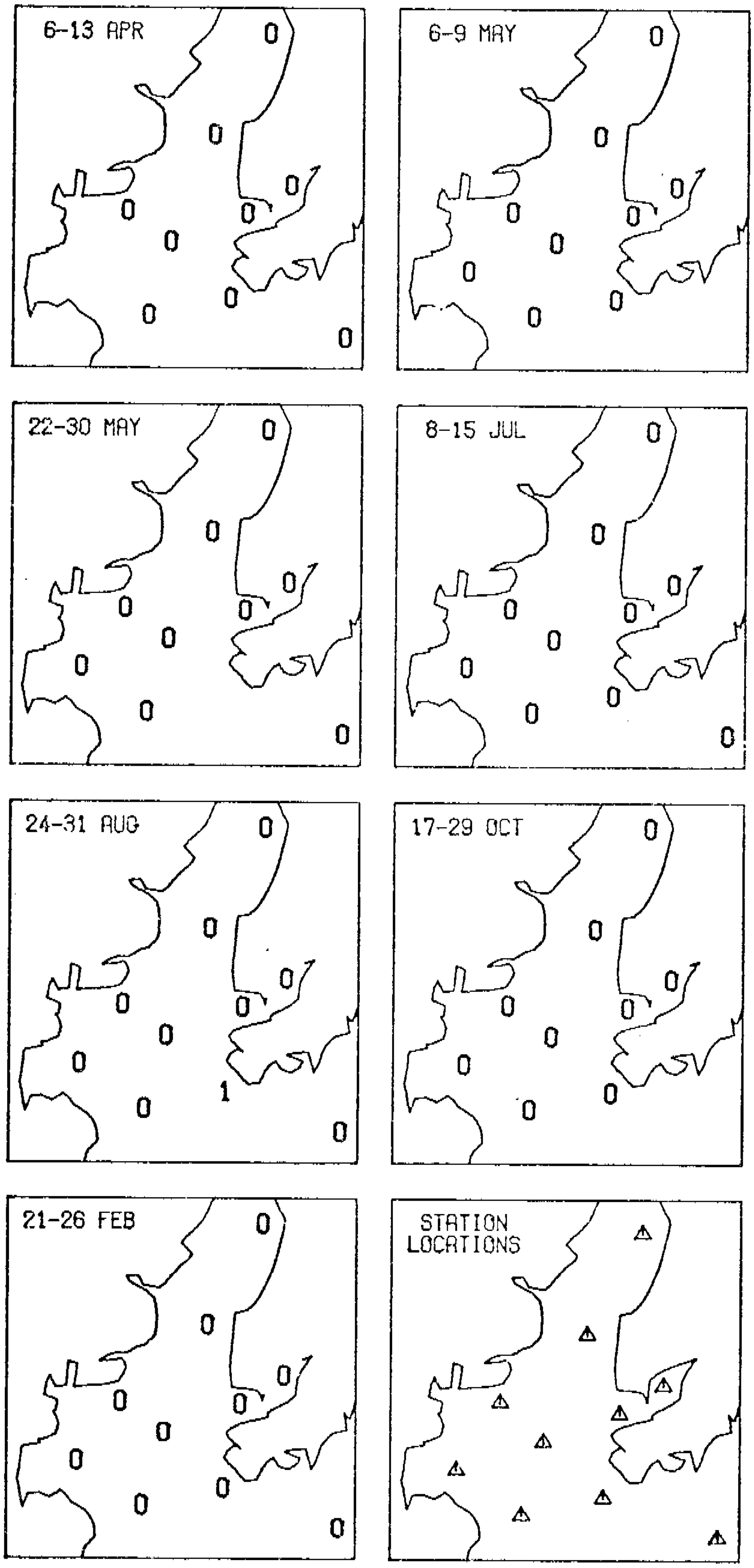


Figure 23.

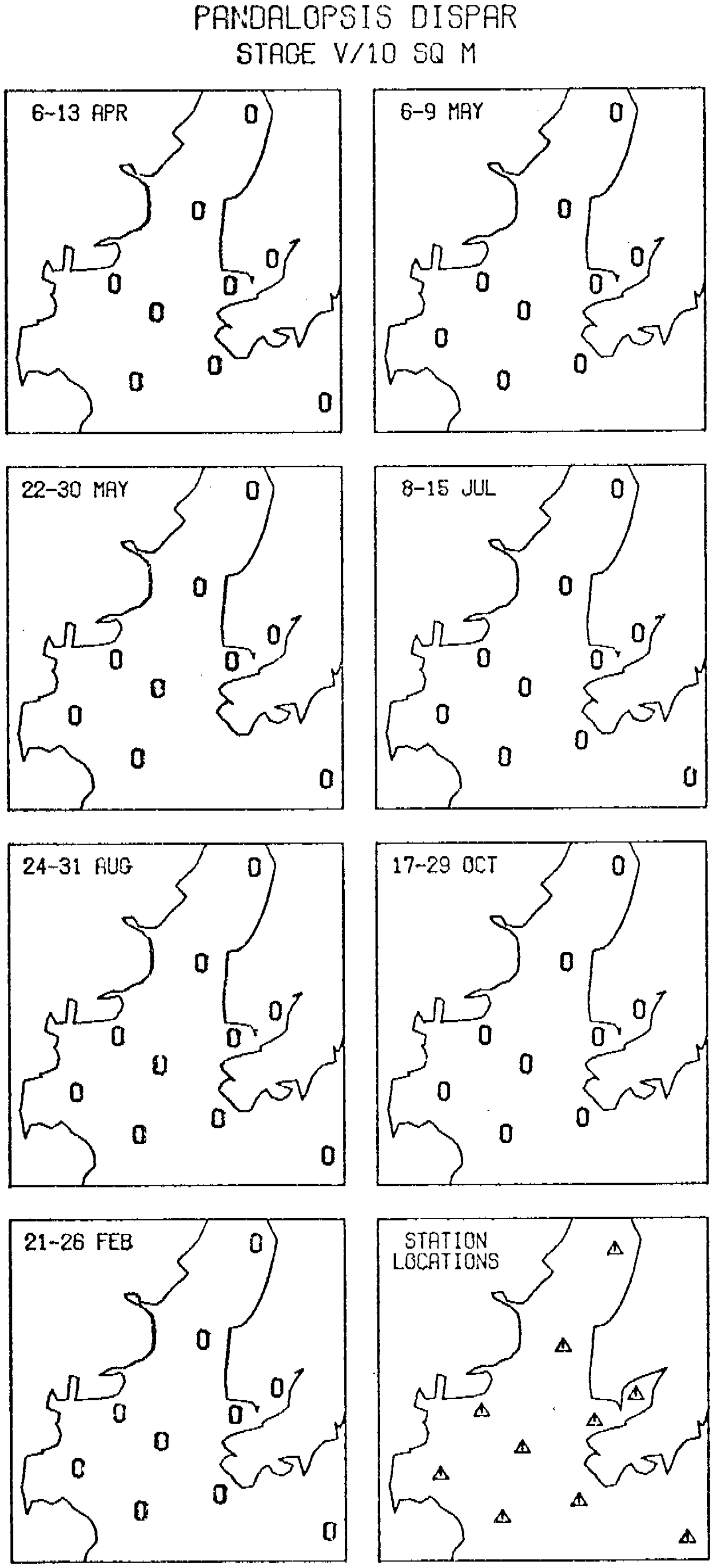

PANDALOPSIS DISPAR
STAGE V/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION
LOCATIONS

Figure 24.

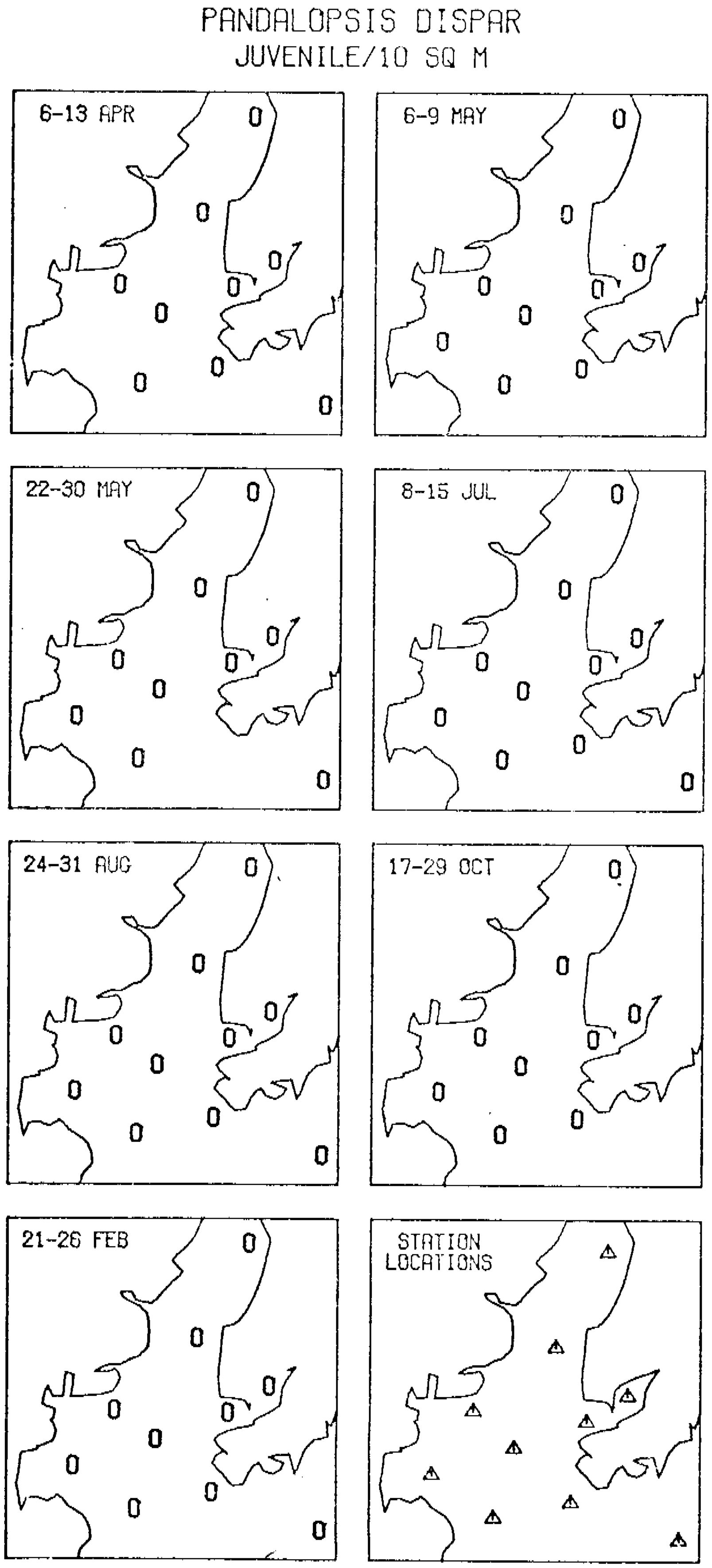

PANDALOPSIS DISPAR
JUVENILE/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION
LOCATIONS

Figure 25.

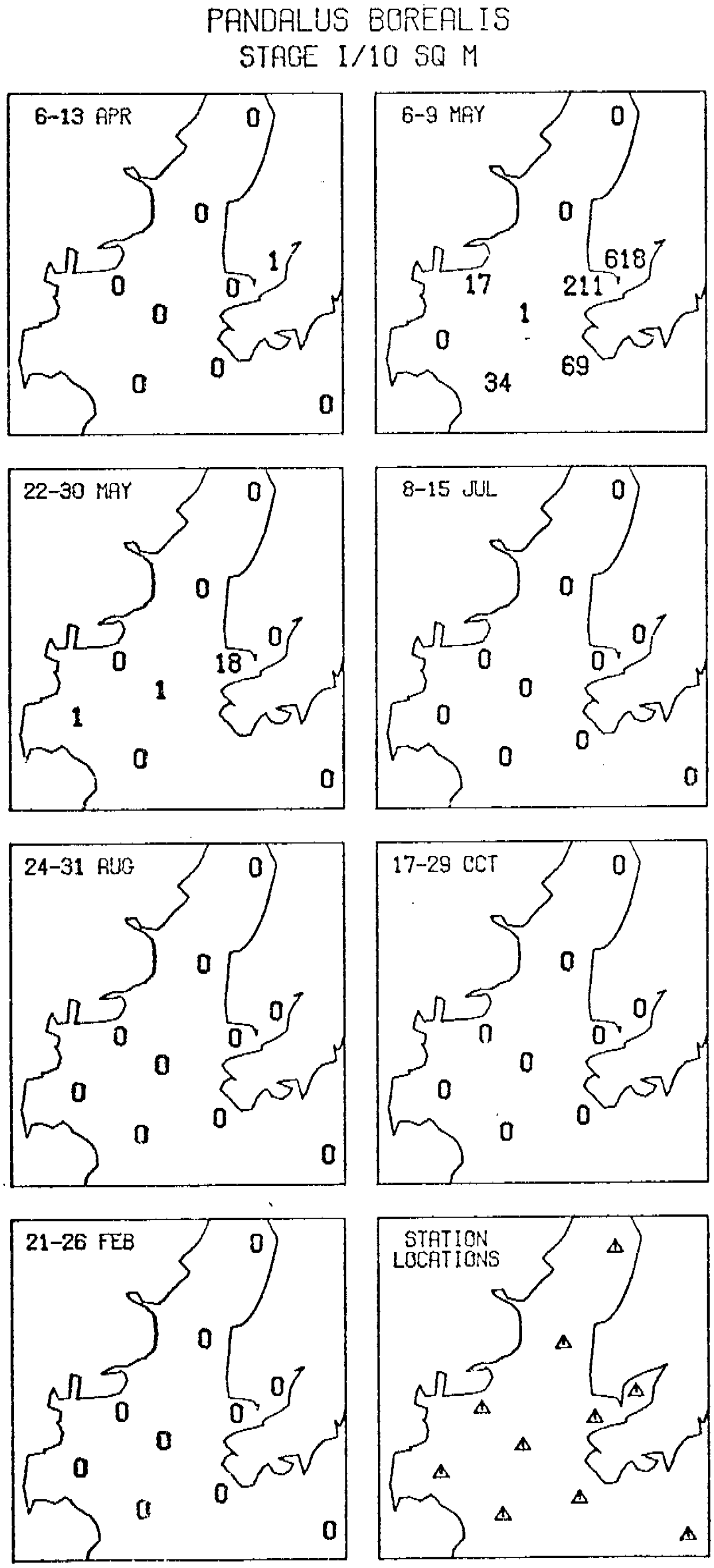

PANDALUS BOREALIS
STAGE I/10 SQ M
6-13 APR
0
0
1
0
0
0
0
0
0
0
6-9 MAY
0
0
618
17
211
1
0
69
34
22-30 MAY
0
0
0
0
18
1
1
0
0
8-15 JUL
0
0
0
0
0
0
0
0
0
0
24-31 AUG
0
0
0
0
0
0
0
0
0
0
17-29 OCT
0
0
0
0
0
0
0
0
0
21-26 FEB
0
0
0
0
0
0
0
0
0
0
STATION
LOCATIONS

Figure 26.

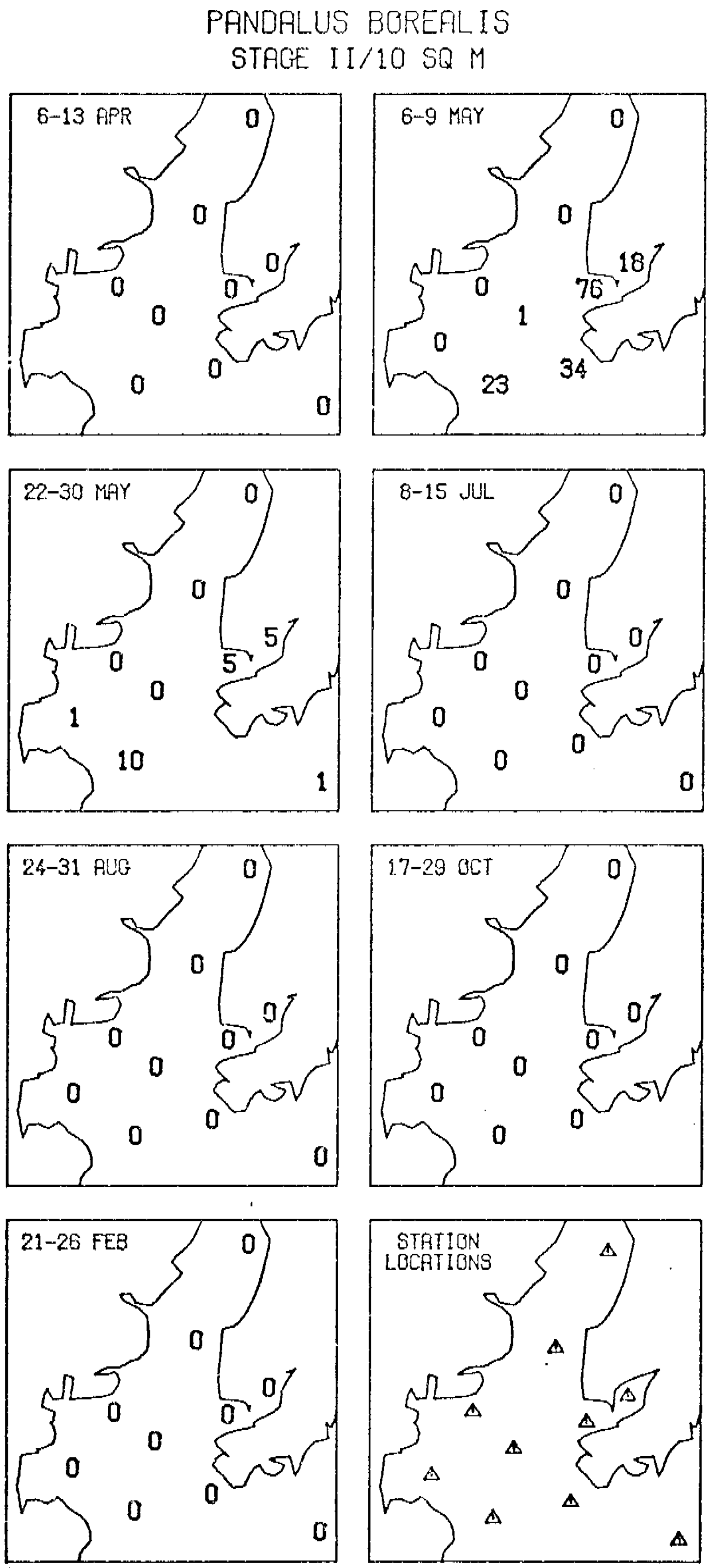

PANDALUS BOREALIS
STAGE II/10 SQ M
6-13 APR
0
0
0
0
0
0
0
0
0
6-9 MAY
0
0
18
0
76
1
0
34
23
22-30 MAY
0
0
5
0
5
0
1
10
1
8-15 JUL
0
0
0
0
0
0
0
0
0
24-31 AUG
0
0
0
0
0
0
0
0
0
0
17-29 OCT
0
0
0
0
0
0
0
0
0
0
21-26 FEB
0
0
0
0
0
0
0
0
0
0
STATION
LOCATIONS

Figure 27.

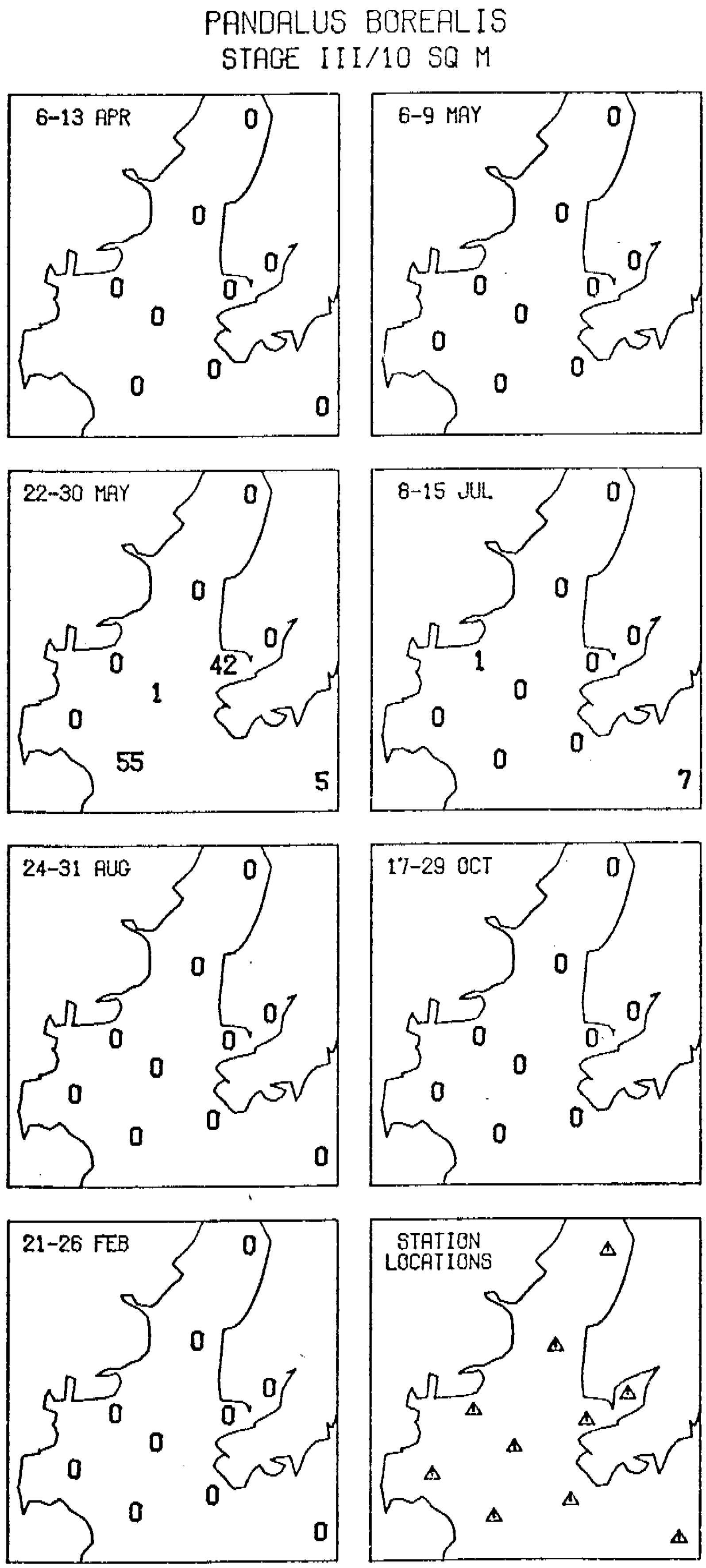

PANDALUS BOREALIS
STAGE III/10 SQ M
6-13 APR
0
0
0
0
0
0
0
0
0
6-9 MAY
0
0
0
0
0
0
0
0
22-30 MAY
0
0
0
42
0
1
0
55
5
8-15 JUL
0
0
0
1
0
0
0
0
0
7
24-31 AUG
0
0
0
0
0
0
0
0
0
0
17-29 OCT
0
0
0
0
0
0
0
0
0
21-26 FEB
0
0
0
0
0
0
0
0
0
0
STATION
LOCATIONS

Figure 28.

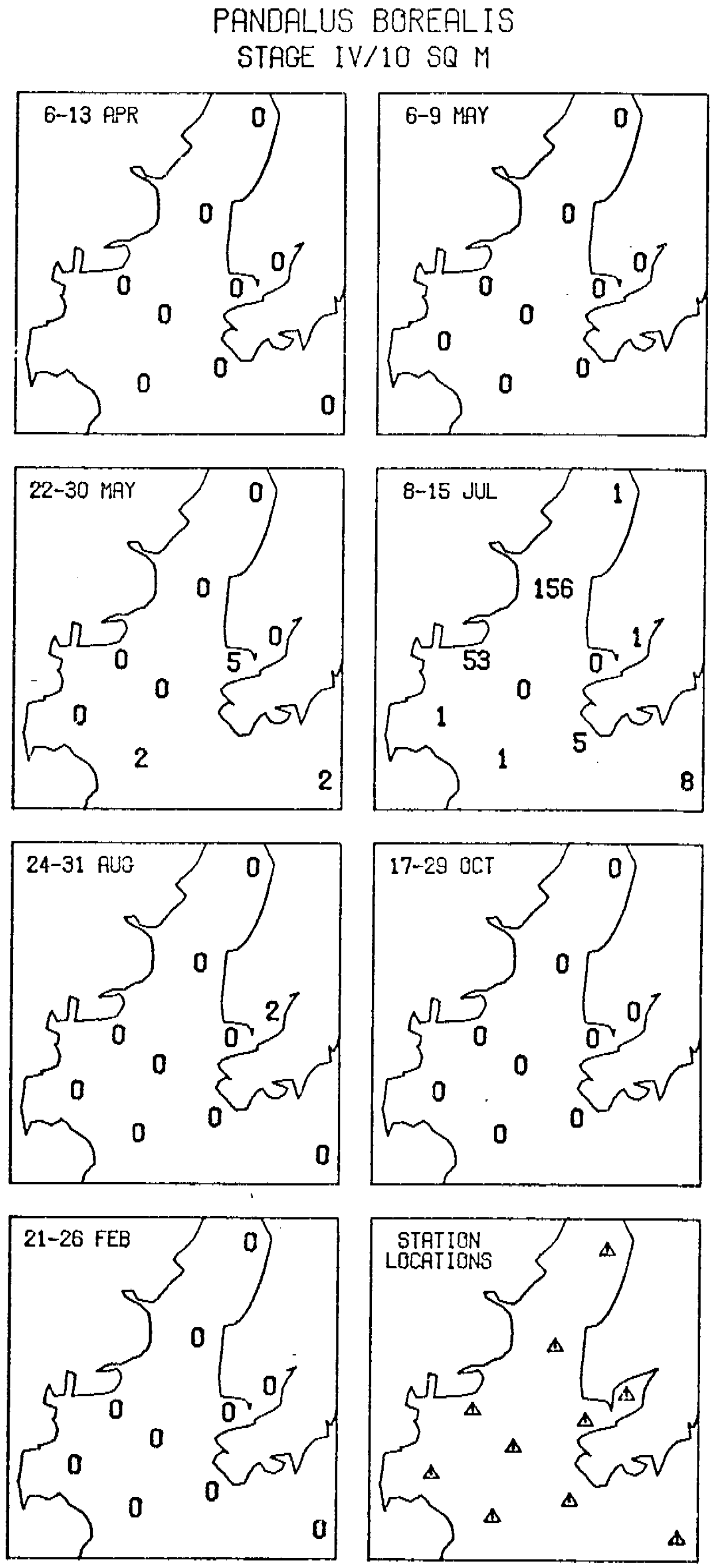

PANDALUS BOREALIS
STAGE IV/10 SQ M
6-13 APR
0
0
0
0
0
0
0
0
0
6-9 MAY
0
0
0
0
0
0
0
0
0
22-30 MAY
0
0
0
5
0
0
0
2
2
8-15 JUL
1
156
1
53
0
0
1
1
5
8
24-31 AUG
0
0
2
0
0
0
0
0
0
0
17-29 OCT
0
0
0
0
0
0
0
0
0
21-26 FEB
0
0
0
0
0
0
0
0
0
0
STATION
LOCATIONS

Figure 29.

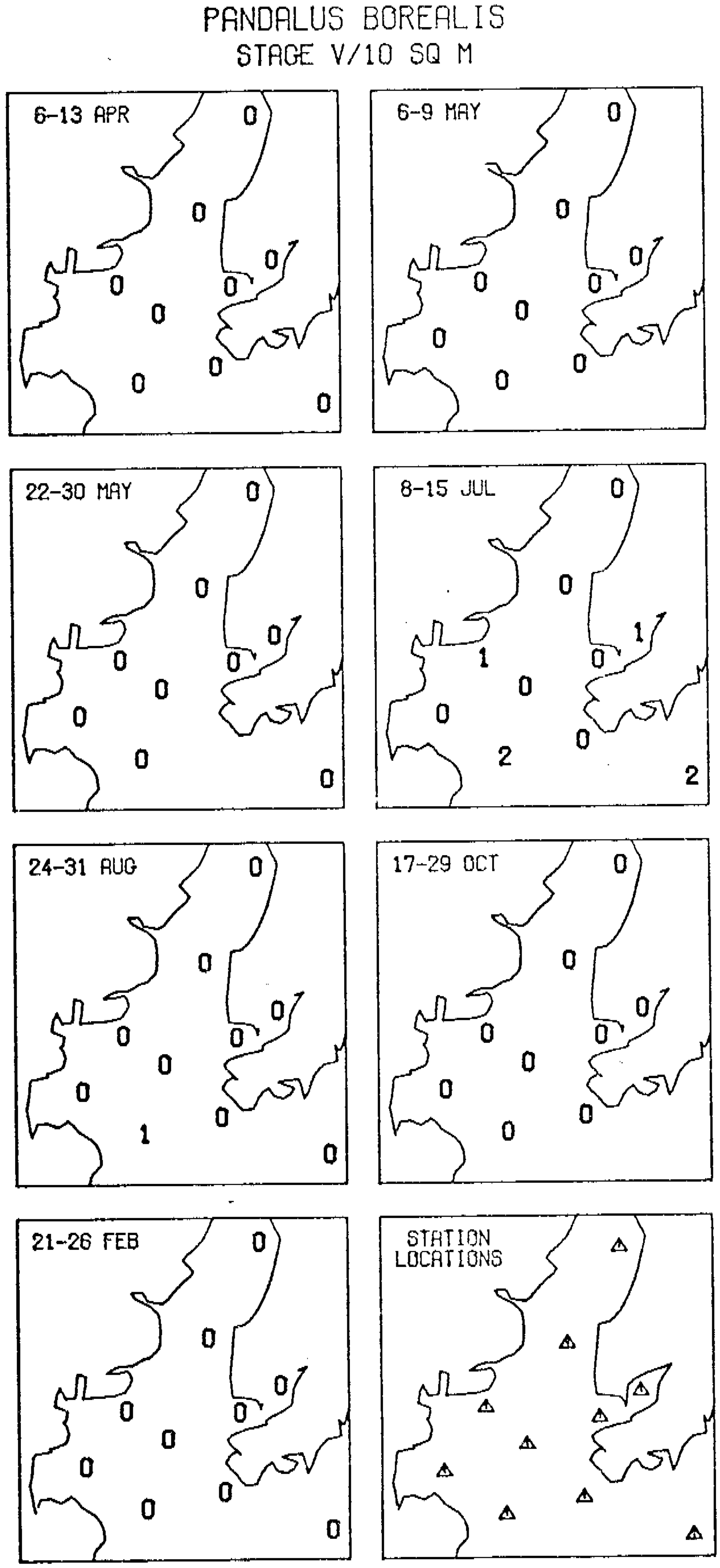

PANDALUS BOREALIS
STAGE V/10 SQ M
6-13 APR
0
0
0
0
0
0
0
0
0
6-9 MAY
0
0
0
0
0
0
0
0
0
22-30 MAY
0
0
0
0
0
0
0
0
0
8-15 JUL
0
0
1
1
0
0
0
0
2
2
24-31 AUG
0
0
0
0
0
0
0
1
0
0
17-29 OCT
0
0
0
0
0
0
0
0
0
21-26 FEB
0
0
0
0
0
0
0
0
0
STATION
LOCATIONS

Figure 30.

PANDALUS BOREALIS
STAGE VI/10 SQ M

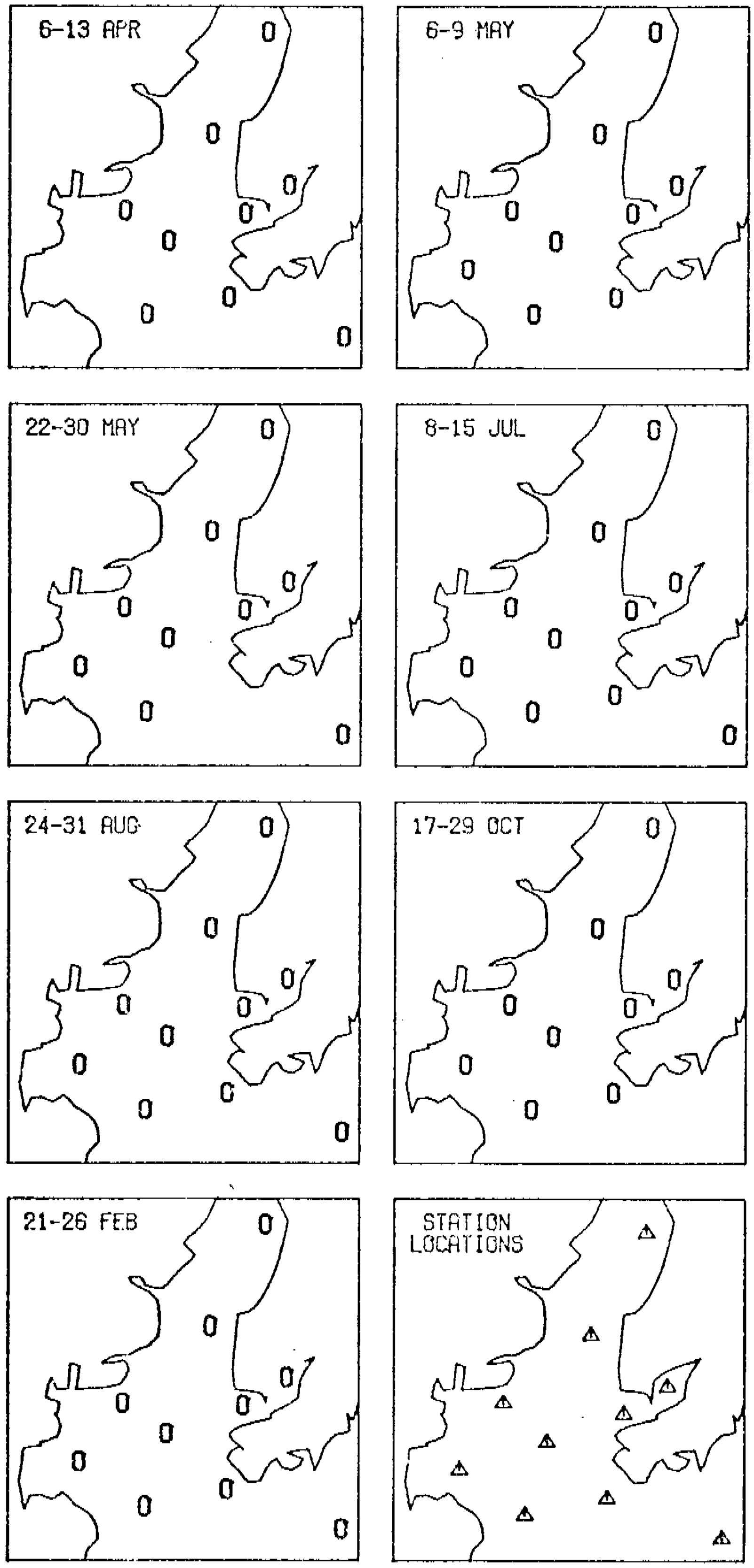


Figure 31.

PANDALUS BOREALIS
STAGE VII/10 SQ M

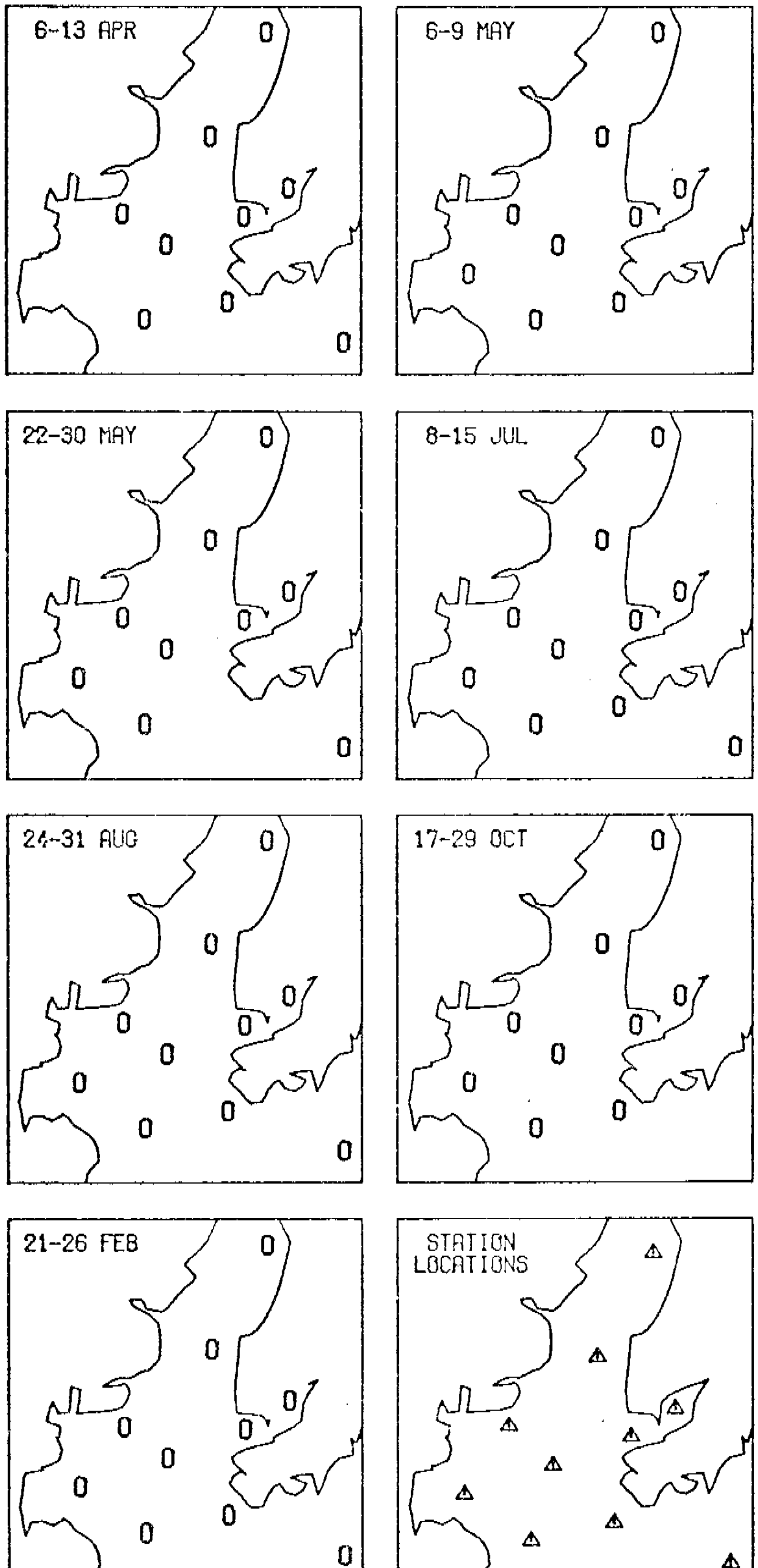


Figure 32.

PANDALUS BOREALIS
JUVENILE/10 SQ M

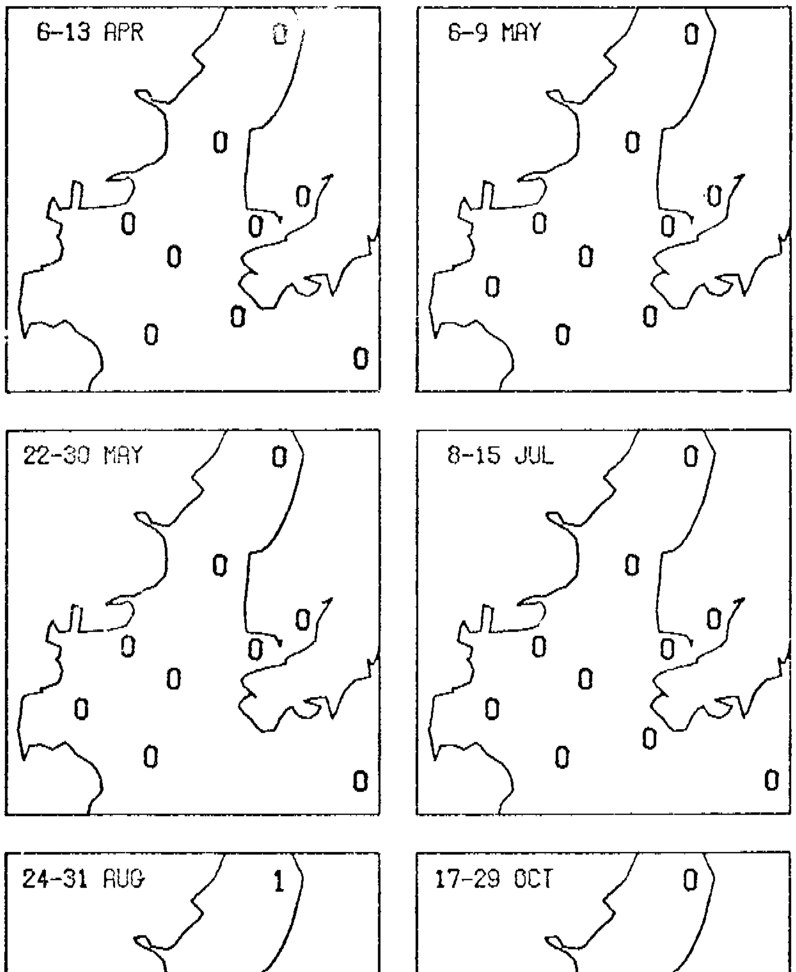


Figure 33.

PANDALUS DANAE
STAGE I/10 SQ M

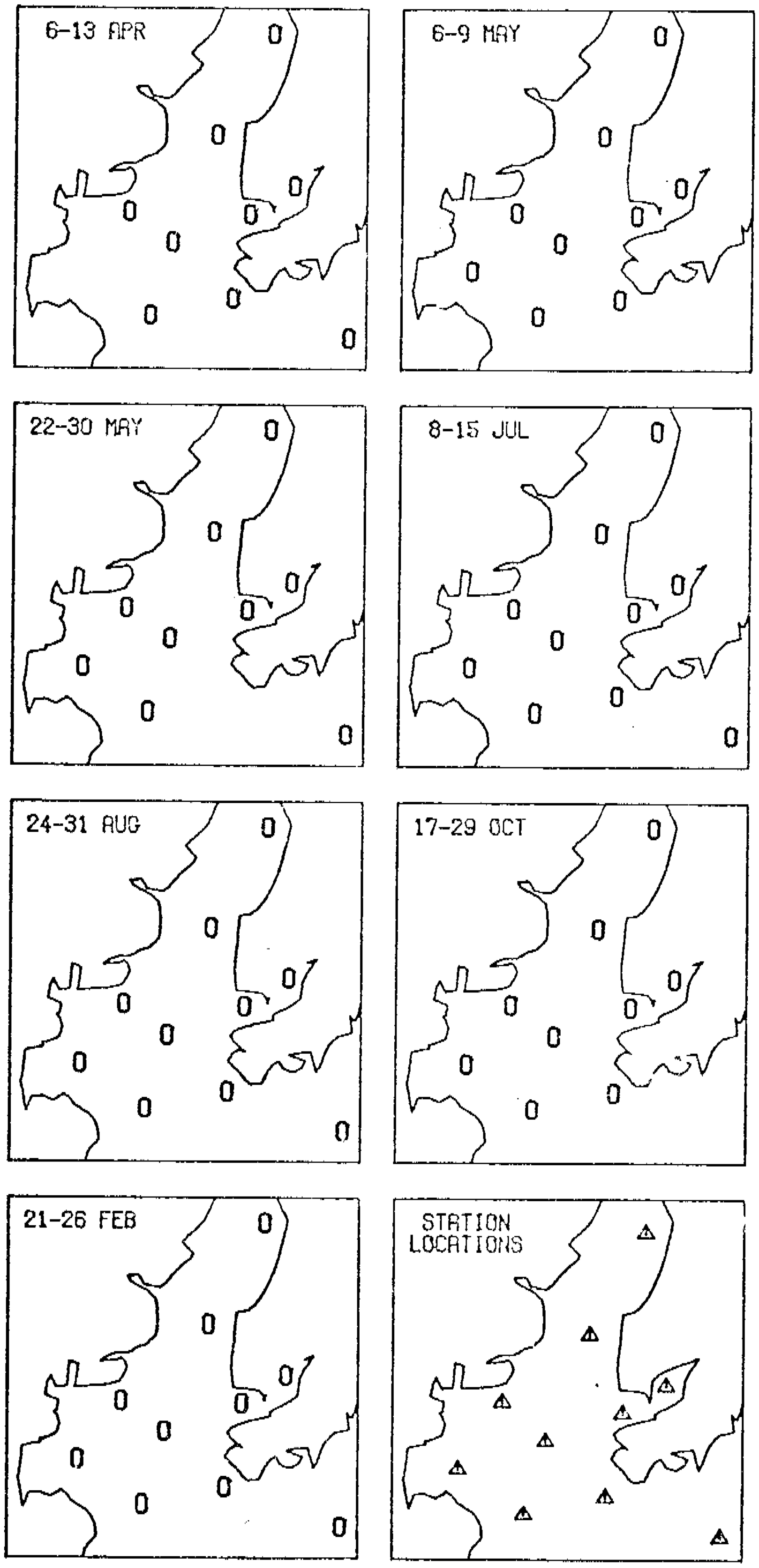
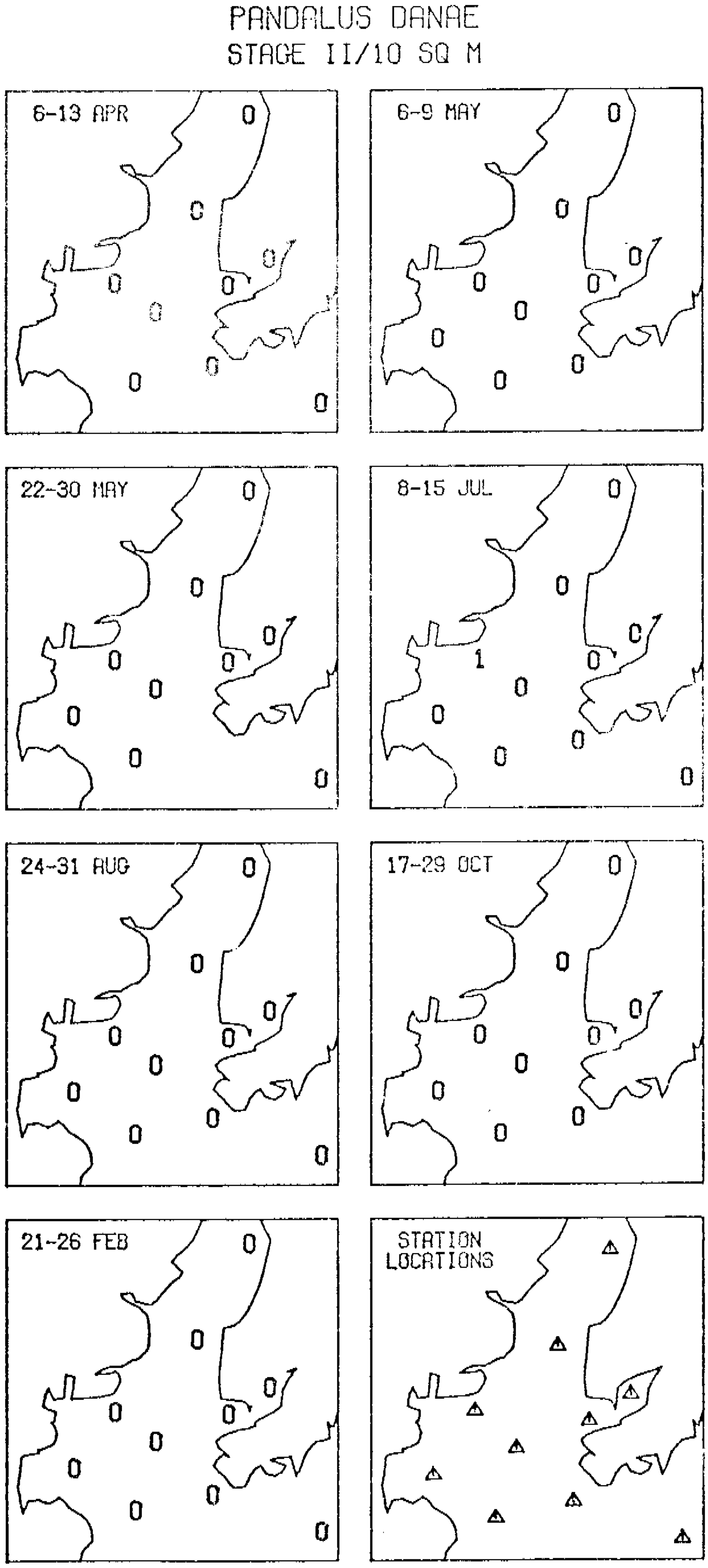


Figure 34.


PANDALUS DANAE
STAGE II/10 SQ M
6-13 APR
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6-9 MAY
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STATION LOCATIONS

Figure 35.

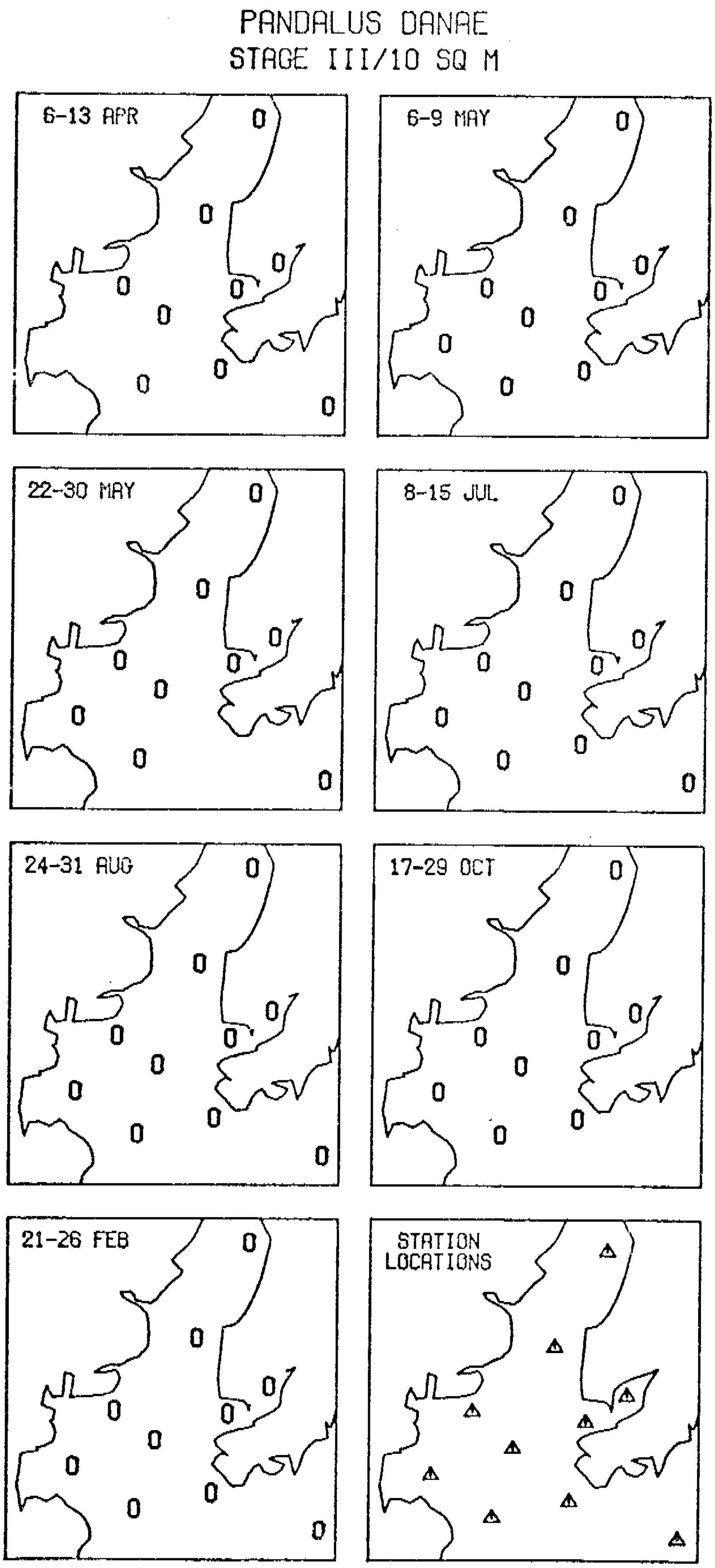
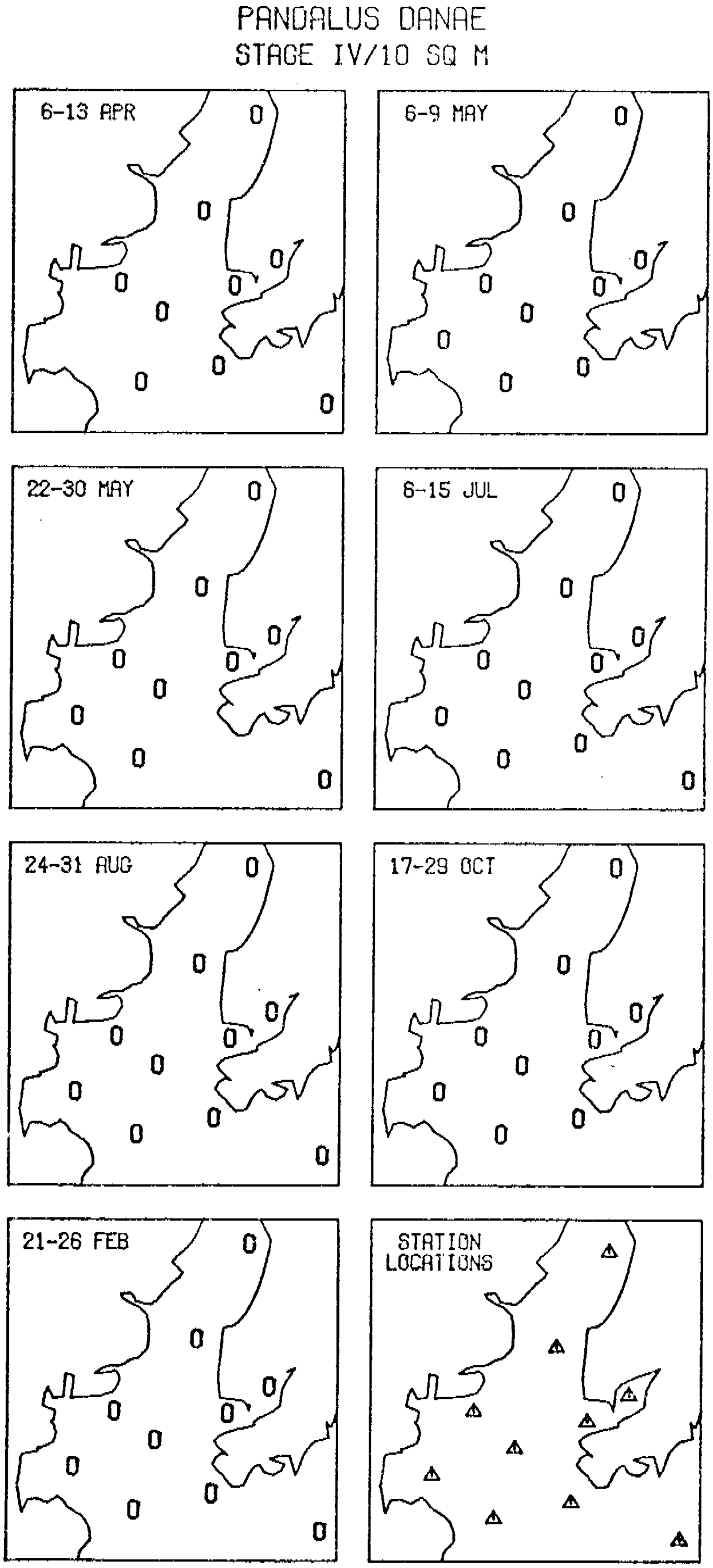

PANDALUS DANAE
STAGE III/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION
LOCATIONS

Figure 36.


PANDALUS DANAE
STAGE IV/10 SQ M
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STATION
LOCATIONS

Figure 37.

PANDALUS DANAE
STAGE V/10 SQ M

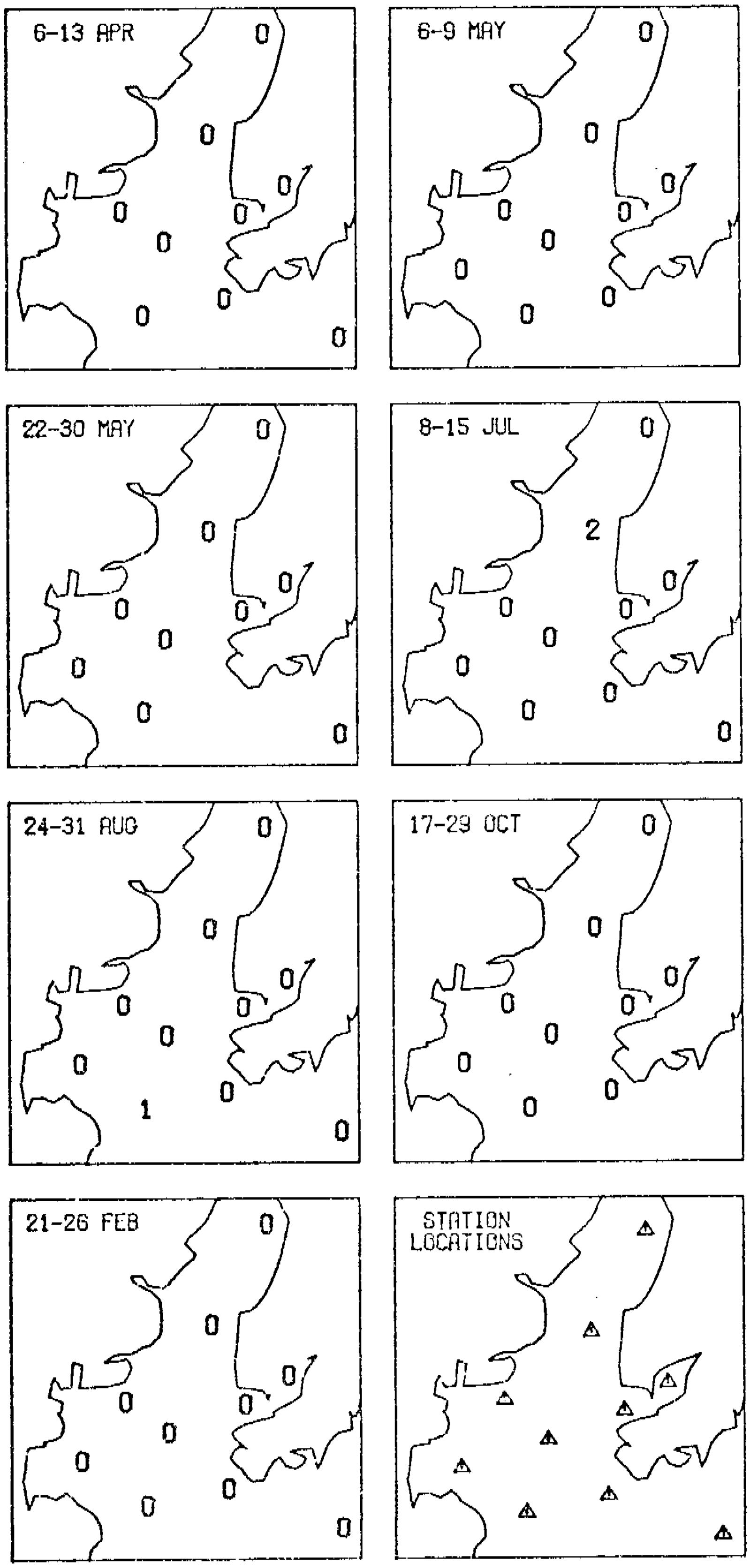


Figure 38.

PANDALUS DANAE
STAGE VI/10 SQ M

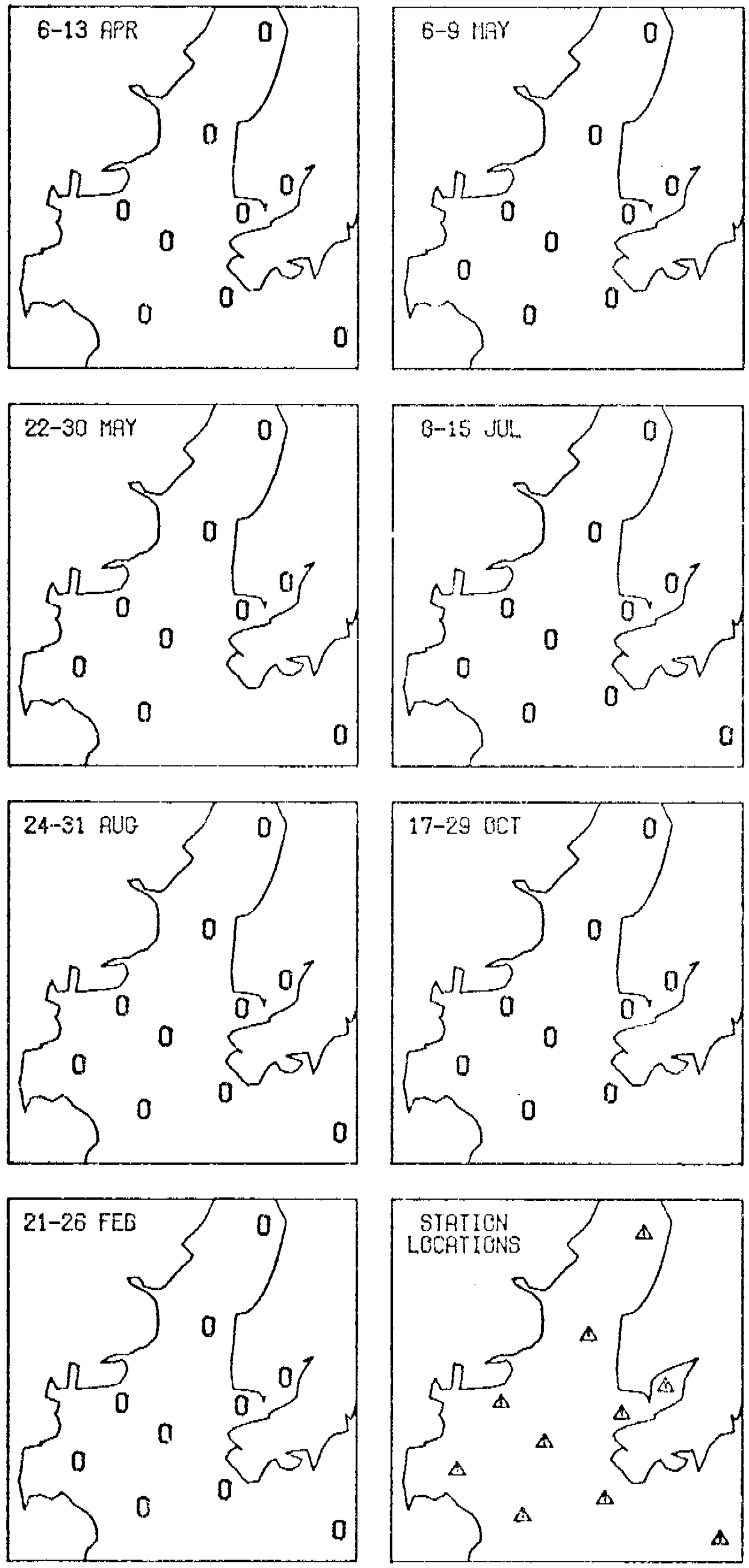


Figure 39.

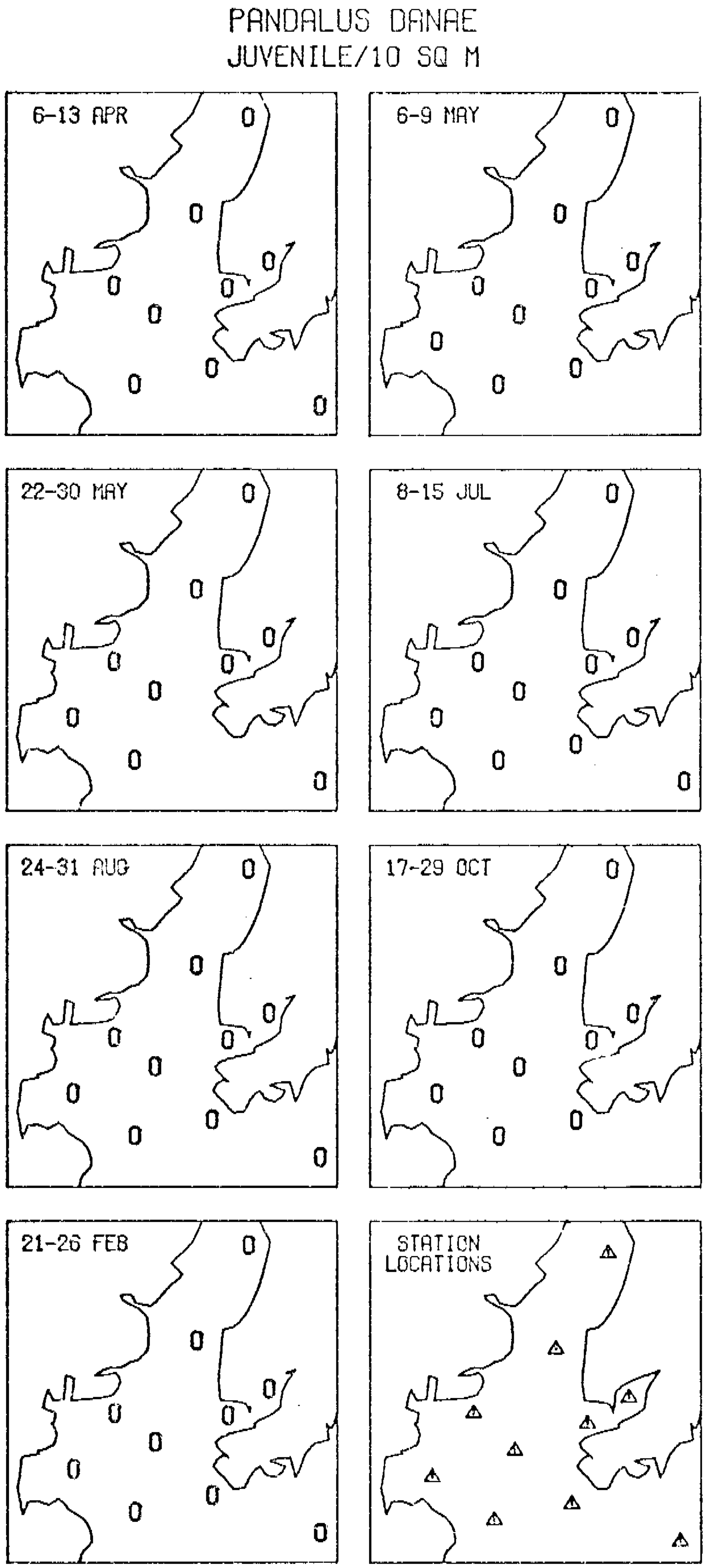
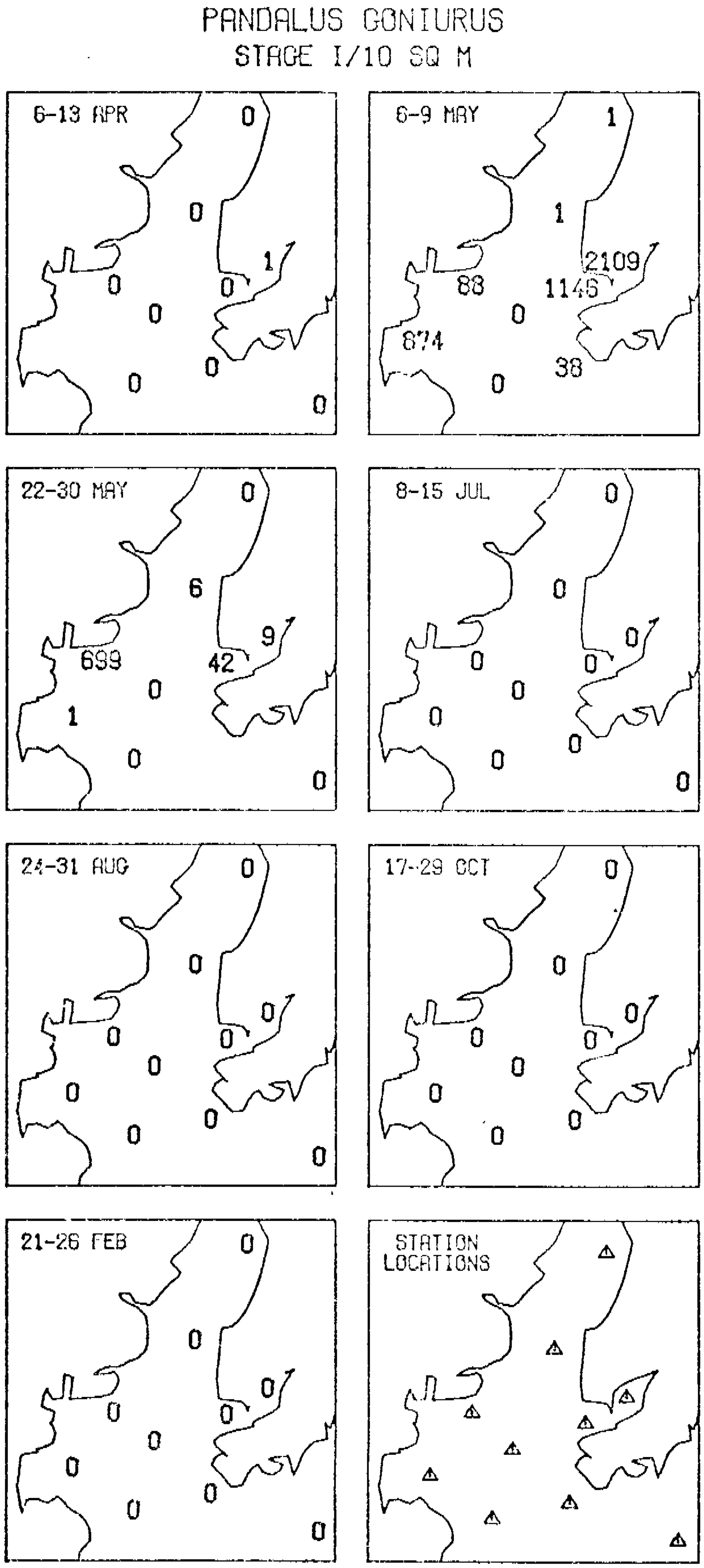

PANDALUS DANAE
JUVENILE/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION
LOCATIONS

Figure 40.


PANDALUS GONIURUS
STAGE I/10 SQ M
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22-30 MAY
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8-15 JUL
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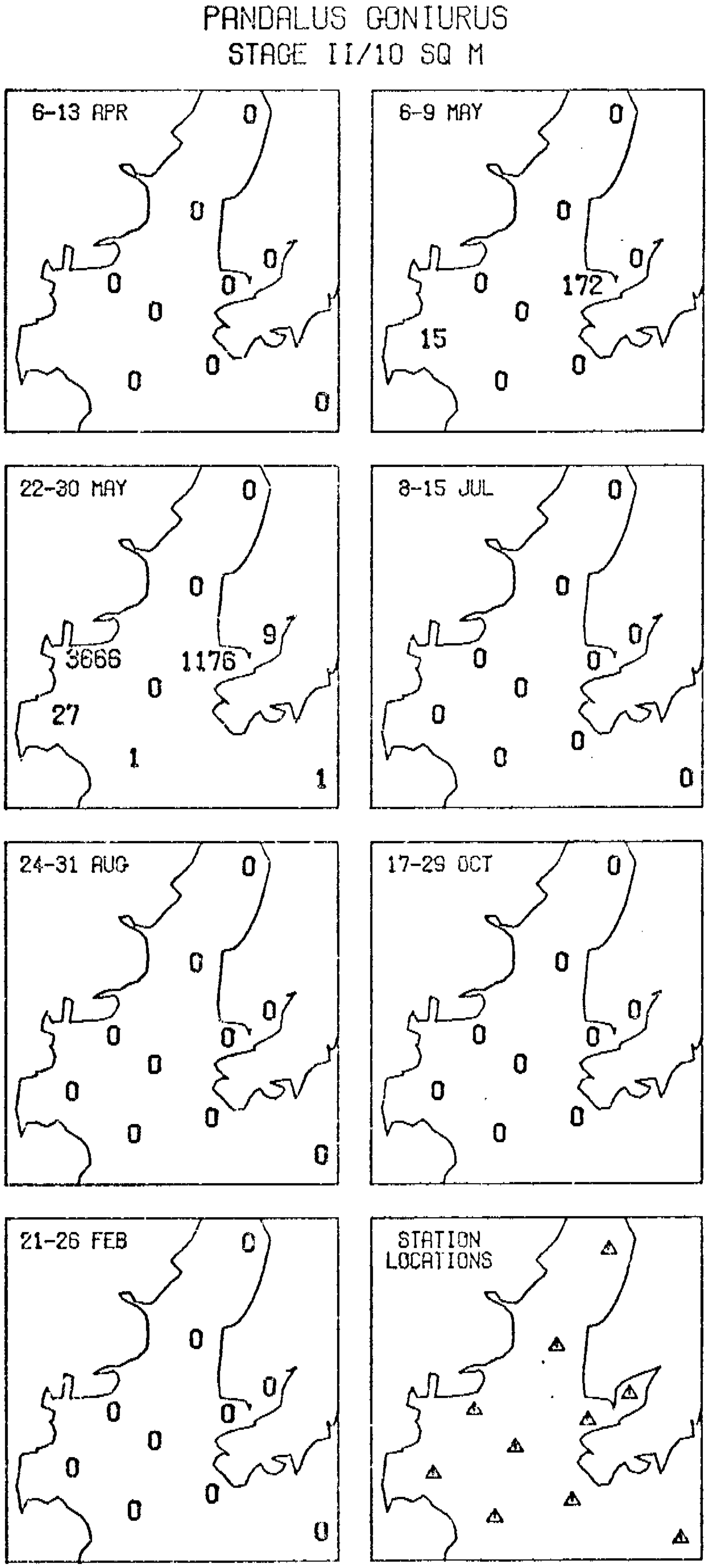
STATION LOCATIONS

Figure 41.


PANDALUS GONIURUS
STAGE II/10 SQ M
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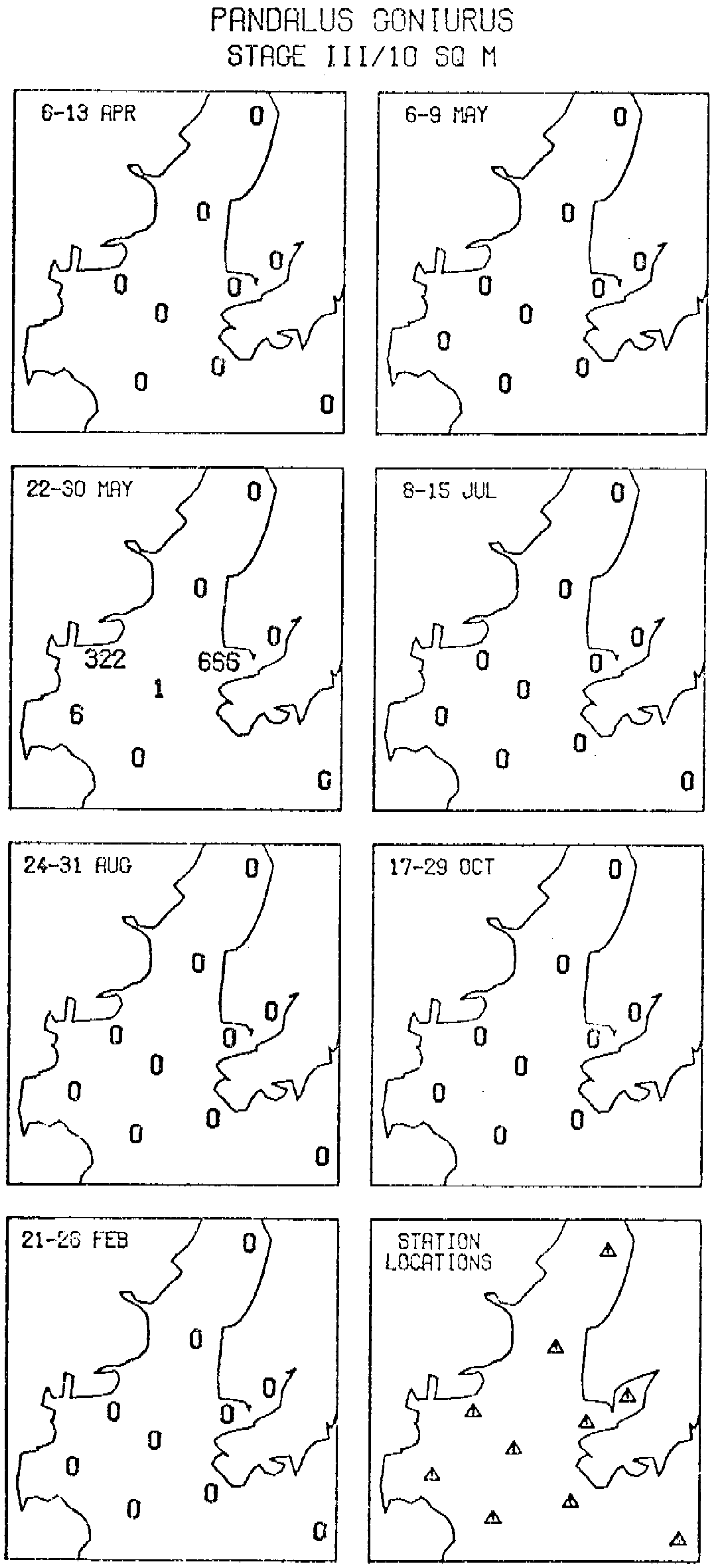
STATION
LOCATIONS

Figure 42.



PANDALUS GONIURUS
STAGE III/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
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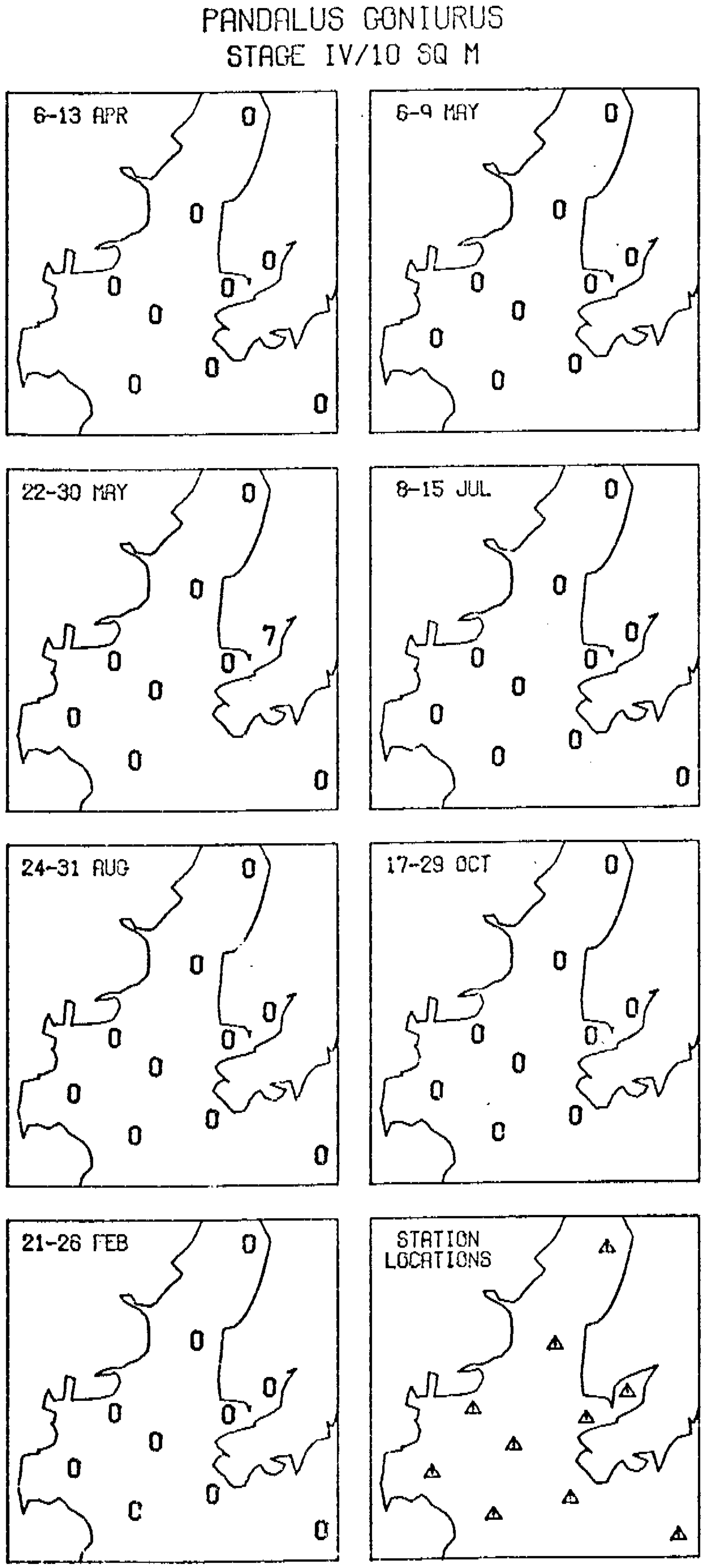
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 43.


PANDALUS GONIURUS
STAGE IV/10 SQ M
6-13 APR
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6-9 MAY
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STATION
LOCATIONS

Figure 44.

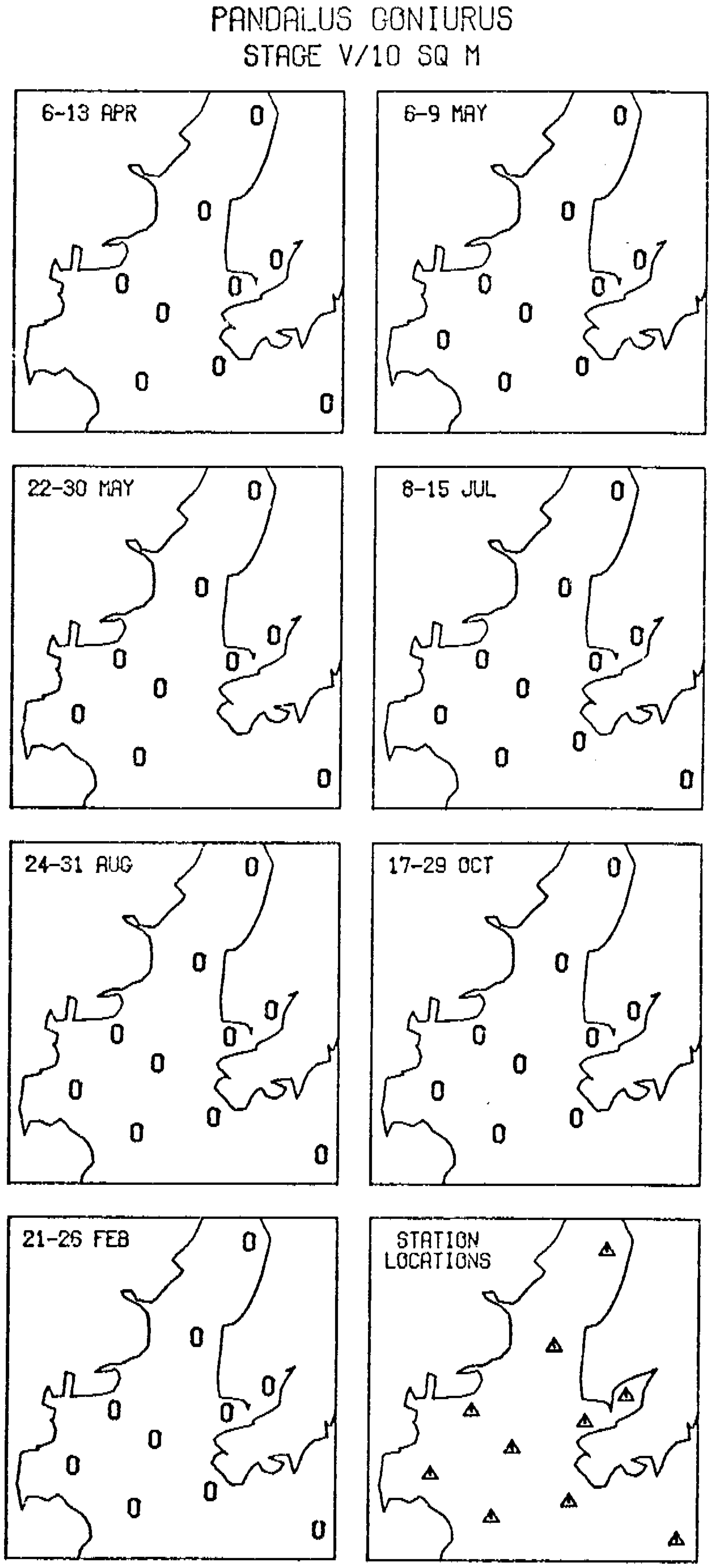

PANDALUS GONIURUS
STAGE V/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS
0

Figure 45.

PANDALUS GONIURUS
STAGE VI/10 SQ M

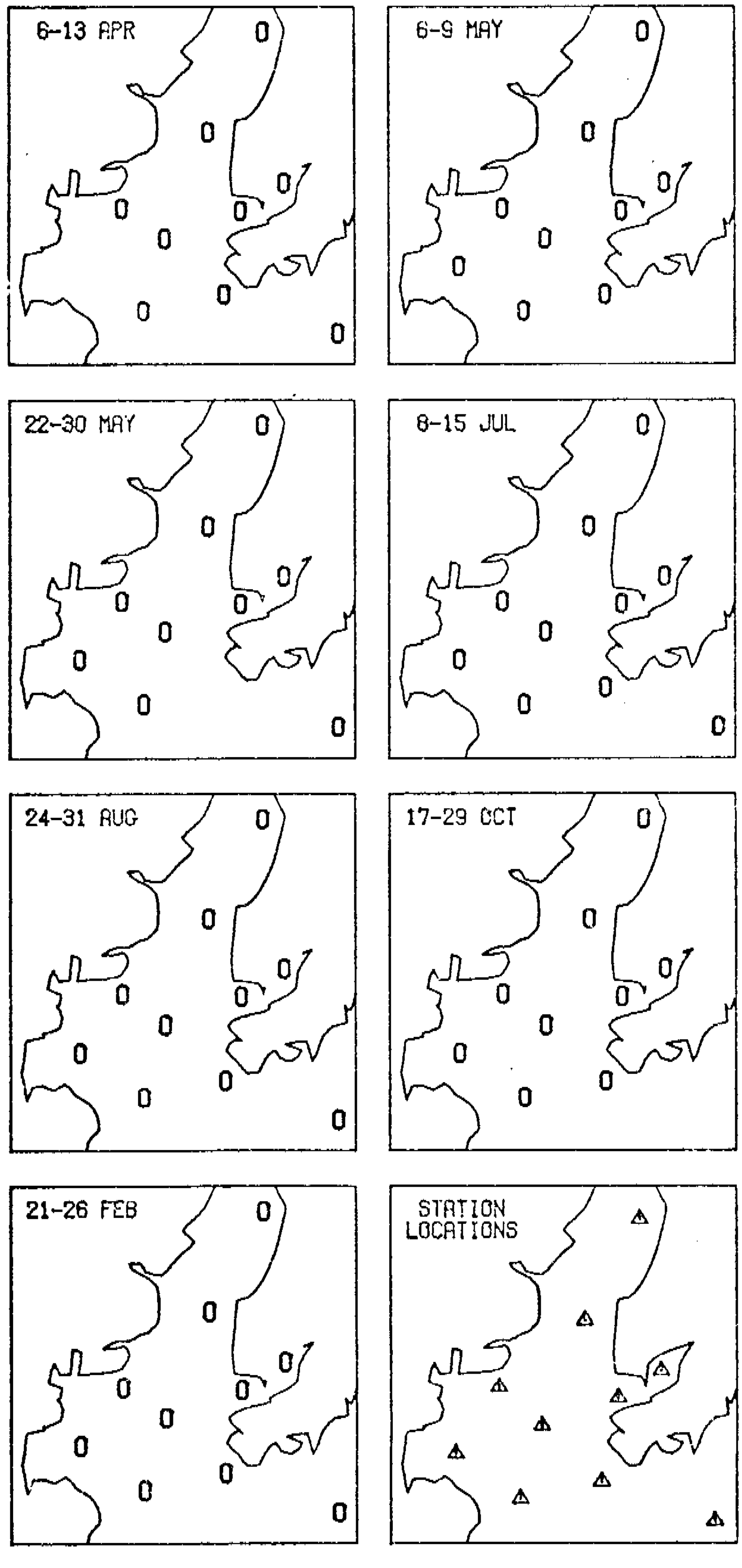


Figure 46.

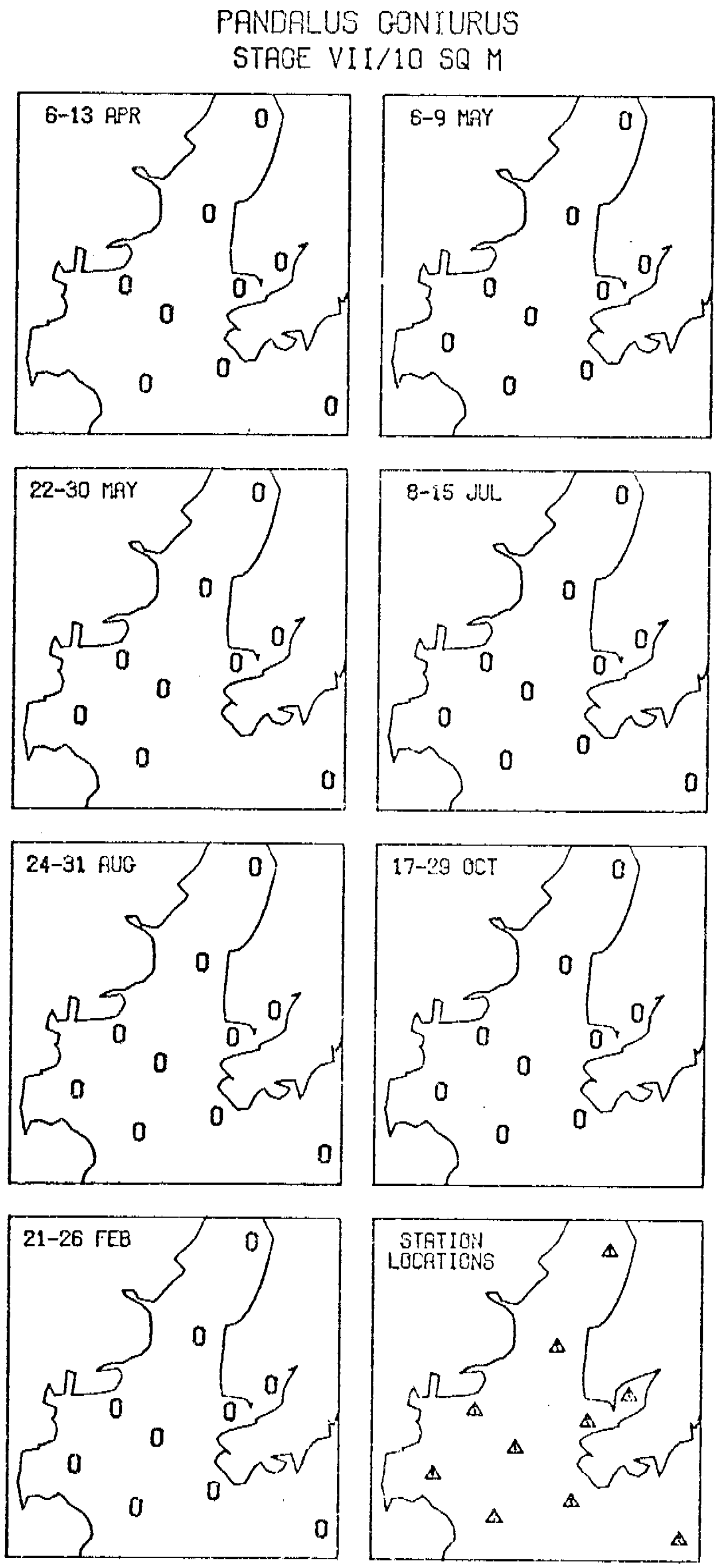

PANDALUS GONIURUS
STAGE VII/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 47.

PANDALUS GONIURUS
JUVENILE/10 SQ M

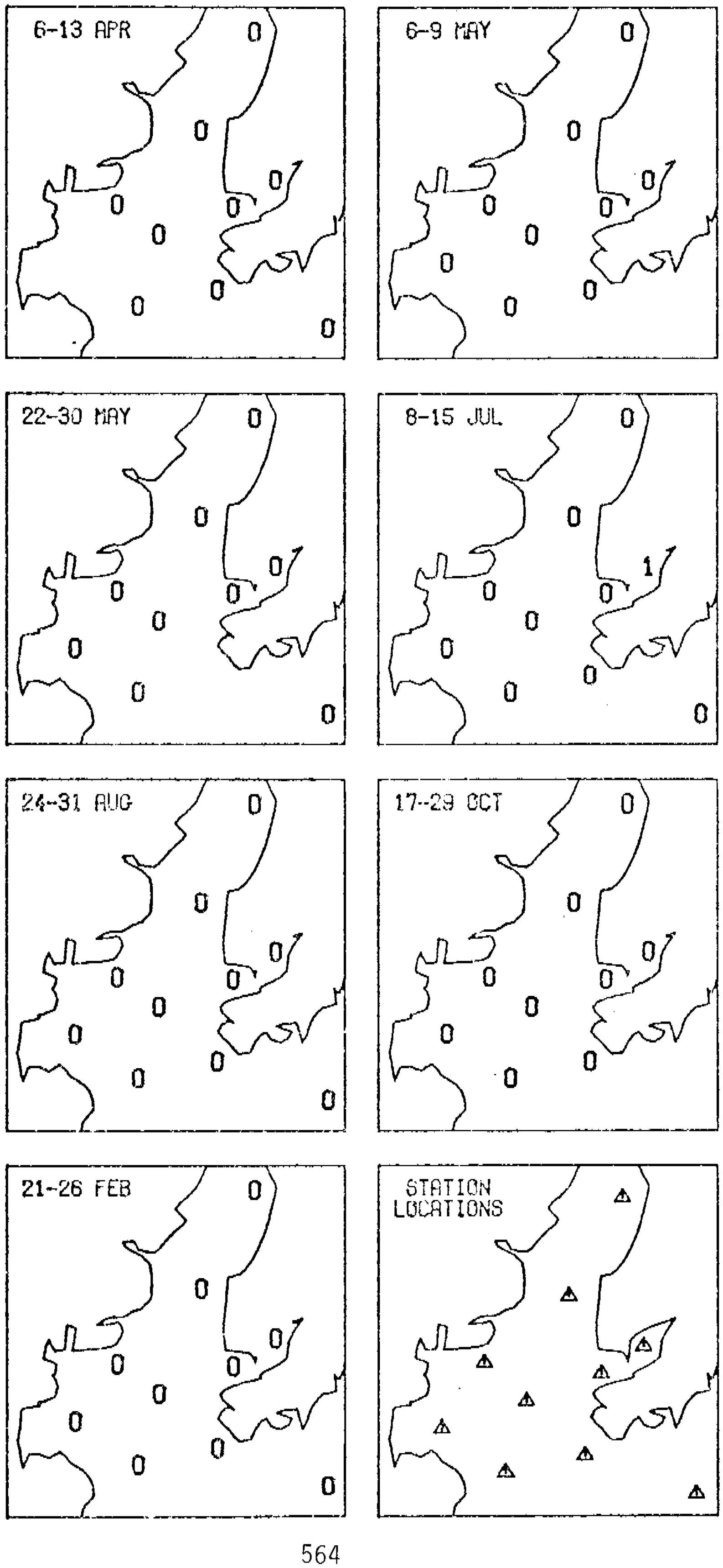


Figure 48.

PANDALUS HYPSINOTUS
STAGE I/10 SQ M

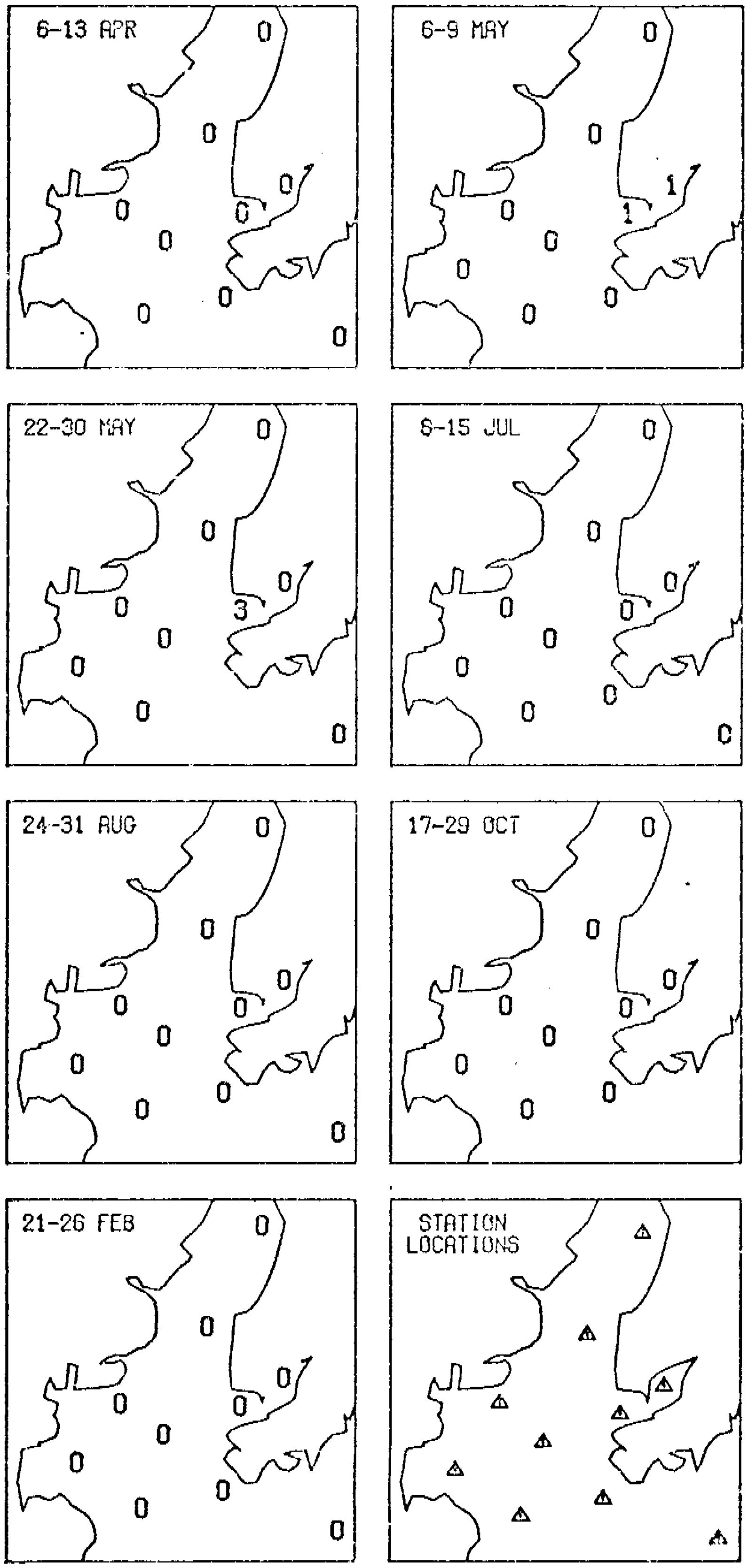


Figure 49.

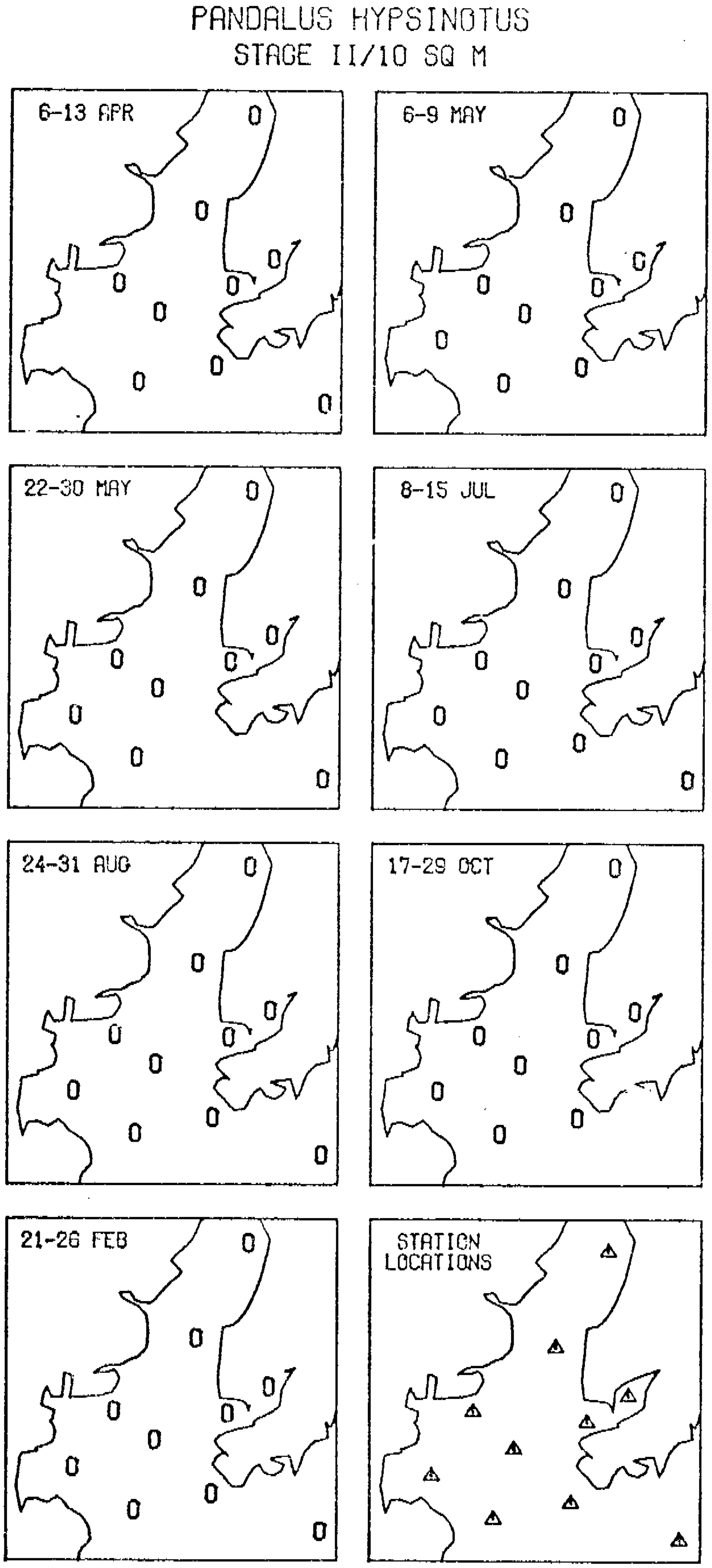

PANDALUS HYPSINOTUS
STAGE II/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION
LOCATIONS

Figure 50.

PANDALUS HYPSINOTUS
STAGE III/10 SQ M

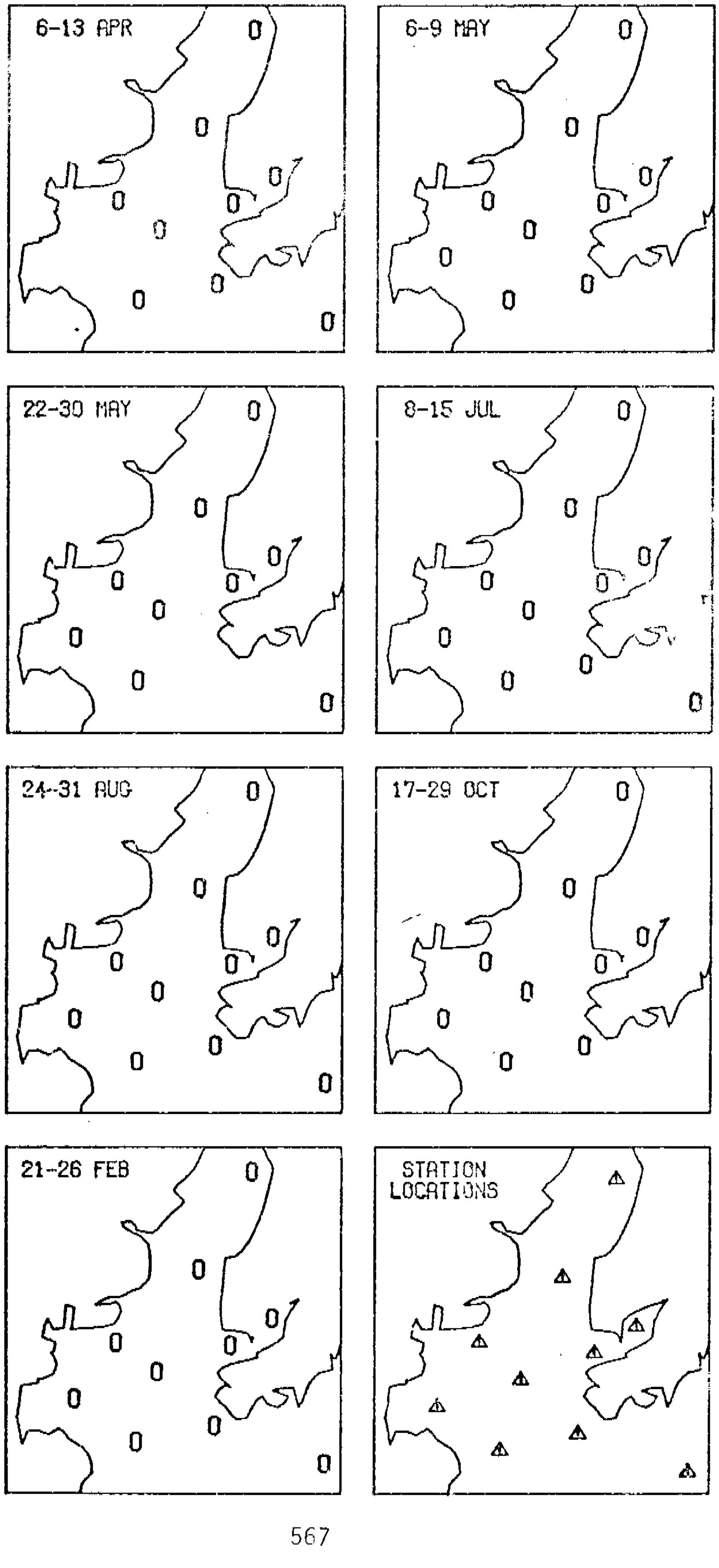


Figure 51.

PANDALUS HYPSINOTUS
STAGE IV/10 SQ M

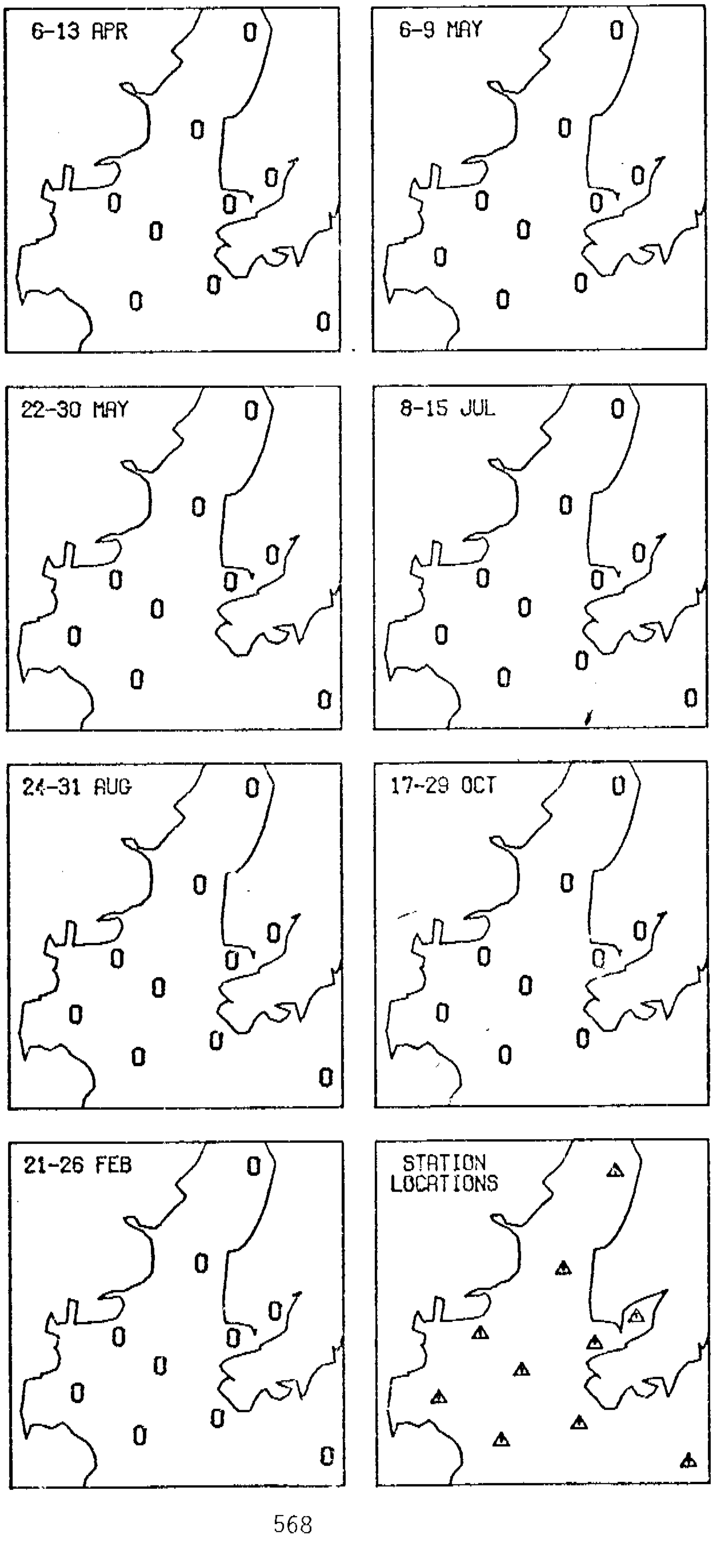


Figure 52.

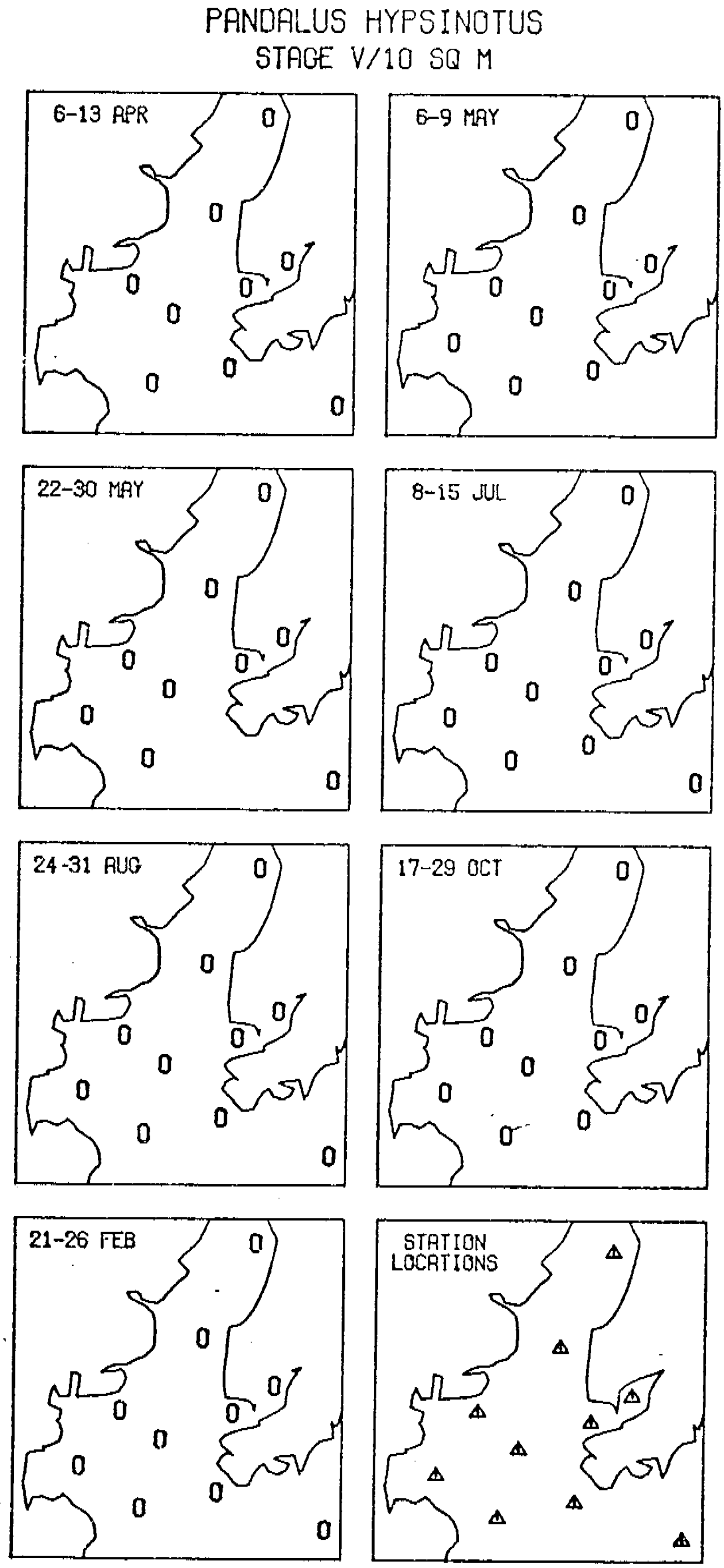

PANDALUS HYPSINOTUS
STAGE V/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 53.

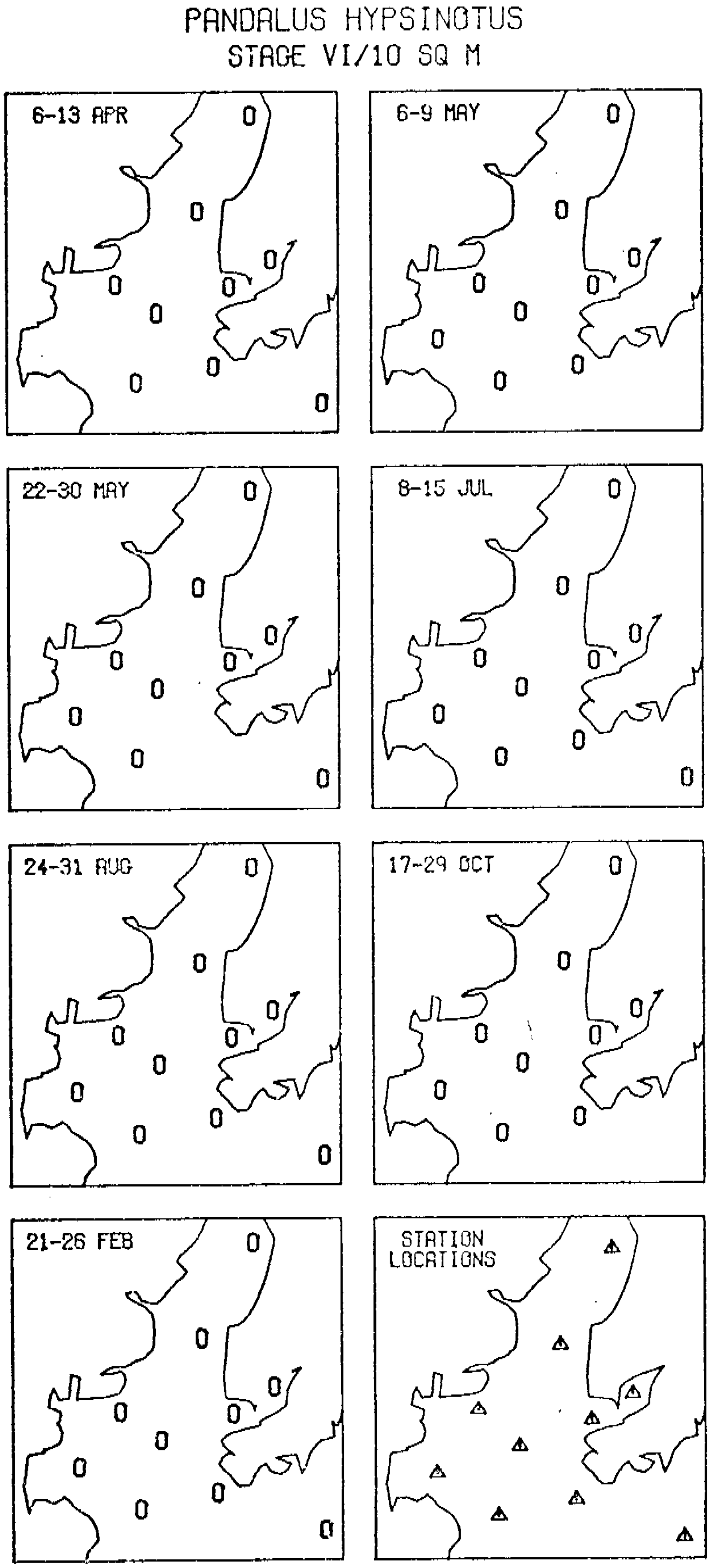

PANDALUS HYPSINOTUS
STAGE VI/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION
LOCATIONS

Figure 54.

PANDALUS HYPSINOTUS
JUVENILE/10 SQ M

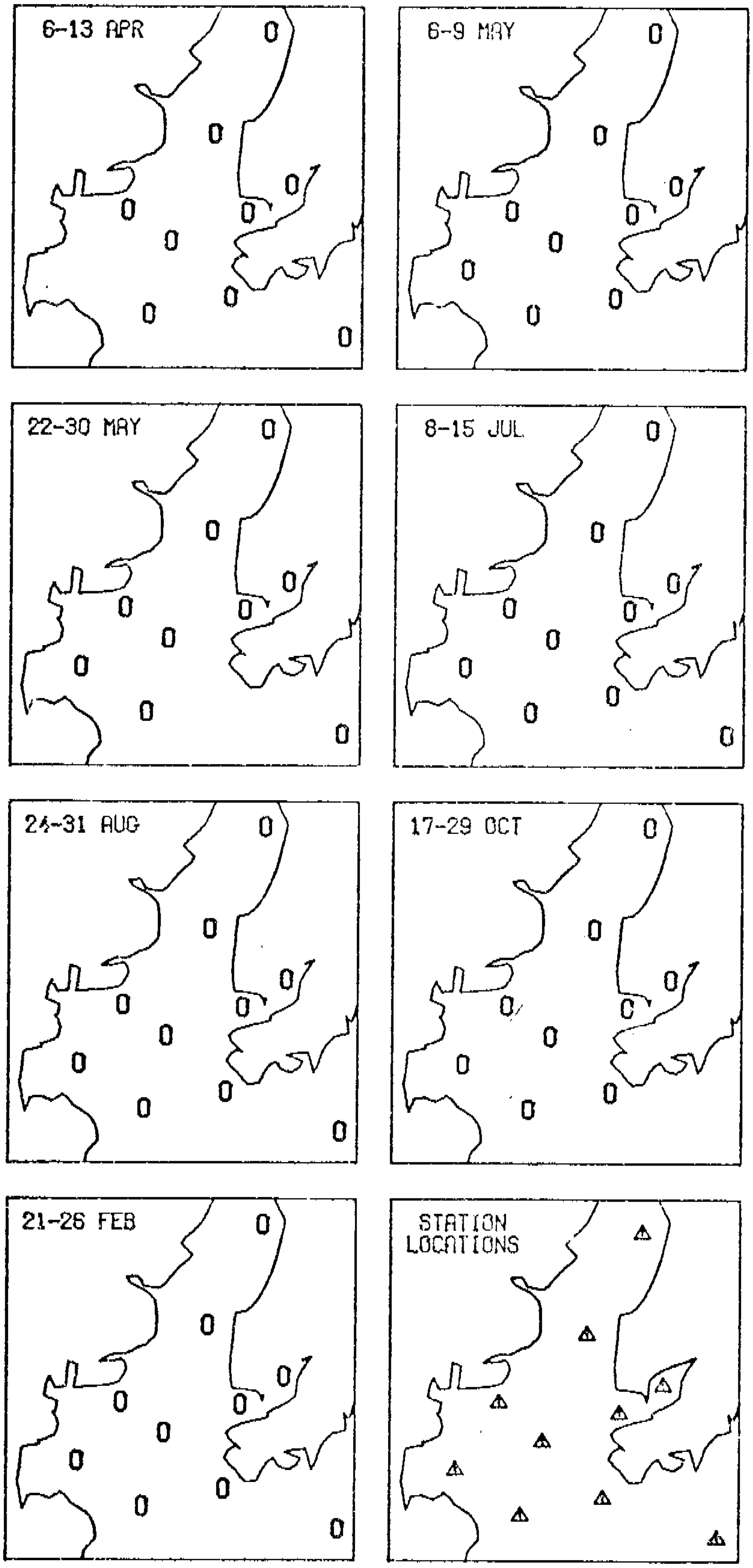


Figure 55.

PANDALUS PLATYCEROS
STAGE I/10 SQ M

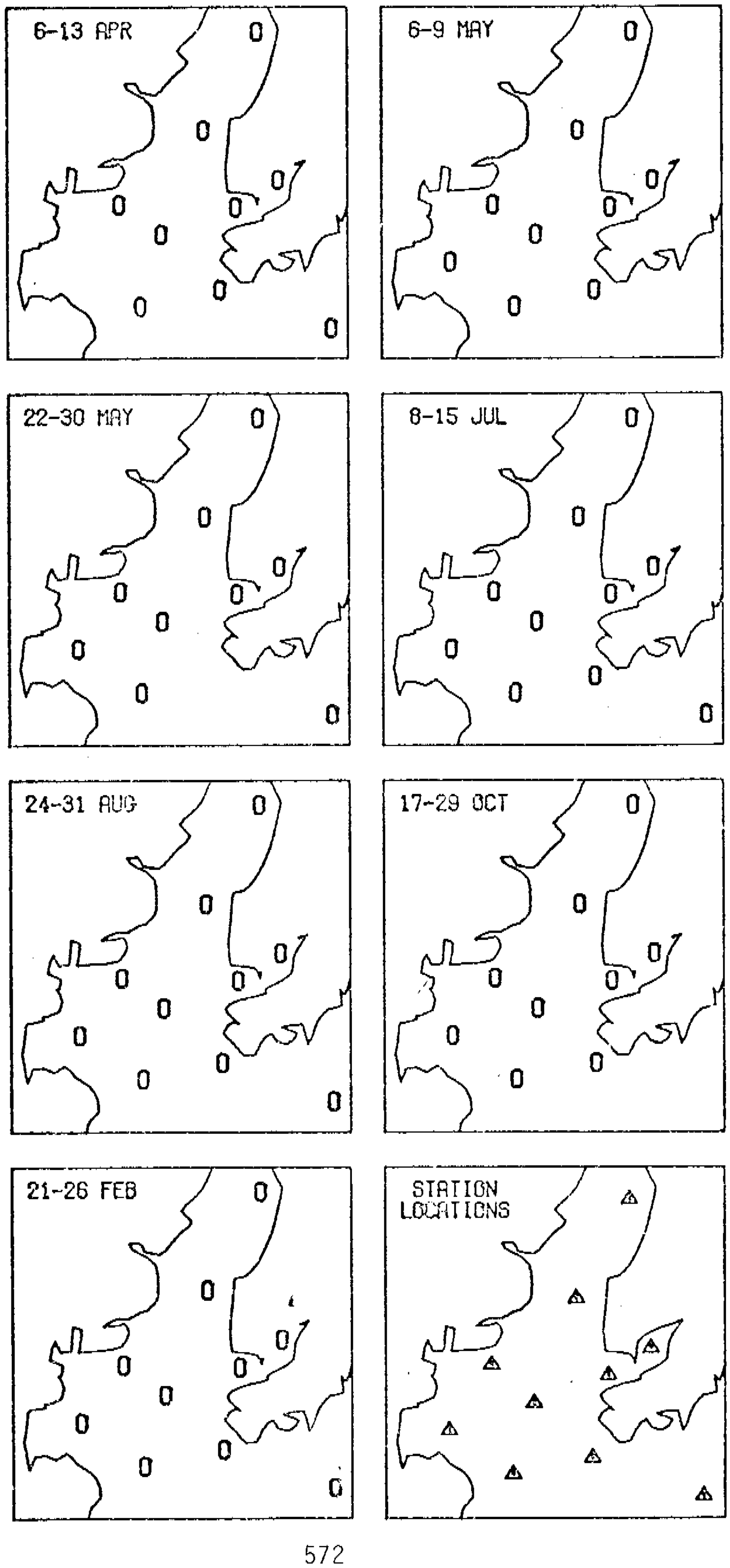


Figure 56.

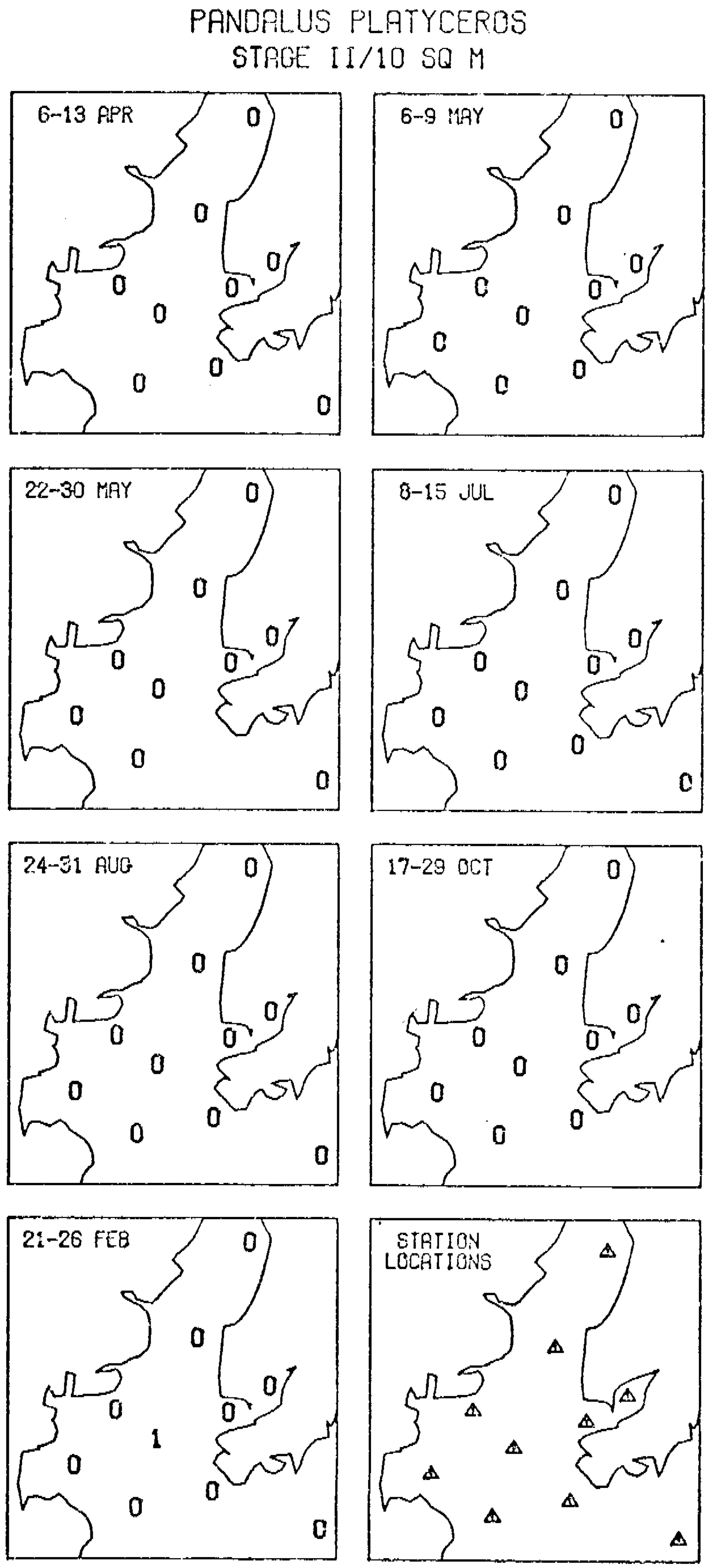
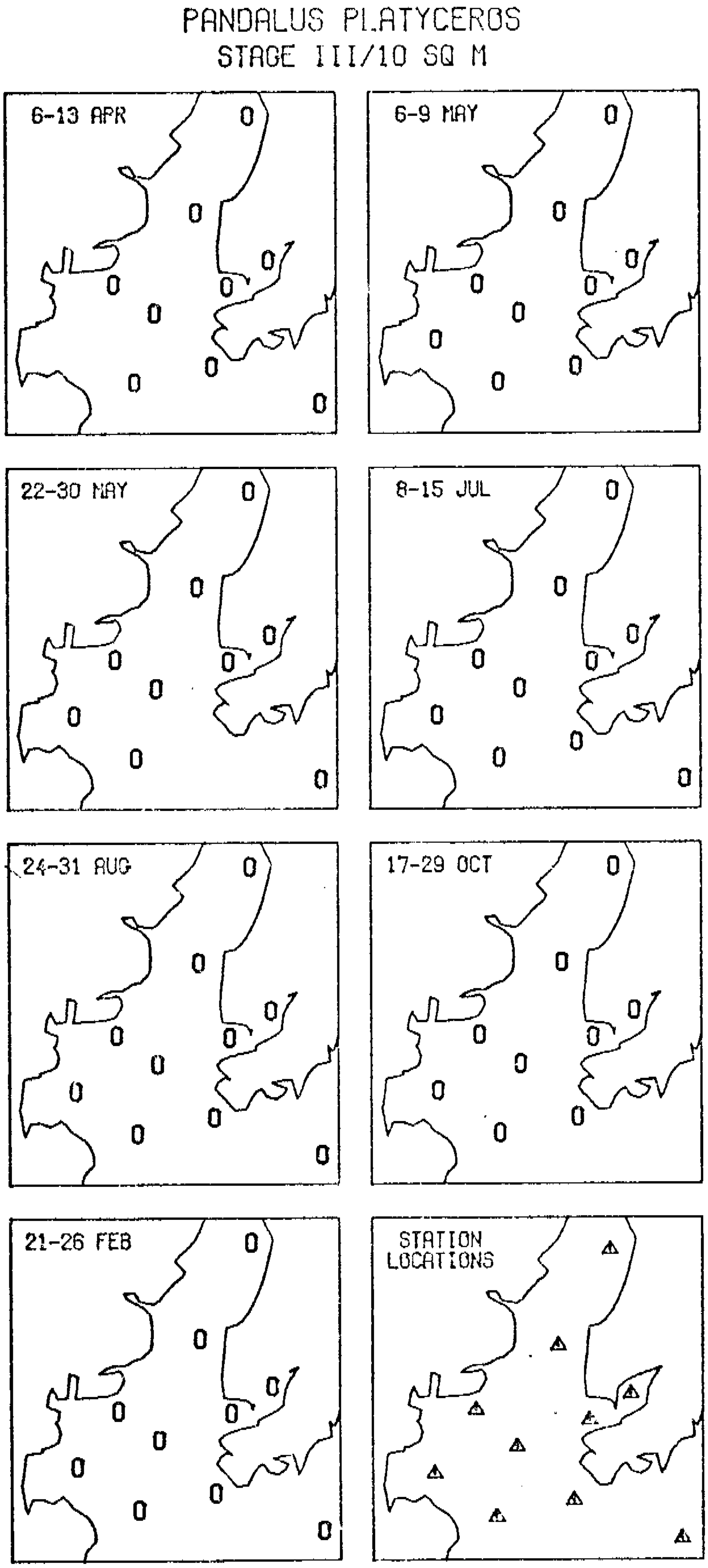

PANDALUS PLATYCEROS
STAGE II/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 57.


PANDALUS PLATYCEROS
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STATION
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Figure 58.

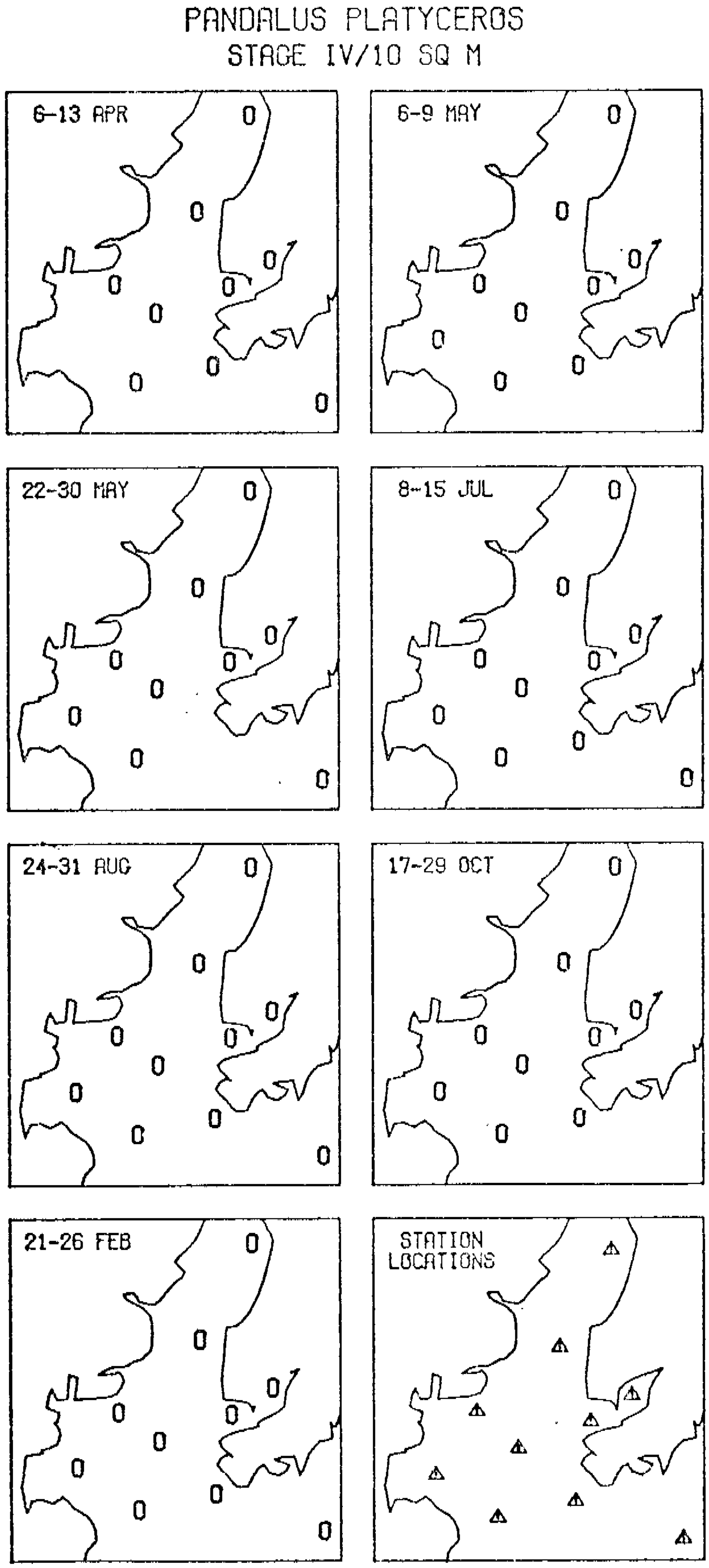

PANDALUS PLATYCEROS
STAGE IV/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 59.

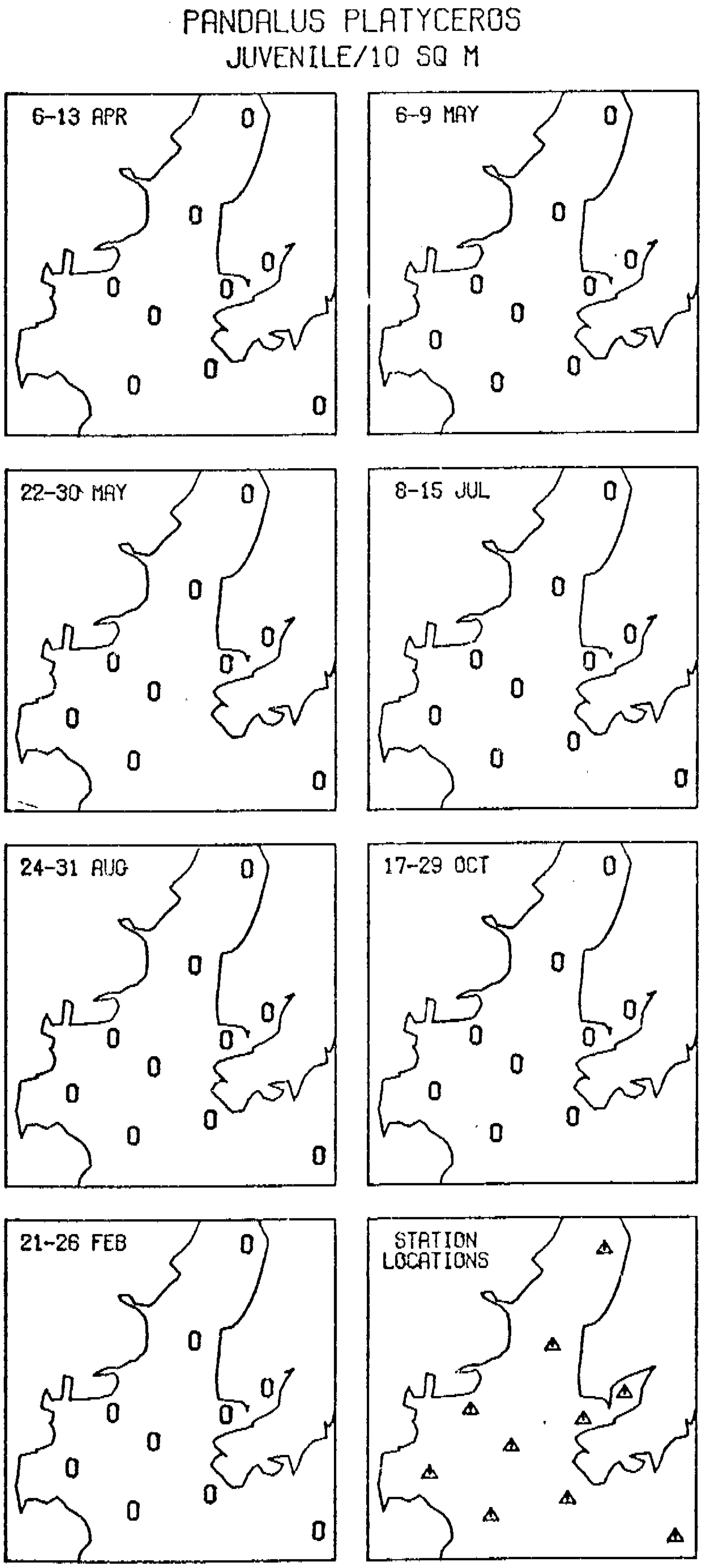

PANDALUS PLATYCEROS
JUVENILE/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 60.

PANDALUS STENOLEPIS
STAGE I/10 SQ M

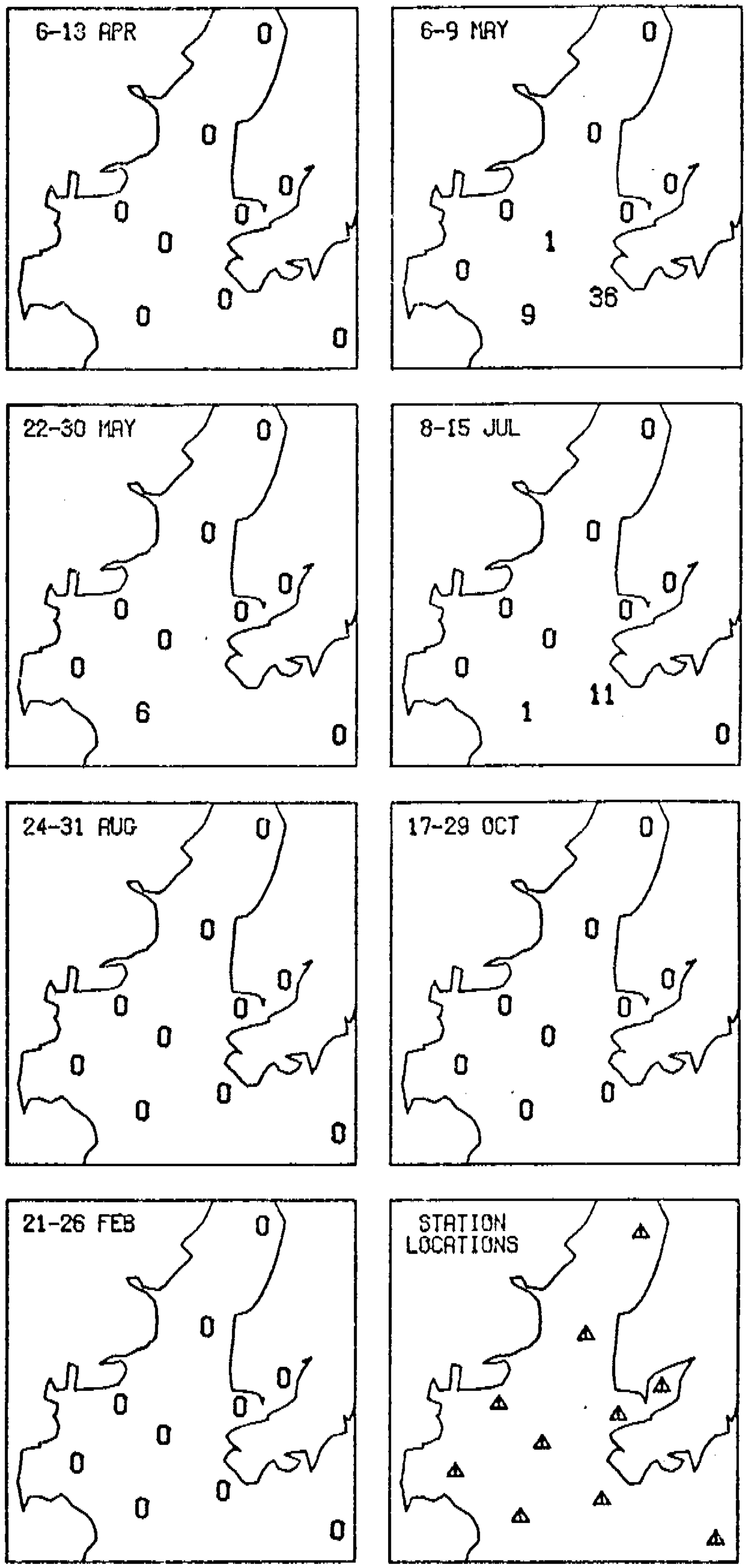
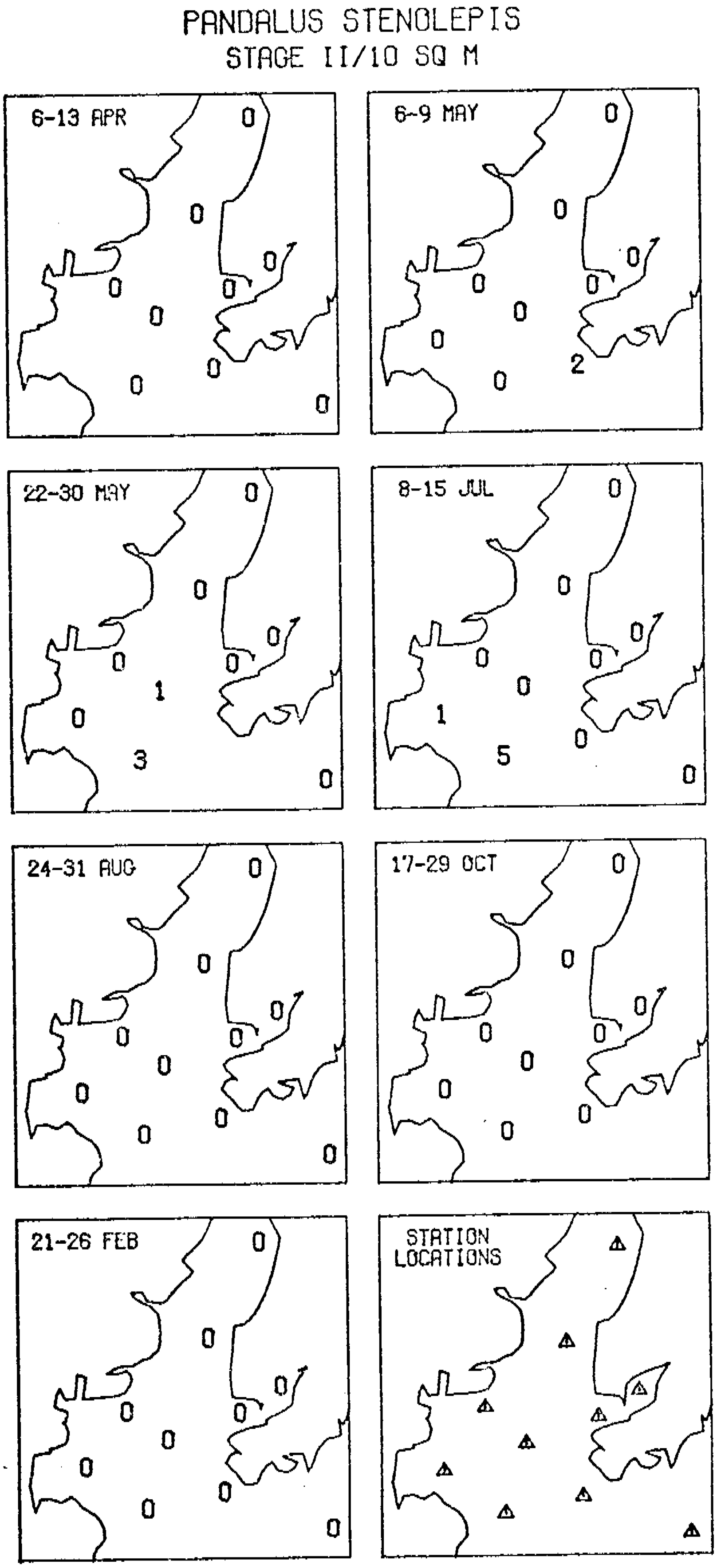


Figure 61.


PANDALUS STENOLEPIS
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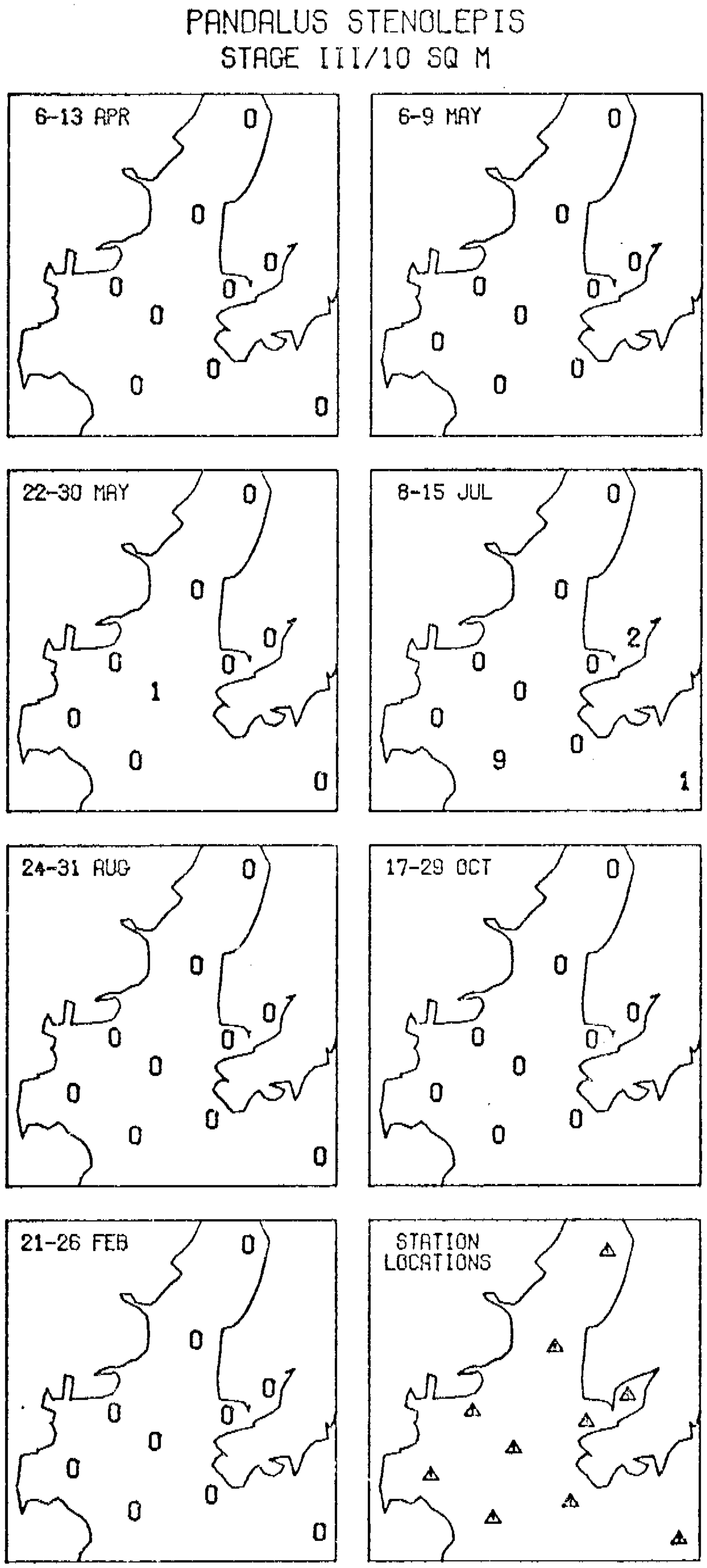
STATION LOCATIONS

Figure 62.



PANDALUS STENOLEPIS
STAGE III/10 SQ M
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STATION
LOCATIONS

Figure 63.

PANDALUS STENOLEPIS
STAGE IV/10 SQ M

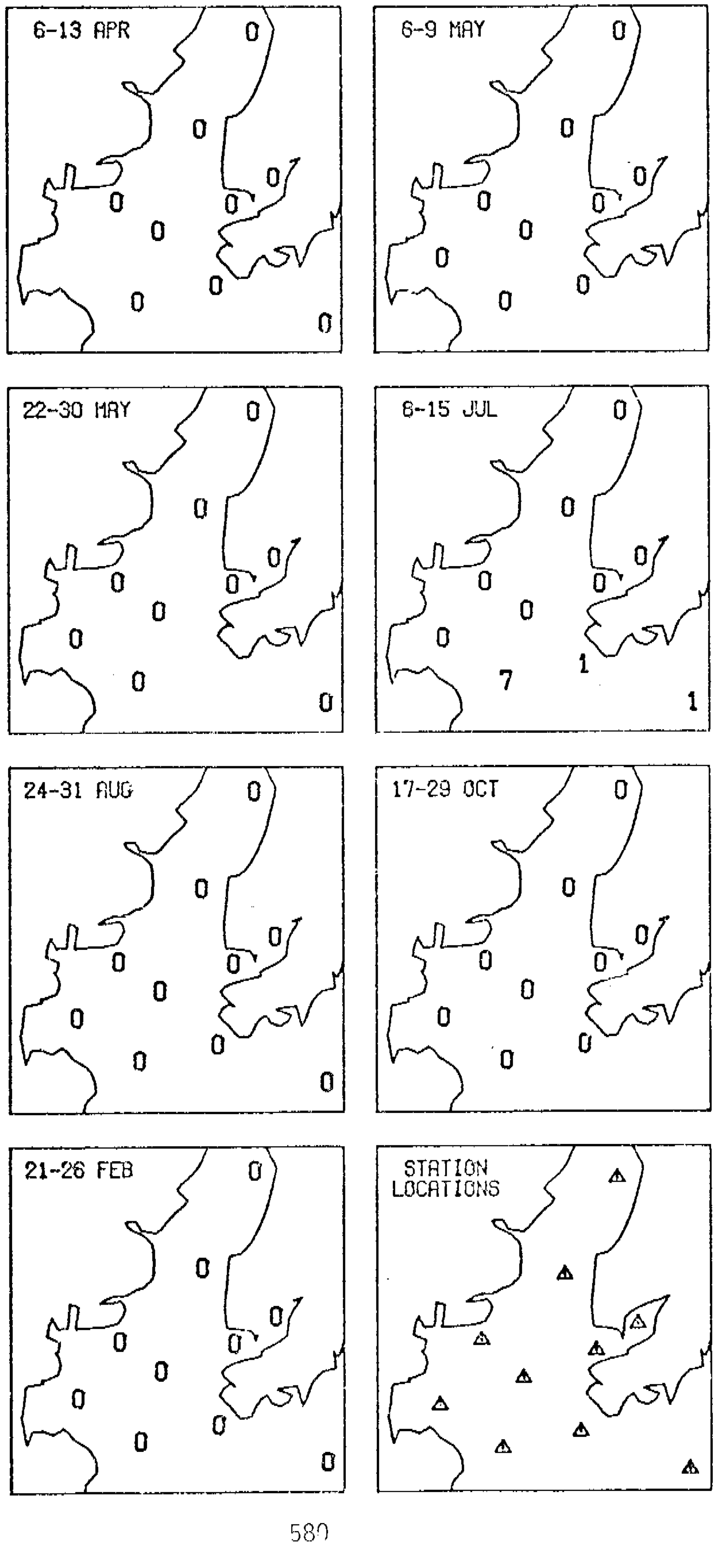


Figure 64.

PANDALUS STENOLEPIS
STAGE V/10 SQ M

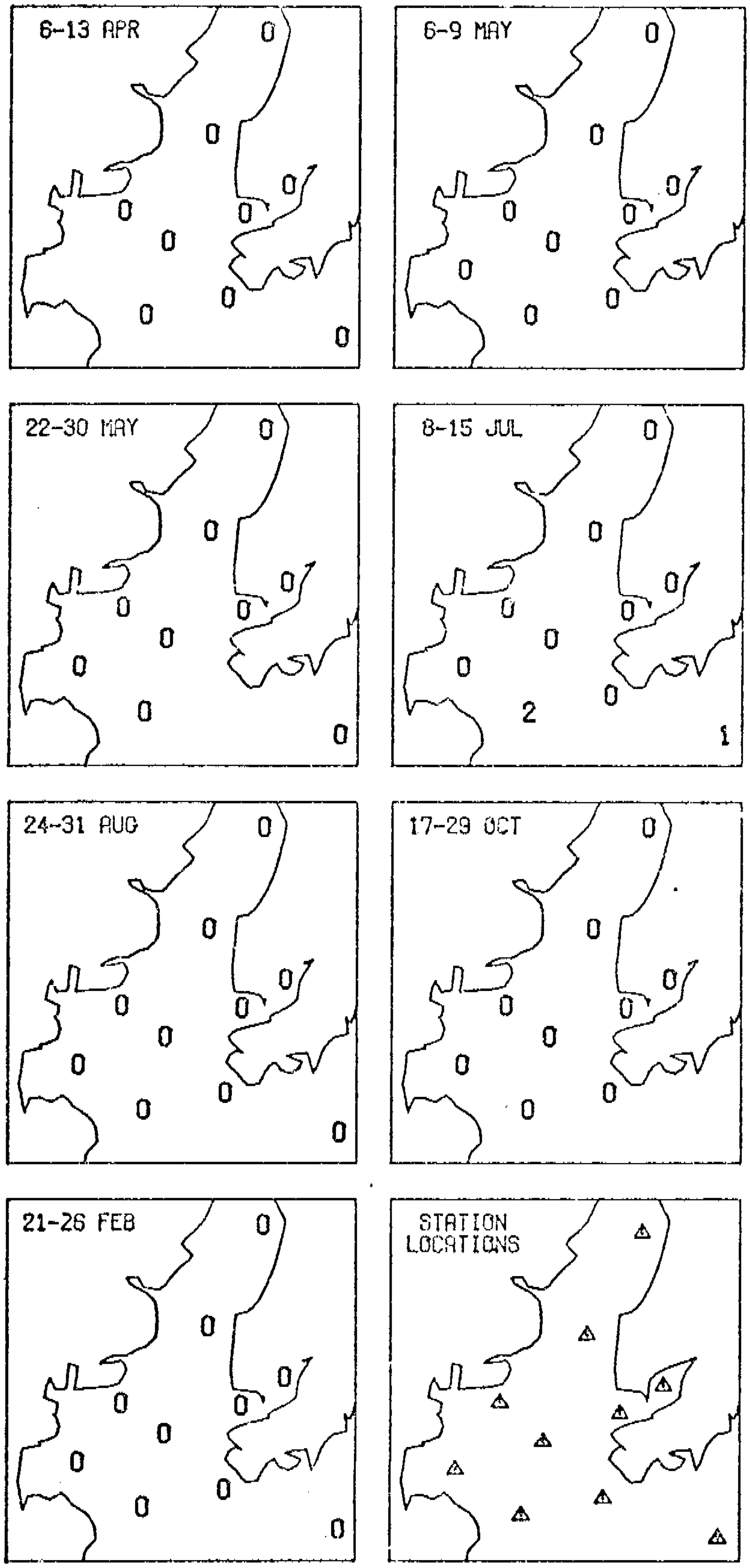
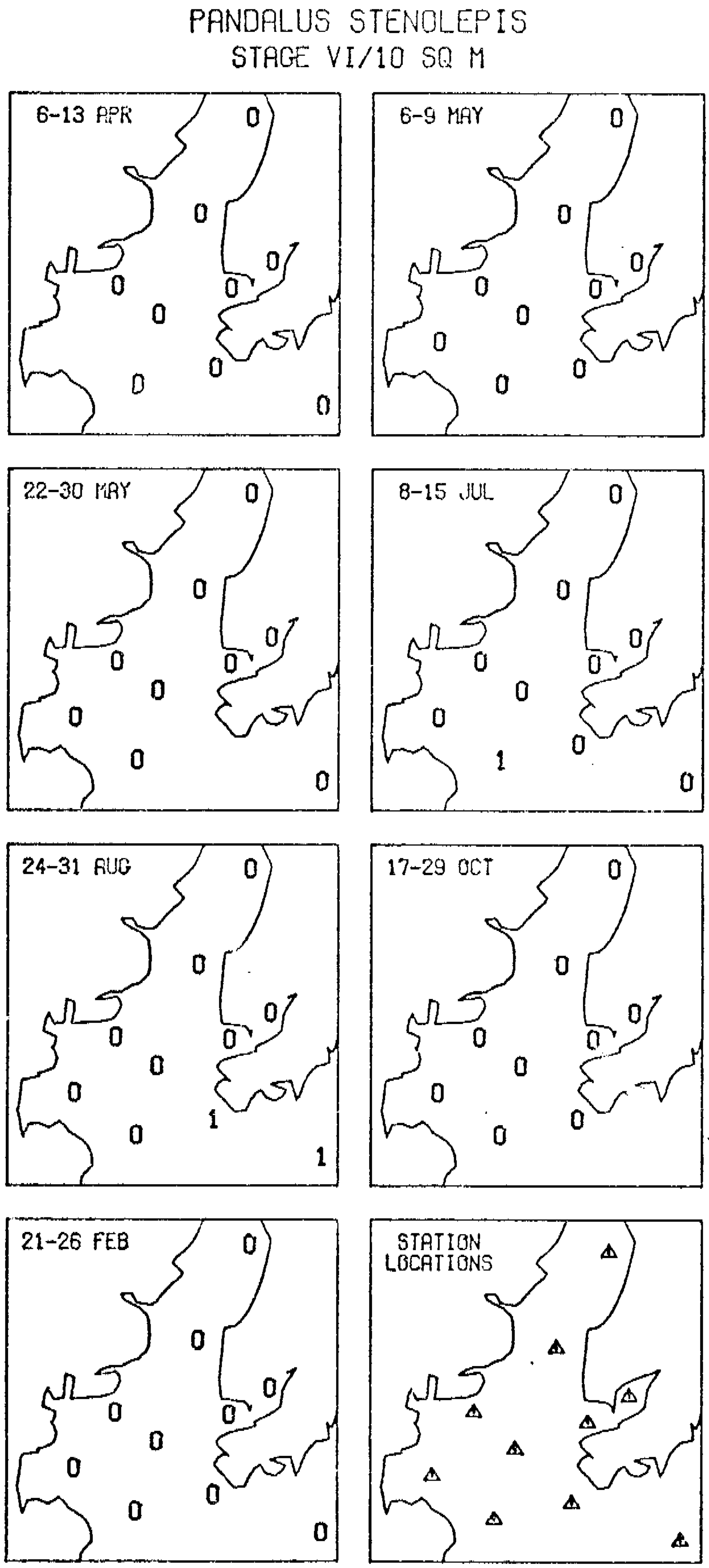


Figure 65.



PANDALUS STENOLEPIS
STAGE VI/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 66.

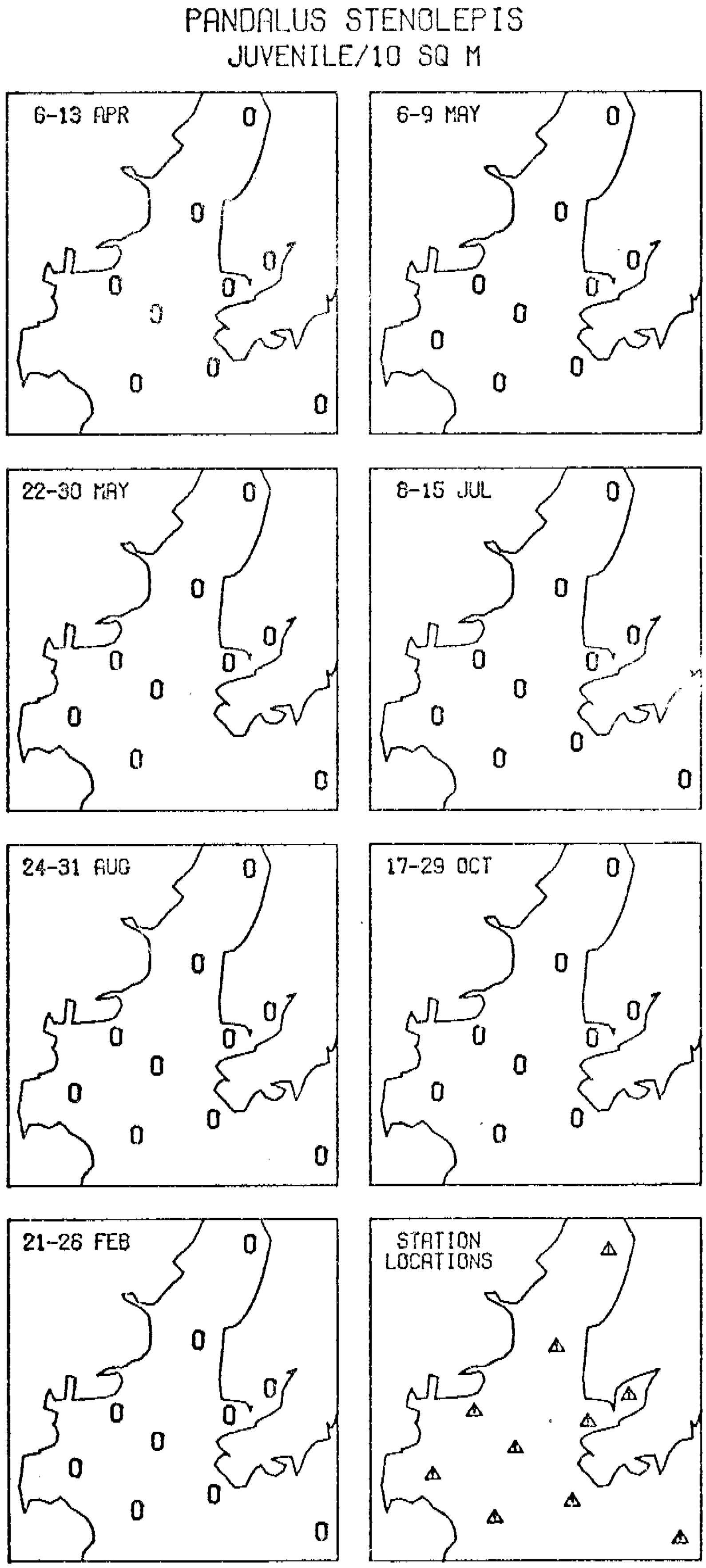
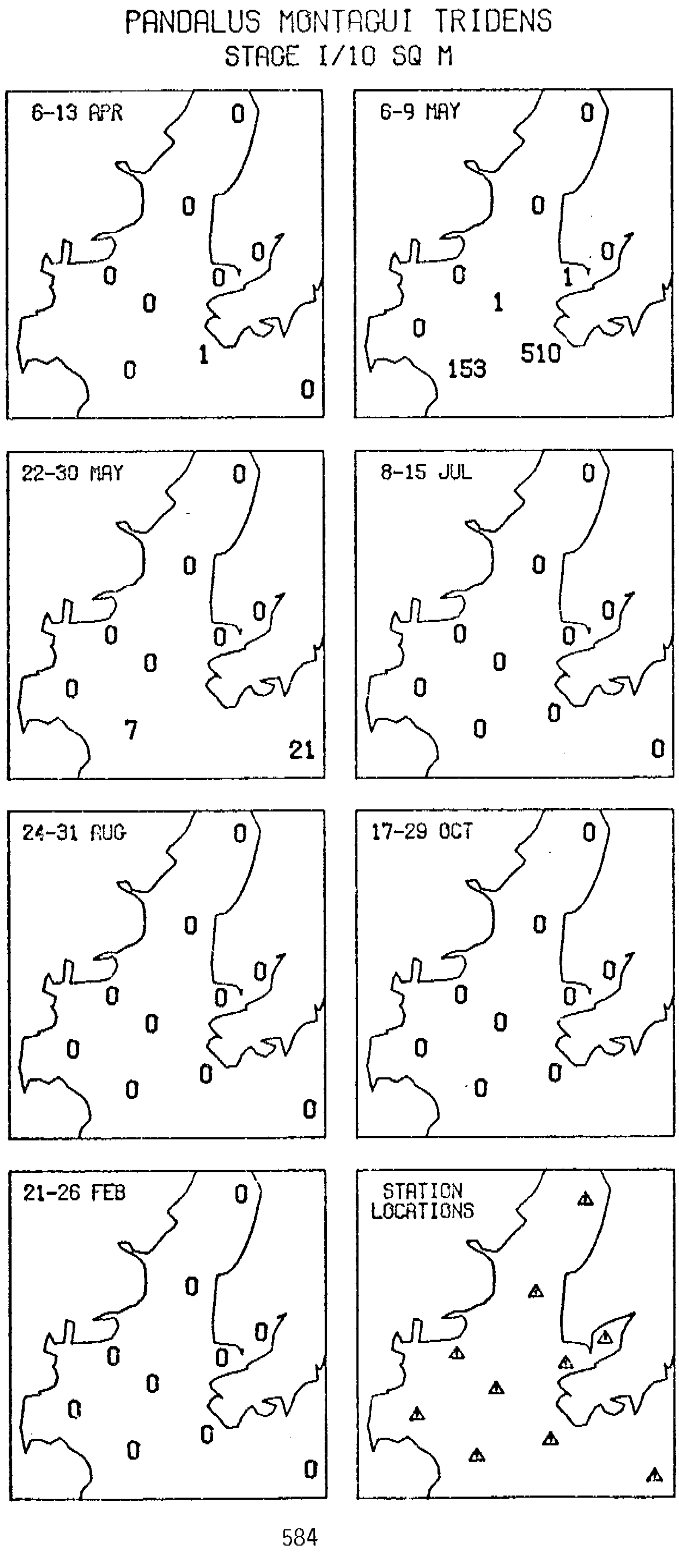

PANDALUS STENOLEPIS
JUVENILE/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 67.



PANDALUS MONTAGUI TRIDENS
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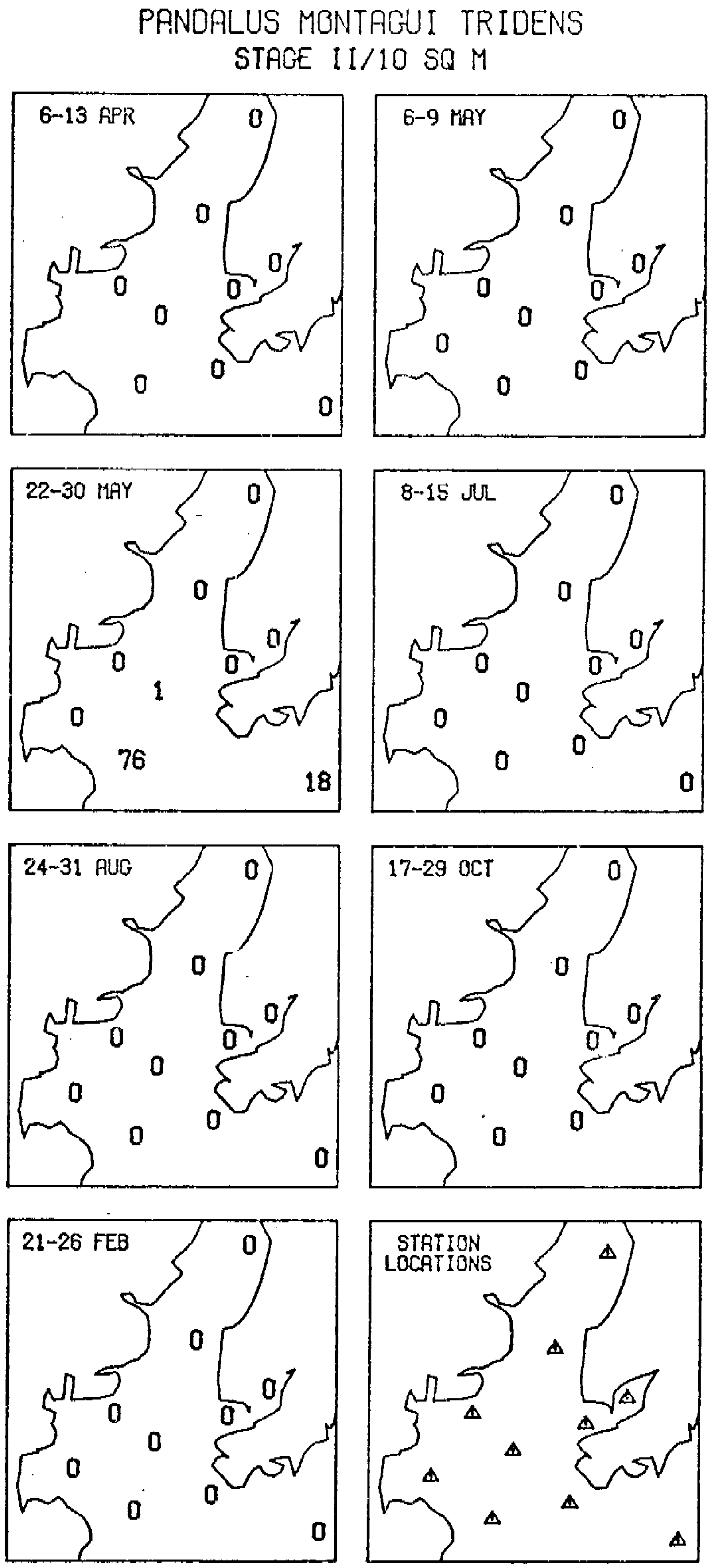
STATION
LOCATIONS

Figure 68.


PANDALUS MONTAGUI TRIDENS
STAGE II/10 SQ M
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6-9 MAY
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0
0
17-29 OCT
0
0
0
0
0
0
0
0
0
21-26 FEB
0
0
0
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0
0
0
0
0
STATION
LOCATIONS

Figure 69.

PANDALUS MONTAGUI TRIDENS
STAGE III/10 SQ M

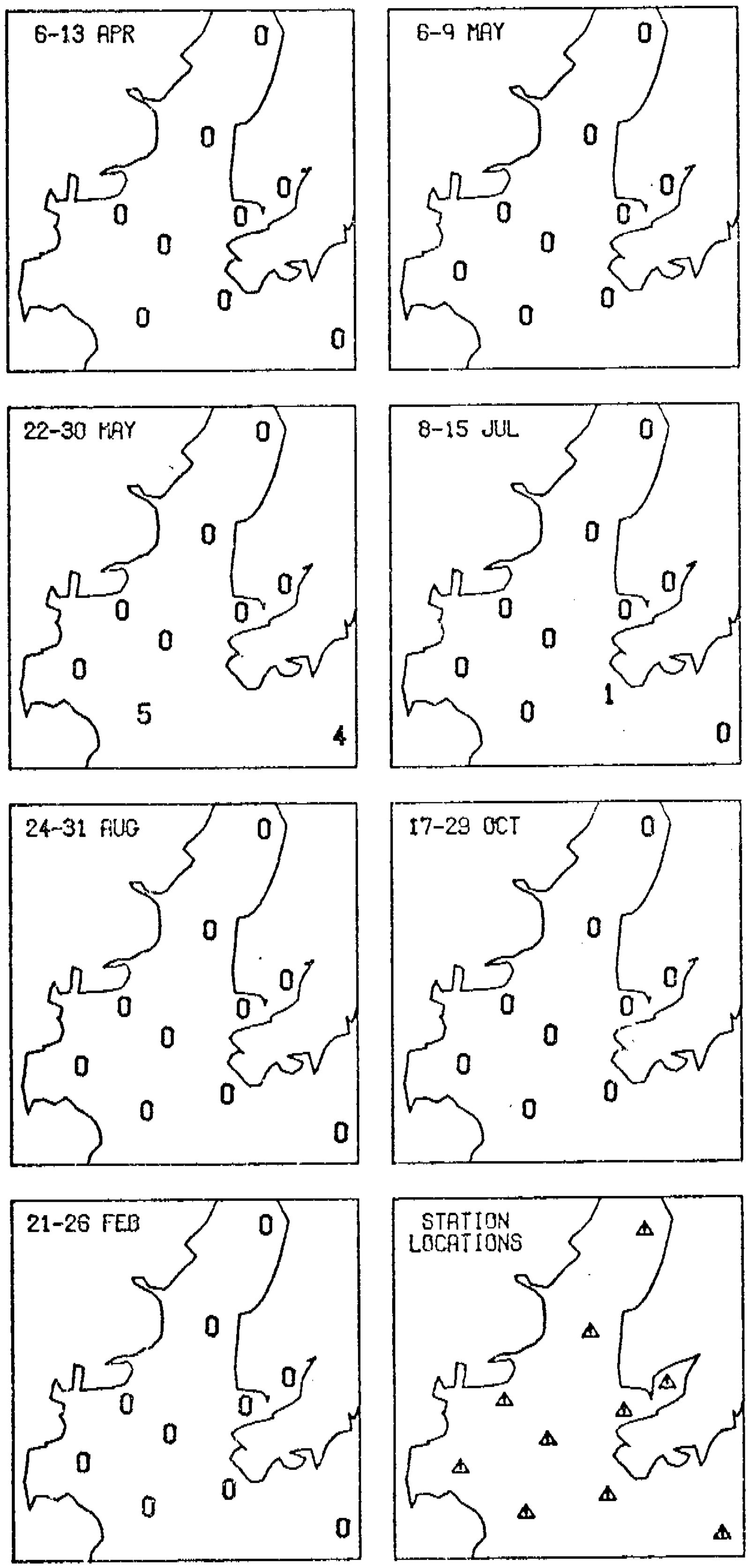


Figure 70.

PANDALUS MONTAGUI TRIDENS
STAGE IV/10 SQ M

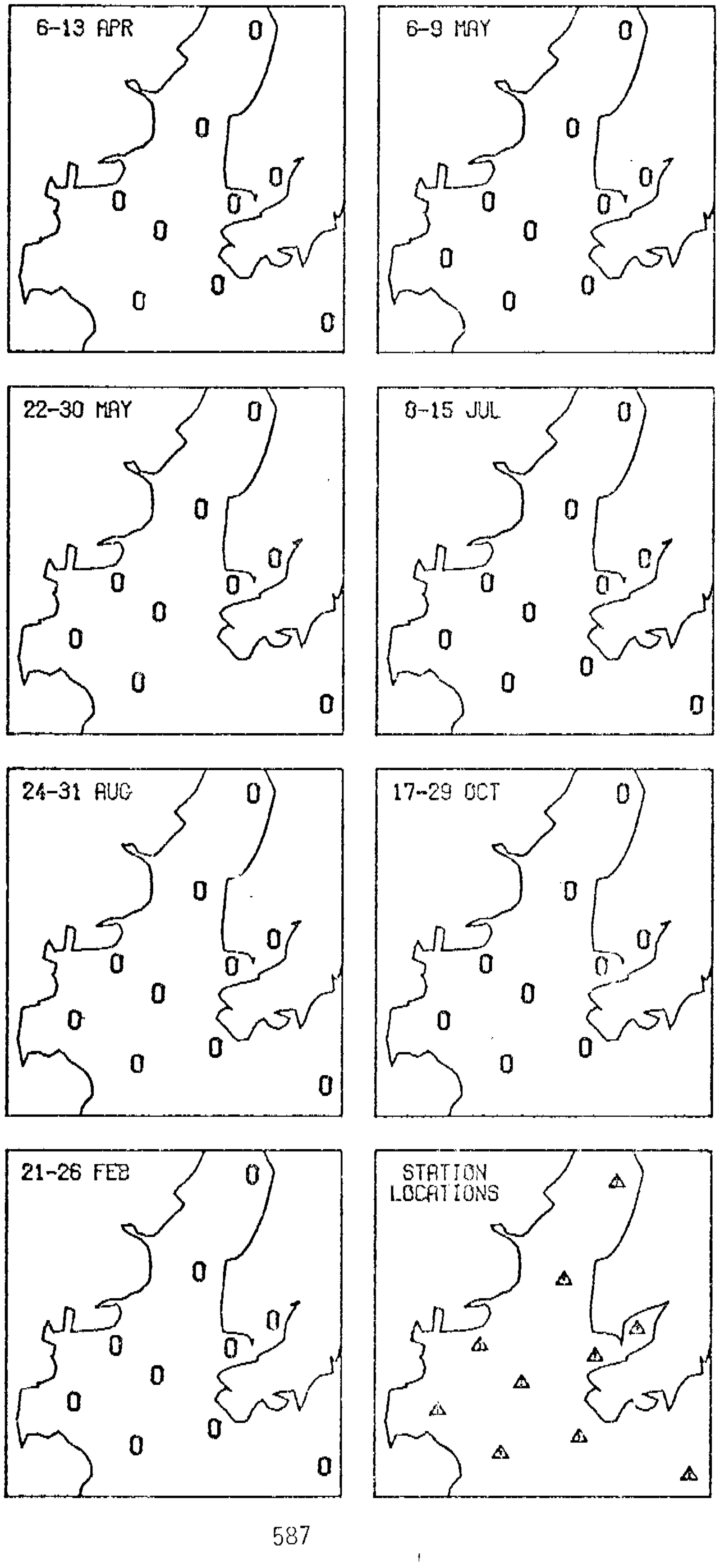


Figure 71.

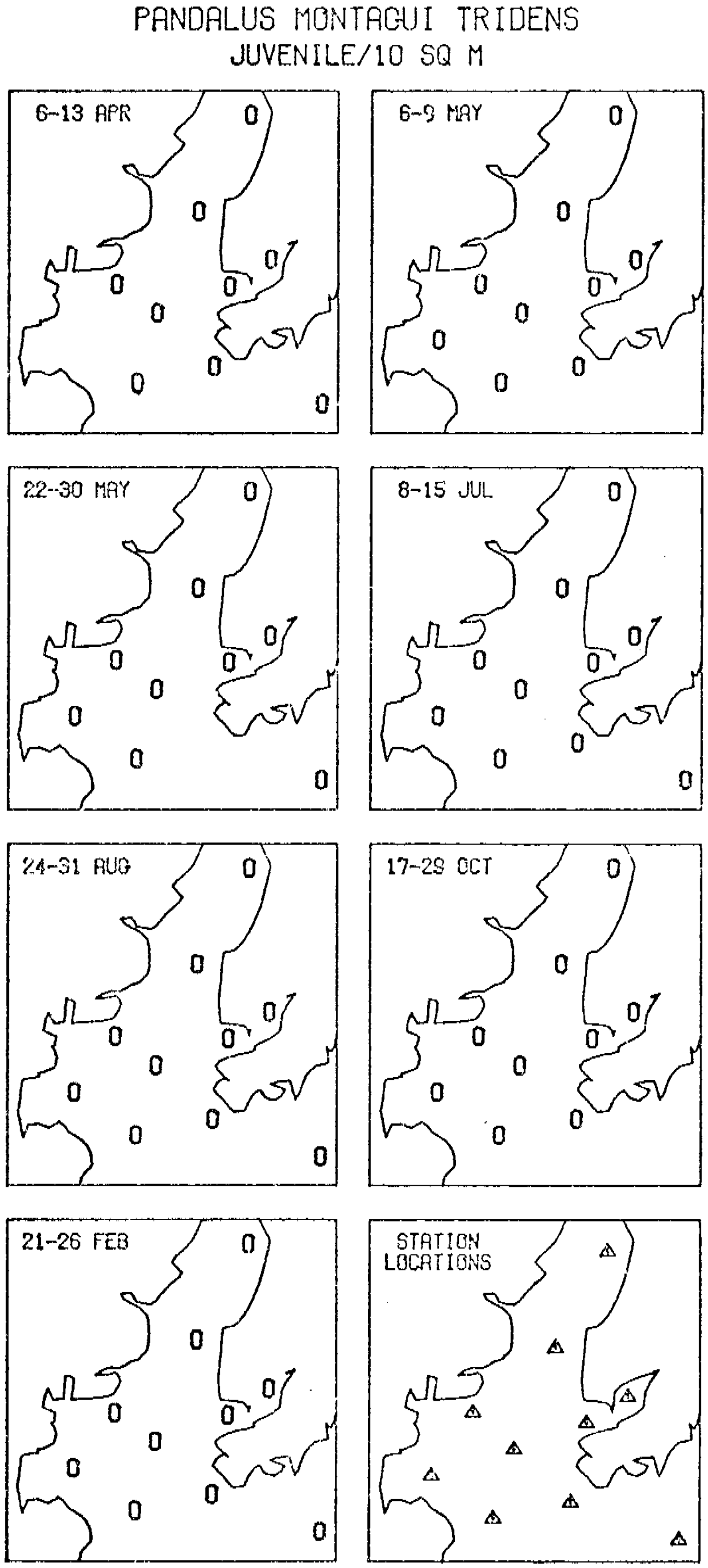

PANDALUS MONTAGUI TRIDENS
JUVENILE/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION
LOCATIONS

Figure 72.

ANOMURA
ZOEA/10 SQ M

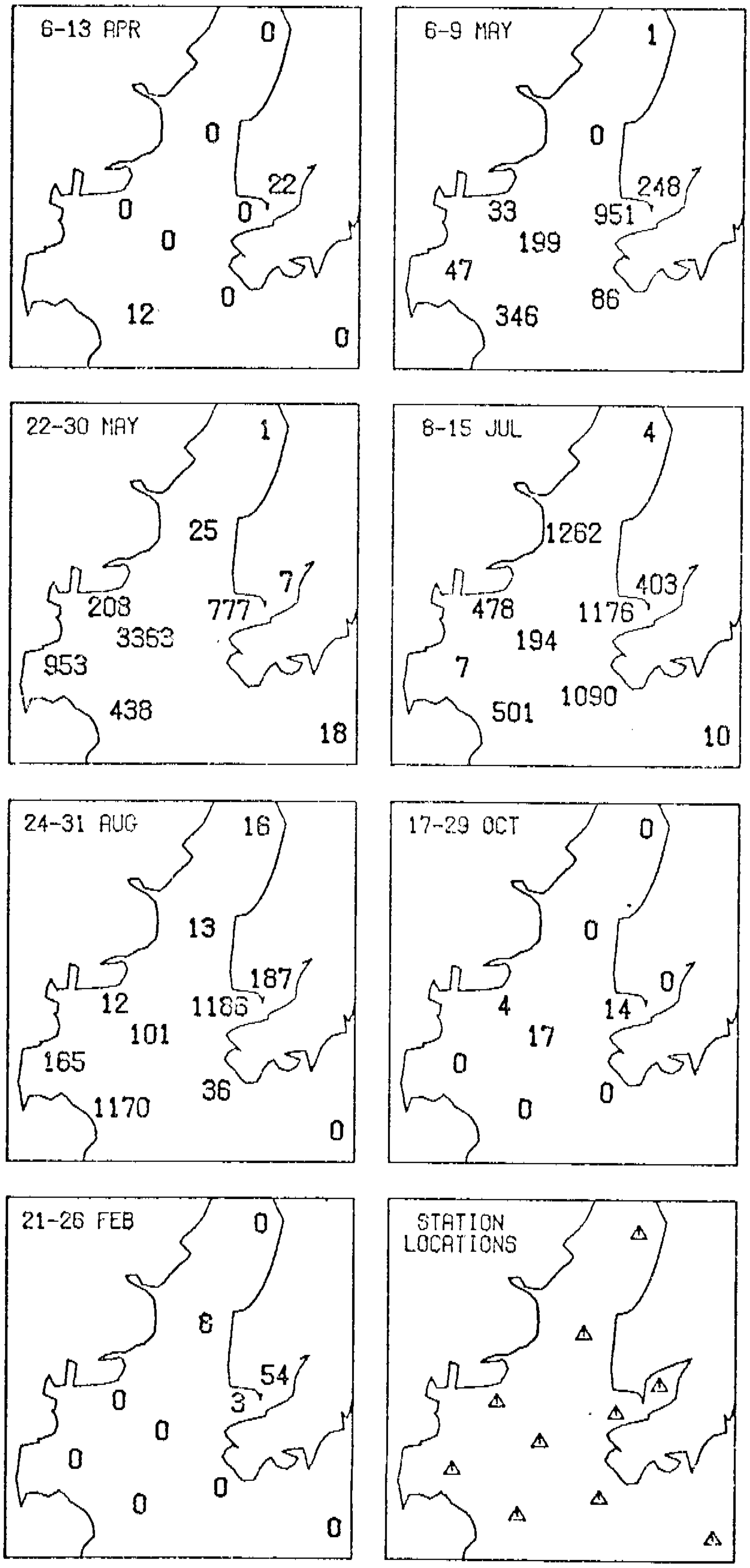


Figure 73.

ANOMURA
MEGALOPA/10 SQ M

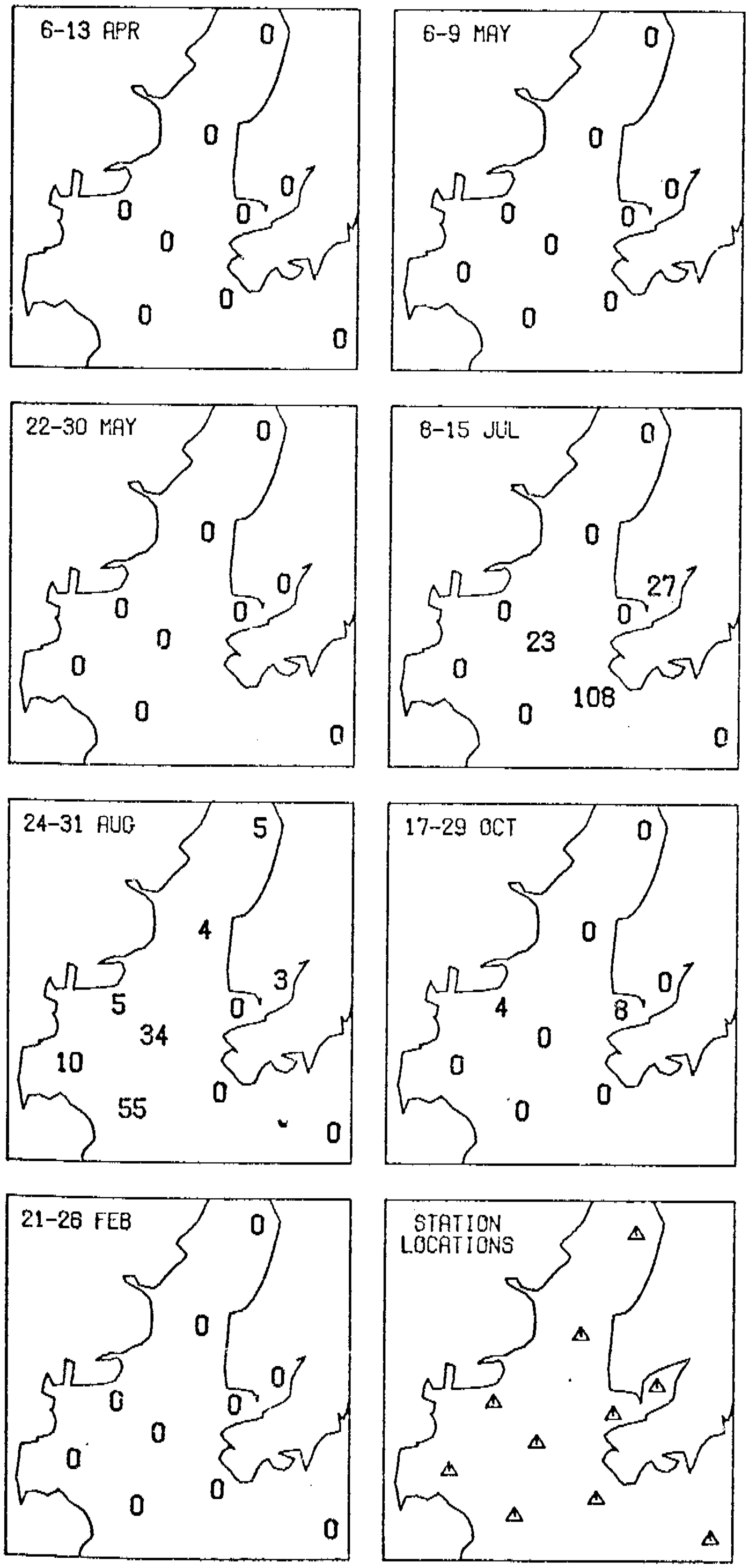


Figure 74.

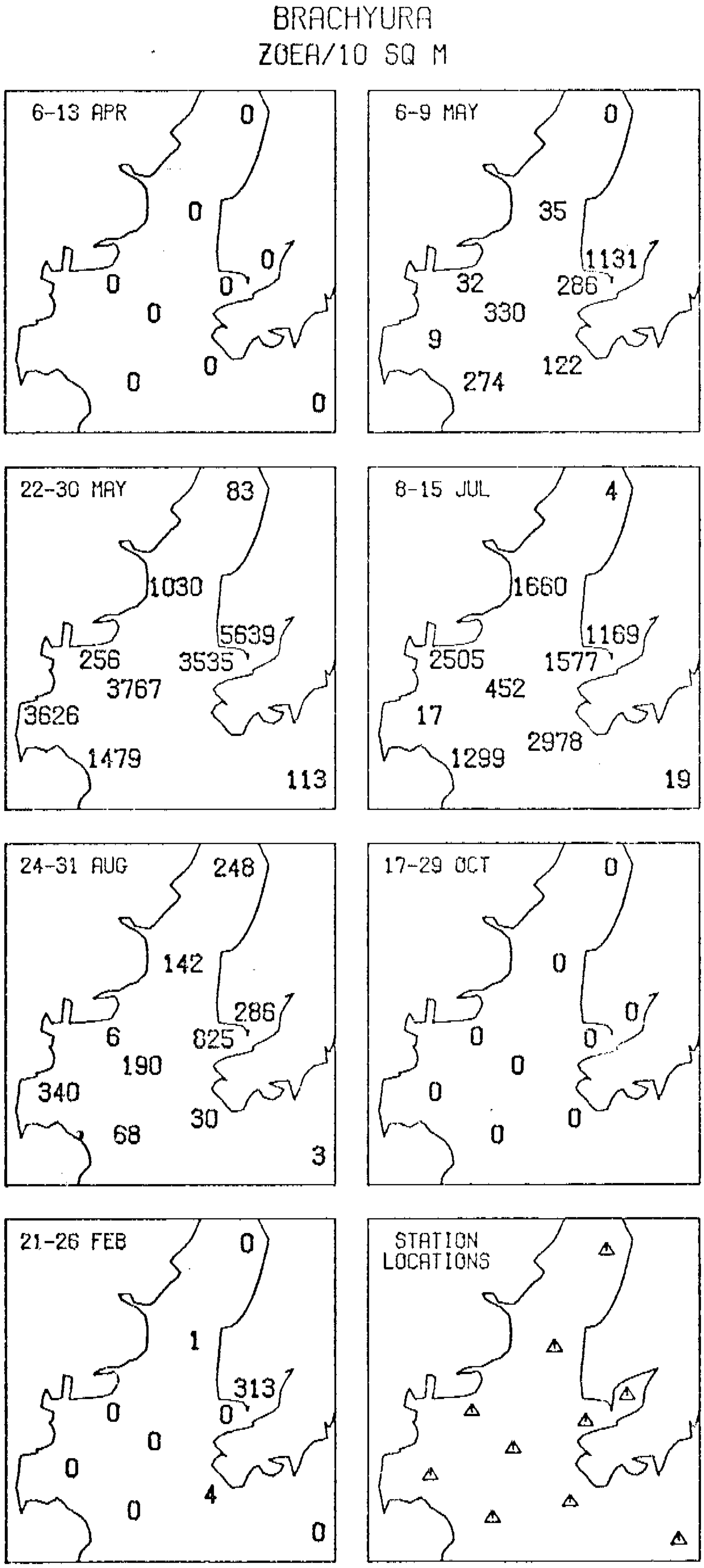
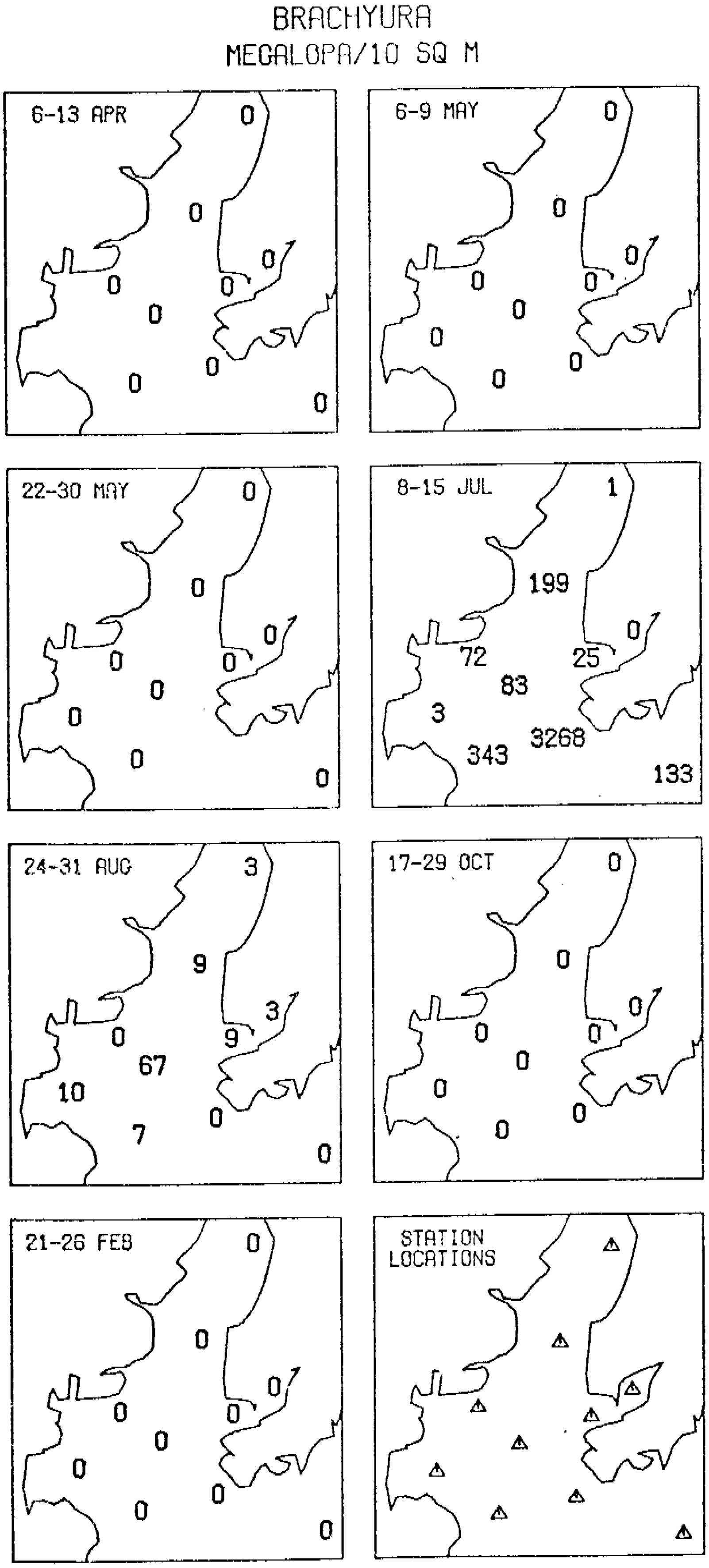

BRACHYURA
ZOEA/10 SQ M
6-13 APR
0
0
0
0
0
0
0
0
0
6-9 MAY
0
35
1131
32
286
330
9
122
274
22-30 MAY
83
1030
5639
256
3535
3767
3626
1479
113
8-15 JUL
4
1660
1169
2505
1577
452
17
2978
1299
19
24-31 AUG
248
142
286
6
825
190
340
30
68
3
17-29 OCT
0
0
0
0
0
0
0
0
0
21-26 FEB
0
1
313
0
0
0
0
4
0
0
STATION
LOCATIONS

Figure 75.


BRACHYURA
MEGALOPA/10 SQ M
6-13 APR
0
0
0
0
0
0
0
0
0
0
6-9 MAY
0
0
0
0
0
0
0
0
0
0
22-30 MAY
0
0
0
0
0
0
0
0
0
0
8-15 JUL
1
199
0
72
25
83
3
3268
343
133
24-31 AUG
3
9
3
0
9
67
10
0
7
0
17-29 OCT
0
0
0
0
0
0
0
0
0
0
21-26 FEB
0
0
0
0
0
0
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0
0
0
STATION
LOCATIONS

Figure 76.

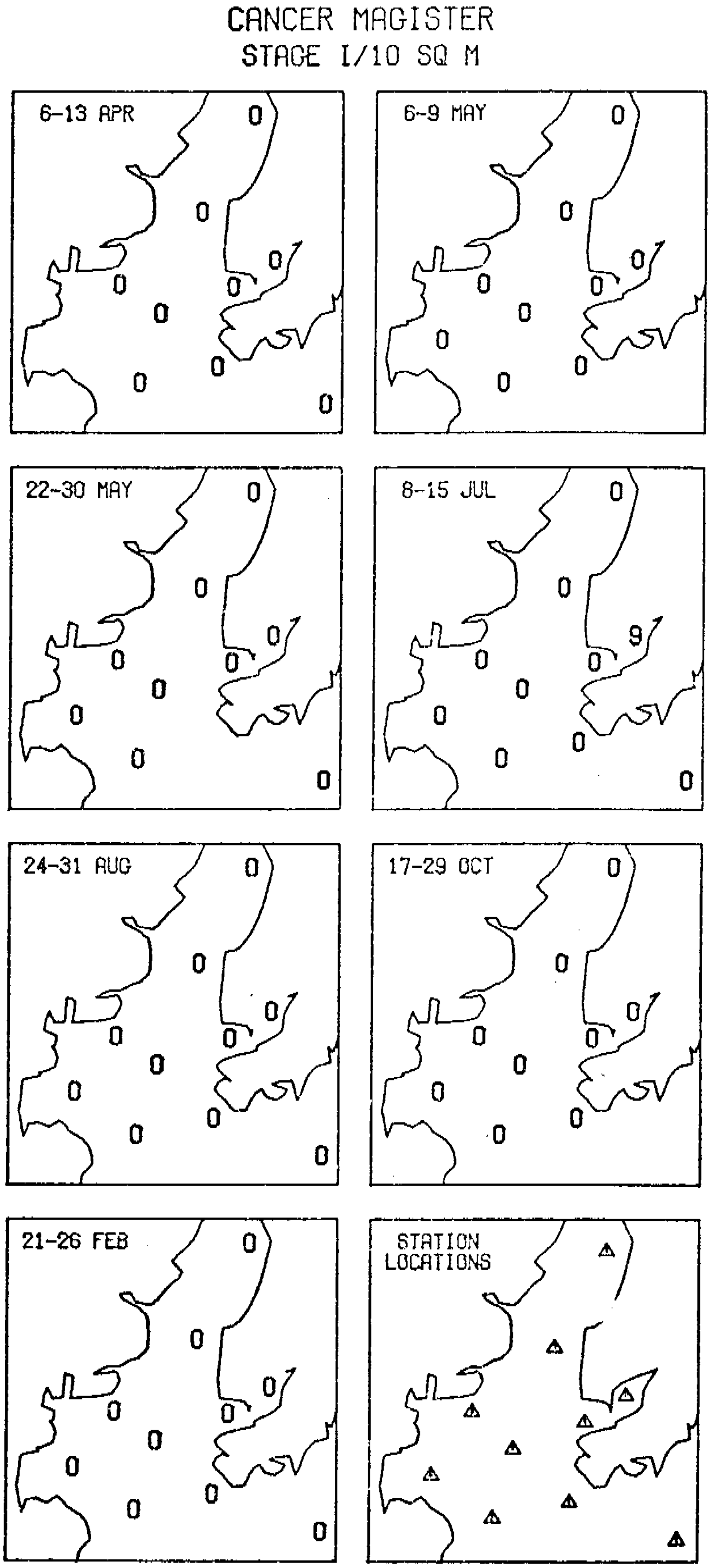

CANCER MAGISTER
STAGE I/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 77.

CANCER MAGISTER
STAGE II/10 SQ M

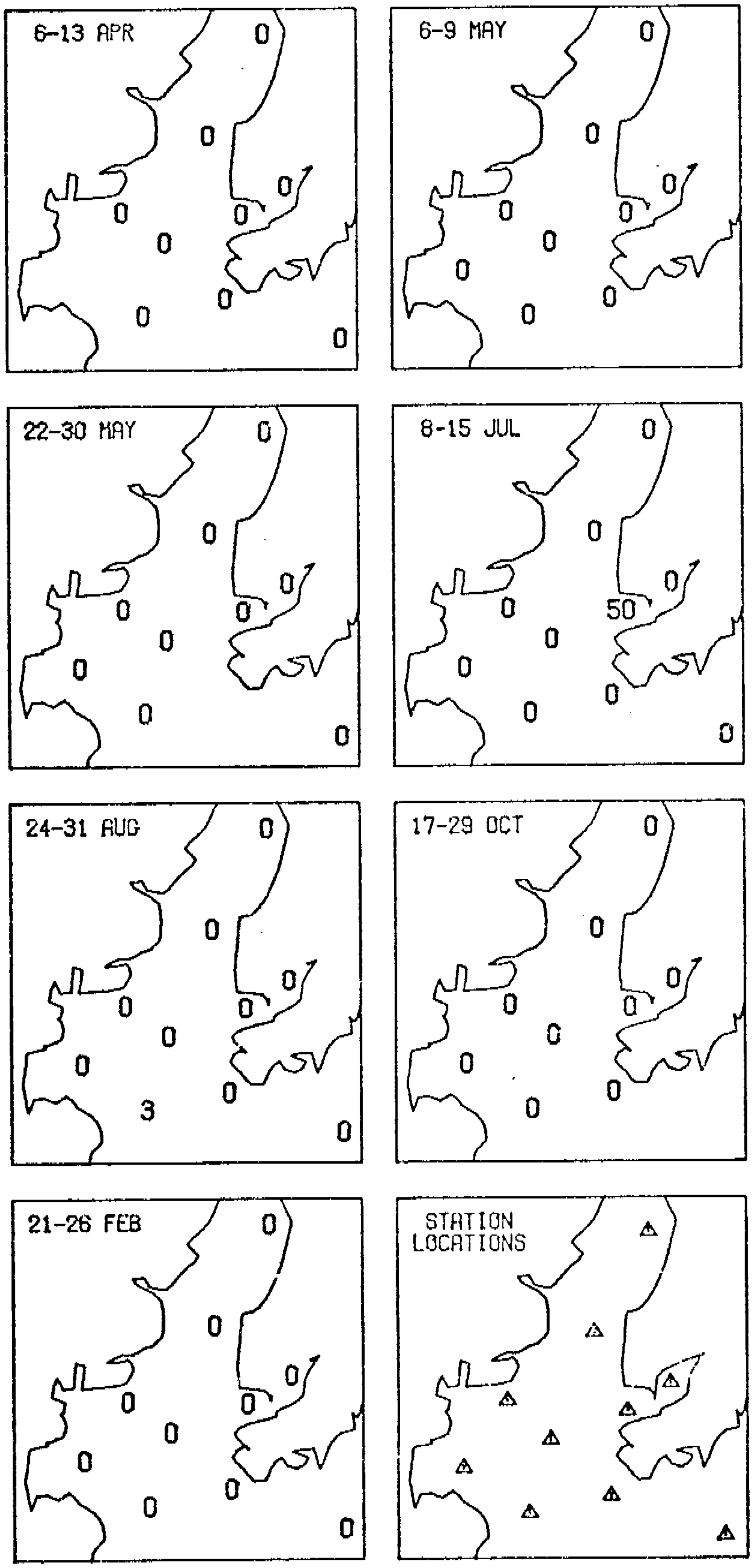


Figure 78.

CANCER MAGISTER
STAGE III/10 SQ M

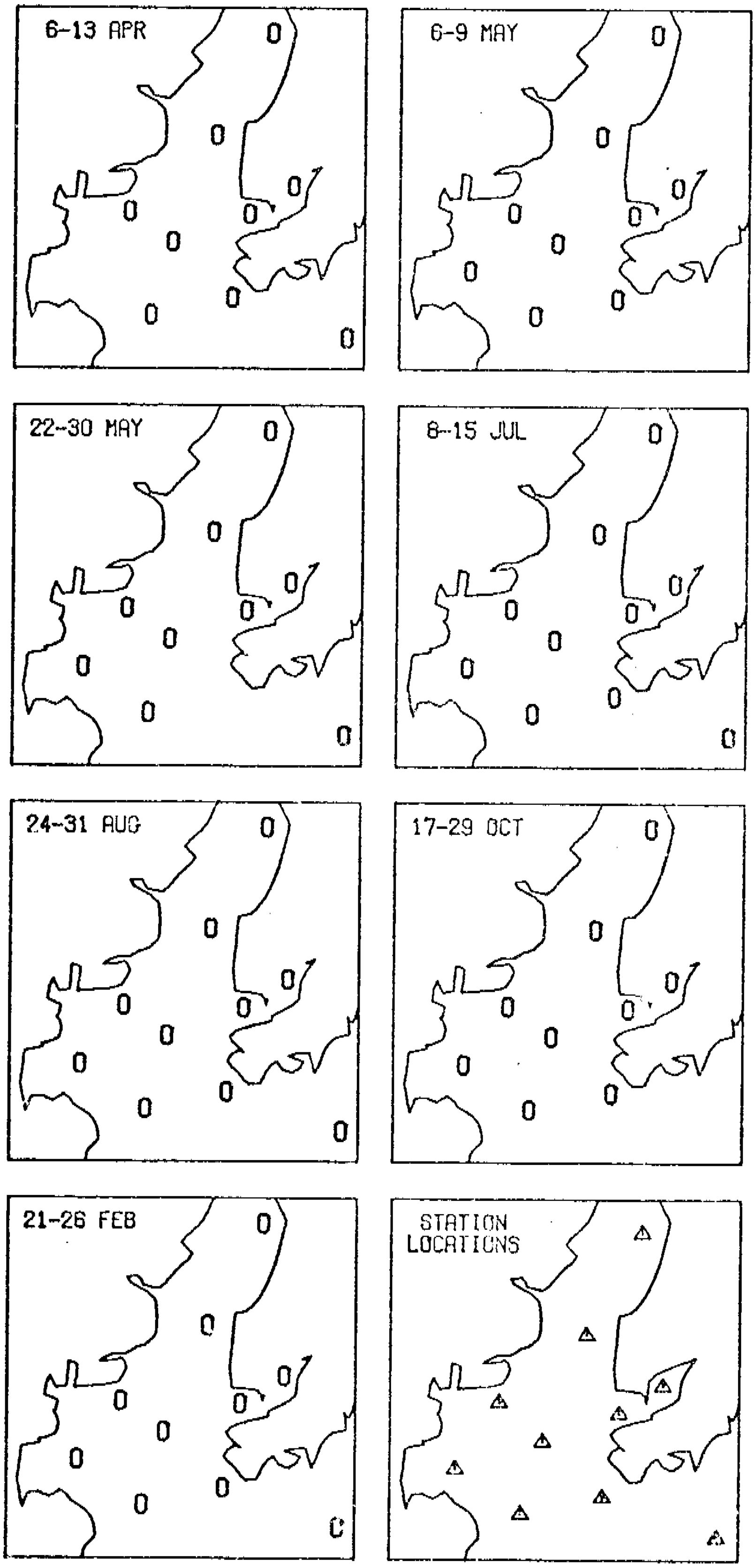
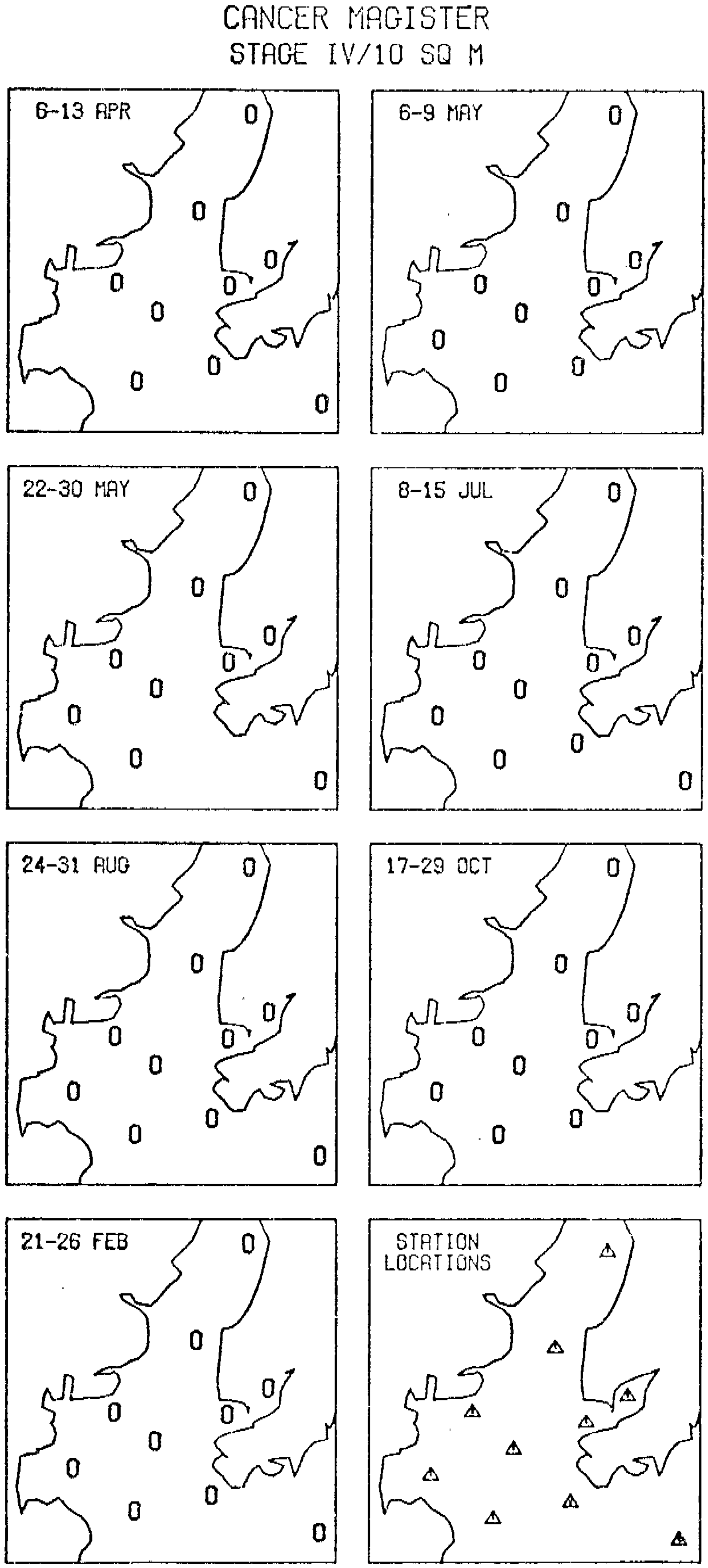


Figure 79.


CANCER MAGISTER
STAGE IV/10 SQ M
6-13 APR
0
0
0
0
0
0
0
0
0
0
6-9 MAY
0
0
0
0
0
0
0
0
0
22-30 MAY
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8-15 JUL
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24-31 AUG
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0
17-29 OCT
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21-26 FEB
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0
0
0
0
STATION
LOCATIONS

Figure 80.

CANCER MAGISTER
STAGE V/10 SQ M

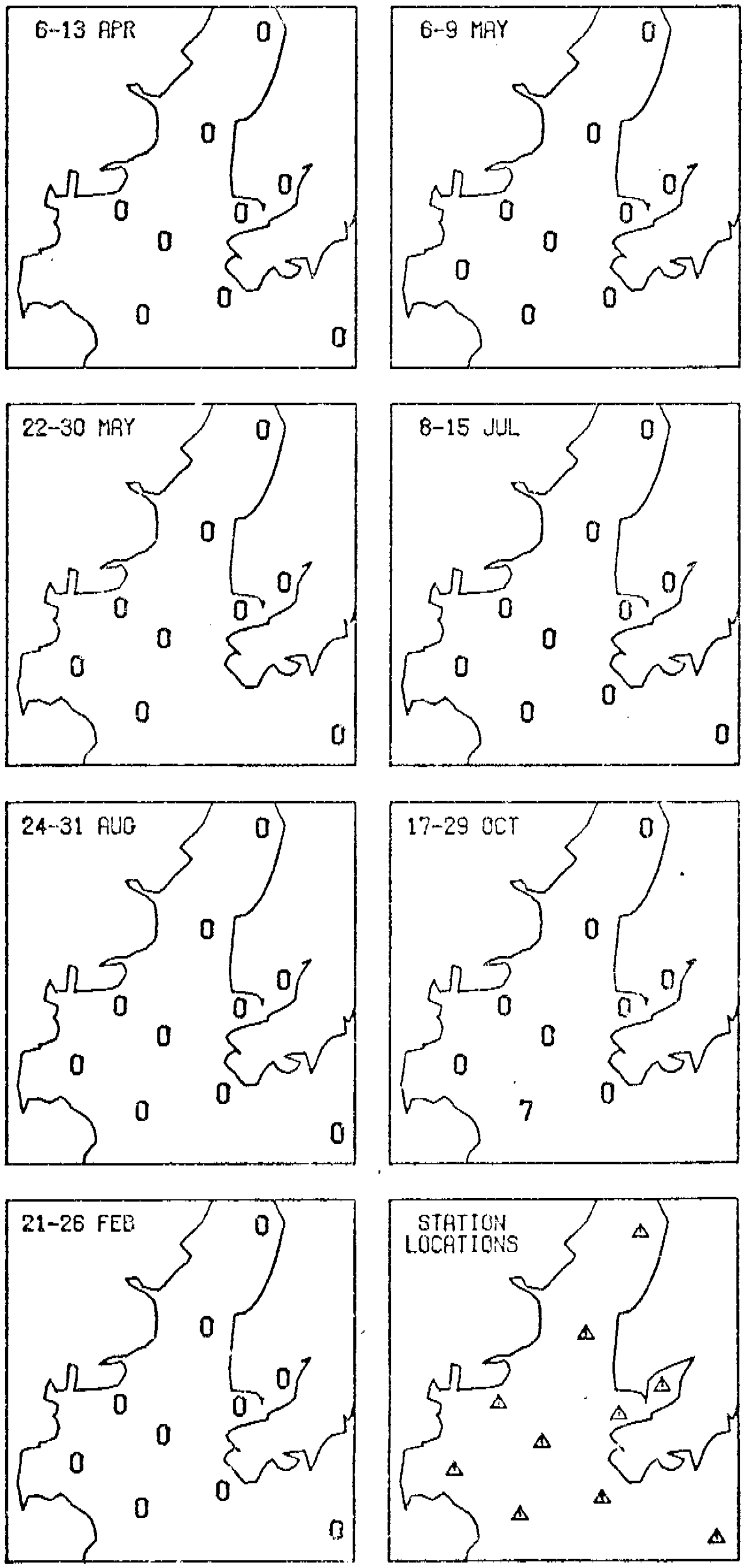


Figure 81.

CANCER MAGISTER
MEGALOPA/10 SQ M

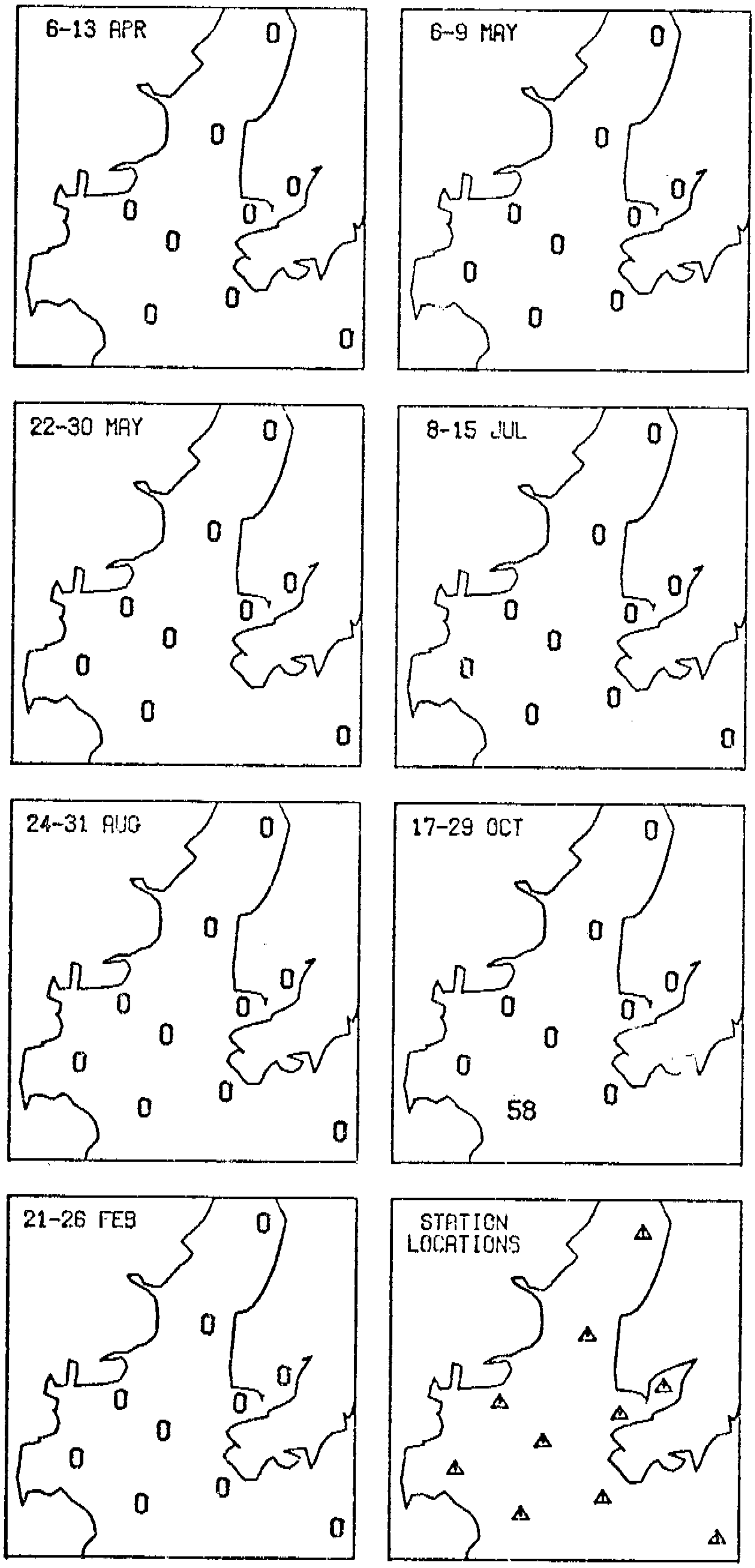


Figure 82.

CANCER OREGONENSIS
STAGE I/10 SQ M

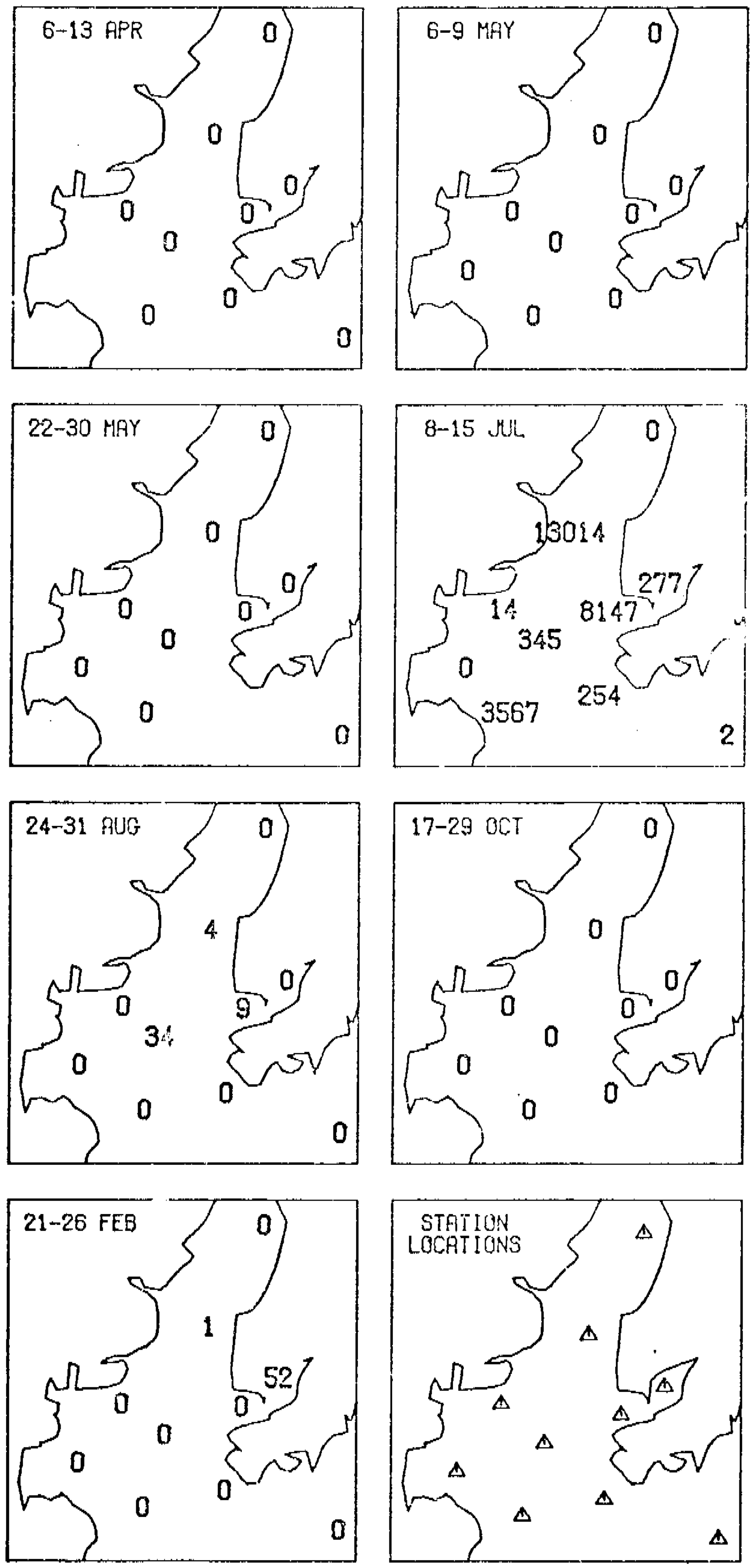


Figure 83.

CANCER OREGONENSIS
STAGE II/10 SQ M

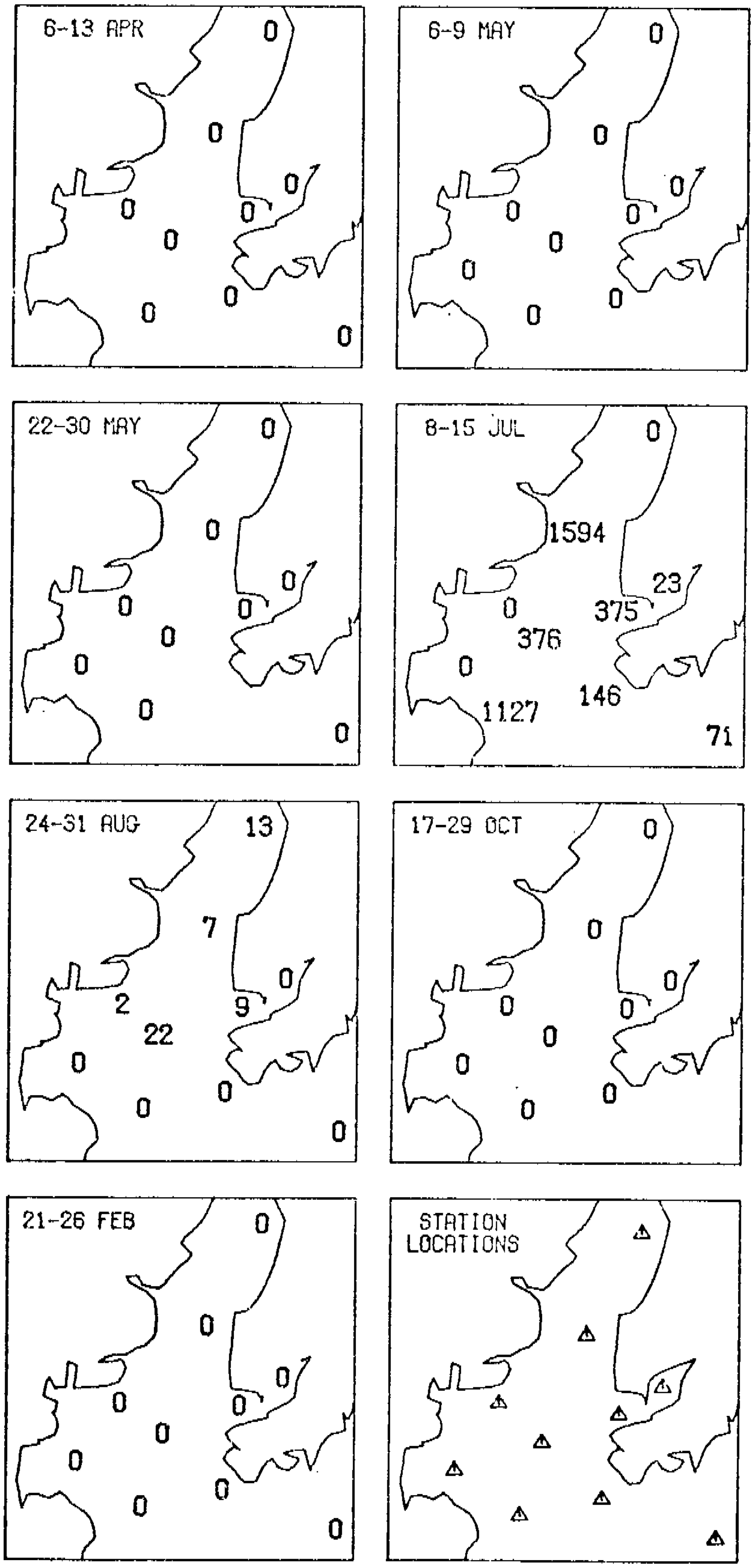


Figure 84.

CANCER OREGONENSIS
STAGE III/10 SQ M

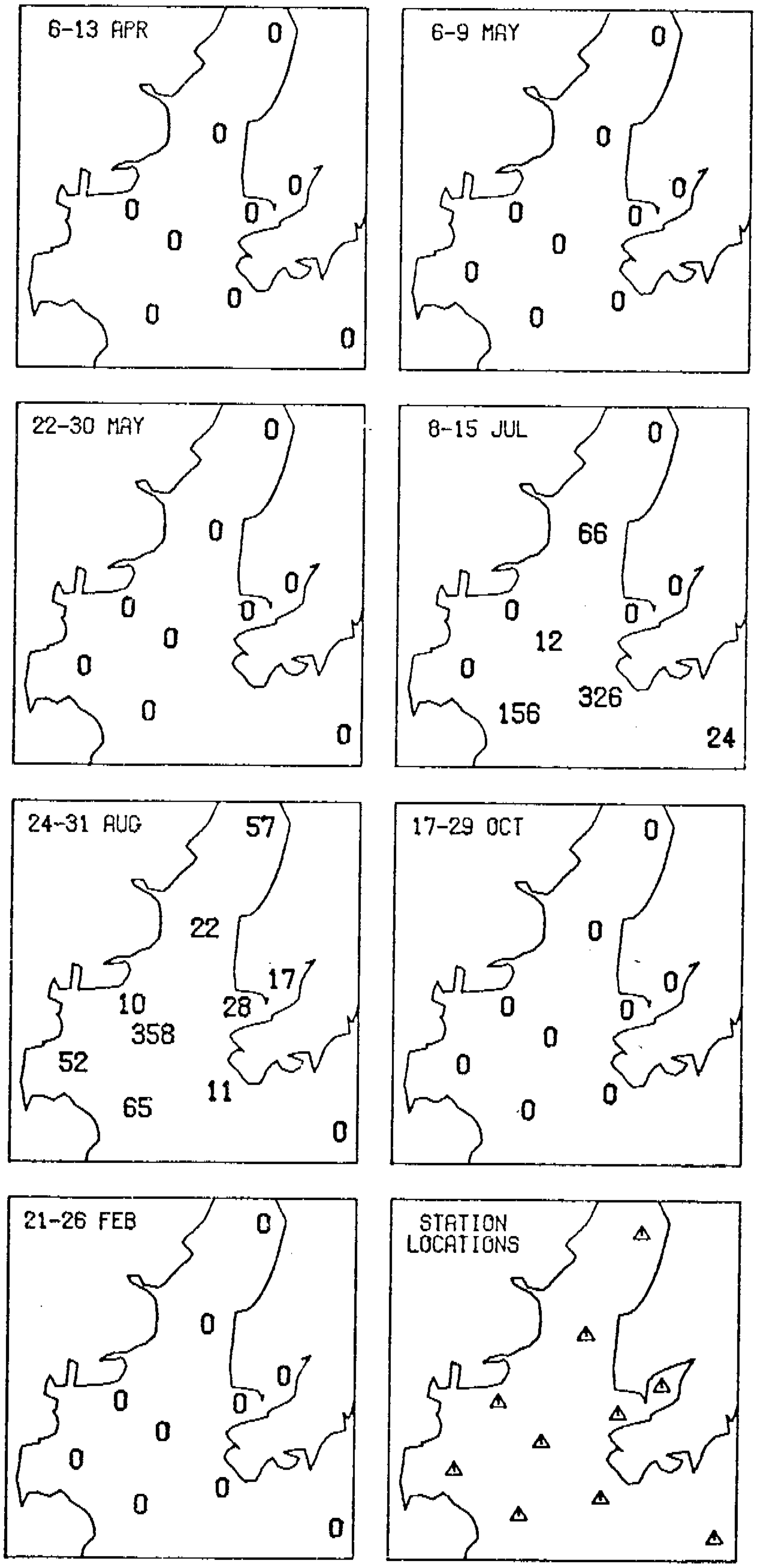


Figure 85.

CANCER OREGONENSIS
STAGE IV/10 SQ M

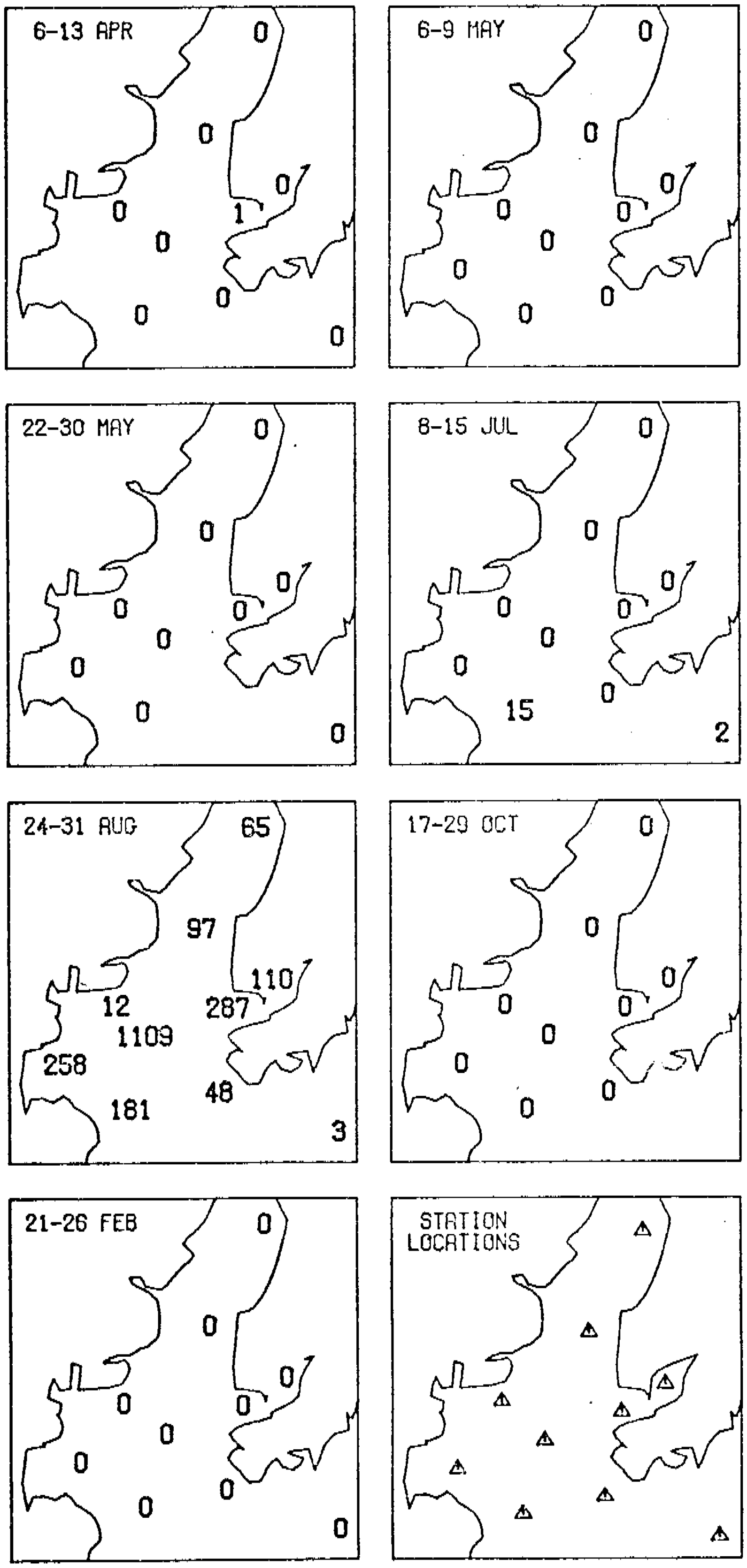


Figure 86.

CANCER OREGONENSIS
STAGE V/10 SQ M

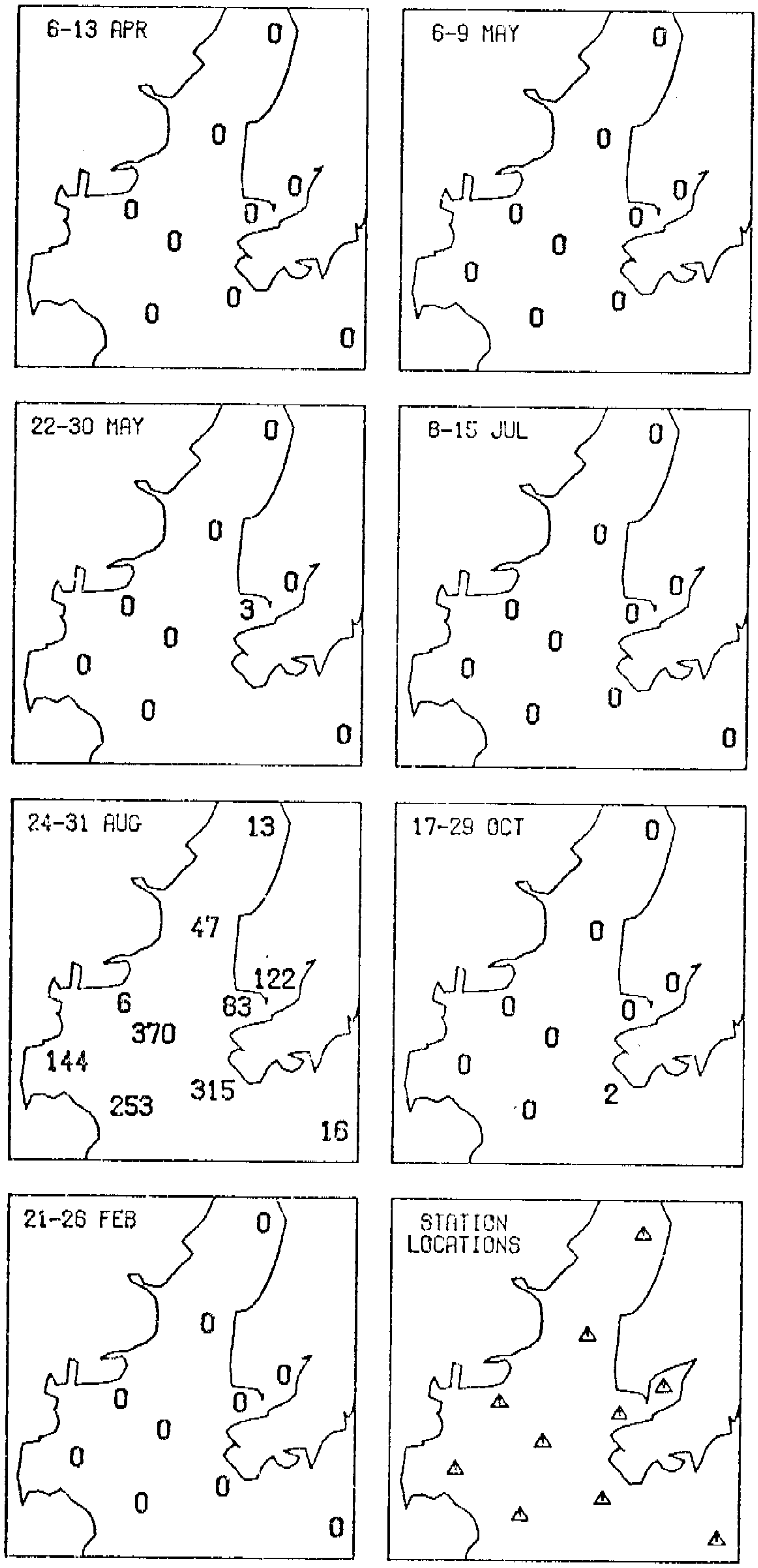


Figure 87.

CANCER OREGONENSIS
MEGALOPA/10 SQ M

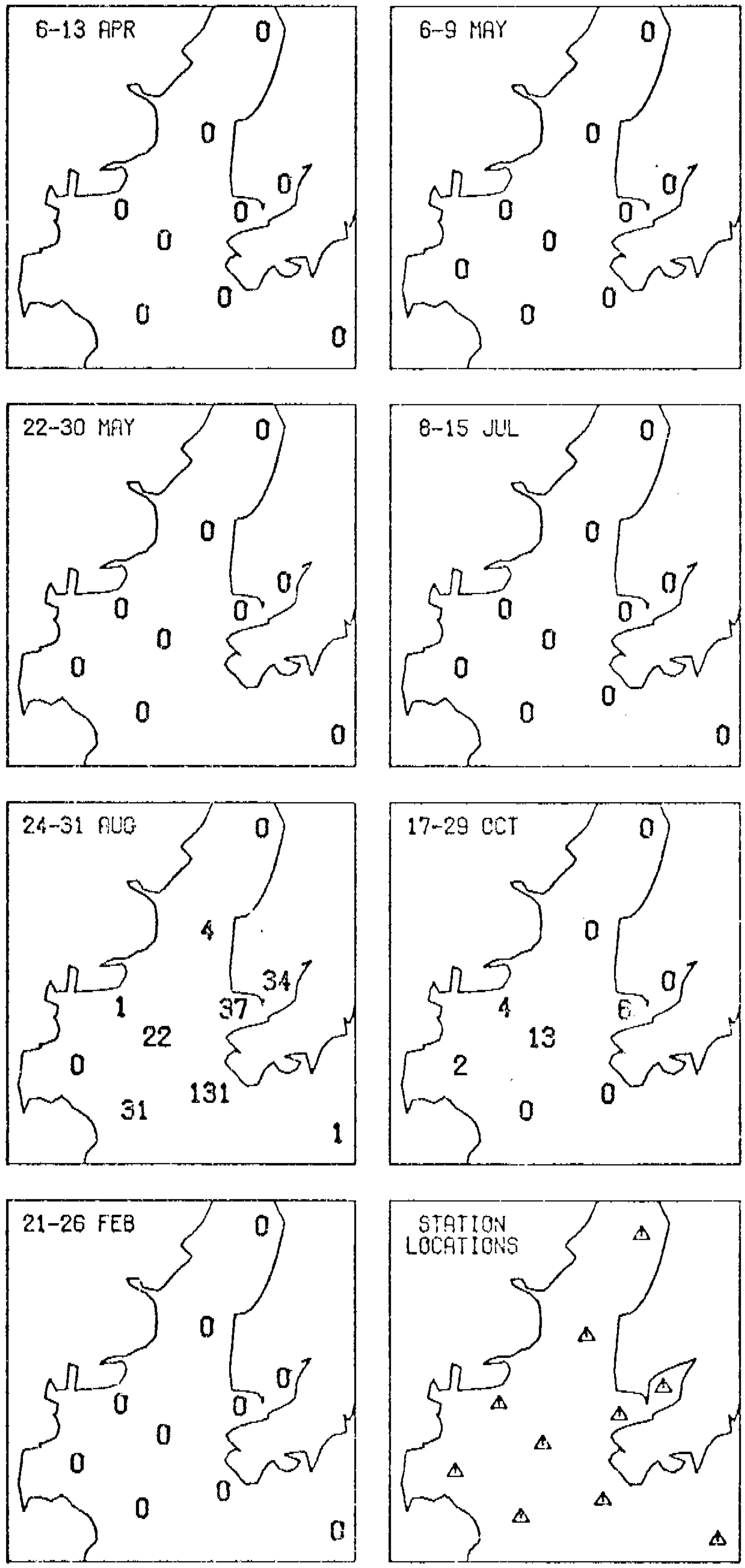


Figure 88.

CANCER PRODUCTUS
STAGE I/10 SQ M

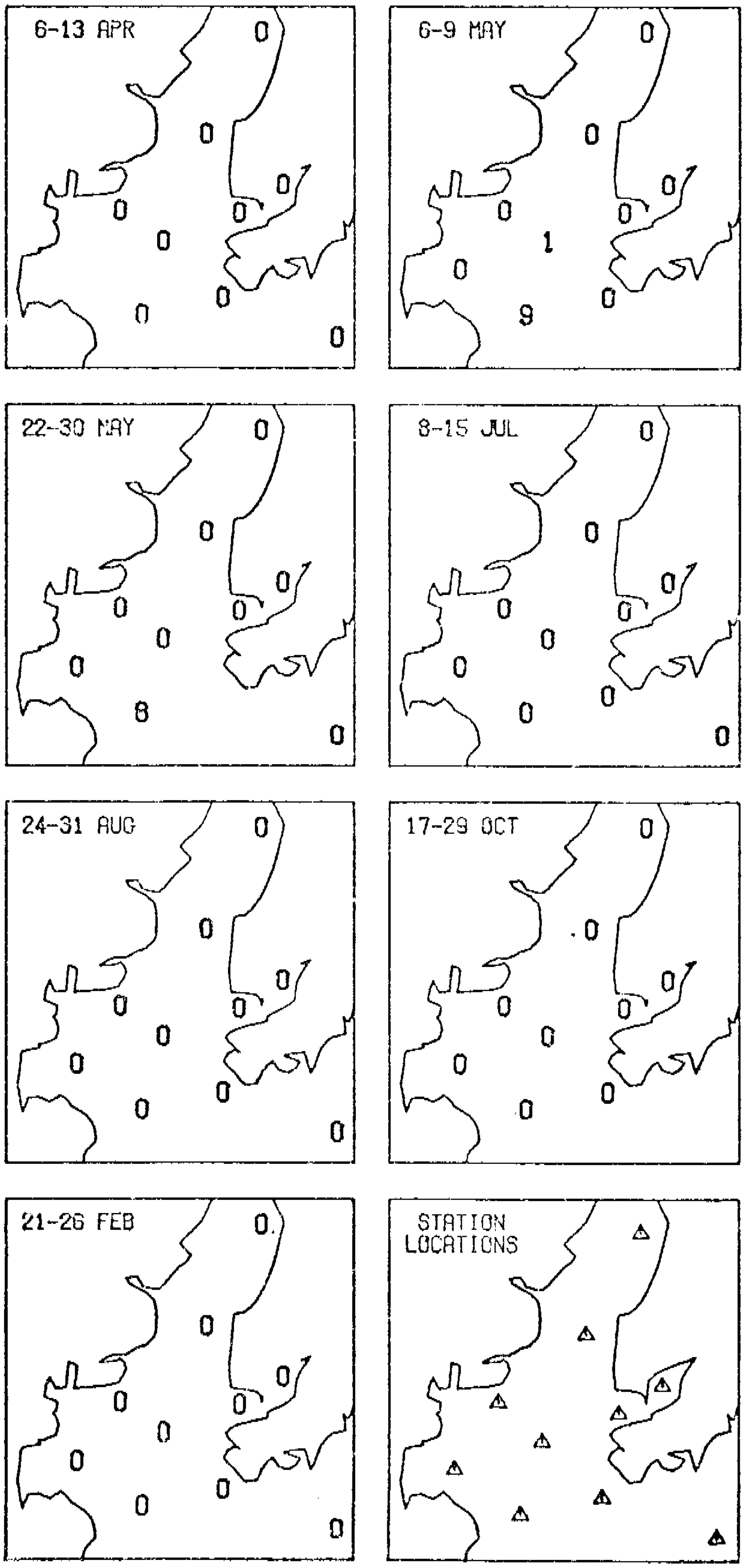


Figure 89.

CANCER PRODUCTUS
STAGE II/10 SQ M

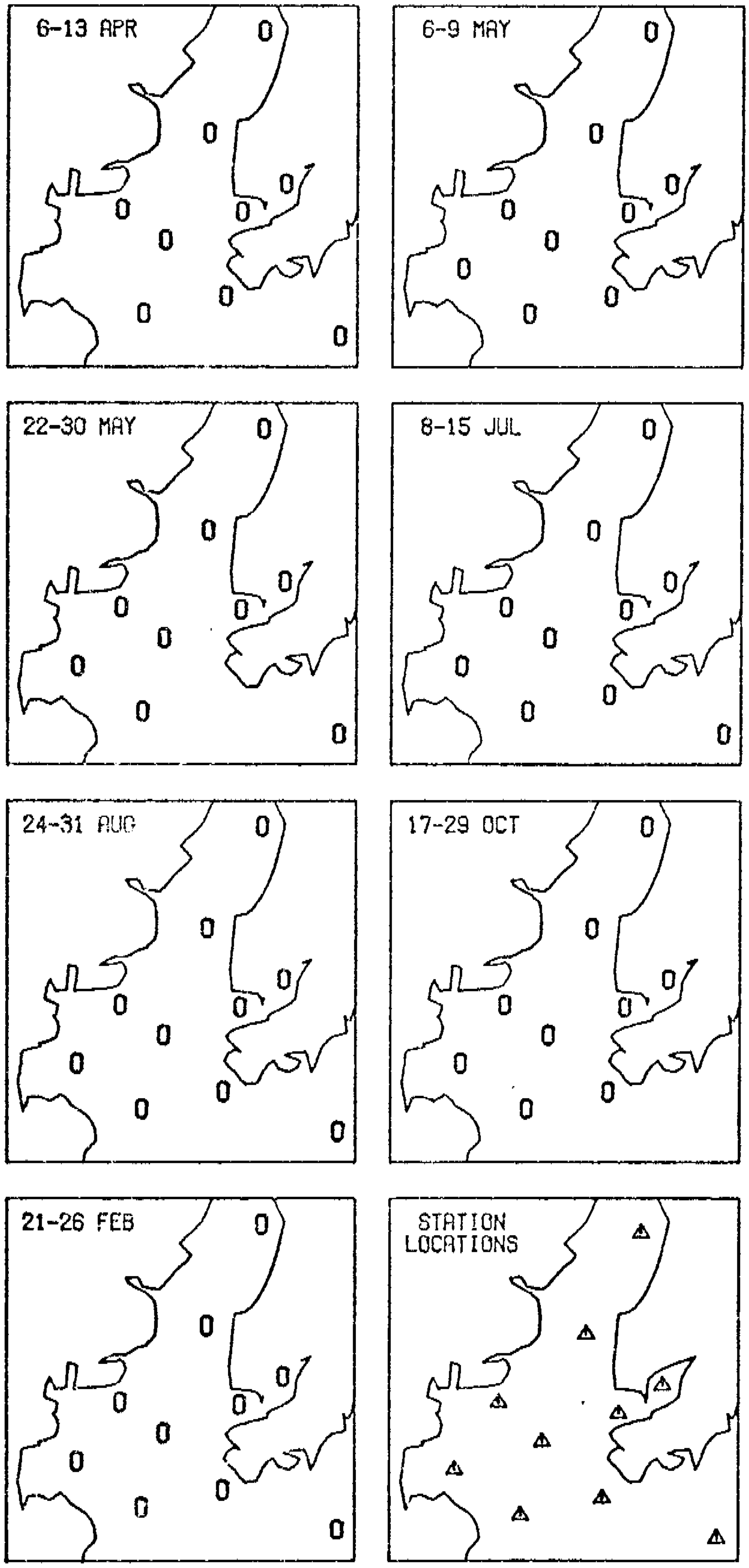


Figure 90.

CANCER PRODUCTUS
STAGE III/10 SQ M

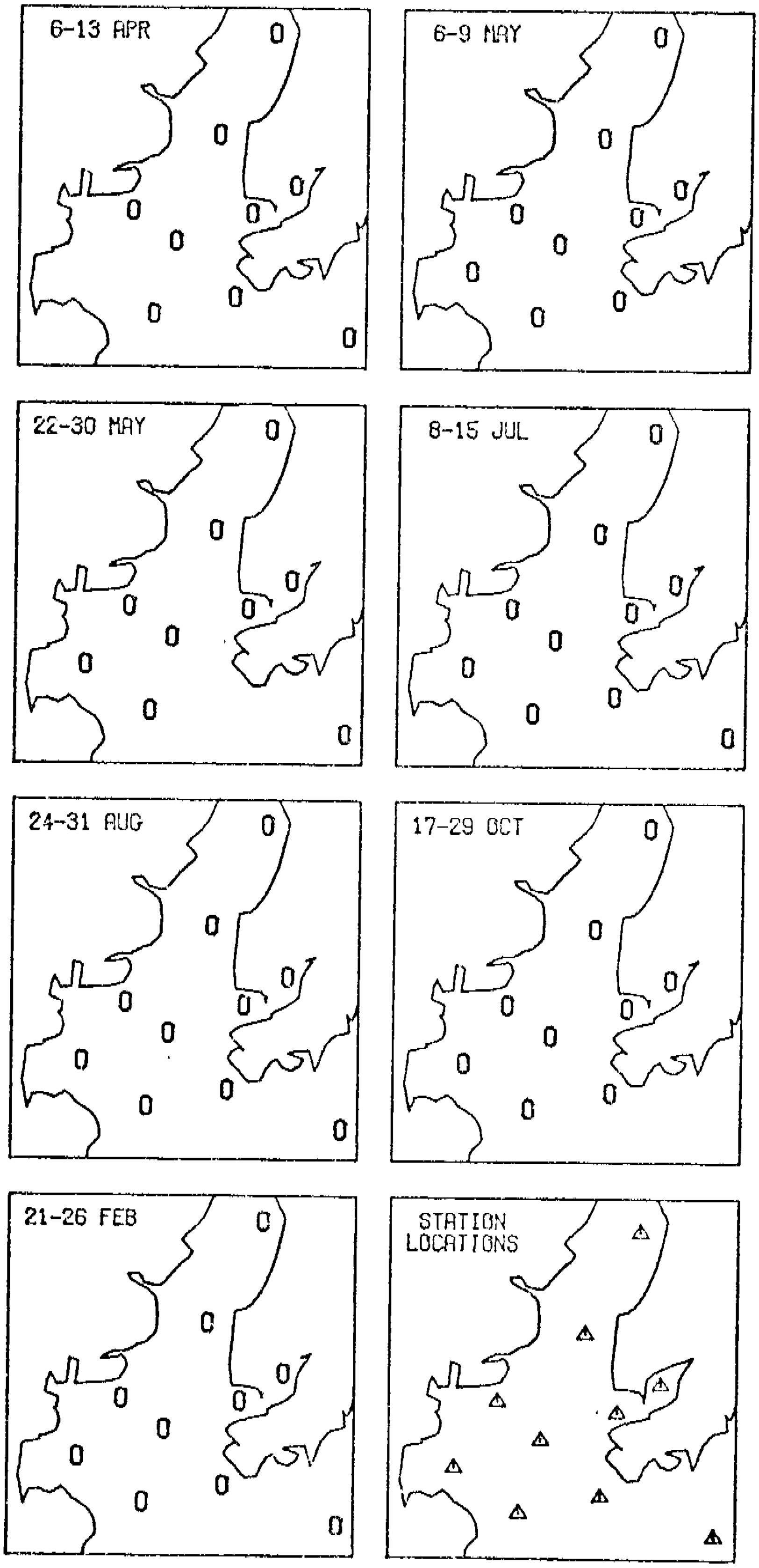


Figure 91.

CANCER PRODUCTUS
STAGE IV/10 SQ M

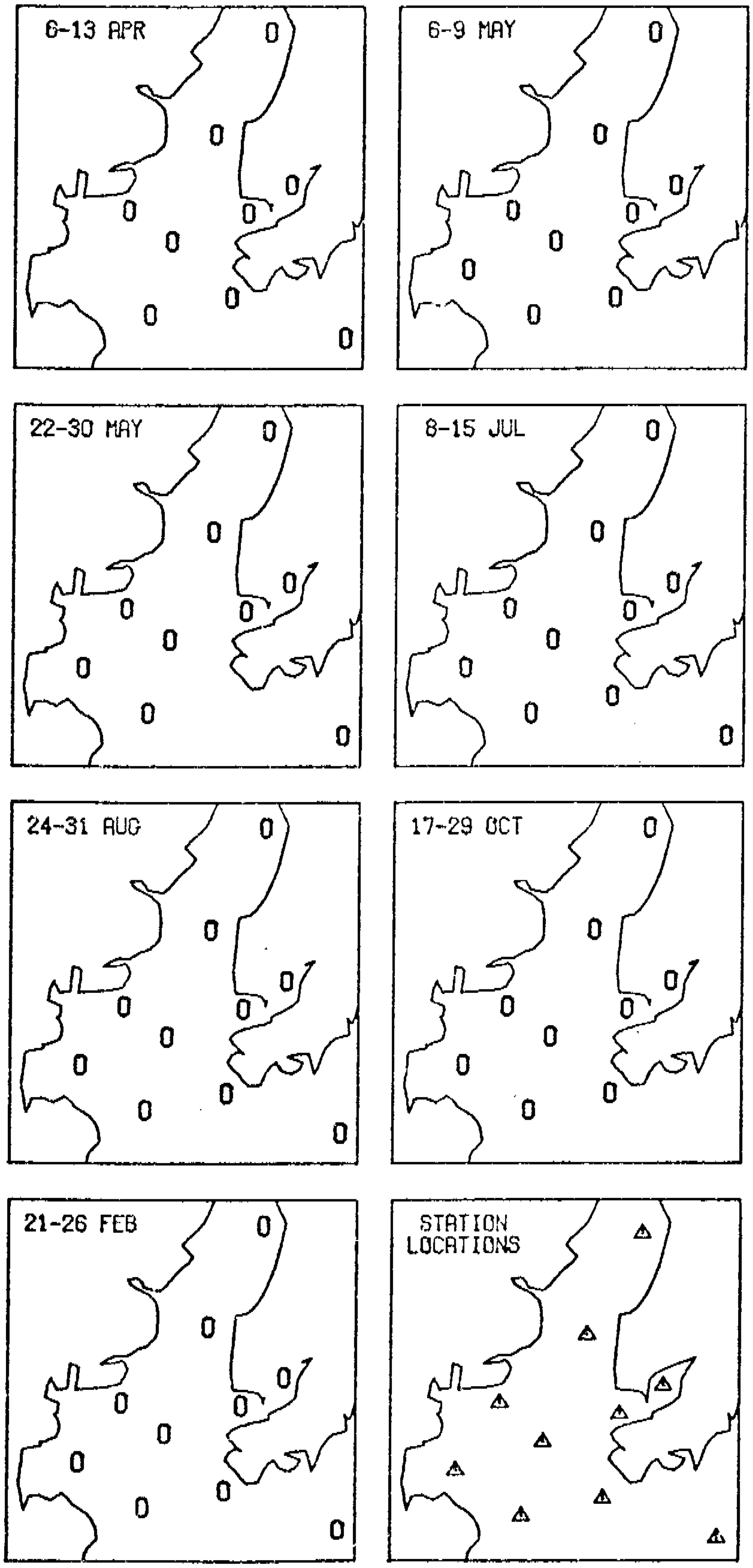


Figure 92.

CANCER PRODUCTUS
STAGE V/10 SQ M

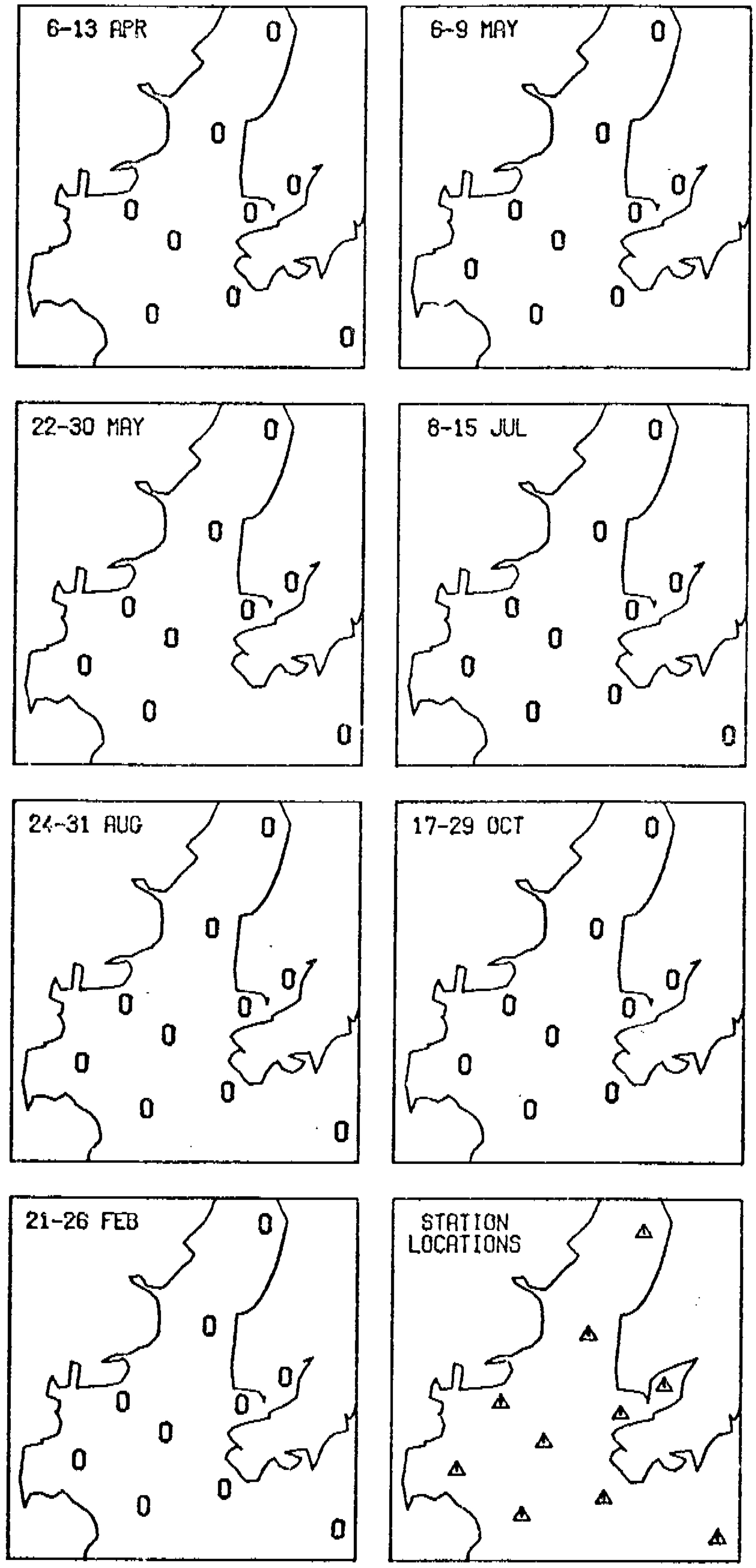


Figure 93.

CANCER PRODUCTUS
MEGALOPA/10 SQ M

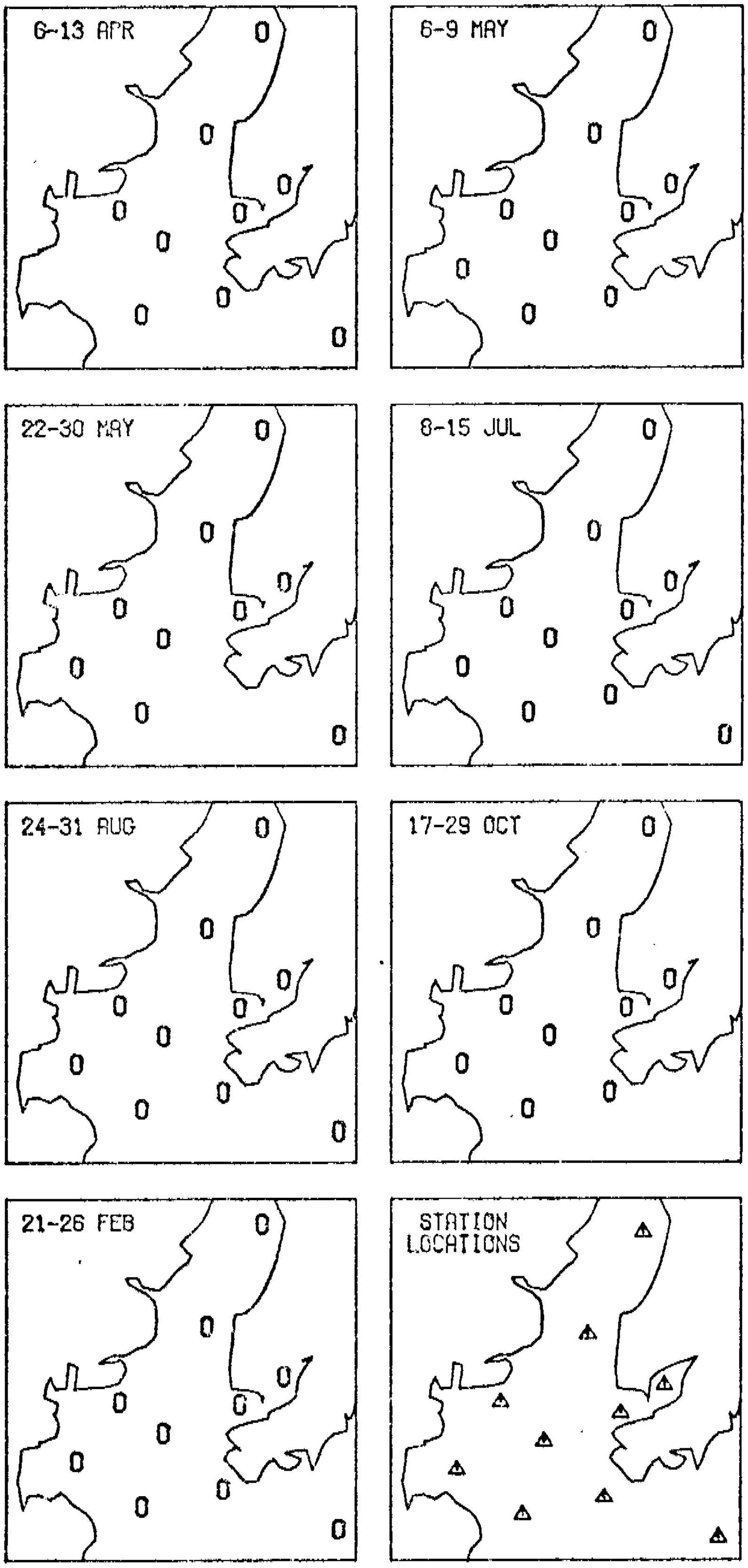
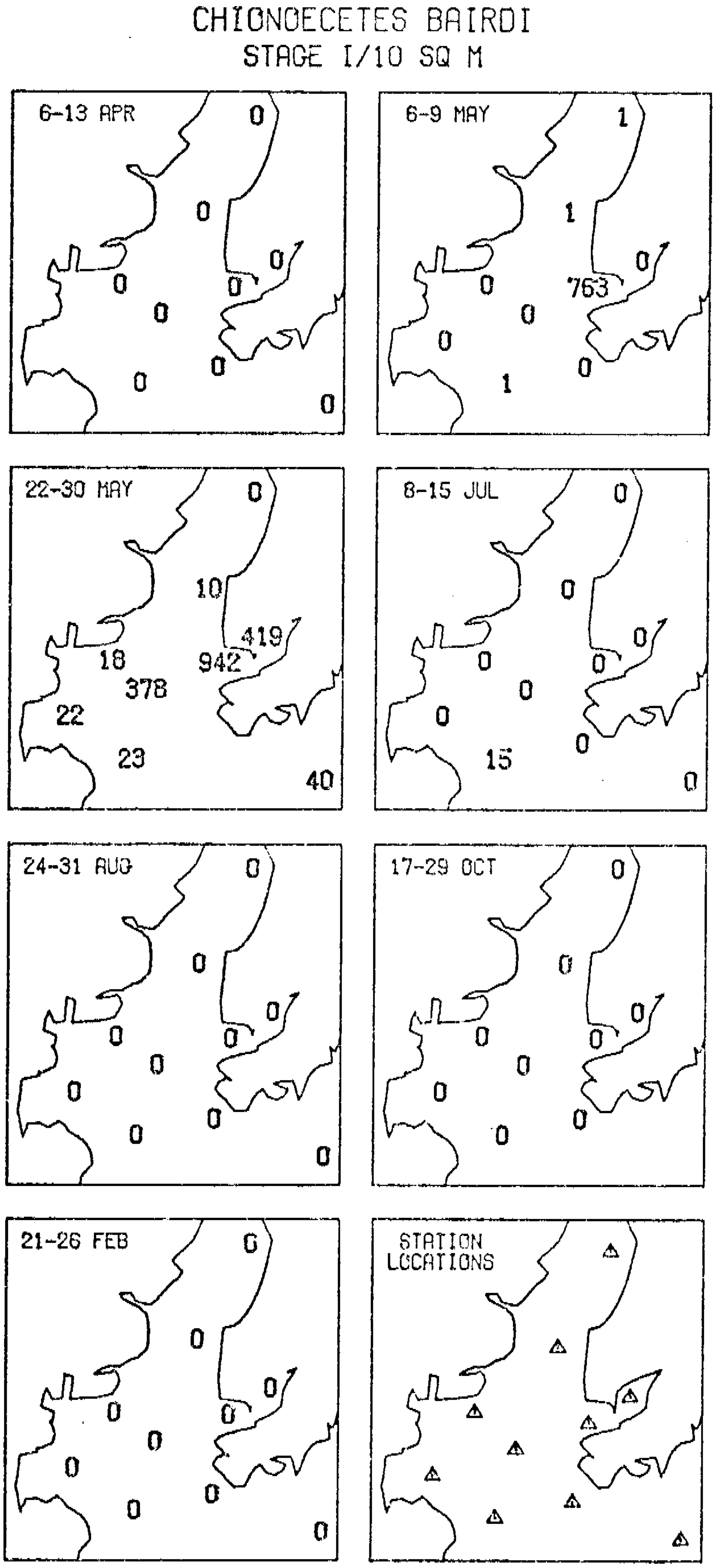


Figure 94.


CHIONOECETES BAIRDI
STAGE I/10 SQ M
6-13 APR
0
0
0
0
0
0
0
0
0
6-9 MAY
1
1
0
763
0
0
0
1
0
22-30 MAY
0
10
419
18
942
378
22
23
40
8-15 JUL
0
0
0
0
0
0
0
15
0
0
24-31 AUG
0
0
0
0
0
0
0
0
0
0
17-29 OCT
0
0
0
0
0
0
0
0
0
21-26 FEB
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0
0
0
0
STATION
LOCATIONS

Figure 95.

CHIONOECETES BAIRDI
STAGE II/10 SQ M

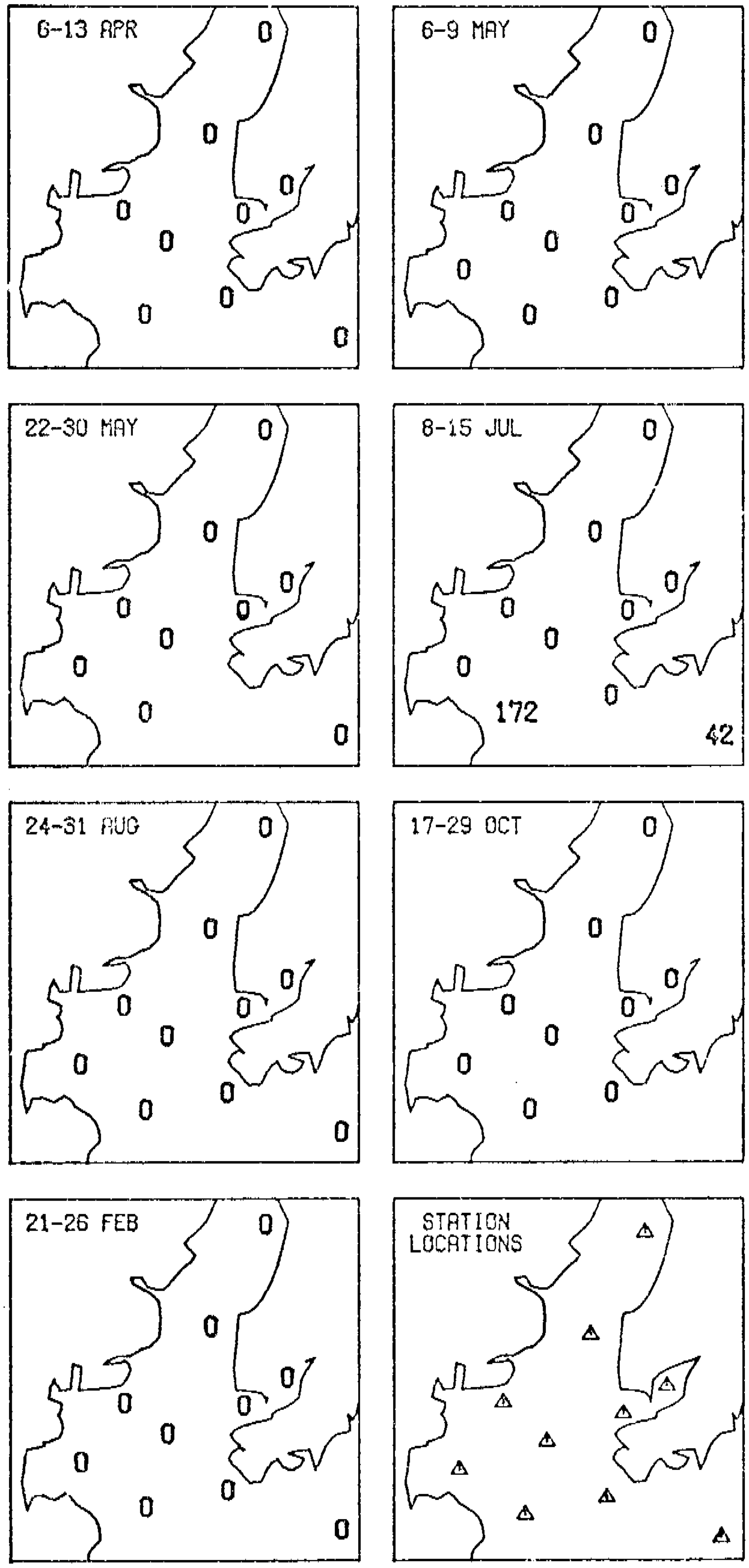


Figure 96. CHIONOECETES SP. MEGALOPA/10 SQ M

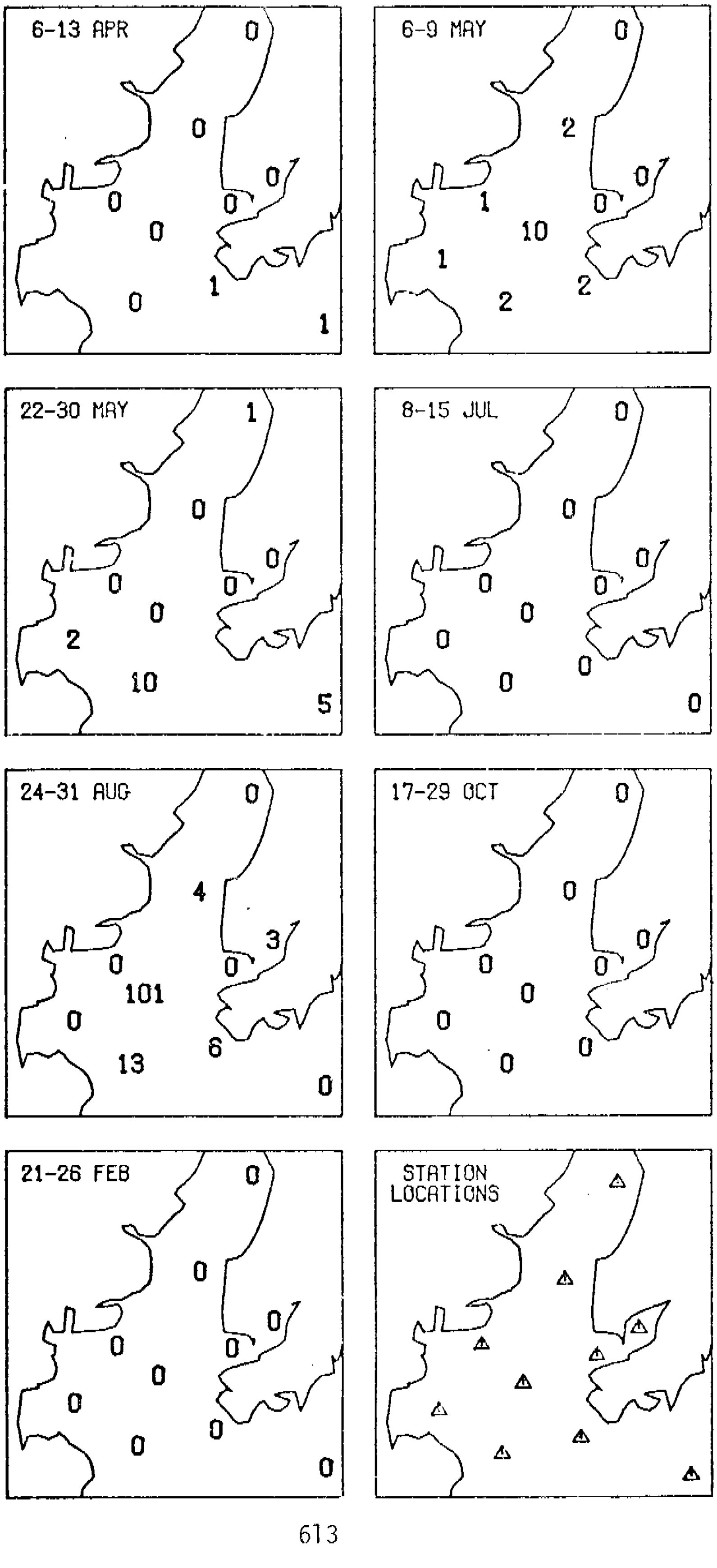


Figure 97.

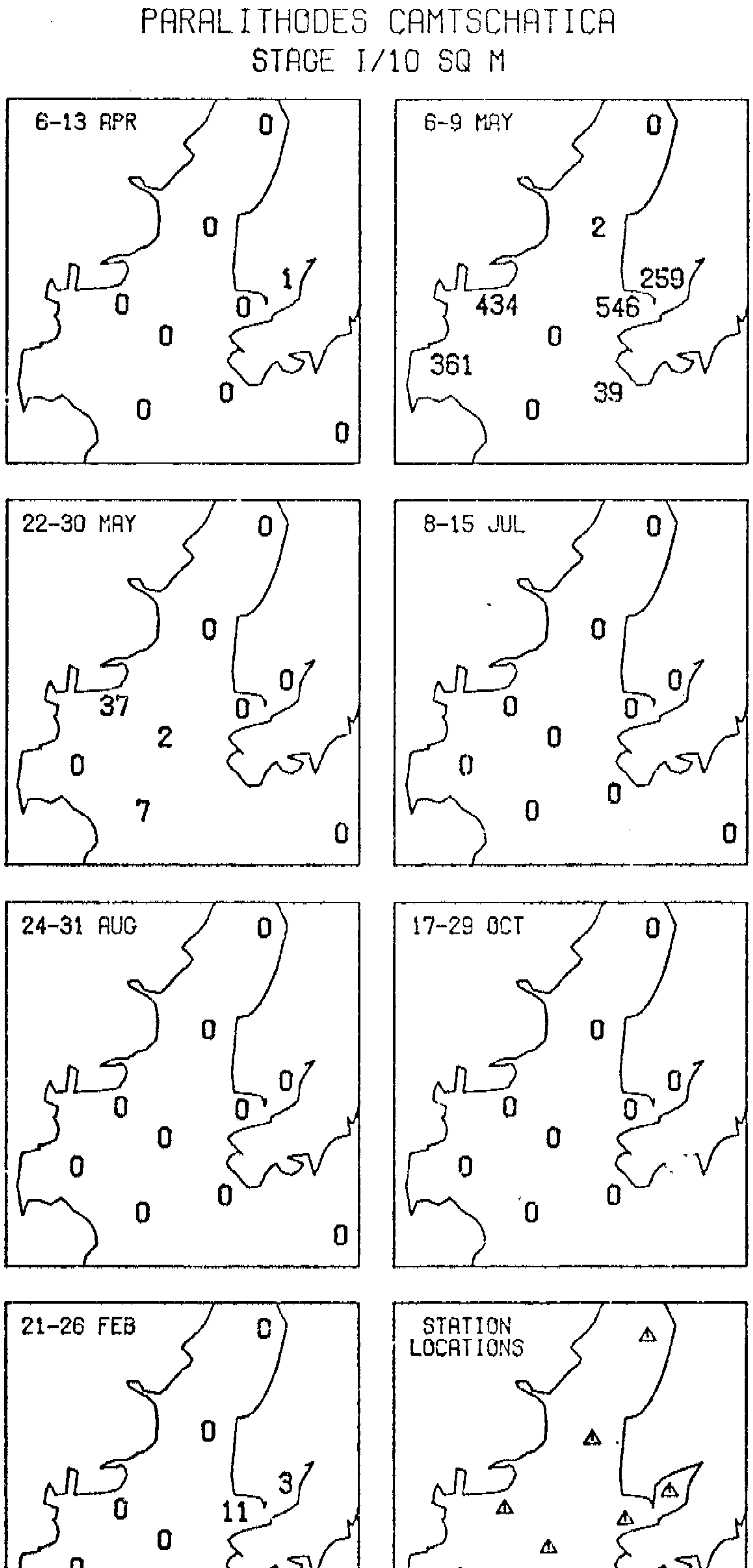
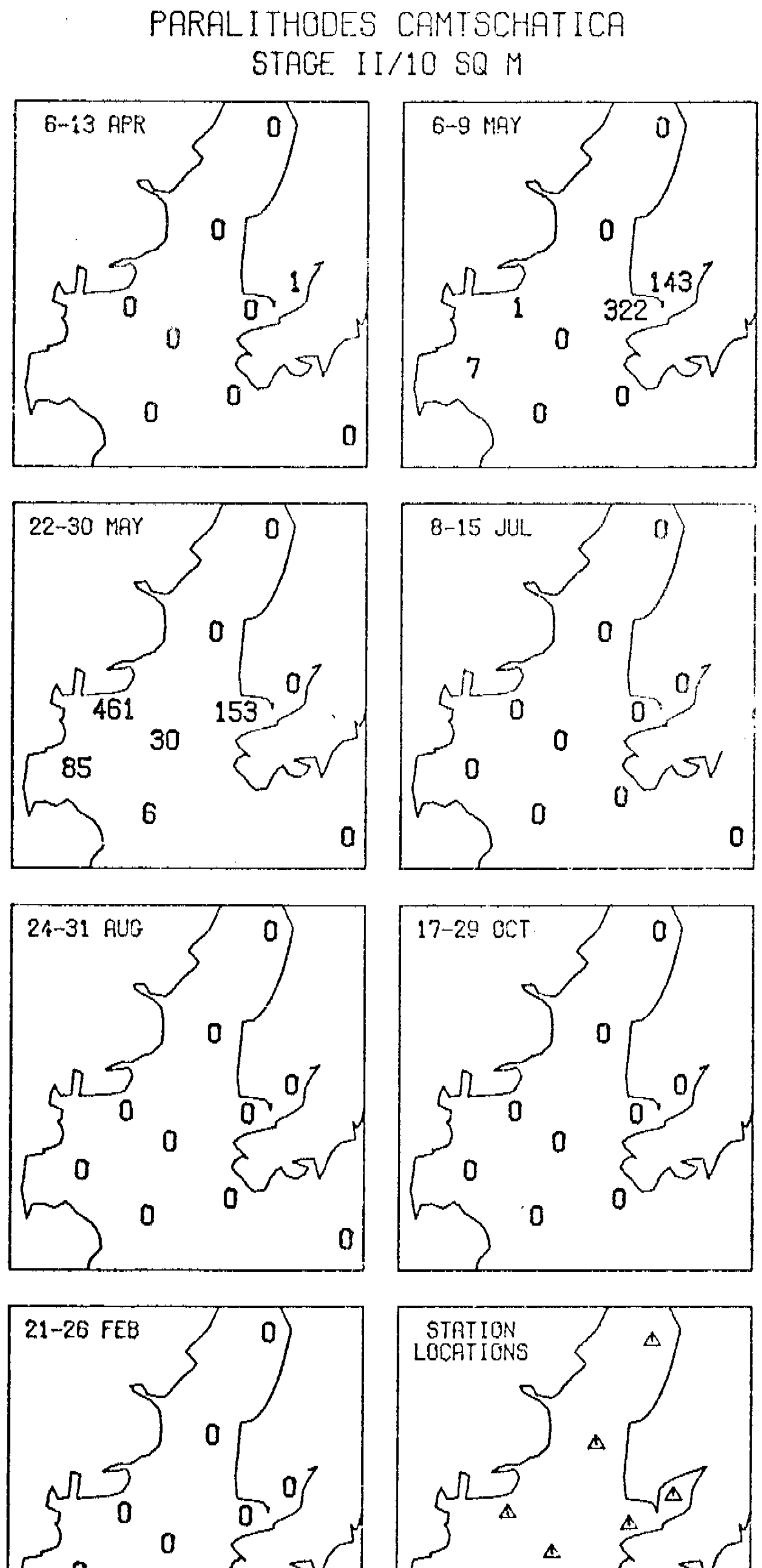

PARALITHODES CAMTSCHATICA
STAGE I/10 SQ M
6-13 APR
0
0
1
0
0
0
0
0
0
6-9 MAY
0
2
259
434
546
0
361
39
0
22-30 MAY
0
0
0
37
0
2
0
7
0
8-15 JUL
0
0
0
0
0
0
0
0
0
0
24-31 AUG
0
0
0
0
0
0
0
0
0
0
17-29 OCT
0
0
0
0
0
0
0
0
0
21-26 FEB
0
0
3
0
11
0
0
0
0
0
STATION
LOCATIONS

Figure 98.


PARALITHODES CAMTSCHATICA
STAGE II/10 SQ M
6-13 APR
0
0
1
0
0
0
0
0
0
6-9 MAY
0
0
143
1
322
0
7
0
0
22-30 MAY
0
0
0
461
153
30
85
6
0
8-15 JUL
0
0
0
0
0
0
0
0
0
0
24-31 AUG
0
0
0
0
0
0
0
0
0
0
17-29 OCT
0
0
0
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21-26 FEB
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0
0
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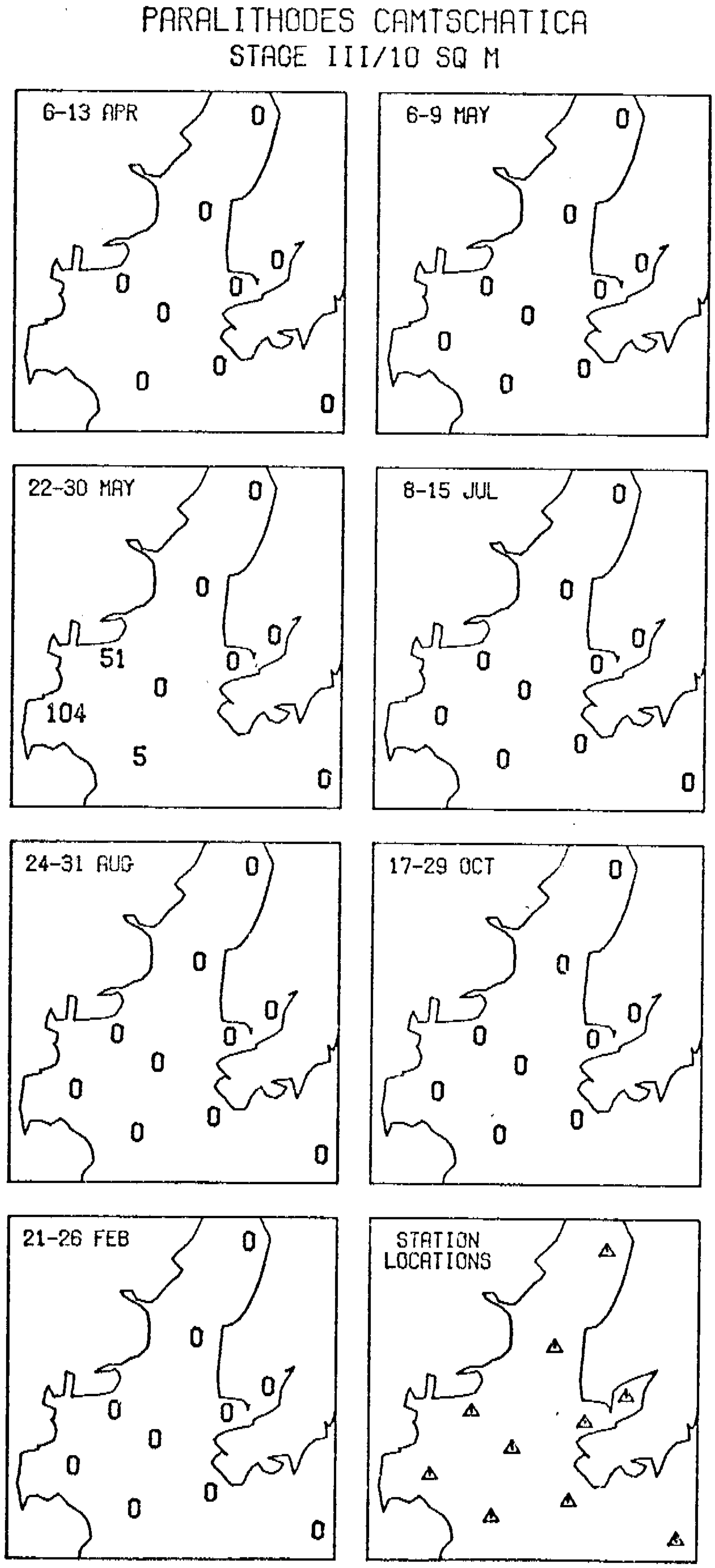
0
0
0
0
0
STATION LOCATIONS

Figure 99.


PARALITHODES CAMTSCHATICA
STAGE III/10 SQ M
6-13 APR
0
0
0
0
0
0
0
0
0
6-9 MAY
0
0
0
0
0
0
0
0
0
22-30 MAY
0
0
0
51
0
0
104
5
0
8-15 JUL
0
0
0
0
0
0
0
0
0
0
24-31 AUG
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0
0
0
0
0
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17-29 OCT
0
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0
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0
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0
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21-26 FEB
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0
0
0
STATION
LOCATIONS

Figure 100.

PARALITHODES CAMTSCHATICA
STAGE IV/10 SQ M

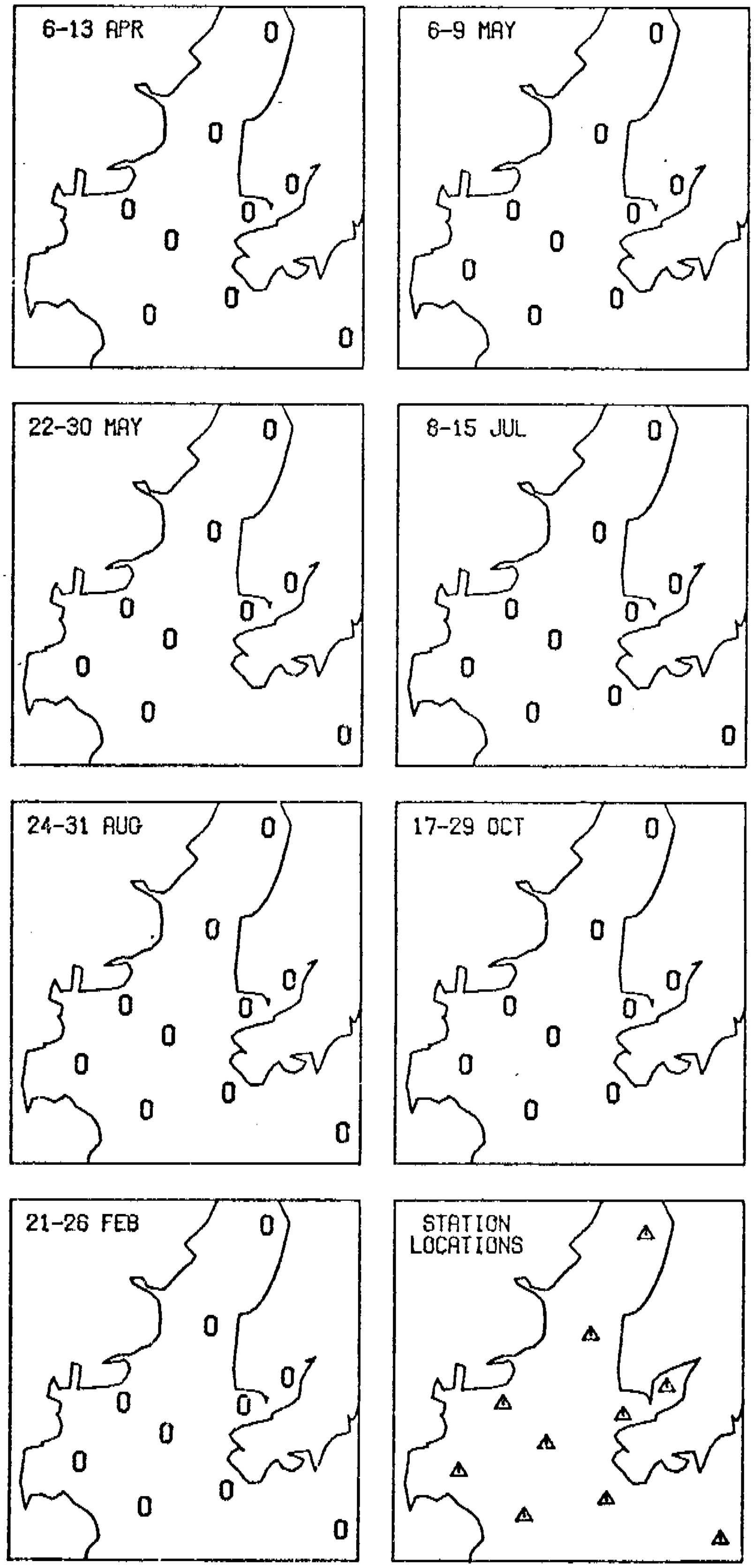
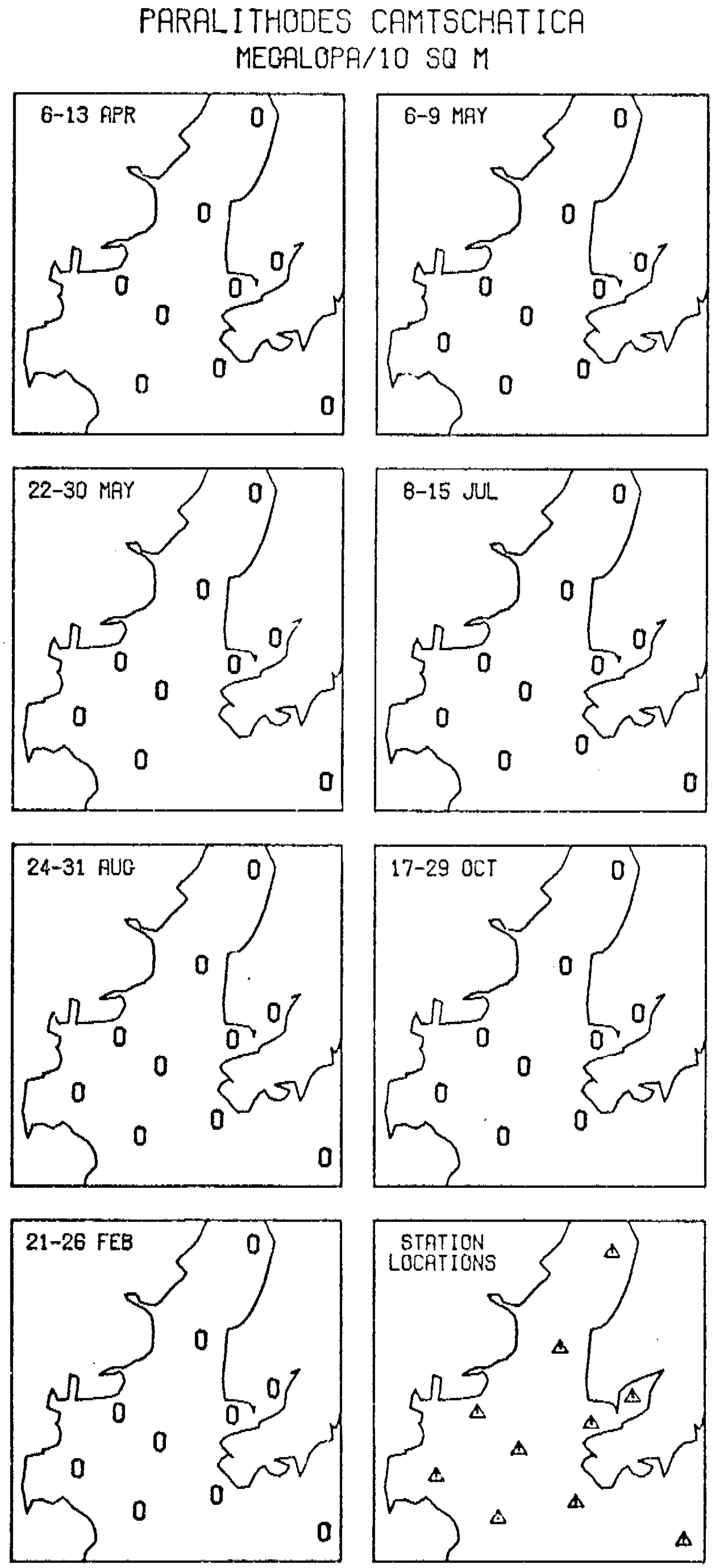


Figure 101.


PARALITHODES CAMTSCHATICA
MEGALOPA/10 SQ M
6-13 APR
0
0
0
0
0
0
0
0
0
6-9 MAY
0
0
0
0
0
0
0
0
22-30 MAY
0
0
0
0
0
0
0
0
0
8-15 JUL
0
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0
0
0
0
0
0
0
0
24-31 AUG
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17-29 OCT
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21-26 FEB
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STATION
LOCATIONS

Figure 102.

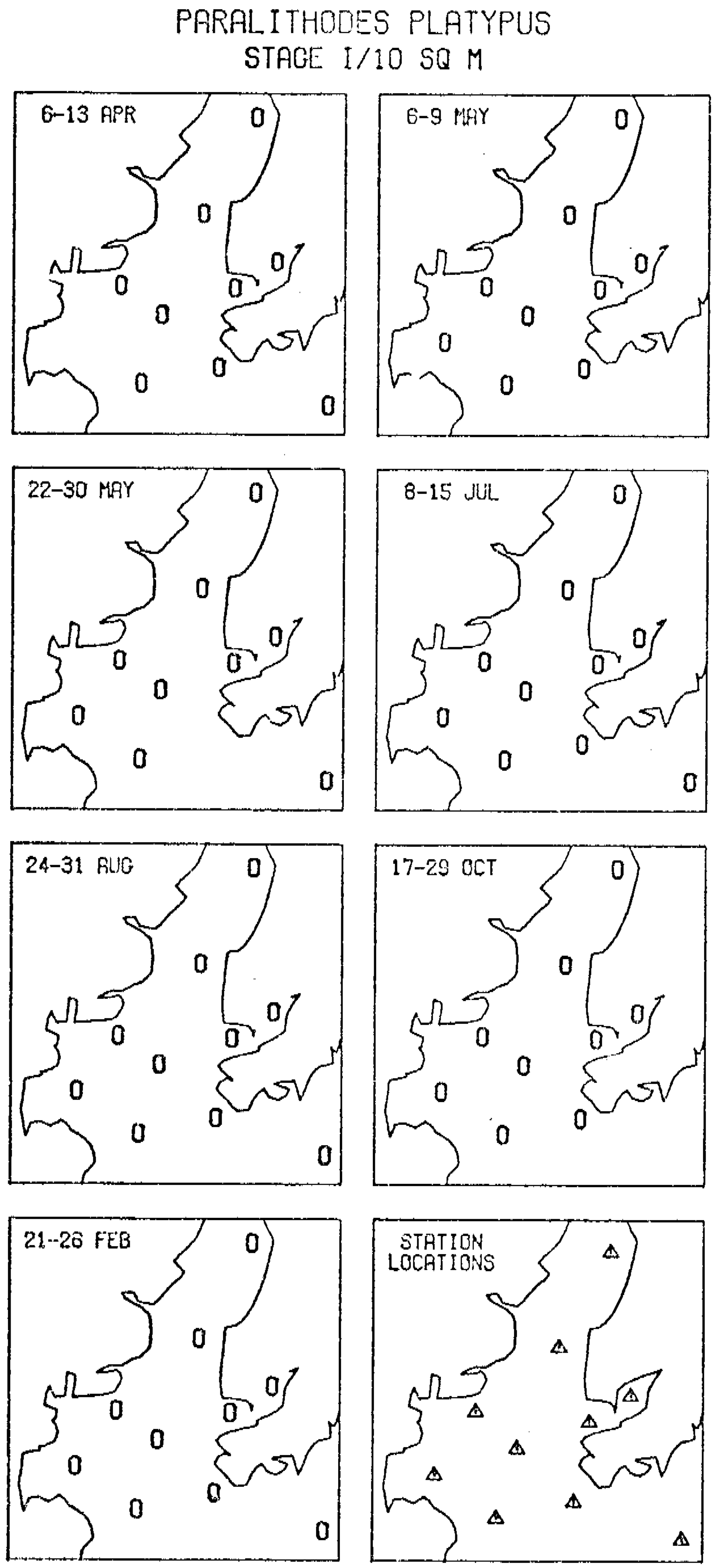

PARALITHODES PLATYPUS
STAGE I/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 103.

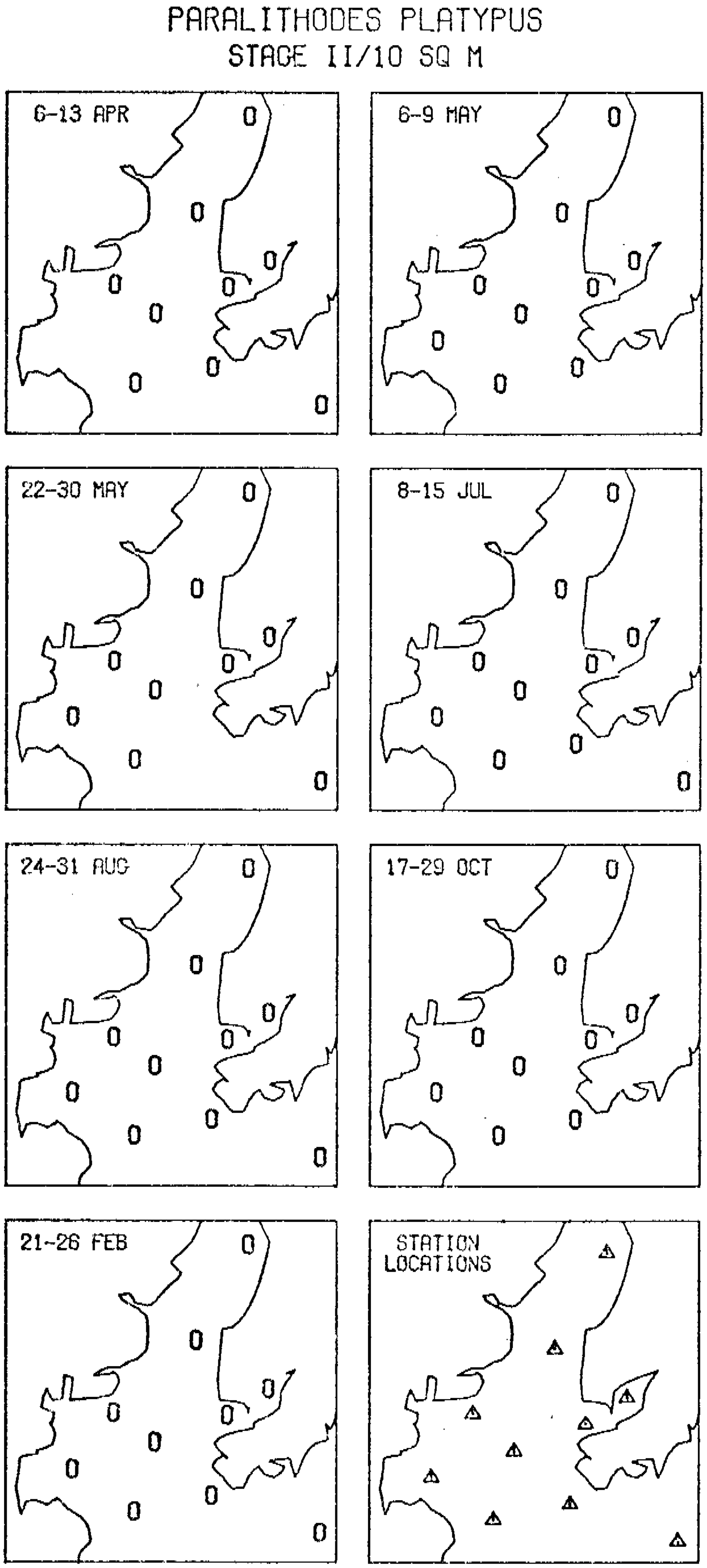

PARALITHODES PLATYPUS
STAGE II/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION
LOCATIONS

Figure 104.

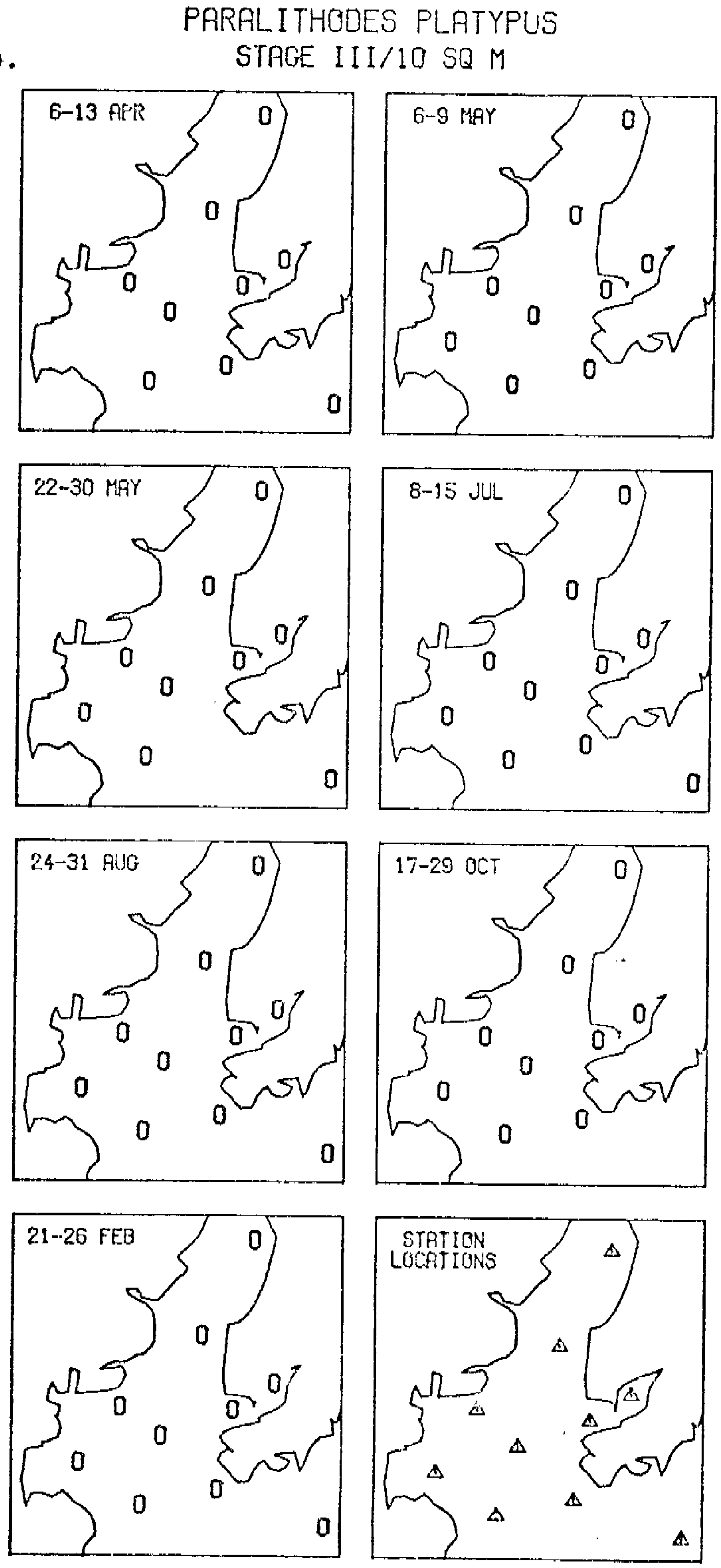

PARALITHODES PLATYPUS
STAGE III/10 SQ M
6-13 APR
6-9 MAY
22-30 MAY
8-15 JUL
24-31 AUG
17-29 OCT
21-26 FEB
STATION LOCATIONS

Figure 105.

PARALITHODES PLATYPUS
STAGE IV/10 SQ M

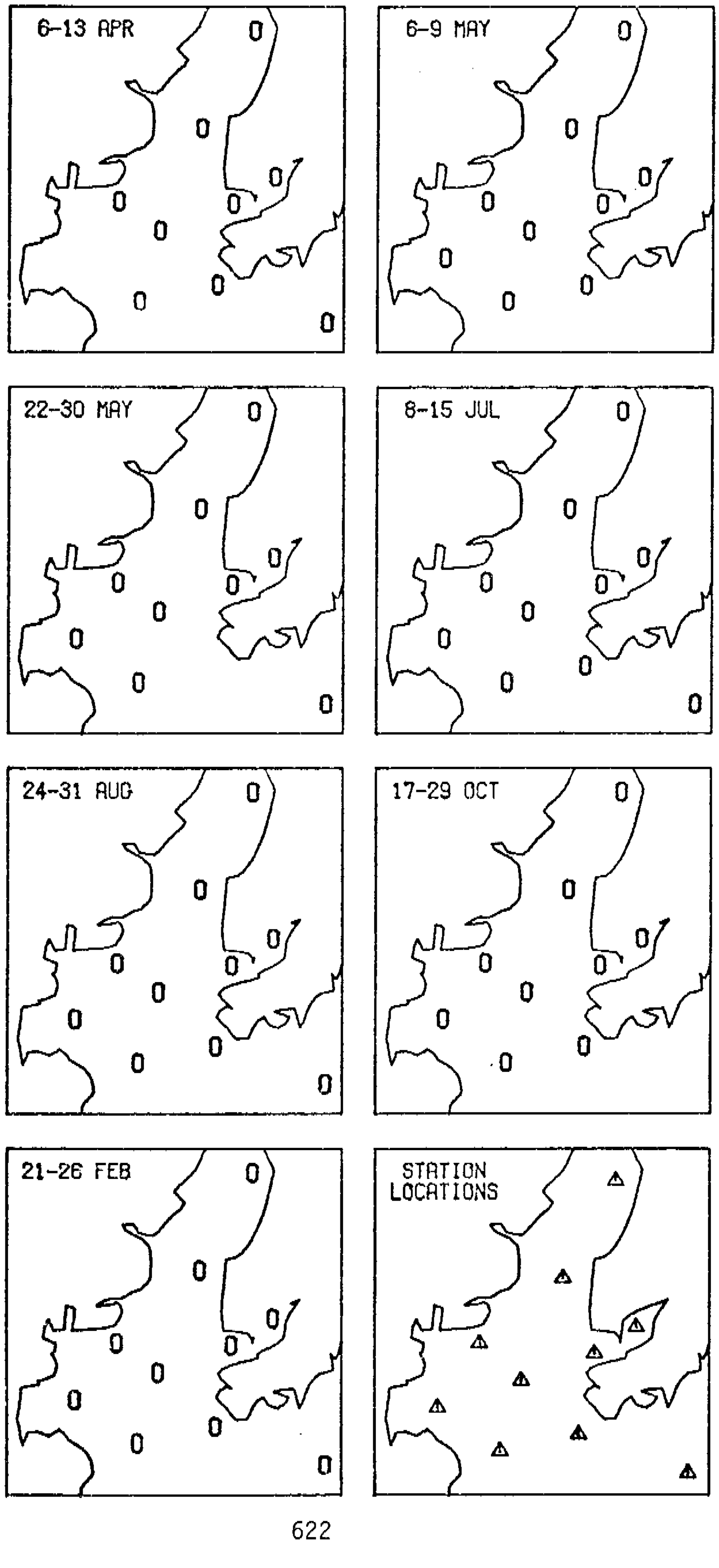
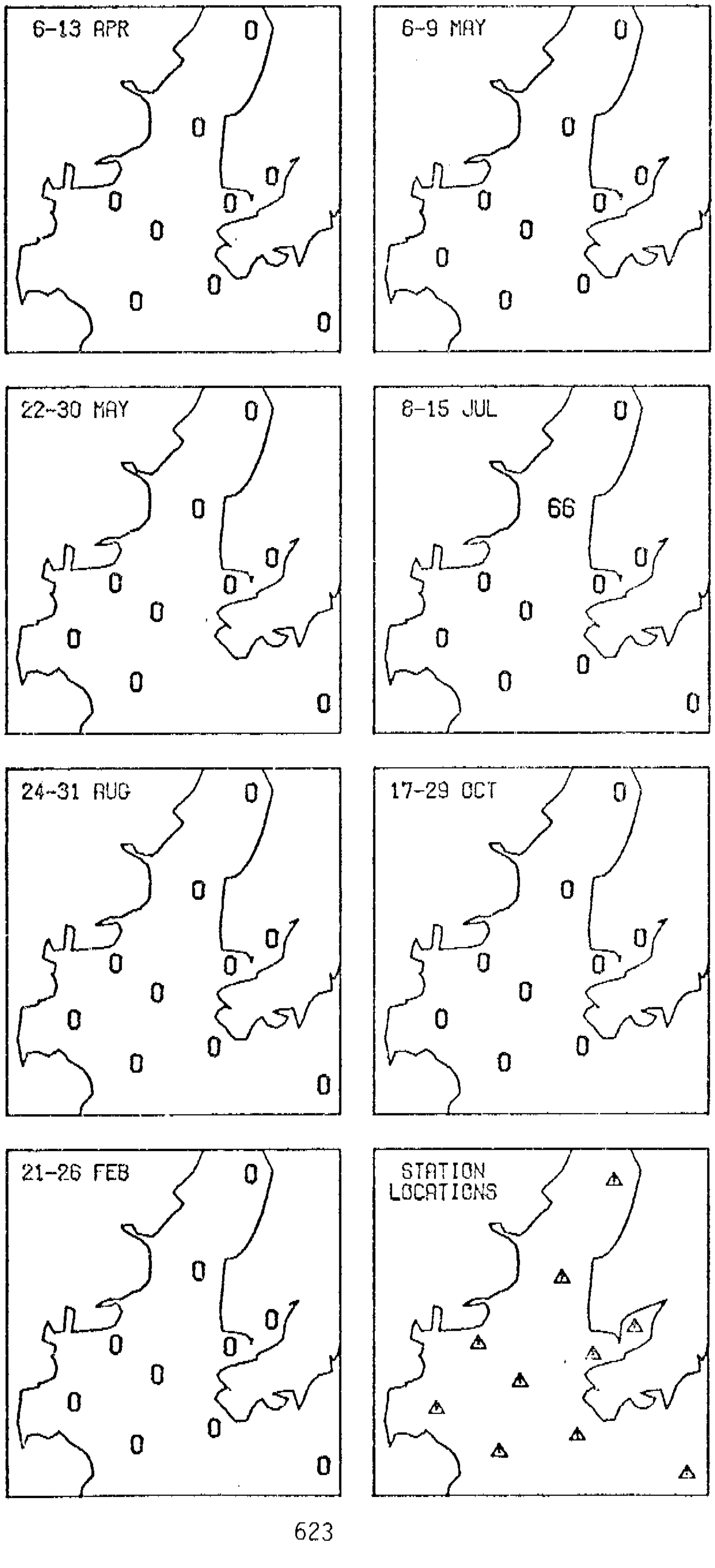


Figure 106.

PARALITHODES PLATYPUS
MEGALOPA/10 SQ M



The fish eggs in the category about 3 mm are 2.56 mm and larger in diameter. The fish eggs in this category are *Hippoglossoides* of an undetermined species, probably *H. elassodon*, the flathead sole. The fish eggs in this category were caught from May through August (Figure 6). These fish eggs were most abundant in the May samples at locations near the mouth of Cook Inlet.

The larvae of *Ammodytes hexapterus*, the Pacific sand lance, were caught from April through August and again in February (Figure 7). These larvae were most abundant in May in Kachemak Bay. No juvenile *Ammodytes* were observed (Figure 8).

The larvae of *Clupea harengus pallasi*, the Pacific herring, were caught in July and August (Figure 9). These larvae were most abundant in July at the most northern station location. One juvenile herring was taken in October at the same location (Figure 10).

The larvae of the Gadidae, the codfishes, are probably *Theragra chalcogramma*, the walleye pollock, and *Gadus macrocephalus*, the Pacific cod. The gadid larvae were caught from April through July (Figure 11). These larvae were most abundant in May toward the mouth of Cook Inlet. One gadid juvenile was taken in August near Kachemak Bay (Figure 12).

The larvae identified as *Hippoglossoides* sp. are probably one species, *H. elassodon*, the flathead sole. The larvae of *Hippoglossoides* were caught from May through August (Figure 13). One juvenile *Hippoglossoides* was taken in August near Kachemak Bay (Figure 14).

The larvae of *Mallotus villosus*, the capelin, were caught on every cruise except late May (Figure 15). The capelin larvae were most abundant in July and August near Kachemak Bay and Kamishak Bay, but were taken at all sampling locations. One juvenile capelin was taken in August and another in February (Figure 16).

The larvae of the family Osmeridae, the smelts, probably include *Thaleichthys pacificus*, the eulachon, *Spirinchus thaleichthys*, the longfin smelt, some small *Mallotus*, and other smelt. The larvae of Osmeridae were caught on five cruises, but not in April and late May (Figure 17). The osmerid larvae were most abundant in July and August and were widely scattered over the Lower Cook Inlet region. One juvenile osmerid was taken in February (Figure 18).

The early life history stages of *Pandalopsis dispar*, the sidestripe shrimp, were taken on all cruises except October (Figures 19-24). Stages I, II, III and IV were represented in the samples; Stage V and juveniles were not represented.

The early life history stages of *Pandalus borealis*, the northern pink shrimp, were taken from April through August (Figures 25-32). Stages I, II, III, IV, V and juveniles were represented; stages VI and VII were not represented.

The early life history stages of the shrimp *Pandalus danae* were taken in July and August (Figures 33-39). Stages II and V were represented; stages I, III, IV, VI, and juveniles were not represented.

The early life history stages of *Pandalus goniurus*, the humpback shrimp, were taken from April through July (Figures 40-47). Stages I, II, III, IV, and juveniles were represented; stages V, VI, and VII were not represented.

The early life history stages of the *Pandalus hypsinotus*, the coonstripe shrimp, were taken in May (Figures 48-54). Stage I was represented; stages II, III, IV, V, VI, and juveniles were not represented.

The early life history stages of the shrimp *Pandalus platyceros* were taken in February (Figures 55-59). Stage II was represented; stages I, III, IV, and juveniles were not represented.

The early life history stages of the shrimp *Pandalus stenolepis* were taken from May through August (Figures 60-66). Stages I, II, III, IV, V, and VI were represented; the juveniles were not represented.

The early life history stages of the shrimp *Pandalus montagui tridens* were taken from April through July (Figures 67-71). Stages I, II, and III were represented; stage IV and juveniles were not represented.

The early life history stages of non-commercial crabs of the category Anomura were taken on all cruises (Figures 72-73). The zoea and megalopa stages were represented.

The early life history stages of non-commercial crabs of the category Brachyura, the true crabs, were taken from May through August and in February (Figures 74-75). The zoea and megalopa stages were represented.

The early life history stages of *Cancer magister*, the Dungeness crab, were taken from July through October (Figures 76-81). Stages I, II, V, and megalopa were represented; stages III and IV were not represented.

The early life history stages of *Cancer oregonensis*, the small non-commercial hairy cancer crab, were taken on all cruises except early May (Figures 82-87). Stages I, II, III, IV, V, and megalopa were represented.

The early life history stages of *Cancer productus*, the rock crab, were taken in May (Figures 88-93). Stage I was represented; stages II, III, IV, V, and megalopa were not represented.

The early life history stages of *Chionoecetes bairdi*, the tanner crab, were taken in May and July (Figures 94-95). Stages I and II were represented. The megalopa stage of *Chionoecetes* sp. is probably mostly *C. bairdi*, but that stage has not been described well enough to be certain. *Chionoecetes* sp. megalopa occurred in April and May, and again in August (Figure 96).

The early life history stages of *Paralithodes camtschatica*, the red king crab, were taken in April and May, and again in February (Figures 97-101). Stages I, II, and III were represented; stage IV and the megalopa were not represented.

The early life history stages of *Paralithodes platypus*, the blue king crab, were taken in July (Figures 102-106). The megalopa stage was represented; stages I, II, III, and IV were not represented.

Time series plots were prepared to emphasize the seasonal aspect of quantitative density distributions of the early life history stages of categories of fish eggs, fish larvae, crabs, and shrimps (Figures 107-124). This graphic representation depicts the samples from the ten station locations on each seasonal cruise as replicates representing the distributions of abundance within the cruise. The wide differences in abundance within and between seasons suggested the format of a semi-logarithmic plot of log abundance against linear time.

The fish eggs of the four size categories occurred from April through August, with the smallest and largest eggs restricted to May through August (Figure 107). The 1-mm eggs were most abundant and the less than 1-mm eggs were the second most abundant.

The fish larvae of the six categories occurred from April through October and in February, with all individual categories restricted to a shorter period (Figure 108). The *Mallotus villosus* and Osmeridae were the most abundant, with *Ammodytes hexapterus* next in abundance.

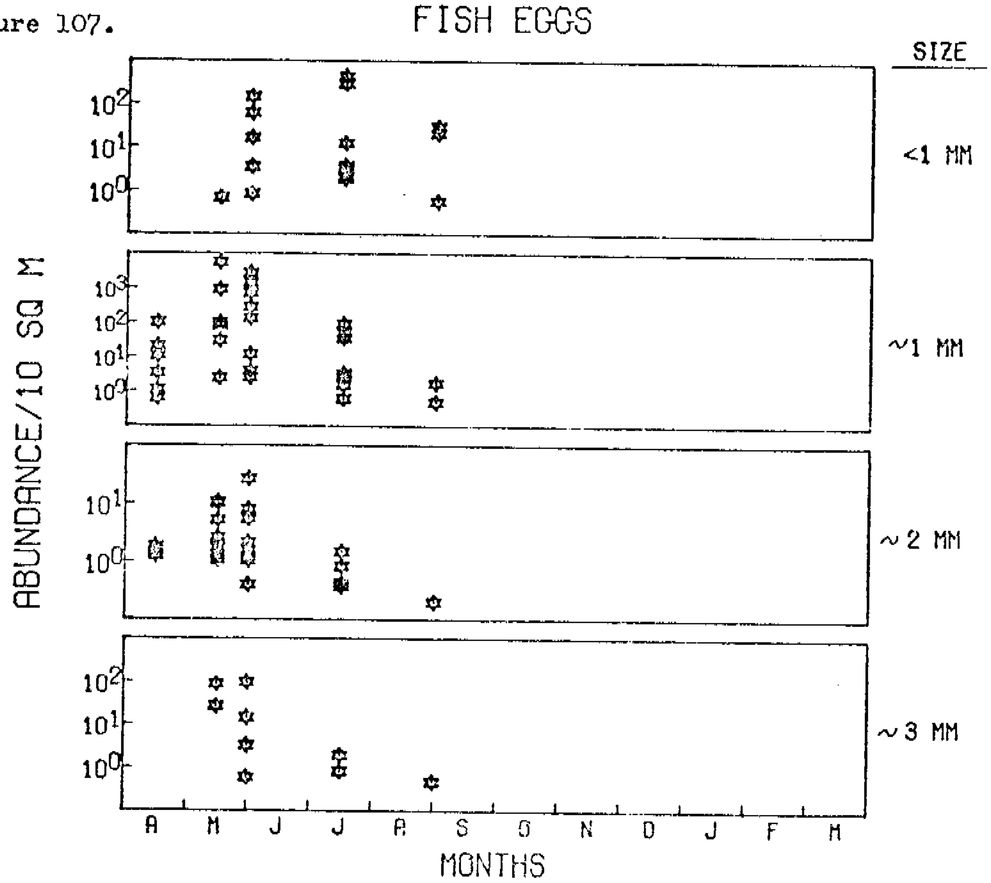
The time series plots for the shrimps and crabs emphasize the seasons at which the species occur, the progression of life history stages over time, and the stages which did not occur in the samples.

The most abundant shrimp was *Pandalus goniurus*, with *Pandalus borealis* and *Pandalus montagui tridens* next most abundant. The non-commercial Anomura and Brachyura were very abundant, and the small *Cancer oregonensis* were the most abundant species identified. *Paralithodes camtschatica* was the most abundant commercial crab, with *Chionoecetes bairdi* next in abundance.

IV. Discussion

The sampling and analysis reported here has provided quantitative seasonal density distributions for the early life history stages of representative fishes, shrimps, and crabs in the Lower Cook Inlet region. The more abundant categories of organisms differed in abundance by factors of 10 to 10,000 between seasons, between stations, and even between stations within seasons.

Figure 107.



Figures 107 - 124. Seasonal quantitative density distributions of early life history stages.

Relative abundance of organisms of commercial, sport, and ecosystem importance from under 10 m^2 surface area. Sums of 10 stations on 7 cruises in the Lower Cook Inlet region.

Figure 108.

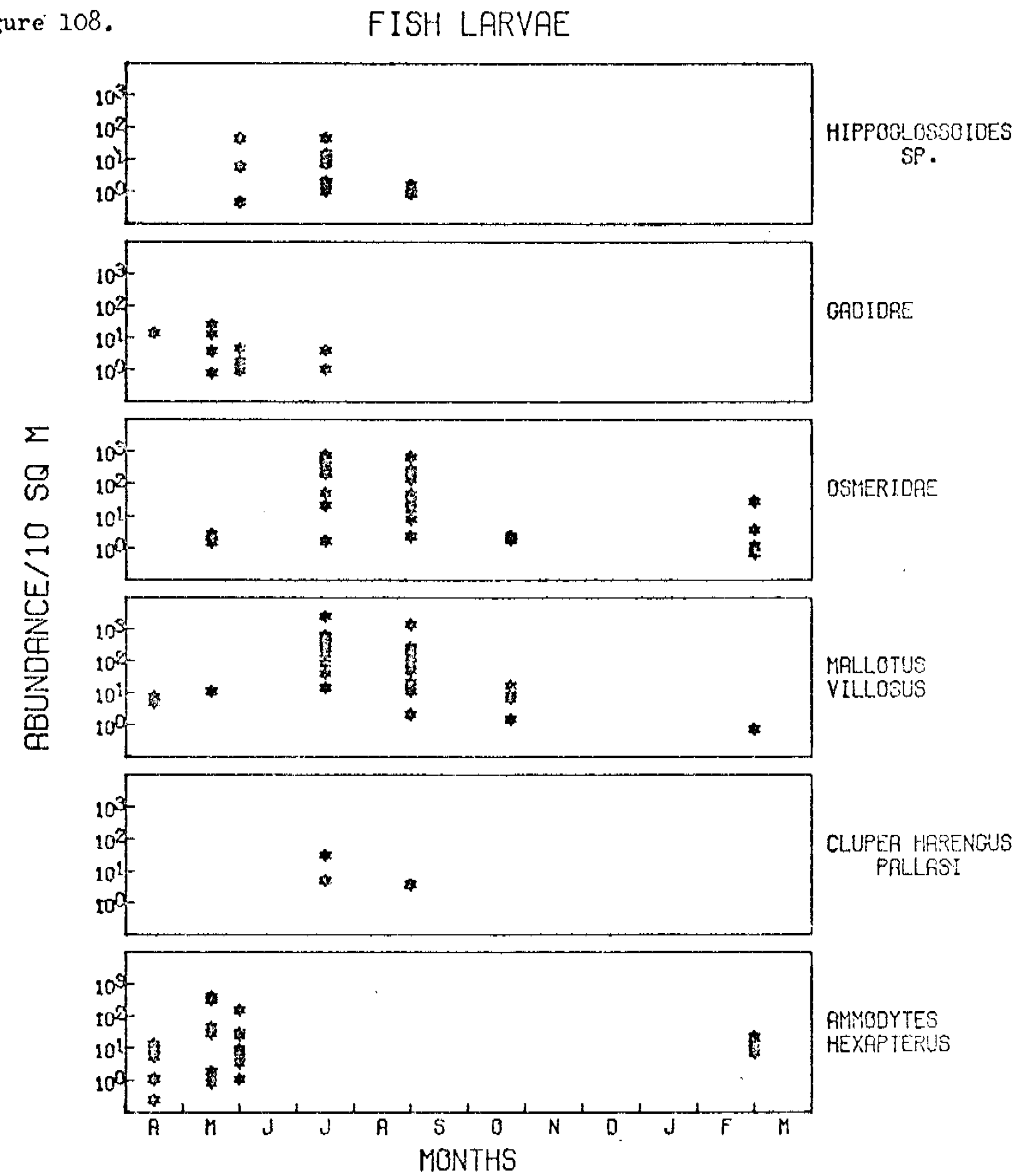

FISH LARVAE
ABUNDANCE/10 SQ M
HIPPOGLOSSOIDES SP.
GADIDAE
OSMERIDAE
MALLOTUS VILLOSUS
CLUPEA HARENGUS PALLASI
AMMODYTES HEXAPTERUS
A M J J A S O N D J F M
MONTHS

Figure 109.

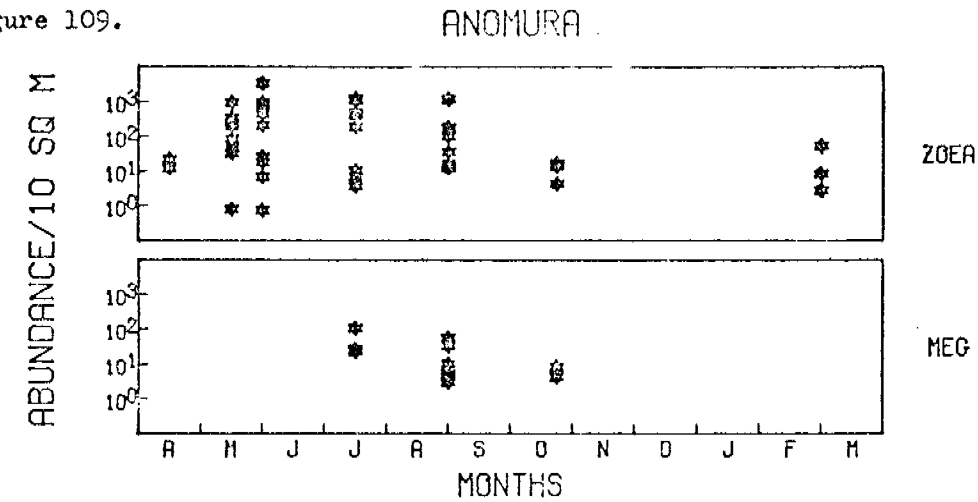


Figure 110.

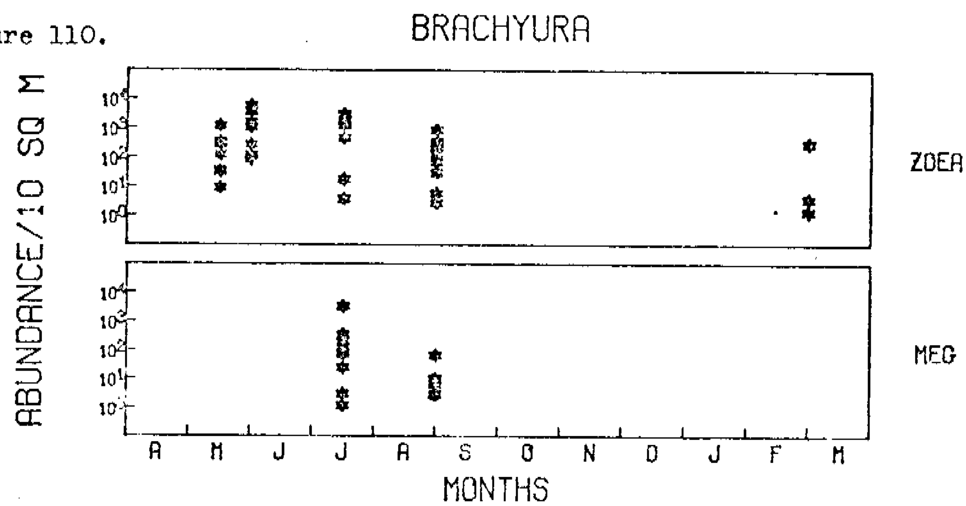


Figure 111.

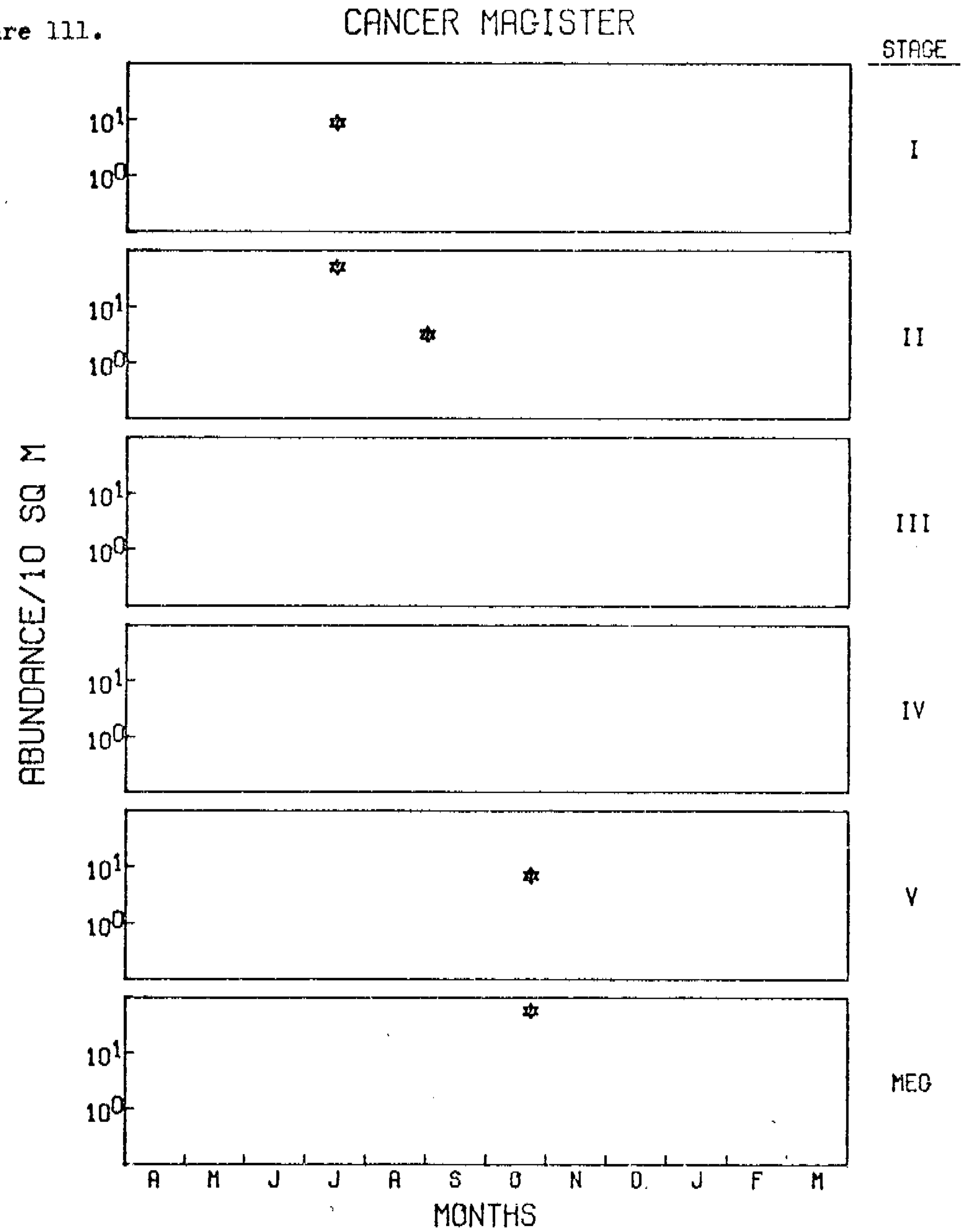
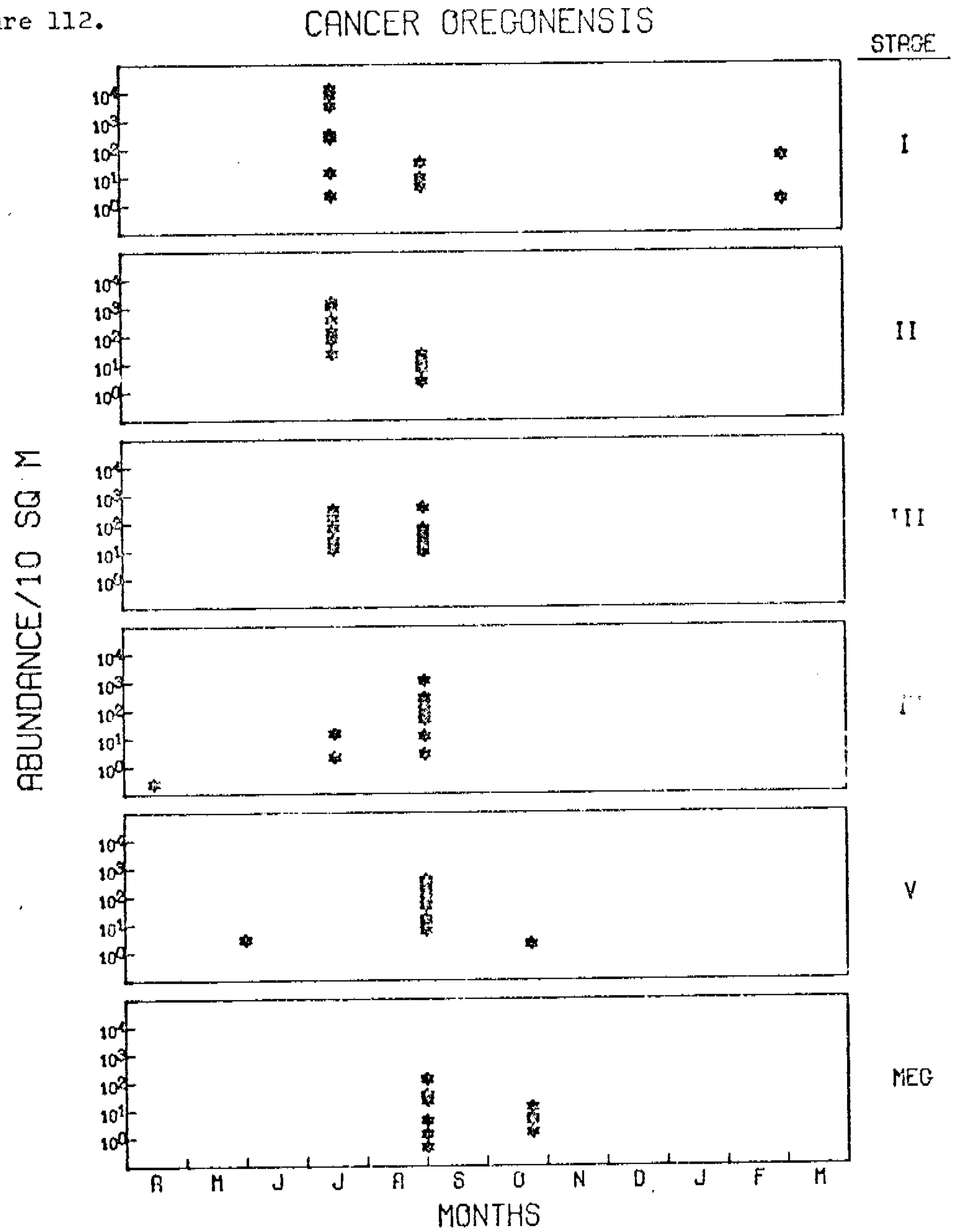
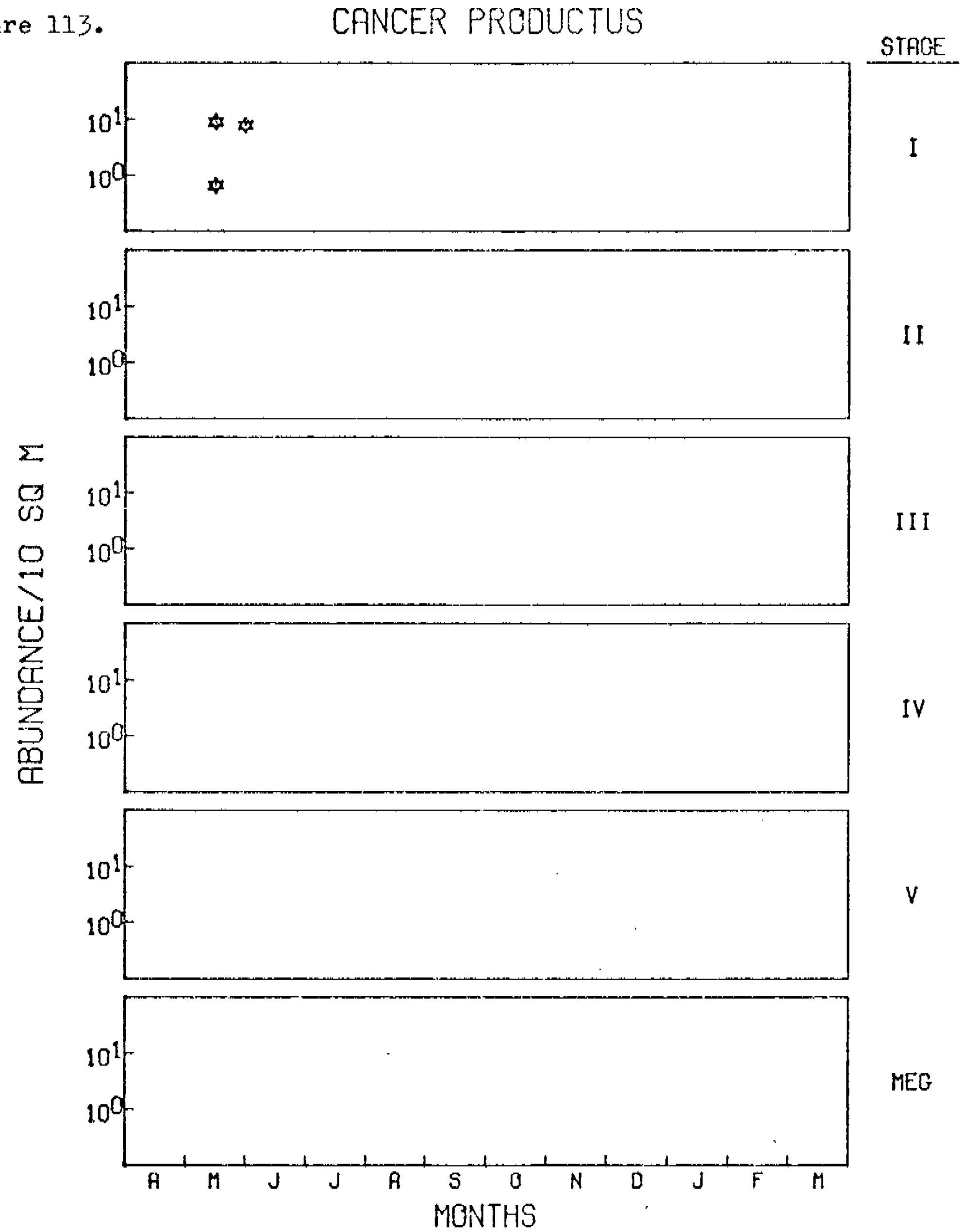

CANCER MAGISTER
STAGE
I
II
III
IV
V
MEG
ABUNDANCE/10 SQ M
10^1
10^0
A M J J A S O N D J F M
MONTHS

Figure 112.



CANCER OREGONENSIS
STAGE
I
II
III
IV
V
MEG
ABUNDANCE/10 SQ M
10^4
10^3
10^2
10^1
10^0
A
M
J
J
A
S
O
N
D
J
F
M
MONTHS

Figure 113.



CANCER PRODUCTUS
STAGE
I
II
III
IV
V
MEG
ABUNDANCE/10 SQ M
10¹
10⁰
A M J J A S O N D J F M
MONTHS

Figure 114.

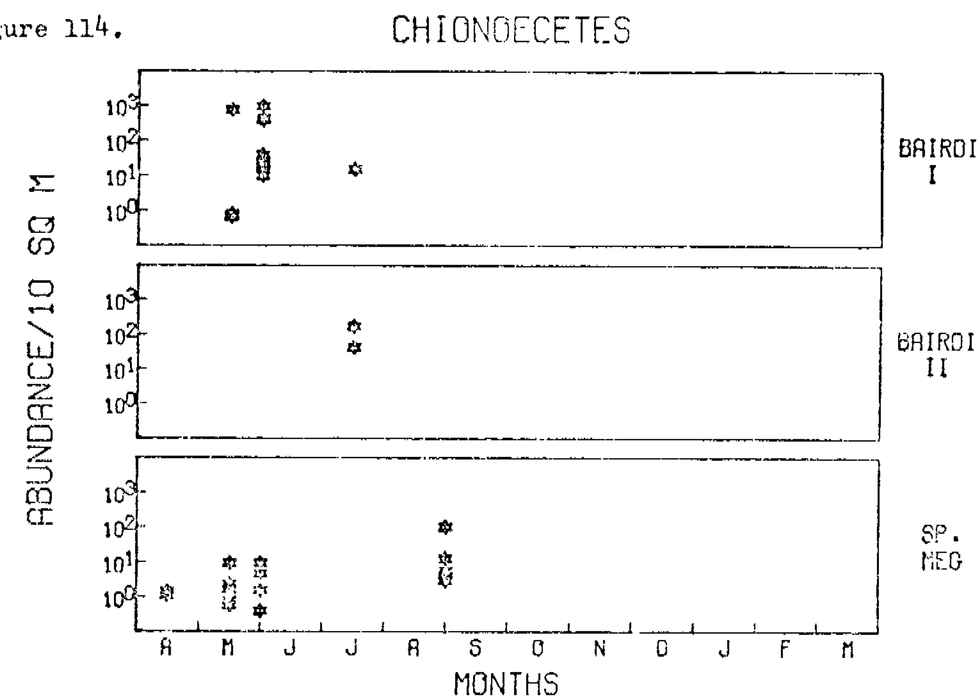

CHIONOECETES
ABUNDANCE/10 SQ M
10^3
10^2
10^1
10^0
BAIRDI I
BAIRDI II
SP. MEG
A M J J A S O N D J F M
MONTHS

Figure 115.

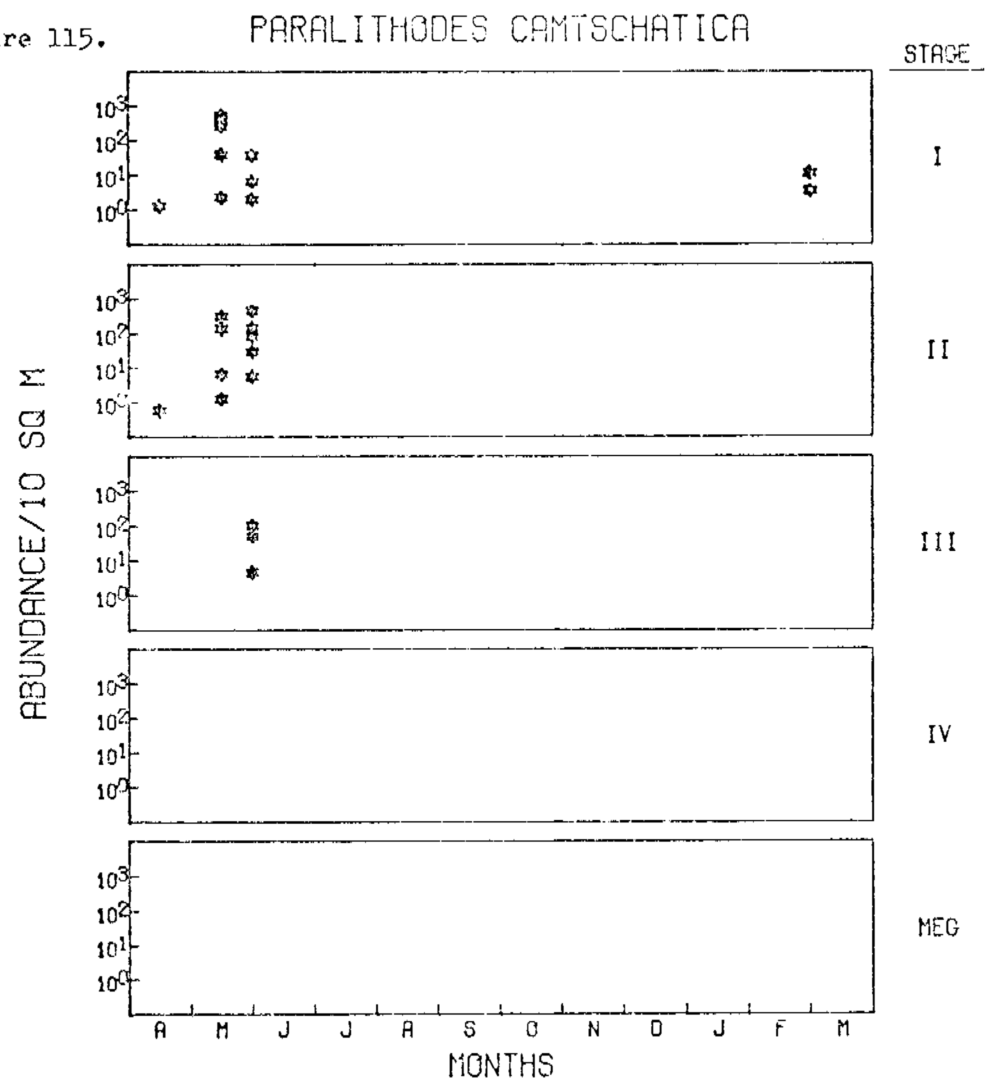

PARALITHODES CAMTSCHATICA
STAGE
I
II
III
IV
MEG
ABUNDANCE/10 SQ M
10^3
10^2
10^1
10^0
A M J J A S O N D J F M
MONTHS

Figure 116.

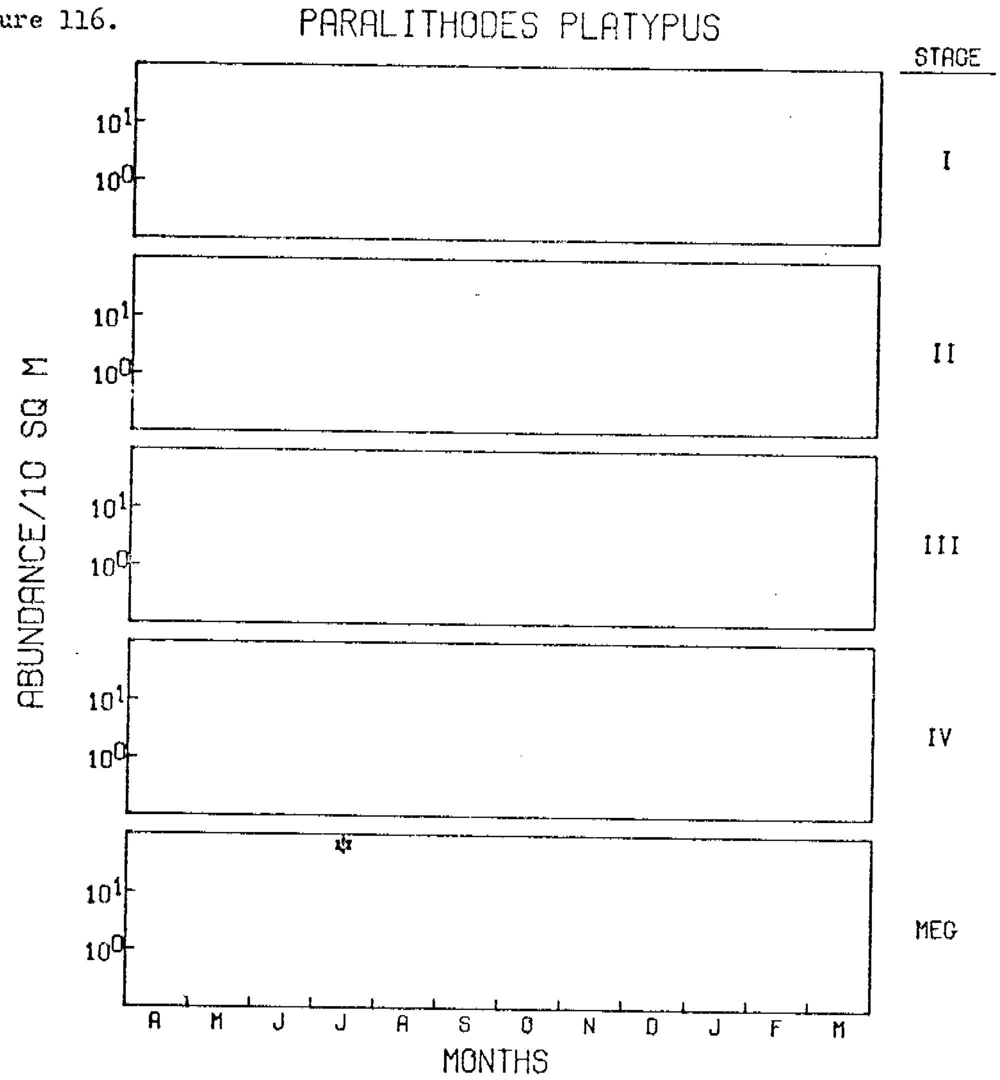

PARALITHODES PLATYPUS
STAGE
I
II
III
IV
MEG
10¹
10⁰
ABUNDANCE/10 SQ M
A
M
J
J
A
S
O
N
D
J
F
M
MONTHS

Figure 117.

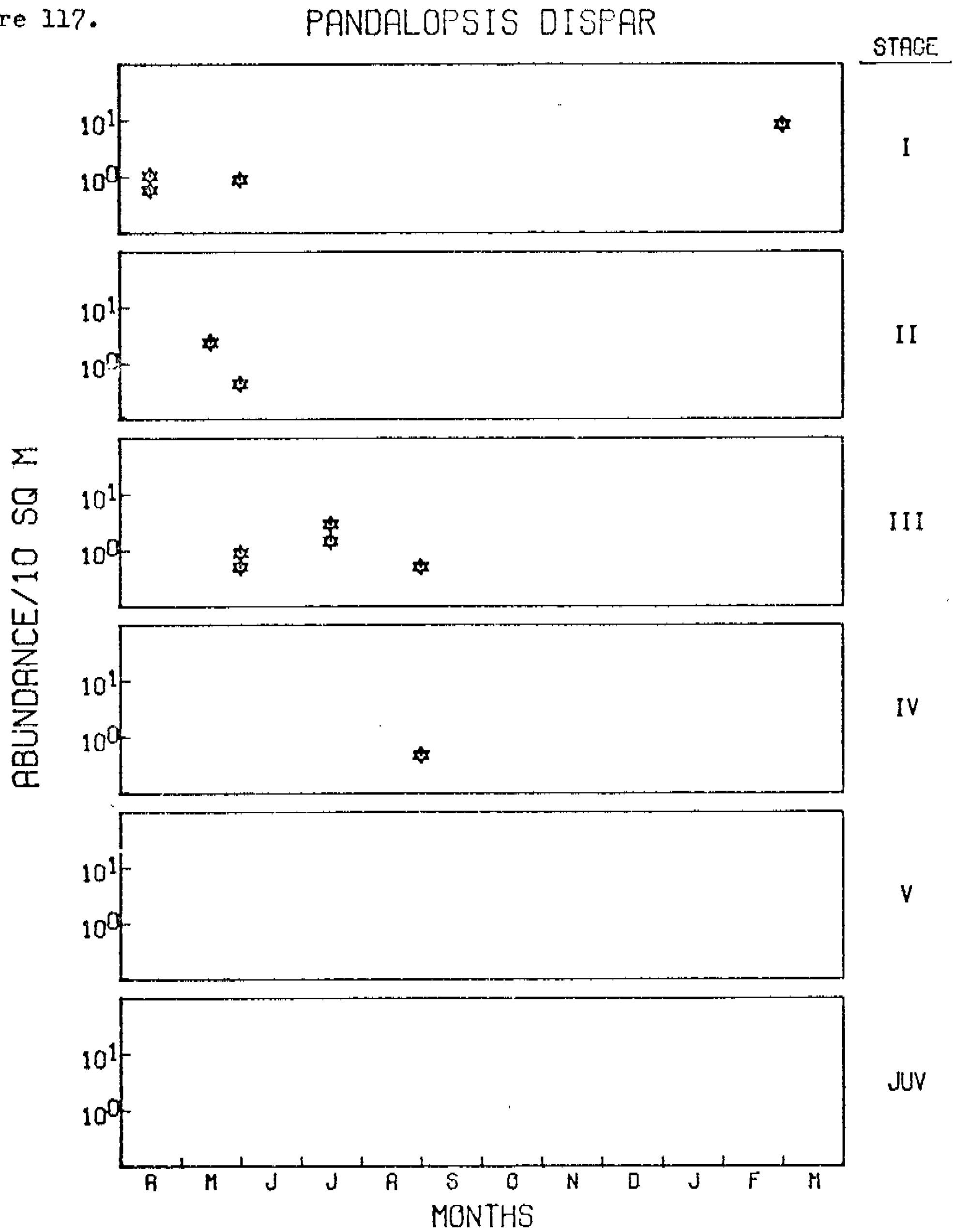
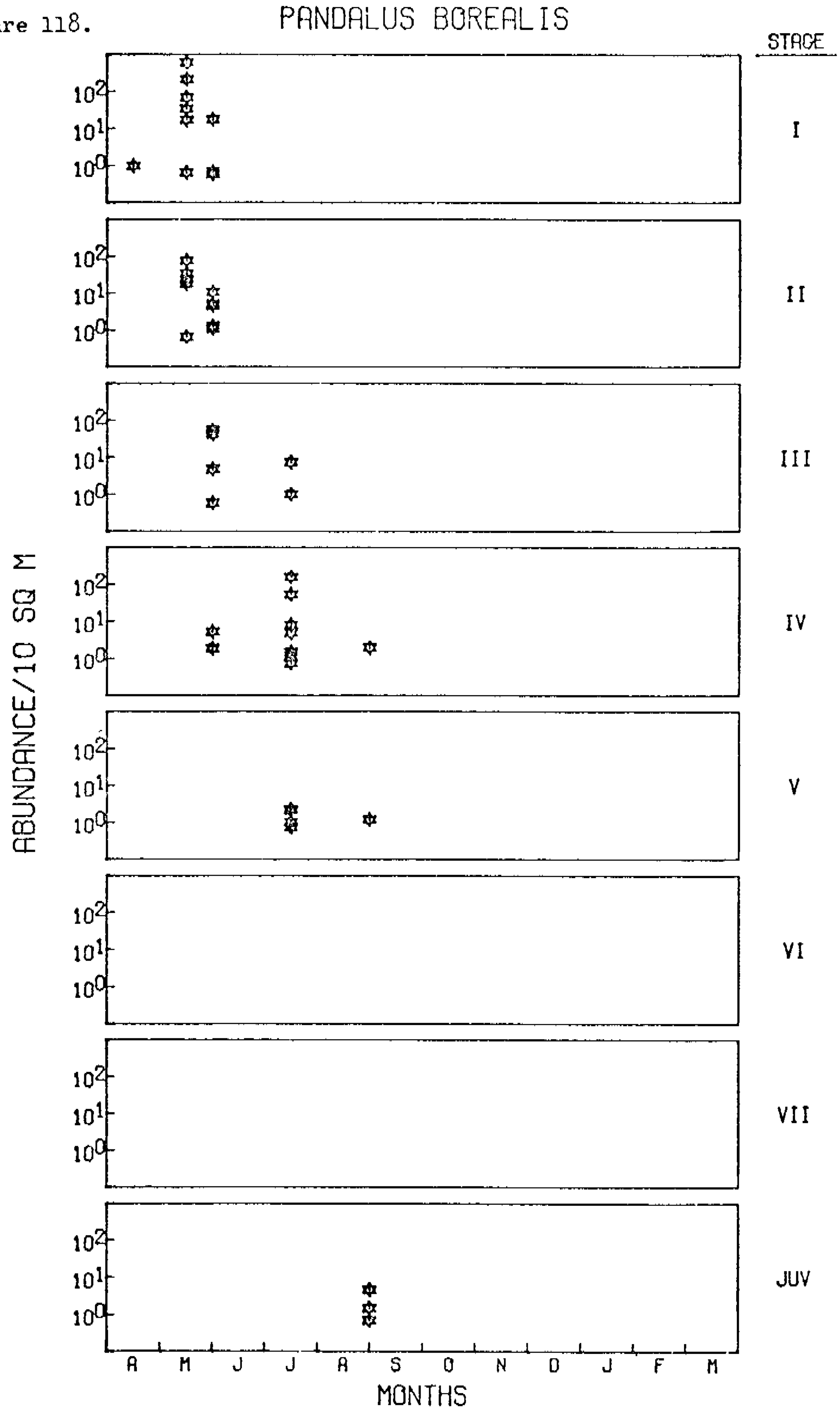

PANDALOPSIS DISPAR
STAGE
I
II
III
IV
V
JUV
ABUNDANCE/10 SQ M
10^1
10^0
A
M
J
J
A
S
O
N
D
J
F
M
MONTHS

Figure 118.



PANDALUS BOREALIS
STAGE
I
II
III
IV
V
VI
VII
JUV
ABUNDANCE/10 SQ M
10^2
10^1
10^0
A M J J A S O N D J F M
MONTHS

Figure 119.

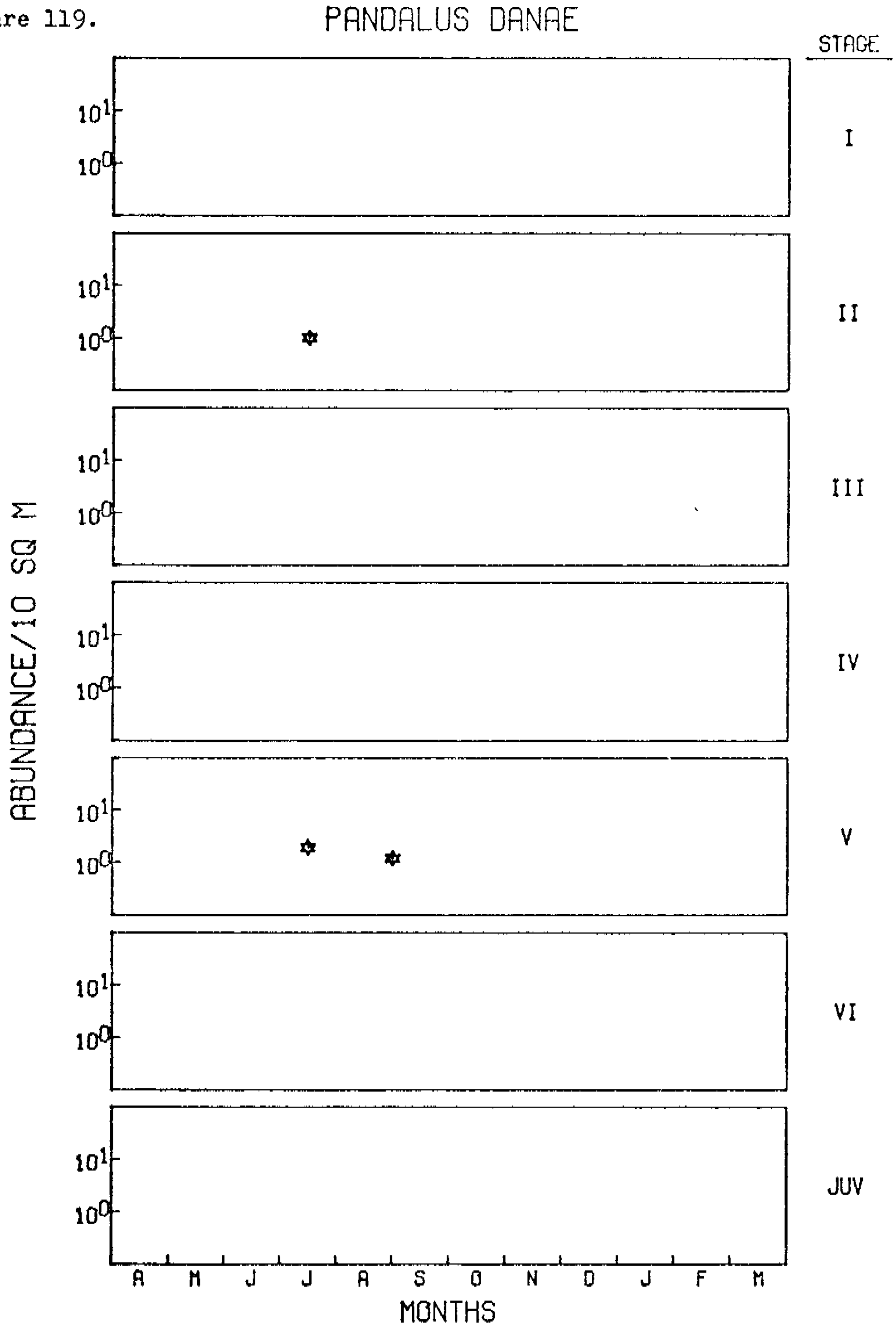

PANDALUS DANAE
STAGE
I
II
III
IV
V
VI
JUV
ABUNDANCE/10 SQ M
10^1
10^0
A M J J A S O N D J F M
MONTHS

Figure 120.

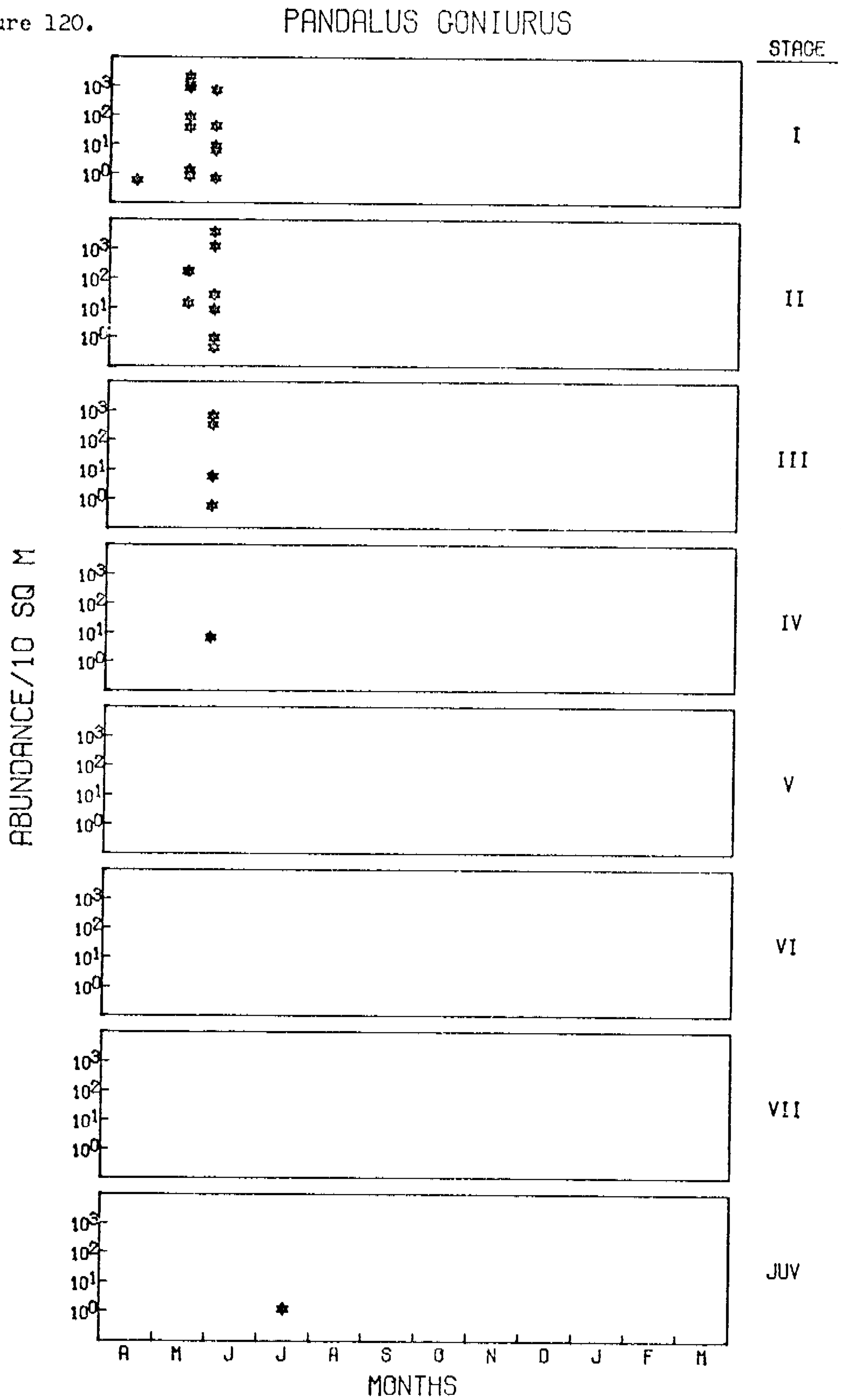

PANDALUS GONIURUS
STAGE
I
II
III
IV
V
VI
VII
JUV
ABUNDANCE/10 SQ M
10^3
10^2
10^1
10^0
A
M
J
J
A
S
O
N
D
J
F
M
MONTHS

Figure 121.

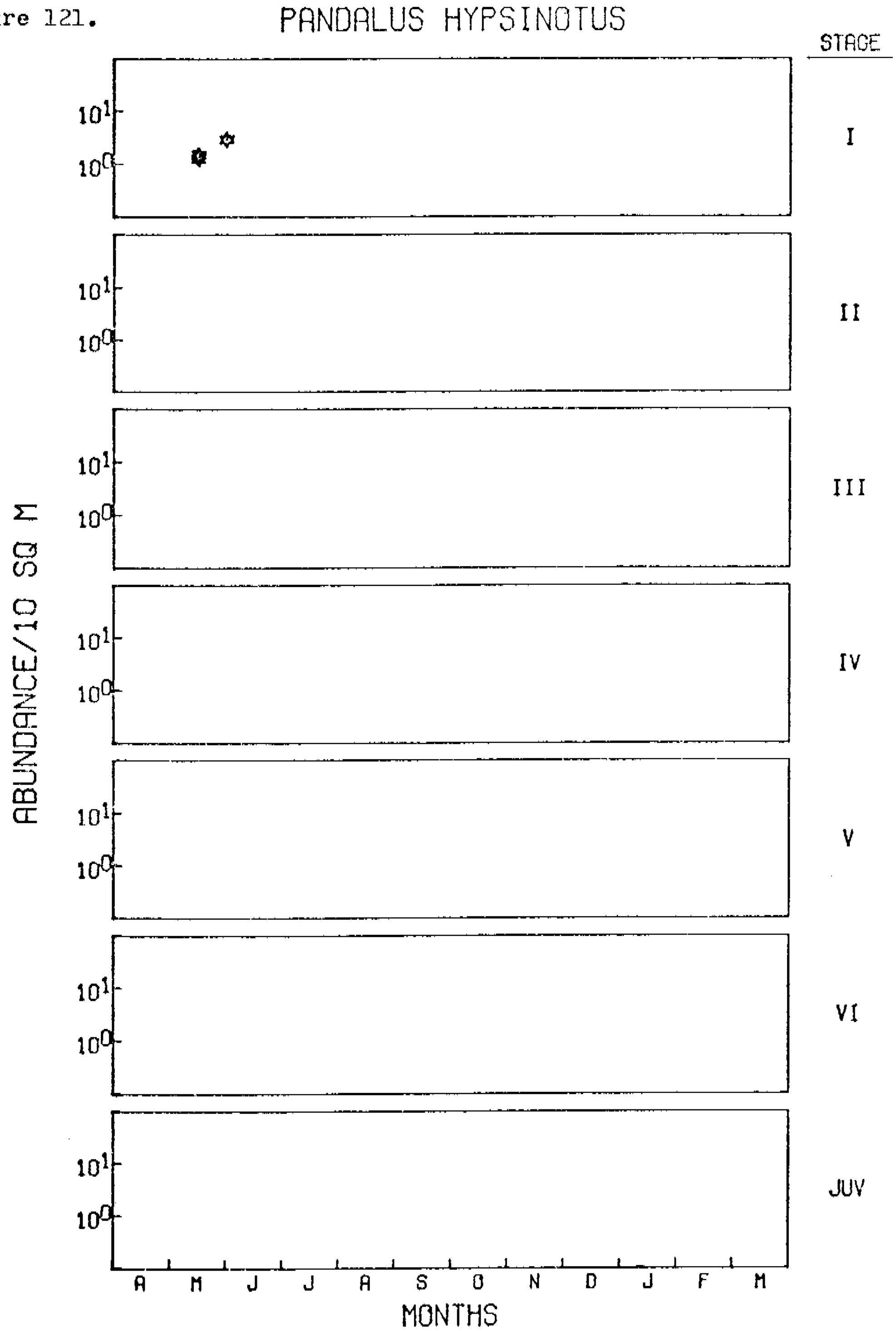
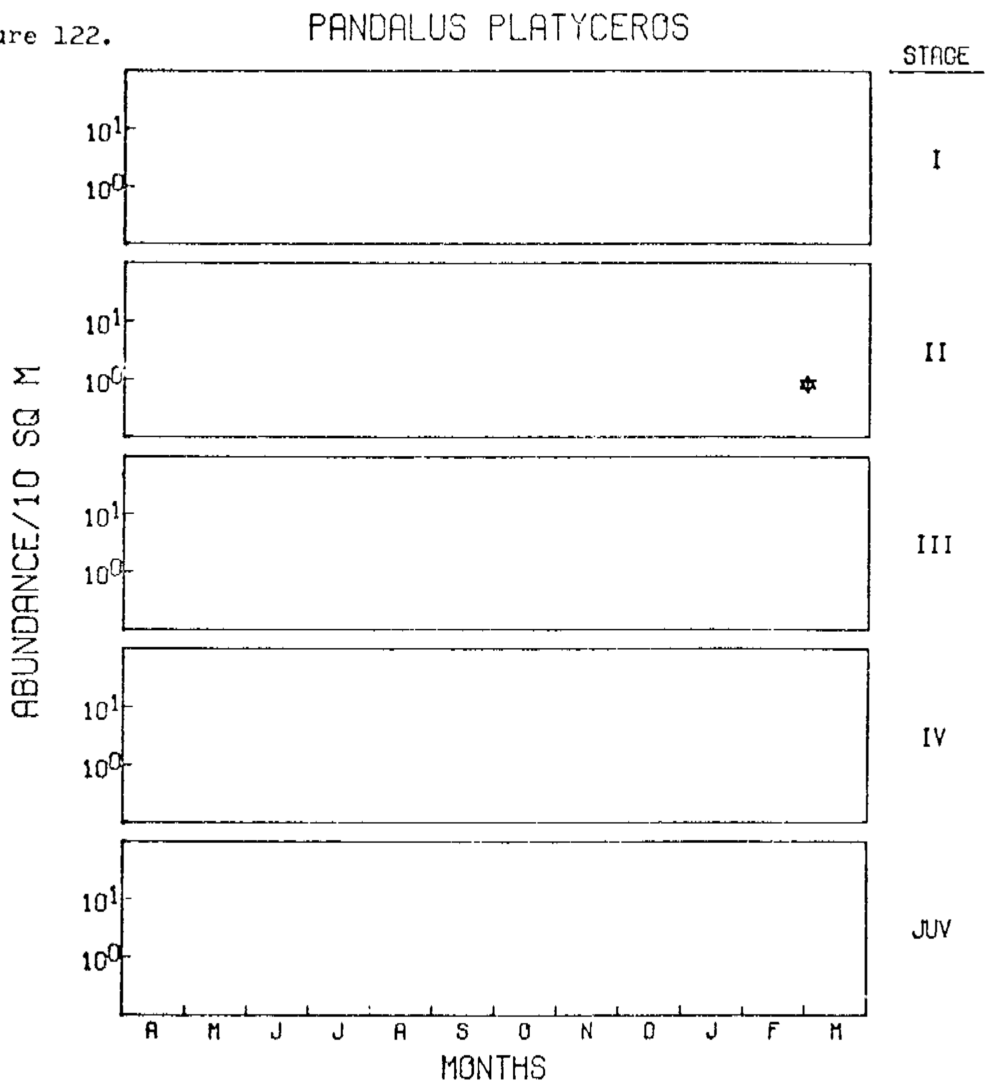

PANDALUS HYPSINOTUS
STAGE
I
II
III
IV
V
VI
JUV
ABUNDANCE/10 SQ M
10^1
10^0
A M J J A S O N D J F M
MONTHS

Figure 122.



PANDALUS PLATYCEROS
STAGE
ABUNDANCE/10 SQ M
10^1
10^0
I
II
III
IV
JUV
A
M
J
J
A
S
O
N
D
J
F
M
MONTHS

Figure 123.

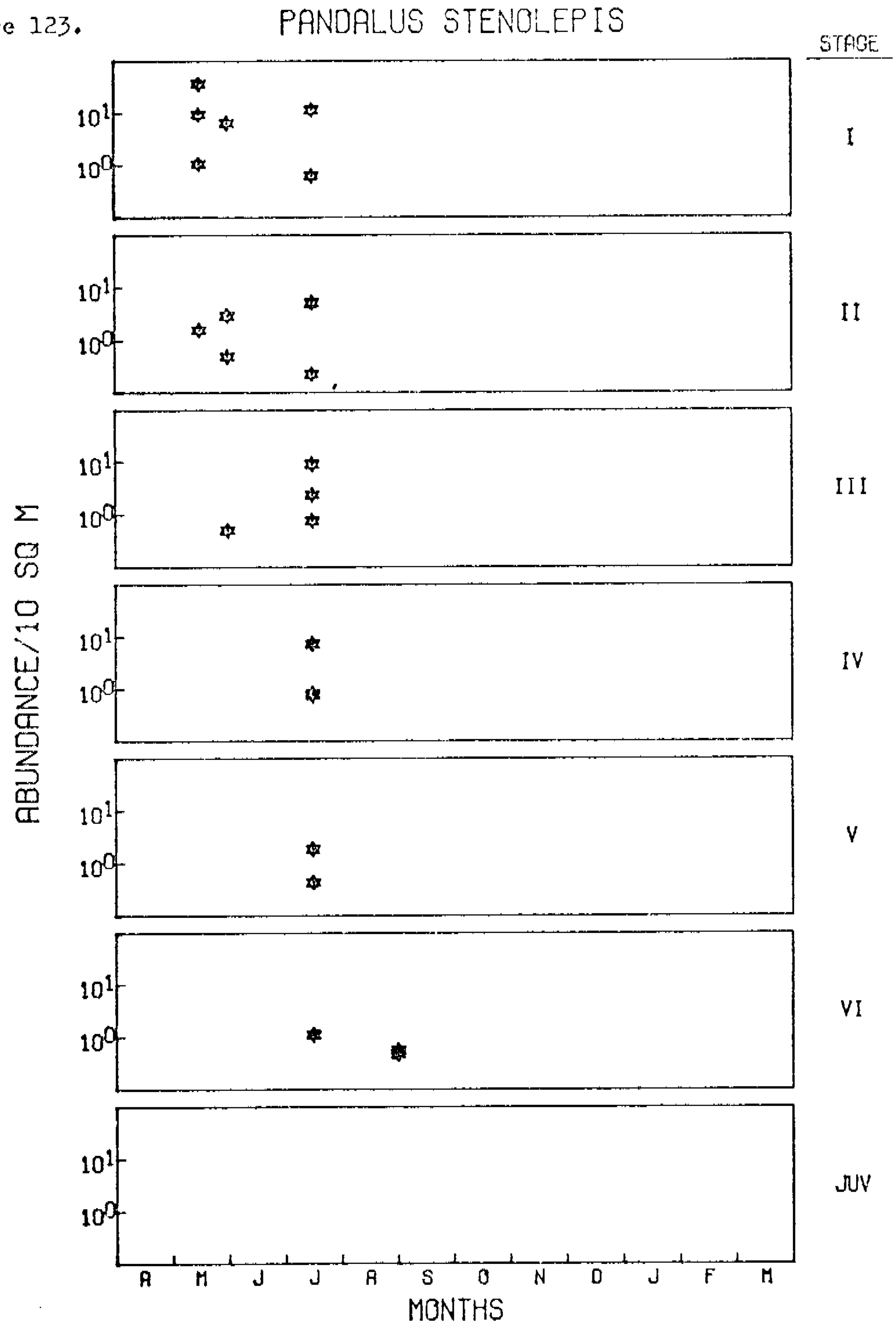
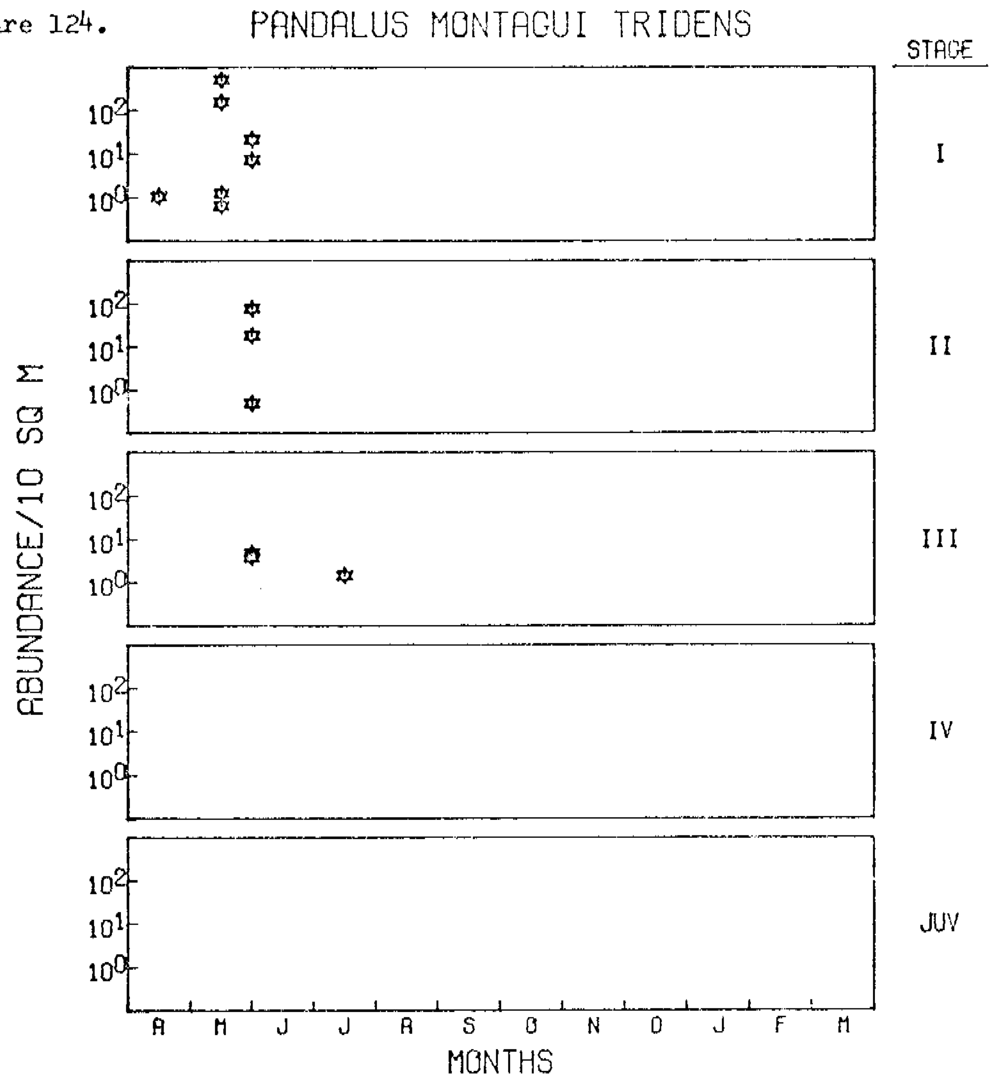

PANDALUS STENOLEPIS
STAGE
ABUNDANCE/10 SQ M
10^1
10^0
I
II
III
IV
V
VI
JUV
A
M
J
J
A
S
O
N
D
J
F
M
MONTHS

Figure 124.



PANDALUS MONTAGUI TRIDENS
STAGE
I
II
III
IV
JUV
ABUNDANCE/10 SQ M
10^2
10^1
10^0
A M J J A S O N D J F M
MONTHS

The Kachemak Bay area, and secondarily the Kamishak Bay area, were foci of abundance for the earliest life history stages of a variety of species. The lowest concentrations of abundance were often in the most northern sampling locations, in the center of Lower Cook Inlet on a line between Kachemak Bay and Kamishak Bay, and near the mouth of Lower Cook Inlet.

The older early life history stages tended to be more uniformly distributed and less concentrated near the locations of maximum abundance of the earliest life history stages. There is no reason to believe that most populations in Lower Cook Inlet are supplied from spawning populations outside Cook Inlet which provide planktonic early life history stages that are swept into Lower Cook Inlet and concentrated.

The seasonal and geographic sampling patterns were sufficiently diffuse to leave many unanswered questions. The apparent low relative abundance of early life history stages of several exploited species, the Dungeness crab, the sidestripe shrimp, and the coonstripe shrimp, is believed to reflect inadequate temporal and spatial sampling, although we have no information on the range of natural annual variability. Several populations show indications of peak abundances at two or more times or places, but the observations are too few to establish such patterns with any confidence.

The apparent seasons of abundance are undoubtedly extended when more than one species is contained in a category. Better identifications of planktonic fish eggs will be possible when living eggs can be reared until the formation of pigment can be observed. The larval fishes can be identified with more certainty when more complete developmental series can be obtained.

The bongo nets caught few juvenile fishes and relatively few later life history stages of shrimps and crabs. More effective sampling gear could increase the catch of larger organisms which may have avoided the bongo nets.

The year of reconnaissance level sampling has demonstrated that some early life history stages of organisms important in sport and commercial fisheries and forage fishes and non-commercial shell fishes of ecosystem significance were present during all seasons sampled in Lower Cook Inlet. Those early life history stages are necessary to sustain many important fish and shellfish populations in Lower Cook Inlet. These data are adequate to give a preliminary indication of the geographic areas and seasons with the greatest abundance of early life history stages in Lower Cook Inlet.

The reconnaissance level sampling strongly suggests that unit populations can be identified in Lower Cook Inlet, particularly near Kachemak Bay. A major strength of the bongo net sampling is that a complex of heavily exploited and unexploited non-commercial species of fishes, shrimp, and crabs are available for analysis to establish a quantitative ecological baseline and to allow monitoring for input to models to assess changes related to exploitation, natural variation, and environmental degradation.

The abundance of small pelagic forage fishes is striking. The herring, smelt, and sand lance spawn on the bottom in relatively shallow water. That complex of species can provide a good annual integrated assessment of any effects of environmental degradation in the shallow areas of Lower Cook Inlet. The bongo net, as expected, does not catch many juvenile fishes, juvenile shrimp, or crab megalopa. Those later early life history stages should not be emphasized in the analysis of bongo net catches; the older, larger forms can be sought with other sampling equipment when the hypothesis of interest evolves toward more site specific process studies.

V. Future Work

We are working toward the synthesis meeting in December and the annual report in March. We will try to separate several more categories of fish eggs and fish larvae for tabular and graphic presentation. We will seek graphic formats that further summarize the results of our analyses. The trade-off will be to sacrifice some detail to gain visual impact and enhance comprehension.

We will continue to attempt to synthesize our work with other research units. The residual currents in Lower Cook Inlet have a strong influence on the dispersal of early life history stages of fishes, shrimps, and crabs from the area in which they were spawned. The apparent tendency toward retention of populations in Kachemak Bay, and to a lesser extent Kamishak Bay, must reflect relatively restricted water movements in those areas. The favorable aspect of being able to determine the relative, and sometimes absolute, ages in days of early life history stages could be used to track and verify water movements if a sufficiently intensive sampling scheme could be implemented. Further insight into the earliest stages released near the bottom and later stages settling toward the bottom could be gained by a sampling plan to determine vertical distributions.

We should be able to begin a preliminary model of an appropriate portion of the Lower Cook Inlet ecosystem when the synthesis meeting has clarified BLM needs and OCSEAP objectives. The year of reconnaissance level sampling has provided the necessary preliminary quantitative information about important species present and spatial and temporal patterns to facilitate the design of an efficient approach to program objectives.

VI. Estimate of funds expended.

100% of the funds have been expended.

QUARTERLY REPORT

Contract 03-5-022-56
Research Unit #426
Task Order #13
Reporting Period 7/1-9/30/77

ZOOPLANKTON AND MICRONEKTON STUDIES OF THE BERING/CHUKCHI SEAS - INSHORE STUDIES

Dr. R. Ted Cooney
Institute of Marine Science
University of Alaska
Fairbanks, Alaska 99701

October 15, 1977

I. Task Objectives:

This study addresses the survey of zooplankton and micronekton communities in the inshore region from Norton Sound to Point Hope. Standing stocks and occurrance of cominant species in the diets of fish collected by other investigators will be used to evaluate the importance of animal plankters in the nearshore zone during the mid-summer period.

II. Field Activities:

Samples were collected from the NOAA vessel Surveyor, June 26-July 7, 1977 in the Norton Sound-Bering Strait region. Unseasonably heavy and late ice restricted the survey to the nearshore area south of Kotzebue Sound. The following samples were obtained:

1.	1-m net (vertical tows)	55
2.	1/2-m net (horizontal tows)	8
3.	Bongo net	3
4.	Tucker trawl	16

The field effort was undertaken by Mr. Ken Coyle, Mr. Lee Neimark, Ms. Liz Clarke, and Mr. Al Rude.

Sampling locations and the ships track is available as part of the cruise report filed by the Chief Scientist.

III. Results:

The onsite evaluation of sampling is included as part of the cruise report for Surveyor June 26-July 7, 1977. Due to budget limitations, the samples presently on hand cannot be processed. Monies allocated for these collections were spent analysing the remainder of the extensive inventory from the previous summer which was considerably larger than anticipated. I estimate that an additional $5,000 will be required to sort, tabulate, and submit these results.

IV. Problems:

Aside from the sample processing problem, the field work went relatively smoothly. The Surveyor has become a very adequate platform to work from particularly since the crew is now familiar with our filed sampling requirements.

RU #485

NO REPORT WAS RECEIVED

Quarterly Report

Contract #03-5-022-69
Research Unit #486
Reporting Period July 1, 1977 - September 30, 1977
Number of Pages: 1

Demersal Fish and Shellfish Assessment in Selected Estuary Systems of Kodiak Island

James E. Blackburn
Alaska Department of Fish and Game
P.O. Box 686
Kodiak, Alaska 99615

September 30, 1977

I. Task Objectives

A. Determine the spatial and temporal (June-September) distribution, relative abundance and inter-relationships of the various demersal finfish and shellfish species in the study area.

B. Determine the growth rate and food habits of selected demersal fish species.

C. Conduct literature survey to obtain and summarize an ordinal level documentation of commercial catch, stock assessment data, distribution as well as species and age group composition of various shellfish species in the study area.

D. Obtain basic oceanographic and atmospheric data to determine any correlations between these factors and migrations and/or relative abundance of various demersal fish and shellfish species encountered.

II. Field or Laboratory Activities

Activities have consisted of data analysis and final report preparation.

III. Results

The final report is partially completed and will be completed and reviewed during the coming quarter and prepared for submission December 31, 1977, as approved per letter from Herb Bruce dated September 9, 1977.

IV. Preliminary Interpretation of Results

Not applicable.

V. Problems Encountered/Recommended Changes

We have had difficulty implementing the use of the computer for data analysis.

VI. Estimate of Funds Expended

The contract period is ending at this time and preliminary accounting indicates the budget is virtually exhausted. An exact accounting of funds expended is being determined by State auditors.

RU #502

NO REPORT WAS RECEIVED

Quarterly Report

Contract #03-5-022-69
Research Unit #512
Reporting Period July 1, 1977 -
September 30, 1977
Number of Pages: 1

Pelagic and Demersal Fish Assessment in the Lower Cook Inlet Estuary System

James E. Blackburn
Alaska Department of Fish and Game
P.O. Box 686
Kodiak, Alaska 99615

September 30, 1977

I. Task Objectives

A. Determine the spatial and temporal (June-September) distribution, relative abundance and inter-relationships of the various pelagic and demersal finfish and shellfish species in the study area.

B. Determine when, where, at what rate and in what relative abundance pelagic fish species (primarily salmonids) migrate into and through the study area.

C. Determine the growth rate and food habits of selected pelagic and demersal fish species.

D. Survey the literature to obtain and summarize an ordinal level documentation of commercial catch, stock assessment data, distribution, as well as species and age group composition of various shellfish species in the study area.

E. Survey the literature to inventory and characterize salmon spawning streams as well as timing of fry and smolt migrations.

F. Obtain basic oceanographic and atmospheric data to determine any correlations between these factors and migrations and/or relative abundance of various pelagic and demersal fish and shellfish species encountered.

II. Field or Laboratory Activities

Activities have consisted of data analysis and final report preparation.

III. Results

The final report is largely completed and will be reviewed during the coming quarter and prepared for submission on December 31, 1977 as approved per letter from R. Engelmann, dated September 14, 1977.

IV. Preliminary Interpretation of Results

Not applicable.

V. Problems Encountered/Recommended Changes

We have had difficulty in implementing the use of the computer for data analysis.

VI. Estimate of Funds Expended

The contract period is ending at this time and preliminary accounting indicates the budget is virtually exhausted. An exact amount of funds expended is being determined by State auditors.

FINAL REPORT

CONTRACT #: 03-5-022-56
TASK ORDER #: 29
RESEARCH UNIT #: 517
REPORTING PERIOD: June 1, 1976 - September 30, 1977
NUMBER OF PAGES: 79

THE DISTRIBUTION, ABUNDANCE AND DIVERSITY OF THE EPIFAUNAL BENTHIC ORGANISMS IN TWO BAYS (ALITAK AND UGAK) OF KODIAK ISLAND ALASKA

Dr. H. M. Feder, Principal Investigator

with

Stephen C. Jewett

Institute of Marine Science
University of Alaska
Fairbanks, Alaska 99701

1 October 1977

ACKNOWLEDGEMENTS

We would like to thank the following for assistance during this study: the crew of the M/V *Big Valley*; Pete Jackson and James Blackburn of Alaska Department of Fish and Game, Kodiak, for their assistance in a cooperative benthic trawl study; University of Alaska, Institute of Marine Science personnel Rosemary Hobson for assistance in data processing, Max Hoberg for shipboard assistance, and Nora Foster for taxonomic assistance.

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I. SUMMARY OF OBJECTIVES, CONCLUSIONS AND IMPLICATIONS WITH RESPECT TO OCS OIL AND GAS DEVELOPMENT

Little is known about the biology of the invertebrate components of the shallow, nearshore benthos of the bays of Kodiak Island, and yet these components may be the ones most significantly affected by the impact of oil derived from offshore petroleum operations. Baseline data on species composition is essential before industrial activities take place in waters adjacent to Kodiak Island. It was the intent of this investigation to collect information on the composition, distribution, and biology of the epifaunal invertebrate components of two bays of Kodiak Island.

The specific objectives of this study were:

1. A qualitative inventory of dominant benthic invertebrate epifaunal species within two study sites (Alitak and Ugak Bays).
2. A description of spatial distribution patterns of selected benthic invertebrate epifaunal species in the designated study sites.
3. Observations of biological interrelationships between segments of the benthic biota in the designated study areas.

Fifty-three permanent stations were established in two bays - 28 stations in Alitak Bay and 25 stations in Ugak Bay. These stations were occupied with a 400-mesh Eastern otter trawl on four separate cruises in June, July and August of 1976, and March 1977. Taxonomic analysis of the epifauna collected delineated 12 phyla, 23 classes, 66 families, 79 genera and 106 species. The Arthropoda (Crustacea) dominated in species composition and biomass. Porifera, Cnidaria, Annelida, Mollusca, and Echinodermata accounted for only 2.0% of the biomass collected.

Differences in sex composition and stage of maturity of king and snow crabs between and within the two bays were noted. King crabs, *Paralithodes camtschatica*, occurred mainly at the outer stations of Alitak Bay and consisted mostly of egg-bearing females and juveniles. King crabs were well dispersed throughout Ugak Bay, and mainly consisted of juveniles. Snow crabs, *Chionoecetes bairdi*, in Alitak Bay were primarily juveniles; snow crabs in Ugak Bay were primarily adult males. Preliminary life history data for these crabs for the two bays are now available.

Food data for king and snow crabs for the two bays are also available, and these data, in conjunction with similar data from Cook Inlet and the Bering Sea, enhance our understanding of the trophic role of these crustaceans in their respective ecosystems. Additional food data for three species of flatfishes, as well as an assessment of the literature, have made it possible to develop a preliminary food web for benthic and nektobenthic species of Alitak and Ugak Bays and the inshore waters around Kodiak Island. Comprehension of basic food interrelationships is essential for assessment of the potential impact of oil on the crab-dominated benthic systems of the nearshore waters of Kodiak.

The importance of deposit-feeding clams in the diet of king and snow crabs in the two Kodiak bays has been demonstrated by preliminary feeding data collected there. It is suggested that an understanding of the relationship between oil, sediment, deposit-feeding clams, and crabs be developed in a further attempt to understand the possible impact of oil on the two commercially important species of crabs in the Kodiak area.

Initial assessment of data suggests that a few unique, abundant, and/or large invertebrate species (king crab, snow crab, several species of clams) are characteristic of the bays investigated and that these species may represent organisms that could be useful for monitoring purposes.

It is suggested that a complete understanding of the benthic systems in both bays can only be obtained when the infauna is also assessed in conjunction with the epifauna. Based on stomach analyses, infaunal species are important food items for king and snow crabs. However, the infaunal components of the Kodiak shelf have not been investigated to date. A program designed to examine the infauna should be initiated in the very near future.

II. INTRODUCTION

General Nature and Scope of Study

The operations connected with oil exploration, production, and transportation in the Gulf of Alaska present a wide spectrum of potential dangers to the marine environment (see Olson and Burgess, 1967, for general discussion of marine pollution problems). Adverse affects on a marine environment cannot be assessed, or even predicted, unless background data pertaining to the area are recorded prior to industrial development.

Insufficient long-term information about an environment and the basic biology of species present can lead to erroneous interpretations of changes that might occur if the area becomes altered (see Nelson-Smith, 1973; Pearson, 1971, 1972; Rosenberg, 1973, for general discussions on benthic biological investigations in industrialized marine areas). Populations of marine species fluctuate over a time span of a few to 30 or more years (Lewis, 1970).

Benthic organisms (primarily the infauna and sessile and slow-moving epifauna) are useful as indicator species for a disturbed area because they tend to remain in place, typically react to long-range environmental changes, and by their presence, generally reflect the nature of the substratum. Consequently, the organisms of the infaunal benthos have frequently been chosen to monitor long-term pollution effects, and are believed to reflect the biological health of a marine area (see Pearson, 1971, 1972, 1975; and Rosenberg, 1973, for discussions on usage of benthic organisms for monitoring pollution). The presence of large numbers of benthic epifaunal species of actual or potential commercial importance (crabs, shrimps, scallops, snails, fin fishes) in the shelf ecosystem of Kodiak Island further dictates the necessity of understanding benthic communities since many commercial species feed on infaunal and small epifaunal residents of the benthos (see Feder *et al.*, 1977, Zenkevitch, 1963, and this report for a discussion of the interaction of commercial species and the benthos). Thus, drastic changes in density of the food benthos would affect the health and numbers of these fisheries organisms.

Experience in pollution-prone areas of England (Smith, 1968), Scotland (Pearson, 1972), and California (Straughan, 1971) suggests that at the completion of an initial exploratory study, selected stations should be examined regularly on a long-term basis to determine any changes in species composition, diversity, abundance, and biomass. Such long-term data acquisition should make it possible to differentiate between normal ecosystem variation and pollutant-induced biological alteration. An intensive investigation of the benthos of the Kodiak shelf, as well as its bays, is essential to an understanding of the trophic interactions there and the potential changes that could take place once oil-related activities are initiated. An intensive benthic biological program in the northeast Gulf of Alaska (NEGOA) has emphasized the development of a qualitative and quantitative inventory of prominent species of the benthic infauna and epifauna there (Feder *et al.*, 1976). In addition, a developing investigation concerned with the biology of selected benthic species from NEGOA and lower Cook Inlet will further our understanding of the overall Gulf of Alaska benthic system (Feder *et al.*, 1977). Initiation of a program designed to examine the subtidal benthos of the Kodiak shelf will expand the coverage of the Gulf of Alaska benthic system, and an assessment of the fauna of two bays of Kodiak will extend investigations into little-known shallow-water benthic systems. The study reported here is a preliminary assessment of two shallow bays of Kodiak Island, and is intended to precede a greater overall investigation of the Kodiak Island shelf.

Relevance to Problems of Petroleum Development

The effects of oil pollution on subtidal benthic organisms have been seriously neglected, although the results of a few studies, conducted after serious oil spills, have been published (see Boesch *et al.*, 1974 for review of these papers). Thus, lack of a broad data base elsewhere makes it difficult to predict the effects of oil-related activity on the subtidal benthos of the Kodiak shelf and the two Kodiak bays investigated. However, the expansion of research activities into Kodiak waters should ultimately enable us to identify certain species or areas that might bear closer scrutiny once industrial activity is initiated. It must be emphasized that a considerable time span is needed to understand fluctuations in density of marine benthic species, and it cannot be expected that a short-term research program will result in predictive capabilities. Assessment of the environment must be conducted on a continuing basis.

Data indicating the effects of oil on most subtidal benthic invertebrates are fragmentary (Nelson-Smith, 1973). The tanner or snow crab (*Chionoecetes bairdi*) is a conspicuous member of the shallow shelf of

Kodiak Island and its bays, and supports a commercial fishery of considerable importance there. Laboratory experiments with this species have shown that postmolt individuals lose most of their legs after exposure to Prudhoe Bay crude oil; obviously this aspect of the biology of the snow crab must be considered in the continuing assessment of this benthic species in the Gulf of Alaska (Karinen and Rice, 1974). Few other direct data based on laboratory experiments are available for subtidal benthic species (see Nelson-Smith, 1973 for review). Experimentation on toxic effects of oil on other common members of the subtidal benthos should be strongly encouraged for the near future in Kodiak waters as well as for all Outer Continental Shelf (OCS) areas of investigation. In addition, potential effects of the loss of sensitive species to the trophic structure of the shelf must be examined. The above problems can best be addressed once benthic food studies are made available as a result of the Outer Continental Shelf Environmental Assessment Program (OCSEAP) (e.g., see the following annual reports: Feder *et al.*, 1977, and Smith *et al.*, 1977).

A direct relationship between trophic structure (feeding type) and bottom stability has been demonstrated by Rhoads (see Rhoads, 1974 for review). He describes a diesel-fuel oil spill that resulted in oil becoming adsorbed on sediment particles which in turn caused death of deposit feeders living on sublittoral muds. Bottom stability was altered with the death of these organisms, and a new complex of species became established in the altered substratum. Many common members of the infauna of the Gulf of Alaska are deposit feeders; thus, oil-related mortality of these species could result in a changed near-bottom sedimentary regime with alteration of species composition there. In addition, the commercially important king and snow crabs, and some bottom fishes, use deposit feeders as food (Feder *et al.*, 1977 and present report); thus, contamination of the bottom by oil might indirectly affect the commercial species around Kodiak Island.

III. CURRENT STATE OF KNOWLEDGE

Little is known about the biology of the invertebrate benthos of the Gulf of Alaska, although a compilation of some relevant data on the Gulf of Alaska is available (AEIDC, 1975; Rosenberg, 1972). The exploratory trawl surveys of the National Marine Fisheries Service (undated) are the most extensive investigations of the benthic epifauna of the Kodiak shelf.[1] However, caution must be exercised in interpreting data from these surveys. Results, each directed toward different groups and/or species, are not typically comparable due to the alteration of gear and sampling effort from one cruise to another. Some unpublished information on the epifauna in the vicinity of Kodiak Island is available (i.e., Alaska Department of Fish and Game King Crab Indexing Surveys).[2] The International Pacific Halibut Commission surveys parts of the Kodiak shelf annually, but the only invertebrates recorded are the commercially important crabs (see Intl. Pac. Halibut Comm., 1964).

Alitak Bay has a past history as a king crab mating ground (Kingsbury and James, 1971), and has been a major producer of commercial-sized crab in the Kodiak Island area since 1953 (Gray and Powell, 1966). Outer Alitak Bay was also the site of king crab distribution, abundance, and composition studies (Gray and Powell, 1966; Kingsbury *et al.*, 1974) conducted by the Alaska Department of Fish and Game during the summer months of 1962 and 1970.

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[1] Unpublished data. Reports available from the National Marine Fisheries Service Laboratory, Kodiak, Alaska.

[2] Unpublished reports. Inquiries may be directed to Alaska Department of Fish and Game, Box 686, Kodiak, Alaska 99615.

IV. STUDY AREA

A large number of stations were occupied in two Kodiak Island bays in conjunction with the Alaska Department of Fish and Game. Alitak Bay and Ugak Bay, located on the south and east side of the Island respectively, were the sites of benthic trawling activities during the summer of 1976 and March, 1977 (Figs. 1 and 2).

V. SOURCES, METHODS AND RATIONALE OF DATA COLLECTION

Benthic epifauna was collected onboard the M/V *Big Valley* in 1976 during June 17-22, July 18-28 and August 19-29, and in 1977 during March 3-18. Thirty-minute tows were made at predetermined stations (Figs. 1 and 2) using a commercial size 400-mesh Eastern otter trawl with a 12.2 m horizontal opening.

Fifty-three permanent stations were established in the two bays - 28 stations in Alitak Bay and 25 stations in Ugak Bay.

The number of stations occupied in each bay by cruise are as follows:

Cruise Date	Alitak Bay	Ugak Bay	Total Stations
June 17-22, 1976	28	25	53
July 18-28, 1976	28	25	53
August 19-29, 1976	22	25	47
March 3-18, 1977	21	23	44
TOTAL	99	98	197

Bay stations were arbitrarily divided into three sections; inner stations, mid-bay stations, and outer stations (Figs. 1 and 2).

Invertebrates were sorted on shipboard, given tentative identifications, counted, and weighed. Aliquot samples of individual species were preserved and labeled for final identification at the Institute of Marine Science,

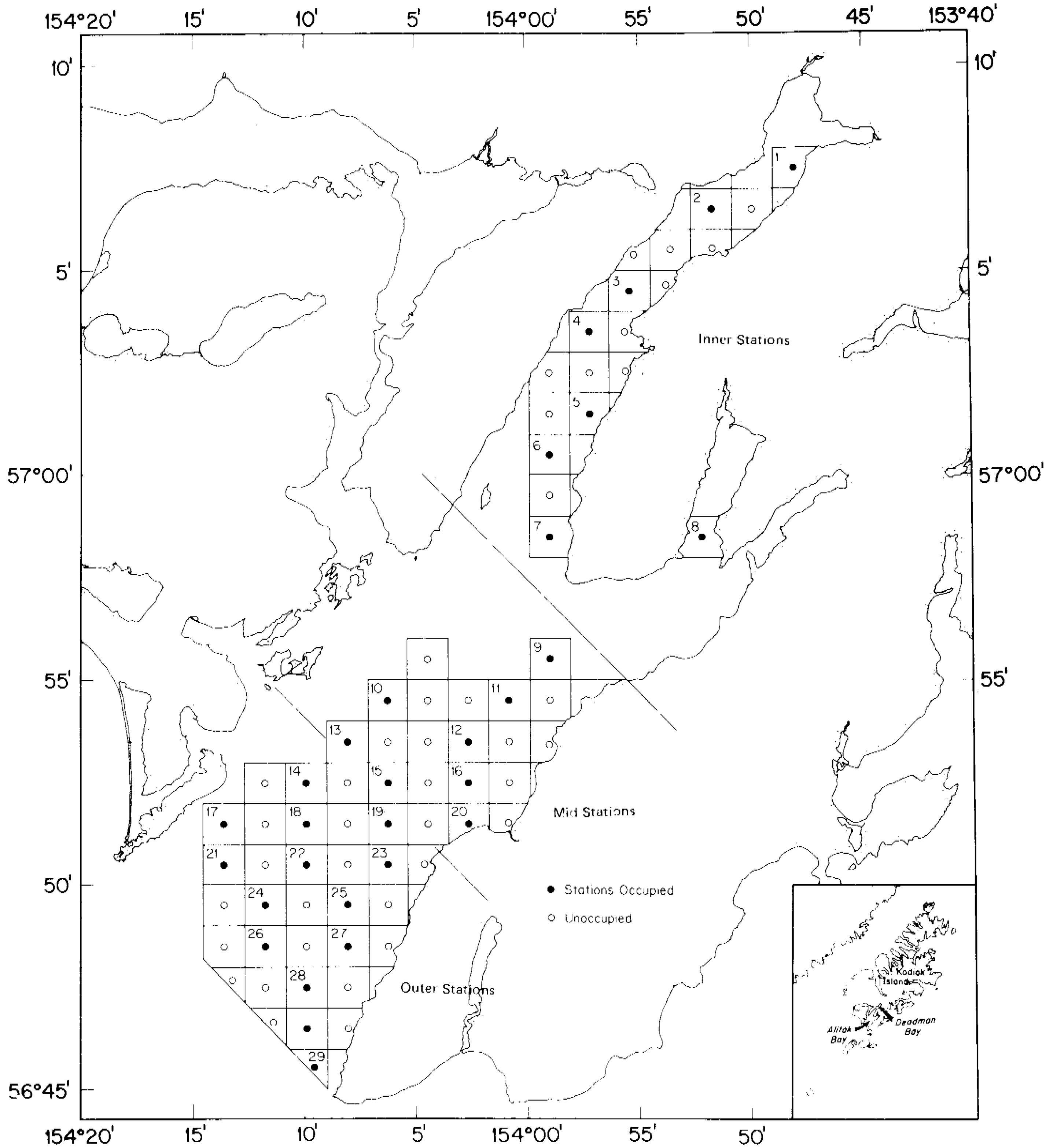

Figure 1. Trawl station grid and stations occupied in Alitak Bay, Kodiak Island, Alaska. June, July, and August 1976, and March 1977. The oblique, dashed lines drawn across the bay divide it into three sections referred to in the text.

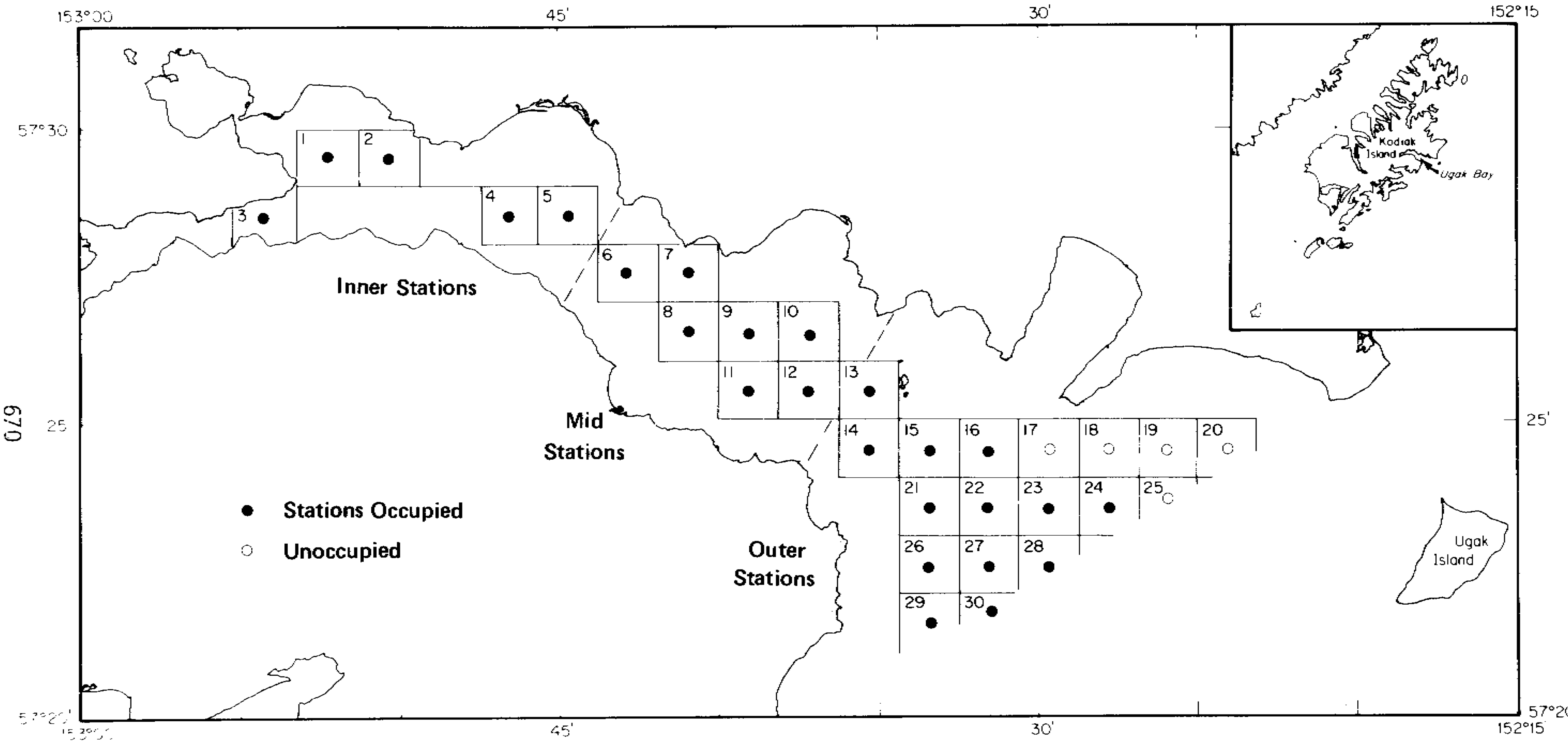

Figure 2. Trawl station grid and stations occupied in Ugak Bay, Kodiak Island, Alaska. June, July, and August 1976, and March 1977. The oblique, dashed lines drawn across the bay divide it into three sections referred to in the text.

University of Alaska. Laboratory examination occasionally revealed more than one species in a sample that had been identified to a single species in the field (e.g., field identifications of *Eualus macilenta* were later found to also contain *E. gaimardii belcheri*). The counts and weights of the species in question were arbitrarily expanded from the laboratory species ratio to encompass the entire catch of the trawl.

After final identification, all invertebrates were assigned code numbers (Mueller, 1975) to facilitate data analysis by computer. Representative and voucher samples of invertebrates are temporarily stored at the Institute of Marine Science, University of Alaska, Fairbanks, Alaska.

The major limitation of the survey was that imposed by the selectivity of the otter trawl used. In addition, rocky-bottom areas could not be sampled since otter trawls of the type used can only be fished on relatively smooth bottoms. Location of stored commercial crab gear in Alitak Bay, necessitated elimination of six stations (9 through 13) during the August sampling period. Seven (7) outer Alitak Bay stations (14, 18, 25 through 29) were eliminated in March, 1977 due to heavy concentrations of ovigerous female king crabs.

Food data were collected by examination of stomachs, either on shipboard or in the laboratory, of two species of crabs (snow crab, *Chionoecetes bairdi* and king crab, *Paralithodes camtschatica*) and four species of flatfishes (*Limanda aspera, Platichthys stellatus, Hippoglossoides elassodon* and *Lepidopsetta bilineata*). Male snow crabs between 75 and 180 mm carapace width and male king crabs between 90 and 200 mm carapace length were examined. Food organisms are expressed in frequency of occurrence, i.e., the percent of stomachs containing various food items from the total number of stomachs analyzed.

King and snow crabs were separated by weight, sex, and state of maturity. Male king crabs were considered sexually mature if their wet weight was at least 2.0 kg. Male snow crabs were considered mature if their wet weight was at least 0.45 kg. Weight criteria established for maturity of both crab species are approximations based on the minimum weight of legal-size crabs (J. Hilsinger and S. Jewett, unpublished data). Female king and snow crabs were classified as immature (pre-reproductive) or mature (reproductive or post-reproductive) based on the enlarged abdomen, modified pleopods, and egg clutch of the adults.

All station data not included in tables and appendices in this report are on file at the National Oceanographic Data Center (NODC).

VI. RESULTS

Distribution, Abundance and Reproductive Biology

Alitak Bay

The average epifaunal invertebrate biomass for all Alitak Bay stations sampled was 6.24 g/m^2 (Table I). The lowest biomass recorded was in August, 3.17 g/m^2, while the highest biomass was in March 1977, 10.59 g/m^2.

Taxonomic analysis of epifaunal invertebrates from Alitak Bay delineated 10 phyla, 16 classes, 46 families, 60 genera, and 79 species (Table II; Appendix Table I). Arthropoda (Crustacea) and Mollusca dominated species representation with 34 and 22 species, respectively (Table II; Appendix Table I). Arthropod crustaceans accounted for 99.1% of the total invertebrate biomass (Table III; Appendix Table II); 97.7% of this biomass was made up of the families Pandalidae, Lithodidae, and Majidae (Table IV; Appendix Table III). The leading species in each of these families, respectively, were the pink shrimp (*Pandalus borealis*), the king crab (*Paralithodes camtschatica*)

TABLE I

TOTAL EPIFAUNAL INVERTEBRATE BIOMASS FROM BENTHIC TRAWLING ACTIVITIES IN ALITAK AND UGAK BAY; JUNE, JULY, AND AUGUST 1976, AND MARCH 1977

	Alitak Bay			Ugak Bay			Alitak and Ugak Bay		
	Weight, kg	Distance fished, km	g/m^2	Weight, kg	Distance fished, km	g/m^2	Weight, kg	Distance fished, km	g/m^2
June, 1976	2998.427	47.15	5.21	1264.732	42.50	2.43	4263.159	89.65	3.98
July, 1976	3313.600	45.30	5.99	2086.509	43.46	3.93	5400.110	88.76	4.98
August, 1976	1431.266	36.98	3.17	1862.656	41.14	3.71	3293.922	78.12	3.45
March, 1977	3939.625	30.49	10.59	1900.674	37.90	4.11	5840.300	68.39	6.99
All months	11682.919	159.92	6.24	7114.572	165.00	3.54	18797.493	324.92	4.74

TABLE II

A LIST OF SPECIES TAKEN BY TRAWL FROM ALITAK BAY, KODIAK ISLAND, ALASKA IN JUNE, JULY, AUGUST, 1976 AND MARCH, 1977

Phylum Porifera
- unidentified sp.

Phylum Cnidaria
- Class Hydrozoa
  - unidentified sp.
- Class Scyphozoa
  - unidentified sp.
- Class Anthozoa
  - Family Pennatulidae
    - *Ptilosarcus gurneyi* (Gray)
  - Family Actinostolidae
    - *Stomphia coccinea* (O. F. Müller)
  - Family Actiniidae
    - *Tealia crassicornis* (O. F. Müller)

Phylum Annelida
- Class Polychaeta
  - Family Polynoidae
    - unidentified sp.
  - Family Nereidae
    - *Nereis* sp.
  - Family Serpulidae
    - *Crucigera irregularis* Bush
- Class Hirudinea
  - Family Acanthochitonidae
    - *Notostomobdella* sp.

Phylum Mollusca
- Class Pelecypoda
  - Family Nuculonidae
    - *Nuculana fossa* Baird
    - *Yoldia thraciaeformis* Storer
  - Family Mytilidae
    - *Mytilus edulis* Linnaeus
    - *Musculus discors* (Gray)
  - Family Pectinidae
    - *Chlamys rubida* Hinds
    - *Pecten caurinus* Gould
  - Family Anomiidae
    - *Pododesmus macrochisma* Deshayes
  - Family Astartidae
    - *Astarte rollandi* Bernardi
    - *Astarte esquimalti* Baird
  - Family Cardiidae
    - *Clinocardium ciliatum* (Fabricius)
    - *Serripes groenlandicus* (Bruguiére)

TABLE II

CONTINUED

Phylum Mollusca (cont'd)
- Family Veneridae
  - *Saxidomus gigantea* (Deshayes)
  - *Protothaca staminea* (Conrad)
- Family Tellinidae
  - *Macoma calcarea* (Gmelin)
- Family Hiatellidae
  - *Hiatella arctica* (Linnaeus)

Class Gastropoda
- Family Calyptraeidae
  - *Crepidula nummaria* Gould
- Family Velutinidae
  - *Velutina* sp.
- Family Cymatiidae
  - *Fusitriton oregonensis* (Pedfield)
- Family Thaididae
  - *Nucella lamellosa* (Gmelin)
- Family Neptunidae
  - *Neptunea lyrata* (Gmelin)

Class Cephalopoda
- Family Gonatidae
  - *Gonatus* sp.
- Family Octopodidae
  - *Octopus* sp.

Phylum Arthropoda

Class Crustacea
- Family Balanidae
  - *Balanus balanus* Pilsbury
  - *Balanus hesperius* Pilsbury
  - *Balanus rostratus* Pilsbury
- Order Amphipoda
  - unidentified sp.
- Order Decapoda
  - Family Pandalidae
    - *Pandalus borealis* Kröyer
    - *Pandalus goniurus* Stimpson
    - *Pandalus hypsinotus* Brandt
    - *Pandalopsis dispar* Rathbun
  - Family Hippolytidae
    - *Eualus biunguis* Rathbun
    - *Eualus gaimardii belcheri* (Bell)
    - *Eualus macilenta* (Kröyer)
  - Family Crangonidae
    - *Crangon dalli* Rathbun
    - *Crangon communis* Rathbun
    - *Sclerocrangon boreas* (Phipps)

TABLE II

CONTINUED

Phylum Arthropoda (cont'd)
- Family Crangonidae (cont'd)
  - *Argis* sp.
  - *Argis lar* (Owen)
  - *Argis dentata* (Rathbun)
  - *Argis crassa* Rathbun
- Family Paguridae
  - *Pagurus* sp.
  - *Pagurus ochotensis* Brandt
  - *Pagurus aleuticus* (Benedict)
  - *Pagurus capillatus* (Benedict)
  - *Pagurus kennerlyi* (Stimpson)
  - *Pagurus beringanus* (Benedict)
  - *Labidochirus splendescens* (Owen)
- Family Lithodidae
  - *Paralithodes camtschatica* (Tilesius)
  - *Paralithodes platypus* Brandt
- Family Majidae
  - *Oregonia gracilis* Dana
  - *Hyas lyratus* Dana
  - *Chionoecetes bairdi* Rathbun
  - *Pugettia gracilis* (Dana)
- Family Cancridae
  - *Cancer magister* Dana
  - *Cancer oregonensis* (Dana)
- Family Atelecyclidae
  - *Telmessus cheiragonus* (Tilesius)

Phylum Sipunculida
- unidentified sp.

Phylum Ectoprocta
- unidentified sp.

Phylum Brachiopoda
- Class Articulata
  - Family Dallinidae
    - *Terebratalia transversa* (Sowerby)

Phylum Echinodermata
- Class Asteroidea
  - Family Echinasteridae
    - *Henricia* sp.
  - Family Pterasteridae
    - *Pteraster tesselatus* Fisher
  - Family Asteridae
    - *Evasterias echinosoma* (Stimpson)
    - *Evasterias troschelii* (Stimpson)

TABLE II

CONTINUED

Phylum Echinodermata (cont'd)
- Family Asteridae (cont'd)
  - *Stylasterias forreri* (de Loriol)
  - *Pycnopodia helianthoides* (Brandt)
- Family Strongylocentrotidae
  - *Strongylocentrotus droebachiensis* (O. F. Müller)
- Class Holothuroidea
  - Family Molpadiidae
    - *Molpadia* sp.
  - Family Cucumariidae
    - *Cucumaria* sp.

Phylum Chordata
- Class Ascidiacea
  - unidentified sp.

TABLE III

NUMBER, WEIGHT, AND DENSITY OF MAJOR EPIFAUNAL INVERTEBRATE PHYLA OF ALITAK AND UGAK BAYS, JUNE, JULY, AUGUST, 1976 AND MARCH 1977

Phylum	Number of organisms		Weight (kg)		Percent of total weight		Mean grams per square meter	
	Alitak	Ugak	Alitak	Ugak	Alitak	Ugak	Alitak	Ugak
Porifera	649	1037	43.86	89.35	0.38	1.25	0.022	0.044
Cnidaria	71	275	12.23	44.75	0.10	0.63	0.006	0.022
Mollusca	276	570	16.62	6.48	0.14	0.09	0.008	0.003
Arthropoda (Crustacea only)	294718	162337	11586.55	6819.85	99.10	95.85	5.938	3.387
Echinodermata	77	577	22.62	137.36	0.19	1.93	0.011	0.068
TOTAL	295791	164796	11681.88	7097.79	99.91	99.75	5.985	3.524

TABLE IV

NUMBER, WEIGHT, AND DENSITY OF MAJOR EPIFAUNAL INVERTEBRATE FAMILIES OF ALITAK AND UGAK BAYS, JUNE, JULY, AUGUST, 1976 AND MARCH 1977

	Number of organisms		Weight (kg)		Percent of total weight		Mean grams per square meter	
Phylum	Alitak	Ugak	Alitak	Ugak	Alitak	Ugak	Alitak	Ugak
Actiniidae	32	249	8.31	43.26	0.07	0.60	0.004	0.021
Pandalidae	263376	143595	2316.23	1392.23	19.82	19.56	1.187	0.691
Hippolytidae	14559	3793	109.34	35.73	0.93	0.50	0.056	0.017
Lithodidae	3013	3460	4366.32	2586.71	37.37	36.35	2.237	1.285
Majidae	7874	6420	4731.85	2743.04	40.50	38.55	2.425	1.362
Asteridae	52	197	21.41	130.03	0.18	1.82	0.010	0.064
TOTAL	288906	157714	11553.46	6931.00	98.87	97.38	5.919	3.440

and the snow or tanner crab (*Chionoecetes bairdi*) (Table V; Appendix Table IV). Although 22 species of Mollusca were represented, these species only accounted for 0.14% of the total invertebrate biomass (Table III).

The average catch of *Pandalus borealis* for all Alitak Bay stations in all sampling periods was 15.97 kg per tow ($\frac{1581.86\ \text{kg}}{99\ \text{tows}}$) (also see Table V). Abundant catches of pink shrimps were obtained during June, July and August 1976, from Alitak Bay stations 11-16 (Fig. 1). During March 1977 the greatest catches came from stations 3-7 (Fig. 1). The greatest single catch was obtained in July at station 23; 426.0 kg.

Pink shrimps were not carrying eggs during June and July. However, in August, aqua-colored eggs were either visible through the cephalothorax and/or were attached to the abdominal appendages. By the following March, the eggs had advanced to the eyed-condition. Other pandalid and crangonid shrimps displayed similar timing of egg maturation.

The average catch of *Paralithodes camtschatica* for all Alitak Bay tows was 44.10 kg per tow ($\frac{4365.87\ \text{kg}}{99\ \text{tows}}$) (also see Table V). During June through August, Alitak Bay stations 21 through 29 had good catches. However, the largest catches were obtained in the outer stations during March 1977. Several 10-minute tows were made in this outer bay area and these short tows produced full catches of adult female king crabs. Due to the concentrations of these female crabs and the high mortality which would probably result from continued sampling, trawling was aborted in seven of the outer Alitak Bay stations.

Ovigerous king crabs were collected in each of the four sampling periods. Many egg clutches were partially hatched and approximatel 3% were completely hatched by March. No grasping was observed at the latter time. Differences in sex composition and stage of maturity were observed over the four sampling

TABLE V

NUMBER, WEIGHT, AND DENSITY OF THE MAJOR EPIFAUNAL SPECIES OF ARTHROPODA (CRUSTACEA) FROM ALITAK AND UGAK BAYS, JUNE, JULY, AUGUST, 1976 AND MARCH, 1977

Phylum	Number of organisms		Weight (kg)		Percent of total weight		Mean grams per square meter	
	Alitak	Ugak	Alitak	Ugak	Alitak	Ugak	Alitak	Ugak
Pandalus borealis	81668	91225	1581.86	881.96	13.54	12.40	0.810	0.438
Pandalus goniurus	33109	26688	270.15	253.04	2.31	3.56	0.138	0.125
Pandalus hypsinotus	45509	25343	414.10	253.81	3.54	3.57	0.212	0.126
Pandalopsis dispar	3089	338	50.54	3.41	0.43	0.05	0.025	0.001
Eualus gaimardii belcheri	11288	–	81.96	–	0.70	–	0.042	–
Argis dentata	2349	1600	17.84	11.33	0.15	0.16	0.009	0.005
Paralithodes camtschatica	3012	3460	4365.87	2586.71	37.37	36.36	2.237	1.285
Chionoecetes bairdi	7772	6085	4728.56	2740.74	40.47	38.52	2.423	1.361
TOTAL	187796	154739	11510.88	6731.00	98.51	94.62	5.896	3.341

periods (Tables VI and VII). The sex ratio of king crabs in the outer Alitak Bay stations for the present study, as well as from other studies (Gray and Powell, 1966; Kingsbury and James, 1971), is presented in Table VIII.

The average catch of *Chionoecetes bairdi* was 47.76 kg per tow ($\frac{4728.56 \text{ kg}}{99 \text{ tows}}$) (also see Table V). Large catches of snow crabs were obtained in Alitak Bay stations 2 through 5 from June through August. The largest catch, 119.51 kg, was recorded at Alitak Bay station 3 in July. The catch of snow crabs in Alitak Bay declined from June to August; the catch was up slightly in March. Adult males were the main component of the population during the summer sampling periods (Table VI); in March adult females carrying eyed-eggs were common (Table VII). Ovigerous snow crabs were present during the four sampling periods.

Ugak Bay

The average epifaunal invertebrate biomass for all Ugak Bay stations sampled was 3.54 g/m^2 (Table I). The lowest and highest biomasses were recorded in June 1976 and March 1977, respectively.

During the four Ugak Bay sampling periods, in which 98 tows were made, epifaunal invertebrates were identified to 12 phyla, 19 classes, 50 families, 67 genera and 84 species (Table IX; Appendix Table V). Arthropoda and Mollusca dominated Ugak Bay in species representation with 30 and 22 species present, respectively (Table IX). Crustaceans accounted for 95.8% of the total invertebrate biomass (see Appendix Tables VI, VII, and VIII for biomass data); 87.2% of the biomass consisting of pink shrimps, king crabs and snow crabs (Table V).

The average catch of *Pandalus borealis* for 98 Ugak Bay tows was 9.0 kg per tow ($\frac{881.96 \text{ kg}}{98 \text{ tows}}$) (Table V). Large catches of pink shrimps were [illegible]

TABLE VI

SEX AND MATURITY COMPOSITION OF KING CRABS AND SNOW CRABS IN ALITAK AND UGAK BAYS, JUNE, JULY, AND AUGUST, 1976

Alitak Bay Stations	Composition	June King crabs No.	June King crabs %	June Snow crabs No.	June Snow crabs %	July King crabs No.	July King crabs %	July Snow crabs No.	July Snow crabs %	August King crabs No.	August King crabs %	August Snow crabs No.	August Snow crabs %
1-7 (inner)	Adult males	0	0	1148	98	0	0	653	97	3	30	417	95
	Adult females[1]	0	0	8	1	0	0	16	2	7	70	11	3
	Juvenile males	0	0	0	0	0	0	0	0	0	0	2	<1
	Juvenile females	0	0	8	1	0	0	6	1	0	0	9	2
	Total	0	0	1164	100	0	0	675	100	10	100	439	100
9-13, 15,[2] 16, 20 (mid-bay)	Adult males	0	0	603	88	41	67	895	92	6	15	84	92
	Adult females	1	100	55	8	4	6	53	6	16	39	4	4
	Juvenile males	0	0	0	0	13	21	14	1	14	34	2	2
	Juvenile females	0	0	27	4	4	6	8	1	5	12	2	2
	Total	1	100	685	100	62	100	970	100	41	100	92	100
14, 17, 18, 19, 21-29 (outer)	Adult males	25	7	1037	76	28	4	583	61	21	8	178	67
	Adult females	165	50	319	23	244	35	271	28	100	37	69	26
	Juvenile males	87	26	8	1	236	34	12	1	92	34	9	3
	Juvenile females	56	17	4	<1	186	27	93	10	56	21	11	4
	Total	333	100	1368	100	694	100	959	100	269	100	267	100
Ugak Bay Stations													
1-5 (inner)	Adult males	8	7	180	87	23	2	214	42	20	5	190	77
	Adult females	1	1	16	8	2	<1	59	12	5	1	19	8
	Juvenile males	43	38	0	0	397	43	196	38	193	50	18	7
	Juvenile females	61	54	11	5	511	55	42	8	169	44	21	8
	Total	113	100	207	100	933	100	511	100	387	100	248	100
6-12 (mid-bay)	Adult males	7	29	567	90	23	6	212	56	2	1	213	81
	Adult females	3	13	31	5	9	2	33	9	1	1	8	3
	Juvenile males	12	50	0	0	189	50	109	29	76	45	25	10
	Juvenile females	2	8	35	5	159	42	25	6	88	53	16	6
	Total	24	100	633	100	380	100	379	100	167	100	262	100

TABLE VI

CONTINUED

Ugak Bay Stations	Composition	June				July				August			
		King crabs		Snow crabs		King crabs		Snow crabs		King crabs		Snow crabs	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
13-30 (outer)	Adult males	21	29	591	83	21	8	728	62	2	<1	339	76
	Adult females	7	10	38	5	36	13	61	5	9	1	23	5
	Juvenile males	29	40	0	0	149	53	189	16	379	57	59	14
	Juvenile females	15	21	79	12	73	26	200	17	282	42	24	5
	Total	72	100	708	100	279	100	1178	100	672	100	445	100

[1] All adult female king and snow crabs in both bays were carrying eggs.

[2] Stations 9-13 in Alitak Bay were not sampled during August due to the presence of stored crab gear.

TABLE VII

SEX AND MATURITY COMPOSITION OF KING CRABS AND SNOW CRABS IN ALITAK AND UGAK BAYS, MARCH, 1977

Alitak Bay stations	Composition	King crabs No.	King crabs %	Snow crabs No.	Snow crabs %
1-7 (inner)	Adult males	1	50	99	51
	Adult females[1]	1	50	5	2
	Juvenile males	0	0	80	41
	Juvenile females	0	0	12	6
	TOTAL	2	100	196	100
9-13, 15, 16, 17, 20 (mid-bay)	Adult males	66	24	109	29
	Adult females	184	67	36	9
	Juvenile males	22	8	146	39
	Juvenile females	2	1	88	23
	TOTAL	274	100	379	100
19, 21-24 (outer)	Adult males	68	7	23	4
	Adult females	862	92	413	82
	Juvenile males	10	1	28	6
	Juvenile females	0	0	40	8
	TOTAL	940	100	504	100
Ugak Bay stations					
1-5 (inner)	Adult males	0	0	94	27
	Adult females	13	12	48	14
	Juvenile males	37	33	190	55
	Juvenile females	61	55	14	4
	TOTAL	111	100	346	100
6-12 (mid-bay)	Adult males	9	16	120	22
	Adult females	10	18	97	18
	Juvenile males	29	52	300	55
	Juvenile females	8	14	29	5
	TOTAL	56	100	546	100
13-16, 21-23, 26-29 (outer)	Adult males	20	9	119	19
	Adult females	31	15	130	21
	Juvenile males	132	63	278	43
	Juvenile females	28	13	106	17
	TOTAL	211	100	633	100

[1]All adult female king crabs and snow crabs in both bays were carrying eggs.

TABLE VIII

SEX RATIOS OF KING CRABS IN OUTER ALITAK BAY[1]

Date	Mature Crabs			Immature Crabs		
	Female	Male	Ratio[2]	Female	Male	Ratio[2]
April 1970[3]	1440	421	3.42:1	77	60	1.28:1
May 1962[4]	584	366	1.60:1	21	28	0.75:1
June 1970[3]	359	198	1.81:1	66	103	0.64:1
June 1976	165	25	6.60:1	56	87	0.64:1
July 1976	244	28	8.71:1	186	236	0.79:1
August 1976	100	21	4.76:1	56	92	0.61:1
March 1977	1047	135	7.76:1	2	32	0.06:1

[1]Additional data for months not reported here is found in Kingsbury *et al.*, 1974.

[2]Females per male.

[3]Kingsbury and James, 1971.

[4]Gray and Powell, 1966.

TABLE IX

LIST OF SPECIES TAKEN BY TRAWL FROM UGAK BAY, KODIAK ISLAND, ALASKA IN JUNE, JULY, AUGUST, 1976 AND MARCH, 1977

Phylum Porifera
- Unidentified species

Phylum Cnidaria
- Class Hydrozoa
  - Family Campanulariidae
    - *Campanularia* sp.
  - Family Lafoeidae
    - Unidentified species
  - Family Sertulariidae
    - *Sertularella* sp.
    - *Sertularia* sp.
    - *Abietinaria* sp.
  - Family Plumulariidae
    - Unidentified species
- Class Scyphozoa
  - Unidentified species
- Class Anthozoa
  - Subclass Alcyonaria
    - Family Actinostolidae
      - *Stomphia coccinea* (O. F. Müller)
    - Family Actiniidae
      - *Tealia crassicornis* (O. F. Müller)

Phylum Ctenophora
- Unidentified species

Phylum Annelida
- Class Polychaeta
  - Family Polynoidae
    - Unidentified species
  - Family Spintheridae
    - *Spinther alaskensis* Hartman
  - Family Nereidae
    - *Nereis* sp.
  - Family Serpulidae
    - *Crucigera irregularis* Bush

Phylum Mollusca
- Class Pelecypoda
  - Family Nuculanidae
    - *Nuculana fossa* Baird
    - *Yoldia hyperborea* Lovén in Torell
  - Family Mytilidae
    - *Mytilus edulis* Linnaeus
    - *Musculus discors* (Gray)
    - *Modiolus modiolus* (Linnaeus)

TABLE IX

CONTINUED

Family Pectinidae
- *Pecten caurinus* Gould
- *Chlamys rubida* Hinds

Family Cardiidae
- *Clinocardium ciliatum* (Fabricius)
- *Clinocardium nuttallii* Conrad
- *Serripes groenlandicus* (Bruguiére)

Family Tellininidae
- *Macoma calcarea* (Gmelin)
- *Macoma moesta* (Deshayes)

Family Hiatellidae
- *Hiatella arctica* (Linnaeus)

Family Teredinidae
- *Bankia* sp.
- *Bankia setacea* Tryon

Class Gastropoda

Family Calyptraeidae
- *Crepidula nummaria* Gould

Family Velutinidae
- *Velutina* sp.

Family Cymatiidae
- *Fusitriton oregonensis* (Redfield)

Family Thaididae
- *Nucella lamellosa* (Gmelin)

Family Dorididae
- Unidentified species

Class Cephalopoda

Family Gonatidae
- *Gonatus* sp.

Family Octopodidae
- *Octopus* sp.

Phylum Arthropoda

Class Crustacea

Family Balanidae
- *Balanus* sp.
- *Balanus balanus* Pilsbury

Order Isopoda
- Unidentified species

Order Decapoda

Family Pandalidae
- *Pandalus borealis* Kröyer
- *Pandalus goniurus* Stimpson
- *Pandalus hypsinotus* Brandt
- *Pandalopsis dispar* Rathbun

Family Hippolytidae
- *Eualus biunguis* Rathbun
- *Eualus macilenta* (Kröyer)

TABLE IX

CONTINUED

Family Crangonidae
- *Crangon dalli* Rathbun
- *Crangon communis* Rathbun
- *Argis* sp.
- *Argis lar* (Owen)
- *Argis dentata* (Rathbun)

Family Paguridae
- *Pagurus ochotensis* Brandt
- *Pagurus aleuticus* (Benedict)
- *Pagurus capillatus* (Benedict)
- *Pagurus kennerlyi* (Stimpson)
- *Pagurus beringanus* (Benedict)
- *Elassochirus tenuimanus* (Dana)

Family Lithodidae
- *Paralithodes camtschatica* (Tilesius)

Family Majidae
- *Oregonia gracilis* Dana
- *Hyas lyratus* Dana
- *Chionoecetes bairdi* Rathbun
- *Pugettia gracilis* (Dana)

Family Cancridae
- *Cancer* sp.
- *Cancer magister* Dana
- *Cancer oregonensis* (Dana)

Family Atelecyclidae
- *Telmessus cheiragonus* (Tilesius)

Family Pinnotheridae
- *Pinnixa occidentalis* Rathbun

Phylum Sipunculida
- Unidentified species

Phylum Echiurida
- Class Echiuroidea
  - Family Echiuridae
    - *Echiurus echiurus* Fisher

Phylum Ectoprocta
- Class Cheilostomata
  - Family Flustridae
    - Unidentified species
  - Family Microporidae
    - *Microporina* sp.
- Class Ctenostomata
  - Family Flustrellidae
    - *Flustrella* sp.

Phylum Brachiopoda
- Class Articulata
  - Family Cancellothridae
    - *Terebratulina unguicula* Carpenter

TABLE IX

CONTINUED

Family Dallinidae
Terebratalia transversa (Sowerby)

Phylum Echinodermata
Class Asteroidea
Family Solasteridae
Solaster stimpsoni Verrill
Family Asteridae
Stylasterias forreri (de Loriol)
Evasterias echinosoma (Stimpson)
Evasterias troschelii (Stimpson)
Pycnopodia helianthoides (Brandt)
Family Stongylocentrotidae
Strongylocentrotus droebachiensis (O. F. Müller)
Class Ophiuroidea
Family Gorgoncephalidae
Gorgonocephalus caryi (Lyman)
Family Ophiactidae
Ophiopholis aculeata (Linnaeus)
Class Holothuroidea
Family Cucumariidae
Cucumaria sp.

Phylum Chordata
Class Ascidiacea
Family Styelidae
Pelonaia corrugata Forbes Goods

from Ugak Bay stations 10-14, 22 and 23 (Fig. 2) during June, July and August, 1976. During March 1977 the greatest pink shrimp catches came from stations 6-14 (Fig. 2). The reproductive state of pink shrimps in Ugak Bay was similar to that observed for Alitak Bay.

Paralithodes camtschatica was not as common in Ugak Bay as in Alitak Bay. The average catch in Ugak Bay for all stations and all sampling periods was nearly half the average catch of Alitak Bay, i.e., 26.40 kg per tow in Ugak Bay $(\frac{2586.71 \text{ kg}}{98 \text{ tows}})$ (Table V) as opposed to 44.10 kg per tow in Alitak Bay. During June, July, and August, large catches were made at Ugak Bay stations 1-4; the largest catch was 99.88 kg in August at station 4.

King crabs were well dispersed throughout Ugak Bay in all months. The composition during all sampling months was mainly juveniles (Tables VI and VII). Ovigerous females were present in each of the four sampling periods. The king crab sex ratio in Ugak Bay is presented in Table X. Seven grasping pairs were observed in March.

Chionoecetes bairdi was normally dominant at all stations. Large catches were obtained at Ugak stations 9, 10, 13, and 22 during June through August. Station 9 had the largest catch during March; 89.08 kg. The composition was mainly adult males during June through August (Table VI). Ovigerous females and juvenile males and females were more common during March than for the period June through August (Tables VI and VII).

Feeding Data

The food of *Paralithodes camtschatica, Chionoecetes bairdi,* and the yellowfin sole *Limanda aspera* was determined (Table XI). King crabs from Alitak and Ugak Bays fed almost exclusively on molluscs, crustaceans, and unidentified fishes. Snow crabs fed primarily on polychaetes, clams, and

TABLE X

SEX RATIOS OF KING CRABS IN UGAK BAY

Date	Mature Crabs			Immature Crabs		
	Female	Male	Ratio[1]	Female	Male	Ratio[1]
June 1976	11	36	0.31:1	78	84	0.93:1
July 1976	47	67	0.70:1	743	735	1.01:1
August 1976	15	24	0.63:1	539	648	0.83:1
March 1977	54	29	1.86:1	97	198	0.49:1

[1] Females per male.

TABLE XI

PERCENT FREQUENCY OF OCCURRENCE OF FOOD ITEMS (LISTED ACCORDING TO LOWEST LEVEL OF TAXONOMIC IDENTIFICATION) FOUND IN STOMACHS OF KING AND SNOW CRABS AND YELLOWFIN SOLE FROM ALITAK AND UGAK BAYS, KODIAK ISLAND, JUNE, JULY, AUGUST, 1976 AND MARCH 1977

N = Number of Stomachs Examined

	Percent frequency of occurrence of food items found in stomachs of:					
	King Crabs		Snow Crabs		Yellowfin Sole	
Food Item	Alitak N=37	Ugak N=10	Alitak N=34	Ugak N=36	Alitak N=45	Ugak N=12
Polychaeta	-	-	23.5	5.6	-	-
Nuculanidae	5.4	20.0	2.9	13.9	-	-
Nuculana fossa	13.5	20.0	-	-	-	-
Pelecypoda	10.8	30.0	26.5	27.8	6.7	-
Macoma sp.	-	-	-	-	2.2	-
Tellina sp.	-	-	-	2.8	-	-
Spisula polynyma	2.7	-	-	-	2.2	-
Siliqua alta	-	-	-	-	2.2	-
Mytilus edulis	-	-	-	2.8	-	-
Gastropoda	5.4	10.0	-	-	-	-
Margarites sp.	5.4	-	-	-	-	-
Fusitriton oregonensis	2.7	-	-	-	-	-
Octopi	-	-	-	-	4.4	-
Crustacea	2.7	-	-	5.6	-	-
Euphausiacea	2.7	-	-	-	-	-
Caridea	10.8	-	20.6	11.1	-	-
Crangonidae	-	-	-	2.8	-	-
Brachyura	-	-	2.9	13.9	-	-
Majidae	-	10.0	-	-	-	-
Chionoecetes bairdi	-	-	-	-	4.4	-
Atelecyclidae	2.7	-	-	-	-	-
Pisces	18.9	20.0	8.8	5.6	-	25.0
Stichaeidae	-	-	-	-	2.2	-
Osmeridae	-	-	-	-	-	8.3
Mallotus villosus	-	-	-	-	2.2	-

TABLE XI

CONTINUED

Food Item	Percent frequency of occurrence of food items found in stomachs of: King Crabs Alitak N=37	King Crabs Ugak N=10	Snow Crabs Alitak N=34	Snow Crabs Ugak N=36	Yellowfin Sole Alitak N=45	Yellowfin Sole Ugak N=12
Unidentified plants	5.4	10.0	38.2	22.2	-	-
Sediment	-	-	55.9	27.8	-	-
Unidentified remains	-	-	2.9	-	-	-
Empty stomachs	32.4	30.0	11.8	30.6	84.4	58.3

unidentified fishes. Sediment and plant material were also frequently present in stomachs of *C. bairdi*.

Clams and fishes were the main organisms consumed by *L. aspera*. Flathead sole, *Hippoglossoides elassodon*, fed on euphausiids and caridean shrimps (five fish examined), and rock sole, *Lepidopsetta bilineata*, fed primarily on polychaetes and the clam *Nuculana fossa* (four fish examined). Of the 40 yellowfin stomachs examined in March (Alitak Bay) 38 were empty. Also during March, 27 starry flounder, *Platichthys stellatus*, were examined, and were also found to be empty.

The Kodiak Island food web (Fig. 3) is based on data presented in this report, information from McDonald and Peterson (1976), Feder *et al.* (1977), and Jewett (1977). The food web is presented so that carbon flow is generally from bottom to top and always in the direction of the arrows. Data were insufficient to clearly identify major food pathways. Polychaetes, gastropods (snails), pelecypods (clams), amphipods, anomurans (hermit crabs), brachyurans (true crabs), and carideans (shrimps) are the major invertebrate food items in the web. Shrimps and crabs are important food items for most fishes as well as some of the crabs. Small fishes such as herring (*Clupea harengus pallasi*), capelin (*Mallotus villosus*), and sand lance (*Ammodytes hexapterus*) are important as food for larger predatory fishes such as Pacific cod (*Gadus macrocephalus*), king salmon (*Oncorhynchus tshawytscha*), and halibut (*Hippoglossus stenolepis*) (see Feder *et al.*, 1977 for additional Gulf of Alaska food data).

Feeding relationships for snow crabs, king crabs, and Pacific cod (data from Feder *et al.*, 1977 and Jewett, 1977) are shown in more detail in Figures 4, 5, and 6, respectively. Snow and king crabs feed heavily on benthic animals that, in turn, rely in whole or in part on detritus, bacteria,

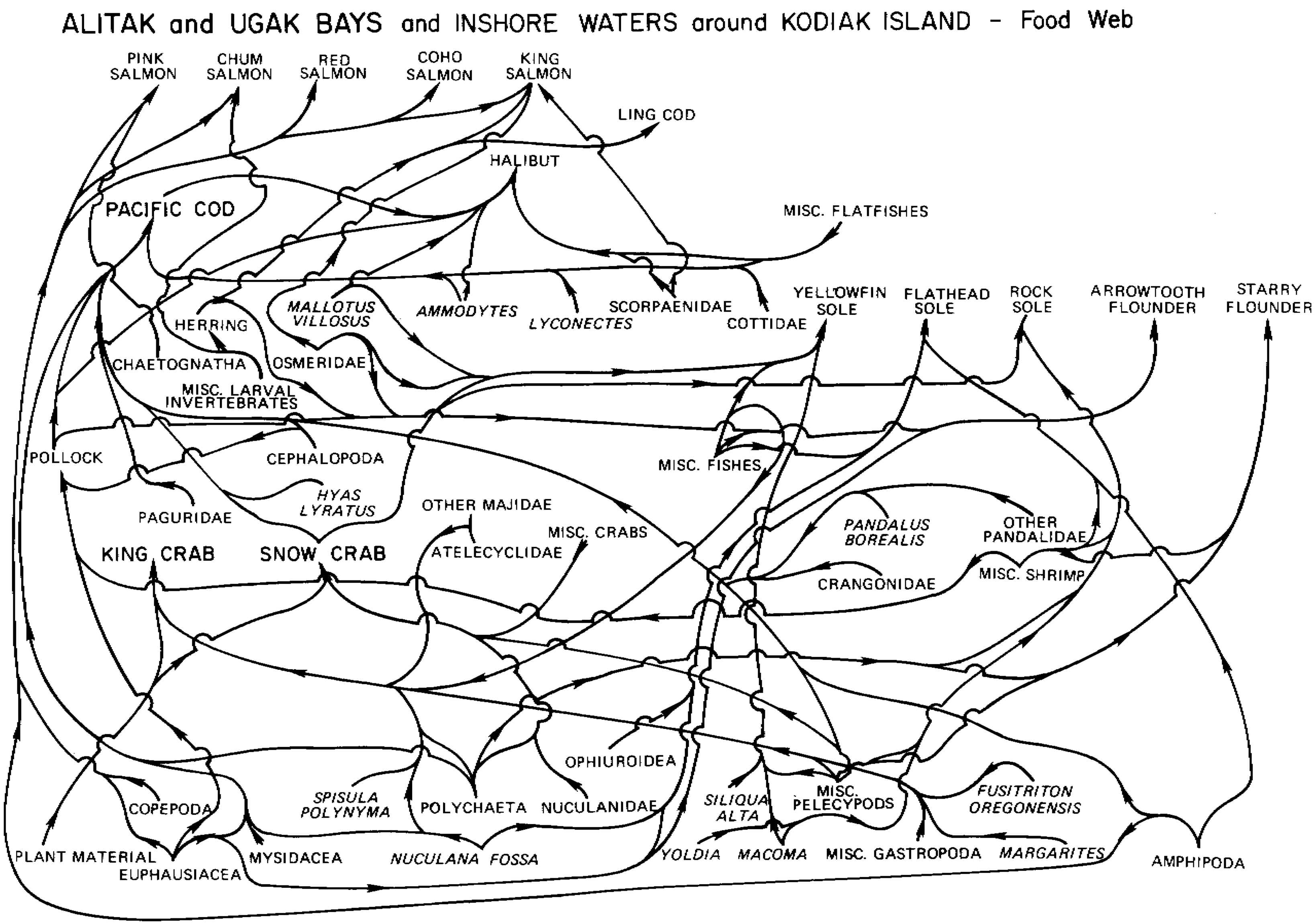

Figure 3. A food web based on the epibenthic species taken from Alitak and Ugak Bays and inshore waters around Kodiak Island, Alaska.

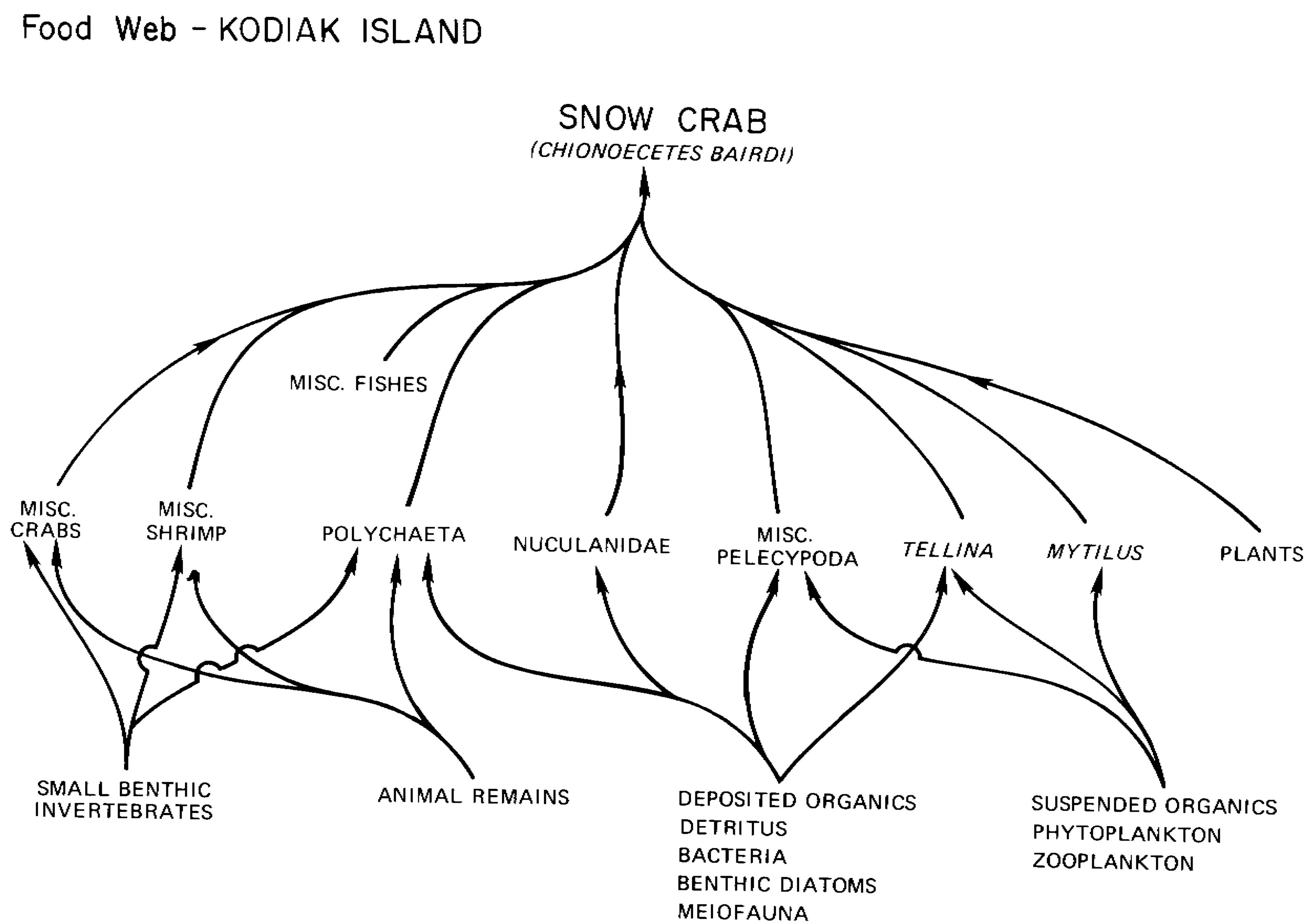

Figure 4. Food web for the snow crab (*Chionoecetes bairdi*) in Alitak and Ugak Bays and inshore waters around Kodiak Island, Alaska.

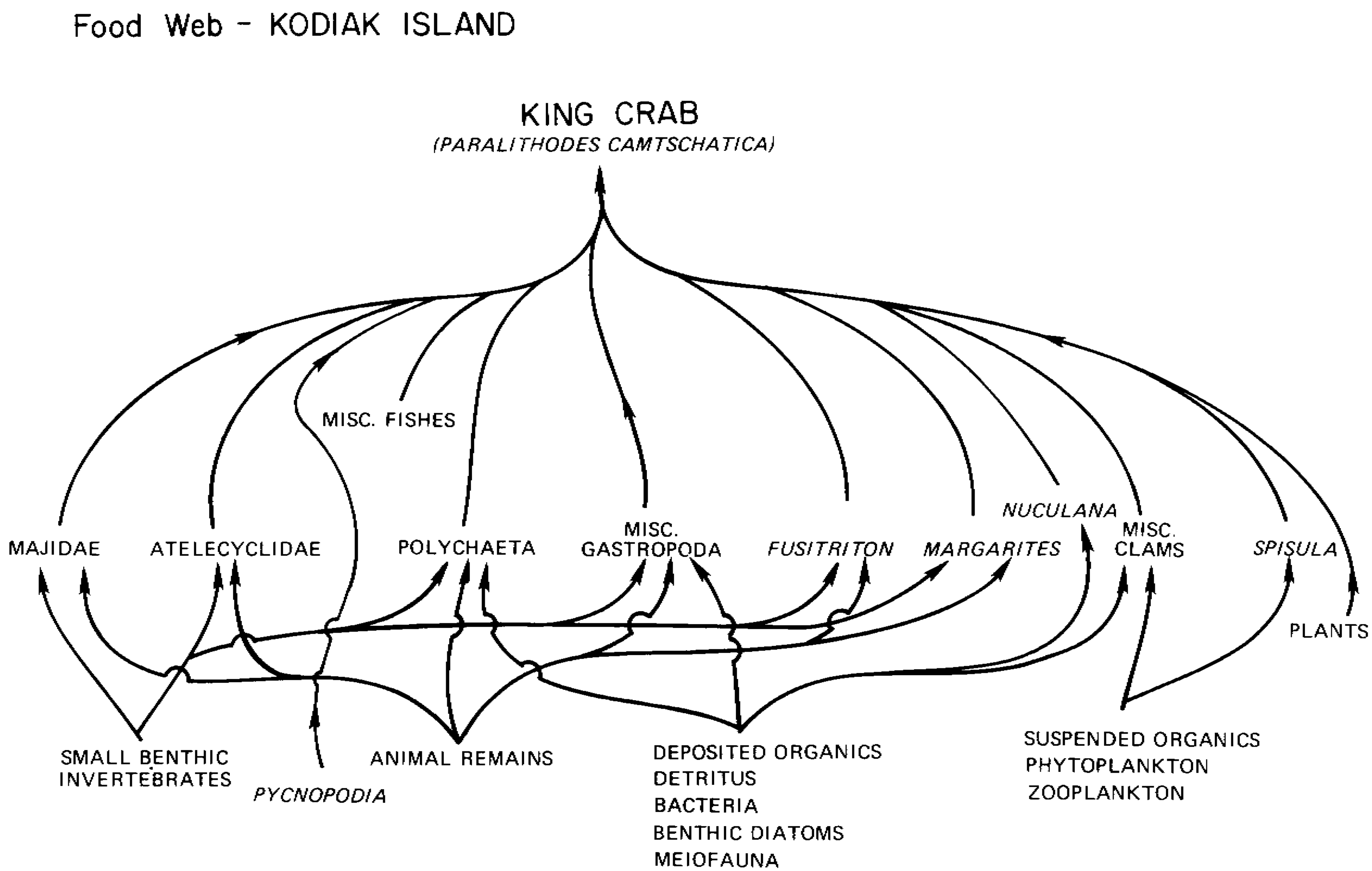

Figure 5. Food web for the king crab (*Paralithodes camtschatica*) in Alitak and Ugak Bays and inshore waters around Kodiak Island, Alaska.

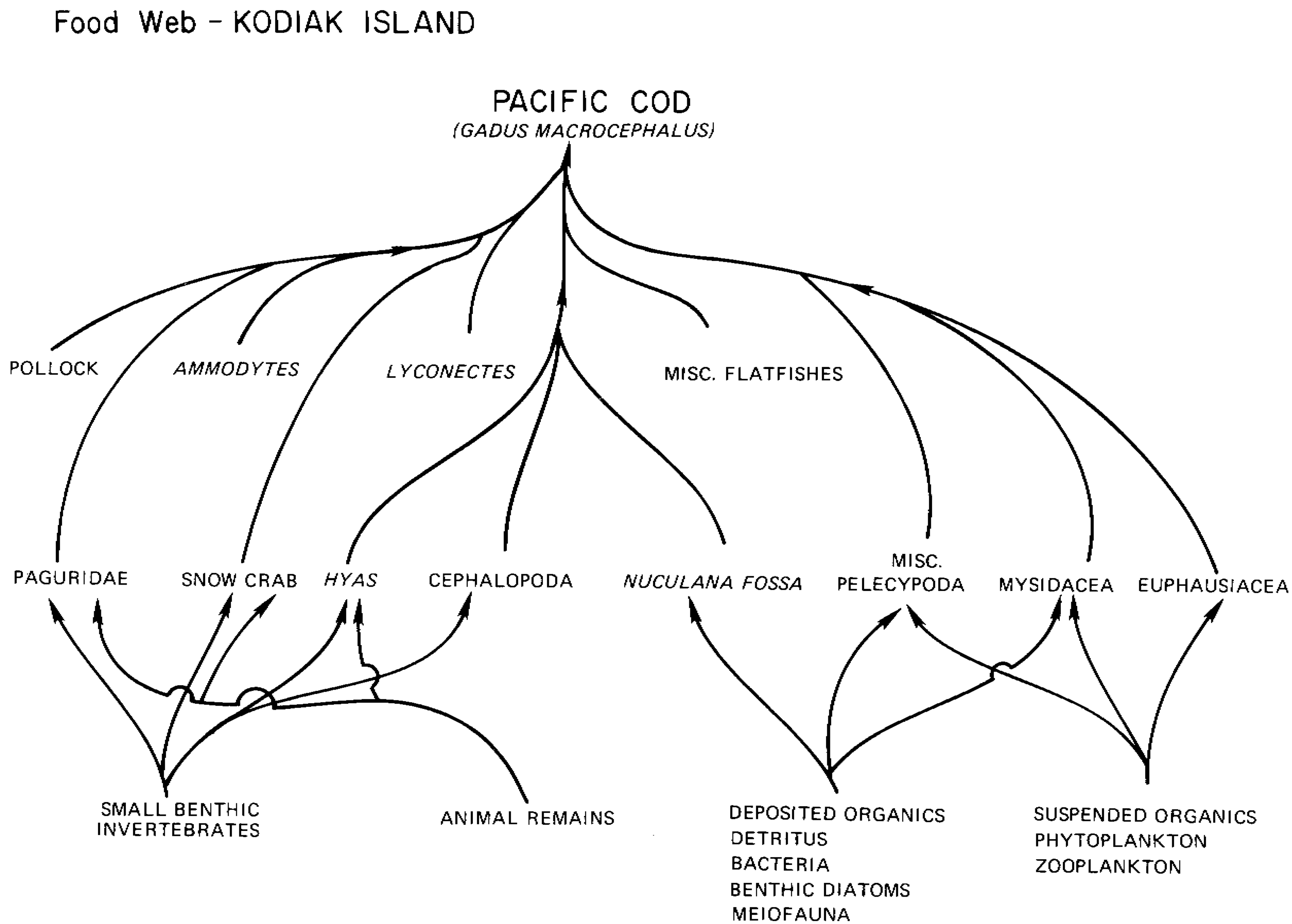

Figure 6. Food web for the Pacific cod (*Gadus macrocephalus*) from inshore waters around Kodiak Island, Alaska. (Also see Jewett, 1977 for comments on cod food habits in the Gulf of Alaska.)

benthic diatoms, and meiofauna for food (Figs. 5 and 6). Pacific cod feeds primarily on animals that are feeding on small benthic invertebrates or scavenging animal remains (Fig. 6; Table XII). The invertebrates in the two bays relied on a variety of feeding methods while the fishes tended to be predators (Table XII).

Number, weight and frequency of occurrence calculations used in this report are based on Appendix Tables I through VIII.

VII. DISCUSSION

Station Coverage

The trawl program discussed in this report represents the first intensive coverage of epifaunal invertebrates of Alitak and Ugak Bays. Preliminary plans called for 28 stations to be occupied monthly in Alitak Bay and 25 stations in Ugak Bay for June, July, and August 1976, and March 1977. August sampling in Alitak Bay was hampered when stored crab gear prevented sampling of five stations. Seven outer Alitak Bay stations were eliminated in March 1977 due to high concentrations of ovigerous king crabs. During the four sampling periods, 99 stations were occupied in Alitak Bay covering a total of 1.99 km^2. Station coverage in the 98 Ugak Bay stations totalled 2.03 km^2. The average distance fished at each station was 1.85 km.

Biomass

The epifaunal standing stock reported in the present study is similar to standing stock estimates presented in other OCSEAP benthic trawl studies elsewhere, i.e., see Jewett and Feder, 1976; Feder *et al.*, 1977. The total biomass of epifaunal invertebrates of the northeast Gulf of Alaska was 2.6 g/m^2 (Jewett and Feder, 1976). The biomass determined for epifaunal

TABLE XII

FEEDING METHODS[1] OF ORGANISMS INCLUDED IN THE KODIAK ISLAND (ALITAK AND UGAK BAYS AND OTHER INSHORE WATERS) FOOD WEB

Phylum abbreviations: A=Annelida; M=Mollusca; Art=Arthropoda; Ecd=Echinodermata Ctn=Chaetognatha; Cho=Chordata; X=dominant feeding method; O=other feeding method

Organism	Phylum	Deposit Feeder	Suspension Feeder	Scavenger	Predator	Unknown
Polychaeta	A	X	X	X	X	–
Gastropoda	M	X	–	X	X	–
Margarites	M	–	–	–	–	X
Fusitriton oregonensis	M	–	–	X	X	–
Nuculana fossa	M	X	–	–	–	–
Yoldia sp.	M	X	–	–	–	–
Spisula polynyma	M	–	X	–	–	–
Axinopsida sp.	M	–	–	–	–	X
Siliqua alta	M	–	–	–	–	X
Macoma sp.	M	X	O	–	–	–
Cephalopoda	M	–	–	X	X	–
Mysidacea	Art	–	X	X	X	–
Amphipoda	Art	X	–	X	X	–
Euphausiacea	Art	–	X	–	–	–
Pandalidae	Art	–	–	X	X	–
Pandalus borealis	Art	–	–	X	X	–
Crangonidae	Art	–	–	X	X	–
Paguridae	Art	–	–	X	X	–
Paralithodes camtschatica	Art	–	–	X	X	–
Majidae	Art	–	–	X	X	–

TABLE XII

CONTINUED

Organism	Phylum	Deposit Feeder	Suspension Feeder	Scavenger	Predator	Unknown
Hyas lyratus	Art	–	–	X	X	–
Chionoecetes bairdi	Art	–	–	X	X	–
Atelecyclidae	Art	–	–	–	–	X
Ophiuroidea	Ecd	X	X	X	X	–
Chaetognatha	Ctn	–	–	–	X	–
Clupea harengus pallasi (herring)	Cho	–	–	–	X	–
Oncorhynchus gorbuscha (pink salmon)	Cho	–	–	–	X	–
O. keta (chum salmon)	Cho	–	–	–	X	–
O. kisutch (coho salmon)	Cho	–	–	–	X	–
O. nerka (red salmon)	Cho	–	–	–	X	–
O. tshawytscha (King salmon)	Cho	–	–	–	X	–
Osmeridae	Cho	–	–	–	X	–
Mallotus villosus (capelin)	Cho	–	–	–	X	–
Theragra chalcogramma (pollock)	Cho	–	–	–	X	–
Gadus macrocephalus (Pacific cod)	Cho	–	–	X	X	–
Lyconectes sp.	Cho	–	–	–	X	–

TABLE XII

CONTINUED

Organism	Phylum	Deposit Feeder	Suspension Feeder	Scavenger	Predator	Unknown
Ammodytes sp. (sand lance)	Cho	–	–	–	X	–
Scorpaenidae	Cho	–	–	–	X	–
Ophiodon sp. (lingcod)	Cho	–	–	–	X	–
Cottidae	Cho	–	–	–	X	–
Atheresthes stomias (arrowtooth flounder)	Cho	–	–	–	X	–
Hippoglossoides elassodon (flathead sole)	Cho	–	–	–	X	–
Hippoglossus stenolepis (Pacific halibut)	Cho	–	–	–	X	–
Lepidopsetta bilineata (rock sole)	Cho	–	–	–	X	–
Limanda aspera (yellowfin sole)	Cho	–	–	–	X	–
Platichthys stellatus (starry flounder)	Cho	–	–	–	X	–

[1]Based on Barnes, 1968; Feder, unpublished data; Hart, 1973; Newell, 1970; Pearce and Thorson, 1967; and Rasmussen, 1973.

invertebrates in the southeast Bering Sea was 3.3 g/m^2 in 1975 and 5.0 g/m^2 in 1976 (Feder *et al.*, 1977). The average epifaunal biomass for Alitak and Ugak Bay during all sampling months was 4.74 g/m^2 (Table I).

Russian benthic investigations (Neyman, 1963), provide biomass estimates based on grab samples for infauna and small epifauna from the southeast Bering Sea with the lowest value reported as 55 g/m^2. Use of a commercial trawl results in the loss of infaunal and small epifaunal organisms that are an important part of the benthic biomass. Therefore, the total benthic biomass value is probably best expressed by combining both grab and trawl values. Combined infaunal and epifaunal surveys should be part of all future investigations designed by OCSEAP.

Species Composition and Diversity

Examination of the species composition of both bays revealed crustaceans and molluscs to be the major epifaunal invertebrates present. In general, epifaunal diversity was similar to that reported in Feder *et al.* (1976) and Jewett and Feder (1976) for the northeast Gulf of Alaska. Major differences between the northeast Gulf of Alaska and the Kodiak bay fauna were the low numbers of species of Annelida and Echinodermata found in the bays. The survey in the northeast Gulf of Alaska revealed 30 species of annelids and 36 species of echinoderms; however, these phyla in Alitak and Ugak Bays only comprised 5 and 12 species respectively. The hermit crab, *Pagurus*, was the most diverse genus present with six species collected (Tables II and IX).

King crabs live most of their lives on the deeper part of the continental shelf, coming into shallow water once a year to mate. Except during the mating season (mid-March to June), the sexes remain segregated in deeper water (Iverson, 1966). Changing physical conditions from year to year may alter the periodicity of migration and breeding. The documented-life history of king crabs reported elsewhere is reflected in the observations made on this crab in the Kodiak bays discussed in this report. Examination of sex composition and stage of maturity of king crabs from past and present studies in outer Alitak Bay indicates a high number of adult females to adult males during the mating season (Tables VI-VIII). The low numbers of adult male king crabs in Alitak Bay during the summer months probably reflect their departure following spawning. The migratory pattern of king crabs in Ugak Bay was not clearly defined during the study period. Segregation between sexes in juveniles is not apparent (Tables VI-VIII; Powell and Nickerson, 1965).

Catches of king and snow crabs in Ugak Bay during the present study reflect a similar sex-maturity composition to that found during the A.D.F. & G. crab indexing studies in this bay, i.e., a predominance of juvenile king crabs of both sexes and adult male snow crabs from June-August (A.D.F. & G., unpublished reports). Juvenile male and female king crabs and juvenile snow crabs were most common in March. Although Ugak Bay does not typically yield commercial-size king crabs, the outer bay is often fished for snow crabs (A.D.F. & G., Kodiak, Alaska snow crab catch statistics).

Food Habits

The main species examined for stomach contents, *Chionoecetes bairdi* and *Paralithodes camtschatica*, in the present study were the most abundant and widely dispersed organisms present.

Inferences from the present study, as well as other snow crab food data (Feder *et al.*, 1977; Yasuda, 1967; Feder, unpublished data from Prince William Sound) concerning prey species, suggest that food used by snow crabs are area specific. Most of the important food items consumed by Alitak Bay and Ugak Bay snow crabs (i.e., polychaetes, clams, shrimps, plants, sediment) differed from food items used by this species in Cook Inlet. Feder *et al.* (1977) examined 715 snow crabs in Cook Inlet, and found the main items, in order of decreasing percent frequency of occurrence, in stomachs were *Macoma* spp. (clams), *Pagurus* spp. (hermit crabs), *Balanus* spp. (barnacles), and sediment. The only similar stomach items in the present study were clams and sediment. The role of sediment in crab feeding is not known. However, Moriarty (1977) reported on the occurrence of sediment in the food contents of five species of Penaeid shrimps. The nutritional benefit of sediment intake to these shrimps appears to be derived from the film of organic carbon, inclusive of bacteria, on sand grains. Yasuda (1967) found benthic diatoms to be abundant in *Chionoecetes opilio elongatus* in the Bering Sea, and postulated that diatoms were taken indirectly with food and sediment.

Food items among king crabs appear to be similar at different geographic locations. McLaughlin and Hebard (1961) found molluscs to be the most frequently consumed food group (69.0%) in Bering Sea king crabs (with pelecypods more frequent than gastropods). Echinoderms ranked second, appearing in 42.2% of the crabs. Takeuchi (1959; 1967) examined the stomach contents of king crabs from the west coast of Kamchatka, and found molluscs (primarily pelecypods) to be the dominant food group. Crustaceans and echinoderms were the second and third most important groups, respectively. Bering Sea king crabs examined by Feder *et al.* (1977) also showed pelecypod molluscs to be the dominant food, specifically *Clinocardium* sp. and *Nuculana* sp. *Nuculana*, a deposit feeder, is the most frequently occurring food used by king crabs in Alitak and Ugak Bays. Gastropods and shrimps were food items of secondary importance in the present study. Although echinoderms were absent from the

46 king crabs examined, sand dollars (*Dendraster* sp.) are occasionally consumed by king crabs occupying the outer continental shelf between Alitak and Ugak Bays (Guy C. Powell, A.D.F. & G., personal communication).

The two commercially important animals of great abundance near Kodiak Island, king crabs and snow crabs, feed on a wide variety of organisms. The king crab, with its large claws, is taking snails, clams, and fishes, while the snow crab with its long, thin, curved claws is better able to remove plant material, polychaetes, shrimps, and small clams from the bottom. Post larval stages of king crabs were not preyed upon by any of the fishes examined. However, the soft-shelled stage of the king crab is probably preyed upon since soft-shell snow crabs are known prey of *Octopus* spp. and sea stars (J. Hilsinger, unpublished data). Juvenile snow crabs are major prey of Pacific cod, *Gadus macrocephalus*, on the Kodiak continental shelf (Jewett, 1977).

The use of deposit-feeding animals as food, as well as the consistent uptake of sediment, by king and snow crabs in the Kodiak area may be critical in the event of oil contamination of sediments on crab feeding grounds.

VIII. CONCLUSIONS

Fifty-three permanent stations have been established in two bays of Kodiak Island - Alitak (28 stations) and Ugak (25 stations) bays. These stations have been occupied in conjunction with Alaska Department of Fish and Game personnel.

There is now a satisfactory knowledge, on a station basis (for the months sampled), of the distribution and abundance of the major epifaunal invertebrates of the two study bays. Twelve phyla are represented in the collection. The important groups, in terms of species, in descending order of importance are the Arthropoda (Crustacea), Mollusca, Echinodermata and Annelida. The latter three groups only accounted for less than 1.0% of the biomass collected in each bay, while Arthropoda accounted for 95.8 and 99.1% of the biomass in Ugak and Alitak Bay respectively.

Additional seasonal data are essential. It is only when such continuing information is available that a reasonable biological assessment of the effect of an oil spill on these bays can be made.

Differences in sex composition and stage of maturity of king and snow crabs between and within the two bays were evident. Throughout the sampling period in Alitak Bay, king crabs occurred mainly at the outer stations and consisted primarily of egg-bearing females and juveniles of both sexes. King crabs were well dispersed throughout Ugak Bay during this period, and consisted mainly of juveniles. Snow crabs in Alitak Bay were primarily juvenile while mainly adult males inhabited Ugak Bay. Life history data for these crabs for March, June, July and August are now available.

Preliminary feeding data for the most common epifaunal species of the two bays is presented in this report. Of special importance is the food data compiled for the two commercially important crabs of the Kodiak area - snow and king crabs. These data in conjunction with similar data compiled for these two species in Cook Inlet and the Bering Sea (Feder *et al.*, 1977) should contribute to an understanding of the trophic role of the crabs in their respective ecosystems and the impact of oil on crab-dominated systems such as those found in Alitak and Ugak Bays.

The importance of deposit-feeding clams in the diet of king and snow crabs is demonstrated for the two bays; this situation is also true for crabs observed elsewhere. A high probability exists that oil hydrocarbons will enter crabs *via* these deposit-feeding molluscs, suggesting that studies interrelating sediment, oil, deposit feeding clams, and crabs should be initiated soon.

Sampling crabs and fishes using trawls and stomach analysis has made it possible to understand a major component (the epifauna) of two Kodiak bays. However, a full comprehension of the benthic system there will only be achieved when these studies are expanded to include an assessment of infauna as well. Data available suggest that adequate numbers of unique, abundant, and/or large species are available to permit nomination of likely monitoring candidates. Presumably, a monitoring program would be based primarily on recruitment, growth, food habits, and reproduction of the chosen species.

IX. NEEDS FOR FURTHER STUDY

1. Although the trawling activities were satisfactory for determination of the distribution and abundance of epifauna, a substantial component of both bays - the infauna - was not sampled. Since infaunal species represent important food items, it is essential that dredging be accomplished at the bay stations in the near future.

2. The present study has produced a data base describing the abundance, density, and distribution of epibenthic invertebrates as well as notes on reproductive biology of commercially important crabs during June, July, and August 1976, and March 1977. Additional studies are needed during other seasons and years to describe seasonal and year-to-year variations in the distribution and relative abundance of the epifauna.

3. Seasonal predator-prey relationships should be examined in conjunction with simultaneous infaunal sampling.

4. It is essential that large samples of the dominant clam prey species be obtained to initiate recruitment, age, growth, and mortality studies. These data will then be comparable to similar data being collected for clams of Cook Inlet and the Bering Sea (Feder *et al.*, 1977). Any future modeling efforts concerned with carbon or energy flow in the Kodiak area will need this type of information.

5. No physical, chemical, and sediment data are currently available. This information should be obtained in the future in conjunction with all biological sampling efforts.

X. REFERENCES

Arctic Environmental Information and Data Center. 1975. Kadyak - a background for living. Univ. Alaska, AEIDC Publ. No. B-75, Sea Grant Publ. No. 75-9. 326 pp.

Barnes, R. D. 1968. *Invertebrate Zoology.* W. B. Sanders Company, Philadelphia. 743 pp.

Boesch, D. F., C. H. Hershner and J. H. Milgram. 1974. *Oil Spills and the Marine Environment.* Ballinger Publishing Co., Cambridge, Mass. 114 pp.

Feder, H. M., G. Mueller, G. Matheke and S. Jewett. 1976. The distribution, abundance, diversity, and productivity of benthic organisms in the Gulf of Alaska. Ann. Rep. to NOAA R.U. #281, Inst. Mar. Sci., Univ. Alaska, Fairbanks. 174 pp.

Feder, H. M., K. Haflinger, J. Hilsinger, M. Hoberg, S. Jewett, G. Matheke and G. Mueller. 1977. The distribution, abundance, diversity, and productivity of benthic organisms in the Gulf of Alaska and the Bering Sea. Ann. Rep. to NOAA R.U. #281, Inst. Mar. Sci., Univ. Alaska, Fairbanks. 340 pp.

Gray, G. W. and G. C. Powell. 1966. Sex ratios and distribution of spawning king crabs in Alitak Bay, Kodiak Island, Alaska (Decapoda Anomura, Lithodidae). *Crustaceana* 10(3):303-309.

Hart, J. L. 1973. Pacific fishes of Canada. *Fish. Res. Bd. Can. Bull.* 180. 740 pp.

International Pacific Halibut Commission. 1964. Catch records of a trawl survey conducted by the Intl. Pac. Halibut Comm. between Unimak Pass and Cape Spencer, Alaska from May 1961 to April 1963. Intl. Pac. Halibut Comm. Doc. No. 36. 524 pp.

Iversen, E. F. 1966. The King-sized crab. *Sea Frontiers* 12(4):228-237.

Jewett, S. C. 1977. Food of the Pacific cod, *Gadus macrocephalus* Tilesius near Kodiak Island, Alaska. M.S. Thesis, Univ. Alaska. 23 pp.

Jewett, S. C. and H. M. Feder. 1976. Distribution and Abundance of Some Epibenthic Invertebrates of the Northeast Gulf of Alaska, with Notes on the Feeding Biology of Selected Species. Inst. Mar. Sci. Rept. R76-8, Univ. of Alaska, Fairbanks. 61 pp.

Karinen, J. F. and S. D. Rice. 1974. Effects of Prudhoe Bay crude oil on molting tanner crabs, *Chionoecetes bairdi*. *Marine Fisheries Review* 36(7):31-37.

Kingsbury, A. P. and K. E. James. 1971. Abundance and composition of king crabs in the Alitak and Kaguyak Bay areas during April and June, 1970. Alaska Dept. Fish Game Inf. Leafl. No. 152. 42 pp.

Kingsbury, A. P., N. P. Johnson and R. J. Kaiser. 1974. King crab study. Completion report for period July 1, 1962 to June 30, 1972. Proj. No. 5-22-R, Comm. Fish Res. Dev. Act. prepared for NOAA, Natl. Mar. Fish. Serv. by Alaska Dept. Fish Game. 93 pp.

Lewis, J. R. 1970. Problems and approaches to base-line studies in coastal communities. FAO Tech. Conf. on Mar. Pollution and its Effect on Living Resources and Fishing. FIR:MP 70/E-22. 7 pp.

McDonald, K. B. and K. K. Petersen. 1976. Kodiak Island: physical environment, biota, and potential problems related to oil exploration. A scientific report based primarily on OCSEAP-sponsored research. Science Applications, Inc., Boulder, Colorado. 146 pp.

McLaughlin, P. A. and J. F. Hebard. 1961. Stomach contents of the Bering Sea king crab. *Intl. North Pac. Fish. Comm. Bull.* 5:5-8.

Moriarty, D. J. W. 1977. Quantification of carbon, nitrogen and bacterial biomass in the food of some Penaeid prawns. *Aust. J. Freshwater Res.* 28:113-118.

Mueller, G. 1975. A preliminary taxon list and code for ADP processing. Sea Grant Proj. A/77-02. 159 pp.

Nelson-Smith, A. 1973. *Oil Pollution and Marine Ecology.* Paul Elek (Scientific Books) Ltd., London. 260 pp.

Newell, R. G. 1970. *Biology of Intertidal Animals.* Logos Press Limited, London. 444 pp.

Neyman, A. A. 1963. Quantitative distribution of benthos and food supply of demersal fish in the eastern part of the Bering Sea. Tr. Vses. Nauchno-issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 48. (Izv. Tikhookean. Nauchno-issled. Inst. Morsk. Tybn., Khoz. Okeanogr. 50): 145-205. (Transl. from Russian by Israel Prog. Sci. Transl., Jerusalem, as Soviet Fish. Inv. Northeast Pacific. Part I. p. 143-217.)

Olson, T. A. and F. J. Burgess, eds. 1967. *Pollution and Marine Ecology.* Interscience, New York. 364 pp.

Pearce, J. B. and G. Thorson. 1967 The feeding and reproductive biology of the red whelk, *Neptunea antigua* (L.) (Gastropoda, Prosobranchia). *Ophelia* 4(2):277-314.

Pearson, T. H. 1971. The benthic ecology of Loch Linnhe and Loch Eil, a sea loch system on the west coast of Scotland. III. The effect on the benthic fauna of the introduction of pulp mill effluent. *J. Exp. Mar. Biol. Ecol.* 6:211-233.

Pearson, T. H. 1972. The effect of industrial effluent from pulp and paper mills on the marine benthic environment. *Proc. Roy. Soc. Lond. B.* 130: 469-485.

Pearson, T. H. 1975. The benthic ecology of Loch Linnhe and Loch Eil, a sea loch system on the west coast of Scotland. IV. Changes in the benthic fauna attributable to organic enrichment. *J. Exp. Mar. Biol. Ecol.* 20:1-41.

Powell, G. C. and R. B. Nickerson. 1965. Aggregations among juvenile king crabs (*Paralithodes camtschatica,* Tilesius) Kodiak, Alaska. *Animal Behaviour* 13:2-3.

Rasmussen, E. 1973. Systematics and ecology of the Iselfjord marine fauna. *Ophelia* 11(1-2):1-495.

Rhoads, D. C. 1974. Organism-sediment relations on the muddy sea floor. *Oceanogr. Mar. Biol. Ann. Rev.* 12:263-300.

Rosenberg, D. H. 1972. A review of the oceanography and renewable resources of the northern Gulf of Alaska. Report R72-23, Inst. Mar. Sci., Univ. Alaska, Fairbanks. Sea Grant Report 73-3, 690 pp.

Rosenberg, R. 1973. Succession in benthic macrofauna in a Swedish fjord subsequent to the closure of a sulphite pulp mill. *Oilos* 24:244-258.

Smith, J. E., ed. 1968. *Torrey Canyon Pollution and Marine Life.* Cambridge Univ. Press, Cambridge. 196 pp.

Smith, R., A. Paulson, J. and J. Rose. 1976. Food and feeding relationships in the benthic and demersal fishes of the Gulf of Alaska and Bering Sea. Ann. Rep. to NOAA R.U. #284, Inst. Mar. Sci., Univ. Alaska, Fairbanks. 38 pp.

Straughan, D. 1971. Biological and oceanographical survey of the Santa Barbara Channel oil spill 1969-1970. Allan Hancock Foundation, Univ. of Southern California, Los Angeles. 425 pp.

Takeuchi, I. 1959. Food of king crab (*Paralithodes camtschatica*) off the west coast of Kamchatka in 1958. *Bull. Hokkaido Reg. Fish. Res. Lab.* 20:67-75. (Transl. from Jap.-Fish. Res. Bd. Can. Transl. Ser. No. 1193.)

Takeuchi, I. 1967. Food of king crab, *Paralithodes camtschatica*, off the west coast of the Kamtchatka Peninsula, 1958-1964. *Bull. Jap. Sea Reg. Fish Res. Lab.* 33:32-44. (Transl. from Jap.-Fish. Res. Bd. Can. Transl. Ser. No. 1194.)

Yasuda, T. 1967. Feeding habits of the zuwaigani, *Chionoecetes opilio elongatus*, in Wakasa Bay. I. Specific composition of the stomach contents. *Bull. Jap. Soc. Sci. Fish* 33(4):315-319. (Transl. from Jap.-Fish. Res. Bd. Can. Transl. Ser. No. 1111.)

Zenkevitch, L. A. 1963. *Biology of the Seas of the USSR.* George Allen and Unwin., Ltd., London. 955 pp.

XI. APPENDIX

The following Appendix tables are taken from computer printouts of OCSEAP data submitted to the National Oceanographic Data Center (NODC).

APPENDIX TABLE I

OCCURRENCE OF EACH SPECIES IN ALITAK BAY - JUNE, JULY, AND AUGUST 1976, AND MARCH 1977

A total of 99 stations were occupied. Taxonomic names represent the lowest level of identification.

Taxonomic name	Cumulative occurrence	% of all[1] occurrence	% of all[2] stations
Porifera	20	2.632	20.619
Hydrozoa	3	0.395	3.093
Scyphozoa	1	0.132	1.031
Ptilosarcus gurneyi	8	1.053	8.247
Stomphia coccinea	1	0.132	1.031
Actiniidae	7	0.921	7.216
Tealia crassicornis	1	0.132	1.031
Polychaeta	1	0.132	1.031
Polynoidae	1	0.132	1.031
Nereis sp.	2	0.263	2.062
Crucigera irregularis	1	0.132	1.031
Hirudinea	1	0.132	1.031
Notostomobdella sp.	8	1.053	8.247
Nuculana fossa	5	0.658	5.155
Yoldia thraciaeformis	1	0.132	1.031
Mytilus edulis	1	0.132	1.031
Musculus discors	3	0.395	3.093
Chlamys rubida	4	0.526	4.124
Pecten caurinus	1	0.132	1.031
Pododesmus macrochisma	1	0.132	1.031
Astarte rollandi	1	0.132	1.031
Astarte esquimalti	1	0.132	1.031
Clinocardium ciliatum	1	0.132	1.031
Serripes groenlandicus	2	0.263	2.062
Saxidomus gigantea	1	0.132	1.031
Protothaca staminea	1	0.132	1.031
Macoma calcarea	5	0.658	5.155
Hiatella arctica	6	0.789	6.186

APPENDIX TABLE I

CONTINUED

Taxonomic name	Cumulative occurrence	% of all[1] occurrence	% of all[2] stations
Crepidula nummaria	2	0.263	2.062
Velutina sp.	1	0.132	1.031
Fusitrition oregonensis	10	1.316	10.309
Nucella lamellosa	3	0.395	3.093
Neptunea lyrata	8	1.053	8.247
Gonatidae	1	0.132	1.031
Gonatus sp.	2	0.263	2.062
Octopus sp.	1	0.132	1.031
Balanus balanus	1	0.132	1.031
Balanus hesperius	3	0.395	3.093
Balanus rostratus	1	0.132	1.031
Amphipoda	1	0.132	1.031
Pandalus borealis	66	8.684	68.041
Pandalus goniurus	39	5.132	40.206
Pandalus hypsinotus	70	9.211	72.165
Pandalopsis dispar	19	2.500	19.588
Eualus biunguis	30	3.947	30.928
Eualus gaimardii belcheri	24	3.158	24.742
Eualus macilenta	14	1.842	14.433
Crangon dalli	17	2.237	17.526
Crangon communis	19	2.500	19.588
Sclerocrangon boreas	2	0.263	2.062
Argis sp.	3	0.395	3.093
Argis lar	14	1.842	14.433
Argis dentata	28	3.684	28.866
Argis crassa	3	0.395	3.093
Pagurus sp.	1	0.132	1.031
Pagurus ochotensis	18	2.368	18.557
Pagurus aleuticus	20	2.632	20.619
Pagurus capillatus	11	1.447	11.340

APPENDIX TABLE I

CONTINUED

Taxonomic name	Cumulative occurrence	% of all[1] occurrence	% of all[2] stations
Pagurus kennerlyi	2	0.263	2.062
Pagurus beringanus	1	0.132	1.031
Labidochirus splendescens	5	0.658	5.155
Paralithodes camtschatica	66	8.684	68.041
Paralithodes platypus	1	0.132	1.031
Oregonia gracilis	16	2.105	16.495
Hyas lyratus	5	0.658	5.155
Chionoecetes bairdi	95	12.500	97.938
Pugettia gracilis	6	0.789	6.186
Cancer magister	6	0.789	6.186
Cancer oregonensis	5	0.658	5.155
Telmessus cheiragonus	1	0.132	1.031
Sipunculida	1	0.132	1.031
Ectoprocta	1	0.132	1.031
Terebratalia transversa	1	0.132	1.031
Henricia sp.	4	0.526	4.124
Pteraster tesselatus	1	0.132	1.031
Evasterias echinosoma	2	0.263	2.062
Evasterias troschelii	3	0.395	3.093
Stylasterias forreri	1	0.132	1.031
Pycnopodia helianthoides	1	0.132	1.031
Strongylocentrotus droebachiensis	6	0.789	6.186
Molpadia sp.	1	0.132	1.031
Cucumaria sp.	1	0.132	1.031
Chordata:Ascidiacea	7	0.921	7.216
TOTAL	760	100.000	-

[1] $\frac{\text{cumulative occurrence}}{\text{total cumulative occurrence}}$

[2] $\frac{\text{cumulative occurrence}}{\text{total no. of stations occupied}}$

APPENDIX TABLE II

PERCENTAGE COMPOSITION BY WEIGHT OF ALL PHYLA FROM ALL STATIONS IN ALITAK BAY - JUNE, JULY, AND AUGUST 1976, AND MARCH 1977

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 all Sta.
Porifera	649	0.2193	43866.00	0.3755	0.02248
Cnidaria	71	0.0238	12230.72	0.1047	0.00627
Annelida	131	0.0443	233.00	0.0020	0.00012
Mollusca	276	0.0934	16629.67	0.1423	0.00852
Arthropoda:Crustacea	294718	99.5748	11586552.50	99.1751	5.93870
Sipunculida	1	0.0003	8.00	0.0001	0.00000
Ectoprocta	1	0.0003	225.00	0.0019	0.00012
Brachiopoda	2	0.0007	28.00	0.0002	0.00001
Echinodermata	78	0.0262	22622.67	0.1936	0.01160
Chordata:Ascidiacea	50	0.0168	524.33	0.0045	0.00027
TOTALS	295977	100.0000	11682919.89	100.0000	5.98810

APPENDIX TABLE III

PERCENTAGE COMPOSITION OF ALL PHYLA BY FAMILY FROM ALL STATIONS IN ALITAK BAY - JUNE, JULY, AND AUGUST 1976, AND MARCH 1977

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 all Sta.
Porifera (unid. family)	649	0.2193	43866.00	0.3755	0.02248
Hydrozoa (unid. family)	4	0.0012	1854.33	0.0159	0.00095
Scyphozoa (unid. family)	1	0.0003	100.00	0.0009	0.00005
Pennatulacea pennatulidae	30	0.0102	597.00	0.0051	0.00031
Actinostolidae	4	0.0014	1360.00	0.0116	0.00070
Actiniidae	32	0.0107	8319.38	0.0712	0.00426
Polychaeta (unid. family)	8	0.0027	16.00	0.0001	0.00001
Polynoidae	2	0.0007	2.00	0.0000	0.00000
Nereidae	10	0.0034	22.00	0.0002	0.00001
Serpulidae	100	0.0338	170.00	0.0015	0.00009
Hirudinea (unid. family)	2	0.0006	1.67	0.0000	0.00000
Acanthochitonidae	9	0.0032	21.33	0.0002	0.00001
Nuculanidae	7	0.0023	55.67	0.0005	0.00003
Mytilidae	32	0.0108	748.00	0.0064	0.00038
Pectinidae	10	0.0034	1832.33	0.0157	0.00094
Anomiidae	4	0.0014	80.00	0.0007	0.00004
Astartidae	4	0.0014	8.00	0.0001	0.00000
Cardiidae	3	0.0010	650.00	0.0056	0.00033
Veneridae	3	0.0010	128.00	0.0011	0.00007

APPENDIX TABLE III

CONTINUED

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 all Sta.
Tellinidae	12	0.0041	198.00	0.0017	0.00010
Hiatellidae	71	0.0240	46.00	0.0004	0.00002
Calyptraeidae	4	0.0014	3.00	0.0000	0.00000
Velutinidae	1	0.0003	2.00	0.0000	0.00000
Cymatiidae	103	0.0349	11380.33	0.0974	0.00583
Thaididae	4	0.0014	25.00	0.0002	0.00001
Neptuneidae	14	0.0047	1010.00	0.0086	0.00052
Gonatidae	3	0.0010	130.00	0.0011	0.00007
Octopodidae	1	0.0005	333.33	0.0029	0.00017
Balanidae	257	0.0868	3525.00	0.0302	0.00181
Amphipoda (unid. family)	2	0.0007	1.00	0.0000	0.00000
Pandalidae	263376	88.9854	2316668.75	19.8295	1.18741
Hippolytidae	14560	4.9191	109340.33	0.9359	0.05604
Crangonidae	5277	1.7830	40458.00	0.3463	0.02074
Paguridae	328	0.1107	6643.21	0.0569	0.00340
Lithodidae	3013	1.0180	4366325.50	37.3736	2.23797
Majidae	7874	2.6604	4731857.00	40.5024	2.42532
Cancridae	31	0.0104	11563.67	0.0990	0.00593
Atelecyclidae	1	0.0003	170.00	0.0015	0.00009
Sipunculida (unid. family)	1	0.0003	8.00	0.0001	0.00000

APPENDIX TABLE III

CONTINUED

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 all Sta.
Ectoprocta (unid. family)	1	0.0003	225.00	0.0019	0.00012
Dallinidae	2	0.0007	28.00	0.0002	0.00001
Echinasteridae	7	0.0024	198.00	0.0017	0.00010
Pterasteridae	1	0.0003	45.00	0.0004	0.00002
Asteridae	52	0.0176	21411.00	0.1833	0.01097
Strongylocentrotidae	15	0.0053	40.67	0.0003	0.00002
Molpadiidae	1	0.0003	20.00	0.0002	0.00001
Cucumariidae	1	0.0003	908.00	0.0078	0.00047
Chordata:Ascidiacea (unid. family)	50	0.0168	524.33	0.0045	0.00027

APPENDIX TABLE IV

PERCENTAGE COMPOSITION OF ALL PHYLA BY SPECIES FROM ALL STATIONS IN ALITAK BAY - JUNE, JULY, AND AUGUST 1976, AND MARCH 1977

Taxonomic names represent the lowest level of identification.

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 Occurrence station	gm/m^2 All Sta.	% of Phylum (count)	% of Phylum (weight)
Porifera	649	0.2	43866.00	0.38	0.1080	0.02248	100.00	100.00
Hydrozoa	4	0.0	1854.33	0.02	0.0329	0.00095	5.20	15.16
Scyphozoa	1	0.0	100.00	0.00	0.0044	0.00005	1.42	0.82
Ptilosarcus gurneyi	30	0.0	597.00	0.01	0.0038	0.00031	43.00	4.88
Stomphia coccinea	4	0.0	1360.00	0.01	0.0603	0.00070	5.67	11.12
Actiniidae	30	0.0	8119.38	0.07	0.0554	0.00416	41.88	66.39
Tealia crassicornis	2	0.0	200.00	0.00	0.0178	0.00010	2.84	1.64
Polychaeta	8	0.0	16.00	0.00	0.0014	0.00001	6.11	6.87
Polynoidae	2	0.0	2.00	0.00	0.0002	0.00000	1.53	0.86
Nereis sp.	10	0.0	22.00	0.00	0.0010	0.00001	7.63	9.44
Crucigera irregularis	100	0.0	170.00	0.00	0.0151	0.00009	76.34	72.96
Hirudinea	2	0.0	1.67	0.00	0.0001	0.00000	1.27	0.72
Notostomobdella sp.	9	0.0	21.33	0.00	0.0001	0.00001	7.12	9.16
Nuculana fossa	6	0.0	5.67	0.00	0.0001	0.00000	2.05	0.03
Yoldia thraciaeformis	1	0.0	50.00	0.00	0.0022	0.00003	0.36	0.30
Mytilus edulis	2	0.0	80.00	0.00	0.0071	0.00004	0.72	0.48
Musculus discors	30	0.0	668.00	0.01	0.0148	0.00034	10.86	4.02
Chlamys rubida	8	0.0	1307.33	0.01	0.0232	0.00067	2.77	7.86
Pecten caurinus	3	0.0	525.00	0.00	0.0233	0.00027	0.90	3.16

APPENDIX TABLE IV

CONTINUED

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 Occurrence station	gm/m^2 All Sta.	% of Phylum (count)	% of Phylum (weight)
Pododesmus macrochisma	4	0.0	80.00	0.00	0.0071	0.00004	1.45	0.48
Astarte rollandi	2	0.0	4.00	0.00	0.0004	0.00000	0.72	0.02
Astarte esquimalti	2	0.0	4.00	0.00	0.0004	0.00000	0.72	0.02
Clinocardium ciliatum	1	0.0	30.00	0.00	0.0013	0.00002	0.36	0.18
Serripes groenlandicus	2	0.0	620.00	0.01	0.0137	0.00032	0.72	3.73
Saxidomus gigantea	2	0.0	118.00	0.00	0.0105	0.00006	0.72	0.71
Protothaca staminea	1	0.0	10.00	0.00	0.0004	0.00001	0.36	0.06
Macoma calcarea	12	0.0	198.00	0.00	0.0018	0.00010	4.34	1.19
Hiatella arctica	71	0.0	46.00	0.00	0.0004	0.00002	25.69	0.28
Crepidula nummaria	4	0.0	3.00	0.00	0.0001	0.00000	1.45	0.02
Velutina sp.	1	0.0	2.00	0.00	0.0002	0.00000	0.36	0.01
Fusitrition oregonensis	103	0.0	11380.33	0.10	0.0561	0.00583	37.33	68.43
Nucella lamellosa	4	0.0	25.00	0.00	0.0007	0.00001	1.45	0.15
Neptunea lyrata	14	0.0	1010.00	0.01	0.0060	0.00052	5.07	6.07
Gonatidae	1	0.0	60.00	0.00	0.0027	0.00003	0.36	0.36
Gonatus sp.	2	0.0	70.00	0.00	0.0016	0.00004	0.72	0.42
Octopus sp.	1	0.0	333.33	0.00	0.0148	0.00017	0.48	2.00
Balanus balanus	180	0.1	1814.00	0.02	0.1616	0.00093	0.06	0.02
Balanus hesperius	24	0.0	111.00	0.00	0.0025	0.00006	0.01	0.00
Balanus rostratus	53	0.0	1600.00	0.01	0.1426	0.00082	0.02	0.01

APPENDIX TABLE IV

CONTINUED

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 Occurrence station	gm/m^2 All Sta.	% of Phylum (count)	% of Phylum (weight)
Amphipoda	2	0.0	1.00	0.00	0.0001	0.00000	0.00	0.00
Pandalus borealis	81668	61.4	1581865.13	13.54	1.1129	0.81079	61.64	13.65
Pandalus goniurus	33109	11.2	270151.00	2.31	0.3193	0.13847	11.23	2.33
Pandalus hypsinotus	45510	15.4	414110.61	3.54	0.2846	0.21225	15.44	3.57
Pandalopsis dispar	3090	1.0	50542.00	0.43	0.1244	0.02591	1.05	0.44
Eualus biunguis	2409	0.8	20219.67	0.17	0.0326	0.01036	0.82	0.17
Eualus gaimardii belcheri	11289	3.8	81966.67	0.70	0.1513	0.04201	3.83	0.71
Eualus macilenta	862	0.3	7154.00	0.06	0.0226	0.00367	0.29	0.06
Crangon dalli	660	0.2	5816.33	0.05	0.0184	0.00298	0.22	0.05
Crangon communis	696	0.2	4893.67	0.04	0.0117	0.00251	0.24	0.04
Sclerocrangon boreas	87	0.0	289.00	0.00	0.0129	0.00015	0.03	0.00
Argis sp.	217	0.1	2825.00	0.02	0.0501	0.00145	0.07	0.02
Argis lar	1261	0.4	8770.00	0.08	0.0278	0.00450	0.43	0.08
Argis dentata	2350	0.8	17841.00	0.15	0.0293	0.00914	0.80	0.15
Argis crassa	7	0.0	23.00	0.00	0.0007	0.00001	0.00	0.00
Pagurus sp.	2	0.0	2.00	0.00	0.0002	0.00000	0.00	0.00
Pagurus ochotensis	192	0.1	3443.21	0.03	0.0109	0.00176	0.07	0.03
Pagurus aleuticus	82	0.0	2583.33	0.02	0.0064	0.00132	0.03	0.02
Pagurus capillatus	23	0.0	356.67	0.00	0.0017	0.00018	0.01	0.00

APPENDIX TABLE IV

CONTINUED

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 Occurrence station	gm/m^2 All Sta.	% of Phylum (count)	% of Phylum (weight)
Pagurus kennerlyi	20	0.0	190.00	0.00	0.0085	0.00010	0.01	0.00
Pagurus beringanus	3	0.0	15.00	0.00	0.0013	0.00001	0.00	0.00
Labidochirus splendescens	5	0.0	53.00	0.00	0.0006	0.00003	0.00	0.00
Paralithodes camtschatica	3012	1.0	4365871.50	37.37	3.4268	2.23773	1.02	37.68
Paralithodes platypus	1	0.0	454.00	0.00	0.0201	0.00023	0.00	0.00
Oregonia gracilis	57	0.0	743.00	0.01	0.0023	0.00038	0.02	0.01
Hyas lyratus	35	0.0	2478.00	0.02	0.0314	0.00127	0.01	0.02
Chionoecetes bairdi	7773	2.6	4728562.00	40.47	2.4518	2.42363	2.64	40.81
Pugettia gracilis	9	0.0	74.00	0.00	0.0007	0.00004	0.00	0.00
Cancer magister	16	0.0	11519.67	0.10	0.0851	0.00590	0.01	0.10
Cancer oregonensis	15	0.0	44.00	0.00	0.0006	0.00002	0.01	0.00
Telmessus cheiragonus	1	0.0	170.00	0.00	0.0151	0.00009	0.00	0.00
Sipunculida	1	0.0	8.00	0.00	0.0004	0.00000	100.00	100.00
Ectoprocta	1	0.0	225.00	0.00	0.0200	0.00012	100.00	100.00
Terebratalia transversa	2	0.0	28.00	0.00	0.0025	0.00001	100.00	100.00
Henricia sp.	7	0.0	198.00	0.00	0.0025	0.00010	9.01	0.88
Pteraster tesselatus	1	0.0	45.00	0.00	0.0020	0.00002	1.29	0.20
Evasterias echinosoma	7	0.0	5598.00	0.05	0.1657	0.00287	9.01	24.75
Evasterias troschelii	42	0.0	14473.00	0.12	0.3215	0.00742	54.08	63.98

APPENDIX TABLE IV

CONTINUED

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 Occurrence station	gm/m^2 All Sta.	% of Phylum (count)	% of Phylum (weight)
Stylasterias forreri	2	0.0	1250.00	0.01	0.1114	0.00064	2.58	5.53
Pycnopodia helianthoides	1	0.0	90.00	0.00	0.0040	0.00005	1.29	0.40
Strongylocentrotus droebachiensis	16	0.0	40.67	0.00	0.0004	0.00002	20.17	0.18
Molpadia sp.	1	0.0	20.00	0.00	0.0009	0.00001	1.29	0.09
Cucumaria sp.	1	0.0	908.00	0.01	0.0402	0.00047	1.29	4.01
Chordata:Ascidiacea	50	0.0	524.33	0.00	0.0039	0.00027	100.00	100.00

APPENDIX TABLE V

OCCURRENCE OF EACH SPECIES IN UGAK BAY - JUNE, JULY, AND AUGUST 1976, AND MARCH 1977

A total of 98 stations were occupied. Taxonomic names represent lowest level of identification.

Taxonomic name	Cumulative occurrence	% of all[1] occurrence	% of all[2] stations
Porifera	32	3.493	32.653
Hydrozoa	4	0.437	4.082
Campanularia sp.	1	0.109	1.020
Lafoeidae	1	0.109	1.020
Sertulariidae	1	0.109	1.020
Sertularella sp.	1	0.109	1.020
Sertularia sp.	1	0.109	1.020
Abietinaria sp.	1	0.109	1.020
Plumulariidae	1	0.109	1.020
Scyphozoa	1	0.109	1.020
Stomphia coccinea	1	0.109	1.020
Actiniidae	20	2.183	20.408
Tealia crassicornis	2	0.218	2.041
Ctenophora	1	0.109	1.020
Polychaeta	6	0.655	6.122
Polynoidae	3	0.328	3.061
Spinther alaskensis	1	0.109	1.020
Nereis sp.	1	0.109	1.020
Crucigera irregularis	2	0.218	2.041
Nuculana fossa	13	1.419	13.265
Yoldia hyperborea	4	0.437	4.082
Mytilus edulis	3	0.328	3.061
Musculus discors	1	0.109	1.020
Modiolus modiolus	1	0.109	1.020
Chlamys rubida	2	0.218	2.041
Pecten caurinus	3	0.328	3.061
Clinocardium ciliatum	10	1.092	10.204
Clinocardium nuttallii	3	0.328	3.061

APPENDIX TABLE V

CONTINUED

Taxonomic name	Cumulative occurrence	% of all[1] occurrence	% of all[2] stations
Serripes groenlandicus	6	0.655	6.122
Macoma calcarea	4	0.437	4.082
Macoma moesta	3	0.328	3.061
Hiatella arctica	4	0.437	4.082
Bankia sp.	1	0.109	1.020
Bankia setacea	3	0.328	3.061
Crepidula nummaria	1	0.109	1.020
Velutina sp.	1	0.109	1.020
Fusitrition oregonensis	4	0.437	4.082
Nucella lamellosa	1	0.109	1.020
Dorididae	1	0.109	1.020
Gonatus sp.	1	0.109	1.020
Octopus sp.	1	0.109	1.020
Balanus sp.	1	0.109	1.020
Balanus balanus	10	1.092	10.204
Isopoda	1	0.109	1.020
Pandalus borealis	73	7.969	74.490
Pandalus goniurus	25	2.729	25.510
Pandalus hypsinotus	72	7.860	73.469
Pandalopsis dispar	10	1.092	10.204
Eualus biunguis	38	4.148	38.776
Eualus macilenta	3	0.328	3.061
Crangon dalli	33	3.603	33.673
Crangon communis	26	2.838	26.531
Argis sp.	6	0.655	6.122
Argis lar	9	0.983	9.184
Argis dentata	41	4.476	41.837
Pagurus ochotensis	23	2.511	23.469
Pagurus aleuticus	37	4.039	37.755
Pagurus capillatus	9	0.983	9.184

APPENDIX TABLE V

CONTINUED

Taxonomic name	Cumulative occurrence	% of all[1] occurrence	% of all[2] stations
Pagurus kennerlyi	1	0.109	1.020
Pagurus beringanus	2	0.218	2.041
Elassochirus tenuimanus	3	0.328	3.061
Paralithodes camtschatica	93	10.153	94.898
Oregonia gracilis	17	1.856	17.347
Hyas lyratus	4	0.437	4.082
Chionoecetes bairdi	97	10.590	98.980
Pugettia gracilis	11	1.201	11.224
Cancer sp.	1	0.109	1.020
Cancer magister	5	0.546	5.102
Cancer oregonensis	10	1.092	10.204
Telmessus cheiragonus	3	0.328	3.061
Pinnixa occidentalis	1	0.109	1.020
Echiurus echiurus alaskanus	1	0.109	1.020
Ectoprocta	1	0.109	1.020
Flustridae	1	0.109	1.020
Microporina sp.	1	0.109	1.020
Flustrella	1	0.109	1.020
Brachiopoda	1	0.109	1.020
Terebratulina unguicula	1	0.109	1.020
Terebratalia transversa	1	0.109	1.020
Solaster stimpsoni	2	0.218	2.041
Evasterias echinosoma	21	2.293	21.429
Evasterias troschelii	9	0.983	9.184
Stylasterias forreri	1	0.109	1.020
Pycnopodia helianthoides	2	0.218	2.041
Strongylocentrotus droebachiensis	22	2.402	22.449
Ophiuroidea	1	0.109	1.020
Gorgonocephalus caryi	1	0.109	1.020
Ophiopholis aculeata	1	0.109	1.020

APPENDIX TABLE V

CONTINUED

Taxonomic name	Cumulative occurrence	% of all[1] occurrence	% of all[2] stations
Cucumaria sp.	5	0.546	5.102
Chordata:Ascidiacea	24	2.620	24.490
Pelonaia corrugata	2	0.218	2.041
TOTAL	916	100.000	-

[1] $\frac{\text{cumulative occurrence}}{\text{total cumulative occurrence}}$

[2] $\frac{\text{cumulative occurrence}}{\text{total no. of stations occupied}}$

APPENDIX TABLE VI

PERCENTAGE COMPOSITION BY WEIGHT OF ALL PHYLA FROM ALL STATIONS IN UGAK BAY - JUNE, JULY, AND AUGUST 1976, AND MARCH 1977

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 all Sta.
Porifera	1037	0.6207	89350.55	1.2559	0.04439
Cnidaria	275	0.1645	44755.90	0.6291	0.02223
Ctenophora	2	0.0012	40.00	0.0006	0.00002
Annelida	1692	1.0133	3980.02	0.0559	0.00198
Mollusca	570	0.3412	6482.70	0.0911	0.00322
Arthropoda:Crustacea	162337	97.1995	6819853.63	95.8575	3.38791
Echiuroidea	2	0.0010	25.00	0.0004	0.00001
Ectoprocta	291	0.1740	102.00	0.0014	0.00005
Brachiopoda	74	0.0446	362.14	0.0051	0.00018
Echinodermata	577	0.3456	137365.27	1.9308	0.06824
Chordata:Ascidiacea	158	0.0945	12255.86	0.1723	0.00609
TOTALS	167015	100.0000	7114573.07	100.0000	3.53430

APPENDIX TABLE VII

PERCENTAGE COMPOSITION OF ALL PHYLA BY FAMILY FROM ALL STATIONS IN UGAK BAY - JUNE, JULY, AND AUGUST 1976, AND MARCH 1977

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 all Sta.
Porifera (unid. family)	1037	0.6207	89350.55	1.2559	0.04439
Hydrozoa (unid. family)	6	0.0038	385.71	0.0054	0.00019
Campanulariidae	1	0.0009	28.57	0.0004	0.00001
Lafoeidae	1	0.0009	28.57	0.0004	0.00001
Sertulariidae	6	0.0034	342.86	0.0048	0.00017
Plumulariidae	1	0.0009	14.29	0.0002	0.00001
Scyphozoa (unid. family)	1	0.0006	45.00	0.0006	0.00002
Actinostolidae	8	0.0048	650.00	0.0091	0.00032
Actiniidae	249	0.1492	43260.90	0.6081	0.02149
Ctenophora (unid. family)	2	0.0012	40.00	0.0006	0.00002
Polychaeta (unid. family)	1556	0.9314	3877.57	0.0545	0.00193
Polynoidae	60	0.0362	61.81	0.0009	0.00003
Spintheridae	1	0.0009	1.43	0.0000	0.00000
Nereidae	3	0.0015	2.50	0.0000	0.00000
Serpulidae	72	0.0434	36.71	0.0005	0.00002
Nuculanidae	113	0.0678	102.74	0.0014	0.00005
Mytilidae	166	0.0993	948.14	0.0133	0.00047
Pectinidae	8	0.0051	2279.78	0.0320	0.00113
Cardiidae	51	0.0305	1690.00	0.0238	0.00084
Tellinidae	12	0.0072	702.62	0.0099	0.00035

APPENDIX TABLE VII

CONTINUED

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 all Sta.
Hiatellidae	54	0.0324	39.18	0.0006	0.00002
Teredinidae	150	0.0896	59.71	0.0008	0.00003
Calyptraeidae	1	0.0009	1.43	0.0000	0.00000
Velutinidae	1	0.0006	1.00	0.0000	0.00000
Cymatiidae	6	0.0037	353.33	0.0050	0.00018
Thaididae	2	0.0013	33.33	0.0005	0.00002
Dorididae	1	0.0009	1.43	0.0000	0.00000
Gonatidae	2	0.0012	20.00	0.0003	0.00001
Octopodidae	1	0.0006	250.00	0.0035	0.00012
Balanidae	65	0.0389	434.81	0.0061	0.00022
Isopoda (unid. family)	1	0.0006	1.00	0.0000	0.00000
Pandalidae	143596	85.9784	1392238.77	19.5688	0.69162
Hippolytidae	3793	2.2712	35734.55	0.5023	0.01775
Crangonidae	4589	2.7478	41478.04	0.5830	0.02061
Paguridae	266	0.1591	7927.65	0.1114	0.00394
Lithodidae	3460	2.0719	2586714.91	36.3580	1.28500
Majidae	6421	3.8445	2743048.47	38.5554	1.36267
Cancridae	137	0.0822	10856.42	0.1526	0.00539
Atelecyclidae	6	0.0035	1416.43	0.0199	0.00070
Pinnotheridae	3	0.0015	2.50	0.0000	0.00000
Echiuridae	2	0.0010	25.00	0.0004	0.00001

APPENDIX TABLE VII

CONTINUED

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 all Sta.
Ectoprocta (unid. family)	2	0.0012	2.00	0.0000	0.00000
Flustridae	1	0.0009	7.14	0.0001	0.00000
Microporidae	1	0.0009	7.14	0.0001	0.00000
Flustrellidae	286	0.1711	85.71	0.0012	0.00004
Brachiopoda (unid. family)	71	0.0428	357.14	0.0050	0.00018
Cancellothyrididae	1	0.0006	1.00	0.0000	0.00000
Dallinidae	2	0.0012	4.00	0.0001	0.00000
Solasteridae	4	0.0025	275.00	0.0039	0.00014
Asteridae	197	0.1180	130035.57	1.8277	0.06460
Strongylocentrotidae	336	0.2009	1346.13	0.0189	0.00067
Ophiuroidea (unid. family)	2	0.0012	2.00	0.0000	0.00000
Gorgonocephalidae	1	0.0008	80.00	0.0011	0.00004
Ophiactidae	29	0.0171	28.57	0.0004	0.00001
Cucumariidae	9	0.0051	5598.00	0.0787	0.00278
Chordata:Ascidiacea (unid. family)	128	0.0768	12190.71	0.1713	0.00606
Styelidae	30	0.0177	65.14	0.0009	0.00003

APPENDIX TABLE VIII

PERCENTAGE COMPOSITION OF ALL PHYLA BY SPECIES FROM ALL STATIONS IN UGAK BAY - JUNE, JULY, AND AUGUST 1976, AND MARCH 1977

Taxonomic names represent the lowest level of identification.

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 Occurrence station	gm/m^2 All Sta.	% of Phylum (count)	% of Phylum (weight)
Porifera	1037	0.6	89350.55	1.26	0.1366	0.04439	100.00	100.00
Hydrozoa	6	0.0	385.71	0.01	0.0043	0.00019	2.34	0.86
Campanularia sp.	1	0.0	28.57	0.00	0.0013	0.00001	0.52	0.06
Lafoeidae	1	0.0	28.57	0.00	0.0013	0.00001	0.52	0.06
Sertulariidae	1	0.0	85.71	0.00	0.0038	0.00004	0.52	0.19
Sertularella sp.	1	0.0	85.71	0.00	0.0038	0.00004	0.52	0.19
Sertularia sp.	1	0.0	85.71	0.00	0.0038	0.00004	0.52	0.19
Abietinaria sp.	1	0.0	85.71	0.00	0.0038	0.00004	0.52	0.19
Plumulariidae	1	0.0	14.29	0.00	0.0006	0.00001	0.52	0.03
Scyphozoa	1	0.0	45.00	0.00	0.0020	0.00002	0.36	0.10
Stomphia coccinea	8	0.0	650.00	0.01	0.0579	0.00032	2.91	1.45
Actiniidae	246	0.1	43100.90	0.61	0.1108	0.02141	89.65	96.30
Tealia crassicornis	3	0.0	160.00	0.00	0.0035	0.00008	1.09	0.36
Ctenophora	2	0.0	40.00	0.00	0.0018	0.00002	100.00	100.00
Polychaeta	1556	0.9	3877.57	0.05	0.0344	0.00193	91.91	97.43
Polynoidae	61	0.0	61.81	0.00	0.0011	0.00003	3.57	1.55
Spinther alaskensis	1	0.0	1.43	0.00	0.0001	0.00000	0.08	0.04
Nereis sp.	3	0.0	2.50	0.00	0.0001	0.00000	0.15	0.06
Crucigera irregularis	72	0.0	36.71	0.00	0.0011	0.00002	4.28	0.92

APPENDIX TABLE VIII

CONTINUED

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 Occurrence station	gm/m^2 All Sta.	% of Phylum (count)	% of Phylum (weight)
Nuculana fossa	103	0.1	74.07	0.00	0.0003	0.00004	18.00	1.14
Yoldia hyperborea	11	0.0	28.67	0.00	0.0004	0.00001	1.87	0.44
Mytilus edulis	48	0.0	480.00	0.01	0.0071	0.00024	8.35	7.40
Musculus discors	114	0.1	457.14	0.01	0.0203	0.00023	20.06	7.05
Modiolus modiolus	4	0.0	11.00	0.00	0.0005	0.00001	0.70	0.17
Chlamys rubida	3	0.0	21.11	0.00	0.0007	0.00001	0.55	0.33
Pecten caurinus	5	0.0	2258.67	0.03	0.0502	0.00112	0.94	34.84
Clinocardium ciliatum	33	0.0	321.67	0.00	0.0017	0.00016	5.85	4.96
Clinocardium nuttallii	5	0.0	996.67	0.01	0.0177	0.00050	0.82	15.37
Serripes groenlandicus	13	0.0	371.67	0.01	0.0033	0.00018	2.28	5.73
Macoma calcarea	6	0.0	520.95	0.01	0.0058	0.00026	1.07	8.04
Macoma moesta	6	0.0	181.67	0.00	0.0032	0.00009	1.05	2.80
Hiatella arctica	54	0.0	39.18	0.00	0.0004	0.00002	9.51	0.60
Bankia sp.	36	0.0	35.71	0.00	0.0032	0.00002	6.27	0.55
Bankia setacea	114	0.1	24.00	0.00	0.0004	0.00001	20.01	0.37
Crepidula nummaria	1	0.0	1.43	0.00	0.0001	0.00000	0.25	0.02
Velutina sp.	1	0.0	1.00	0.00	0.0001	0.00000	0.18	0.02
Fusitrition oregonensis	6	0.0	353.33	0.00	0.0052	0.00018	1.08	5.45
Nucella lamellosa	2	0.0	33.33	0.00	0.0015	0.00002	0.39	0.51
Dorididae	1	0.0	1.43	0.00	0.0001	0.00000	0.25	0.02

APPENDIX TABLE VIII

CONTINUED

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 Occurrence station	gm/m^2 All Sta.	% of Phylum (count)	% of Phylum (weight)
Gonatus sp.	2	0.0	20.00	0.00	0.0009	0.00001	0.35	0.31
Octopus sp.	1	0.0	250.00	0.00	0.0111	0.00012	0.18	3.86
Balanus sp.	3	0.0	15.00	0.00	0.0013	0.00001	0.00	0.00
Balanus balanus	62	0.0	419.81	0.01	0.0021	0.00021	0.04	0.01
Isopoda	1	0.0	1.00	0.00	0.0000	0.00000	0.00	0.00
Pandalus borealis	91226	54.6	881963.02	12.40	0.5770	0.43813	56.20	12.93
Pandalus goniurus	26688	16.0	253044.02	3.56	0.4773	0.12570	16.44	3.71
Pandalus hypsinotus	25344	15.2	253817.72	3.57	0.1643	0.12609	15.61	3.72
Pandalopsis dispar	338	0.2	3414.00	0.05	0.0159	0.00170	0.21	0.05
Eualus biunguis	3737	2.2	35336.55	0.50	0.0432	0.01755	2.30	0.52
Eualus macilenta	56	0.0	398.00	0.01	0.0059	0.00020	0.03	0.01
Crangon dalli	1328	0.8	10970.75	0.15	0.0158	0.00545	0.82	0.16
Crangon communis	788	0.5	5342.95	0.08	0.0099	0.00265	0.49	0.08
Argis sp.	495	0.3	11192.00	0.16	0.0826	0.00556	0.30	0.16
Argis lar	377	0.2	2640.00	0.04	0.0130	0.00131	0.23	0.04
Argis dentata	1601	1.0	11332.34	0.16	0.0132	0.00563	0.99	0.17
Pagurus ochotensis	115	0.1	4253.33	0.06	0.0099	0.00211	0.07	0.06
Pagurus aleuticus	116	0.1	3302.73	0.05	0.0044	0.00164	0.07	0.05
Pagurus capillatus	27	0.0	288.02	0.00	0.0016	0.00014	0.02	0.00
Pagurus kennerlyi	1	0.0	28.57	0.00	0.0013	0.00001	0.00	0.00

APPENDIX TABLE VIII

CONTINUED

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 Occurrence station	gm/m^2 All Sta.	% of Phylum (count)	% of Phylum (weight)
Pagurus beringanus	3	0.0	35.00	0.00	0.0008	0.00002	0.00	0.00
Elassochirus tenuimanus	4	0.0	20.00	0.00	0.0004	0.00001	0.00	0.00
Paralithodes camtschatica	3460	2.1	2586714.91	36.36	1.3613	1.28500	2.13	37.93
Oregonia gracilis	121	0.1	1583.57	2.02	0.0045	0.00079	0.07	0.02
Hyas lyratus	13	0.0	424.29	0.01	0.0054	0.00021	0.01	0.01
Chionoecetes bairdi	6086	3.6	2740746.19	38.52	1.3770	1.36152	3.75	40.19
Pugettia gracilis	201	0.1	294.43	0.00	0.0013	0.00015	0.12	0.00
Cancer sp.	3	0.0	2.50	0.00	0.0001	0.00000	0.00	0.00
Cancer magister	10	0.0	10309.35	0.14	0.1016	0.00512	0.01	0.15
Cancer oregonensis	125	0.1	544.57	0.01	0.0030	0.00027	0.08	0.01
Telmessus cheiragonus	6	0.0	1416.43	0.02	0.0209	0.00070	0.00	0.02
Pinnixa occidentalis	3	0.0	2.50	0.00	0.0001	0.00000	0.00	0.00
Echiurus echiurus alaskensis	2	0.0	25.00	0.00	0.0011	0.00001	100.00	100.00
Ectoprocta	2	0.0	2.00	0.00	0.0001	0.00000	0.69	1.96
Flustridae	1	0.0	7.14	0.00	0.0003	0.00000	0.49	7.00
Microporina sp.	1	0.0	7.14	0.00	0.0003	0.00000	0.49	7.00
Flustrella	286	0.2	85.71	0.00	0.0038	0.00004	98.33	84.03
Brachiopoda	71	0.0	357.14	0.01	0.0158	0.00018	95.97	98.62
Terebratulina unguicula	1	0.0	1.00	0.00	0.0001	0.00000	1.34	0.28

APPENDIX TABLE VIII

CONTINUED

Taxonomic name	Total No. indiv. (count)	% Count	Weight (gm)	% Weight	gm/m^2 Occurrence station	gm/m^2 All Sta.	% of Phylum (count)	% of Phylum (weight)
Terebratalia transversa	2	0.0	4.00	0.00	0.0004	0.00000	2.69	1.10
Solaster stimpsoni	4	0.0	275.00	0.00	0.0061	0.00014	0.72	0.20
Evasterias echinosoma	99	0.1	13268.89	0.19	0.0310	0.00659	17.12	9.66
Evasterias troschelii	22	0.0	4255.57	0.06	0.0236	0.00211	3.76	3.10
Stylasterias forreri	1	0.0	20.00	0.00	0.0009	0.00001	0.17	0.01
Pycnopodia helianthoides	76	0.0	112491.11	1.58	3.3287	0.05588	13.09	81.89
Strongylocentrotus droe-bachiensis	336	0.2	1346.13	0.02	0.0028	0.00067	58.13	0.98
Ophiuroidea	2	0.0	2.00	0.00	0.0001	0.00000	0.35	0.00
Gorgonocephalus caryi	1	0.0	80.00	0.00	0.0071	0.00004	0.23	0.06
Ophiopholis aculeata	29	0.0	28.57	0.00	0.0013	0.00001	4.95	0.02
Cucumaria sp.	9	0.0	5598.00	0.08	0.0496	0.00278	1.47	4.08
Chordata:Ascidiacea	128	0.1	12190.71	0.17	0.0246	0.00606	81.27	99.47
Pelonaia corrugata	30	0.0	65.14	0.00	0.0014	0.00003	18.73	0.53

RECEPTORS (BIOTA)

MICROBIOLOGY

RECEPTORS (BIOTA)

MICROBIOLOGY

Quarterly Report

Contract # 03-5-022-85
Research Unit 29
Period 6/1 - 9/30

Assessment of Potential Interactions of Microorganisms and Pollutants Resulting from Petroleum Development on the Outer Continental Shelf in the Beaufort Sea

Submitted by: Ronald M. Atlas
Principal Investigator
Department of Biology
University of Louisville
Louisville, Kentucky 40208

October 1, 1977

I. Task Objectives

A. To characterize marine microbiological communities in sufficient detail to establish a baseline description of microbiological community characteristics on a seasonal basis.

B. To determine the role of microorganisms in biodegradation of petroleum hydrocarbons.

II. Field and Laboratory Activities

A. Field Schedule

Pilot studies were carried out to test methodology for studying oil degradation in Beaufort Sea sediment. During June, sediment was collected in Elson Lagoon and placed in Plexiglas trays 25 cm x 25 cm x 5 cm. Two hundred ml Prudhoe crude oil was added to each tray. The trays were placed back *in situ* under the ice in Elson Lagoon by scuba divers. Excess oil washed from the sediment. After 1,2 and 3 weeks replicate trays were recovered. During this period ice still covered the area. Replicate trays were also recovered after 8 weeks exposure when there was open water. Observations were made on the benthic invertebrates on or in the oiled sediment and unoiled control sediment.

B. Laboratory Activities

To recover oil from the sediment portions of diethyl ether were mixed with sediment and decanted. The diethyl ether portions were combined and concentrated. Analysis of residual oil will initially be performed by gas liquid chromatography.

III. Results

Nutrient analyses from the 1976 Glacier cruise were received from Dr. Vera Alexander. Results of these analyses are being incorporated into previously established data files at NIH.

Orange pigmented bacteria were found to be dominant in Arctic waters during summer months. Additional cluster analyses were performed on orange pigmented bacteria isolated from 1975 and 1976 samplings. The results indicate that orange pigmentation is distributed in very heterogeneous groups of bacteria and not in a single group. Many of the orange pigmented taxonomic groups appear to represent genera of bacteria not previously described.

The *in situ* oil-sediment exposure experiments showed that oil could be added to sediment under ice and later recovered both under ice and when there is open water. The ability to relocate the oil-sediment trays will permit needed long term studies. Analyses of the recovered oil have not yet been performed.

Initial examination of invertebrates recolonizing the oil contaminated sediment indicates that while extensive recolonization occurs within two months after oil exposure, the benthic invertebrate community recolonizing oil contaminated sediment is significantly different than the benthic invertebrate community of unoiled control sediment.

IV. Interpretation of Results

No new interpretation of analyses were made during this period.

V. Problems Encountered

None.

VI. Estimate of Funds

It is estimated that 100% of this year's funds were expended as of October 1, 1977.

Quarterly Report

Contract # 03-6-022-35109
Research Unit 30
Period 6/1 - 9/30

Assessment of Potential Interactions of Microorganisms and Pollutants Resulting from Petroleum Development in Cook Inlet

Submitted by: Ronald M. Atlas
Principal Investigator
Department of Biology
University of Louisville
Louisville, Kentucky 40208

October 1, 1977

I. Task Objectives

A. To characterize marine microbiological communities in sufficient detail to establish a baseline description of microbiological community characteristics on a seasonal basis.

B. To determine the role of microorganisms in the biodegradation of petroleum hydrocarbons.

II. Field and Laboratory Activities

A. Field Schedule

No field activities were scheduled during this quarter.

B. Laboratory Activities

Numerical taxonomic testing of 500 isolates from the April Cook Inlet sampling was carried out. As previously described, each isolate is characterized by 300 features. Data acquisition from these tests has been completed, and the data is being transmitted to NIH for data archival and analysis.

III. Results

No new samples were collected for enumeration during this period. Also, no new cluster analyses were performed during this period.

IV. Interpretation of Results

No new interpretation of analyses was made during this period.

V. Problems Encountered

Due to the size and cost of cluster analyses of data from Cook Inlet isolates, a decision has been made to change the computer programs we have been using. This change has resulted in a transition period during which no cluster and feature frequency analyses are being performed. Computer programmers at NIH have almost completed initial program modifications. These programs should be functional during the next month. An additional transition will occur later when further efficiency program modifications are made.

An additional problem is a personnel change in our program. Dr. Kaneko, who worked on this project for two years, unexpectly moved to an industrial position. We are presently searching for a replacement according to required affirmative action procedures. This personnel change will result in a temporary delay in analysing data, but should not effect the overall output or quality of our project.

VI. Estimate of Funds

It is estimated that 90% of this year's funds were expended as of October 1, 1977.

Quarterly Report

Task Numbers A-27; B-9
Contract #03-5-022-68
Research Unit 190-E
Reported Period 1 July to
30 September, 1977

Number of pages 7

Study of Microbial Activity in the Lower Cook Inlet and Analysis of Hydrocarbon Degradation by Psychrophilic Microorganisms

SUBMITTED BY:

Richard Y. Morita
Principal Investigator
Professor of Microbiology and Oceanography
Department of Microbiology
Oregon State University
Corvallis, OR 97331

Robert P. Griffiths
Co-Investigator
Research Associate
Department of Microbiology
Oregon State University
Corvallis, OR 97331

Date Submitted

September 30, 1977

I. Task Objectives

a. To measure the relative levels of microbial activity in the waters and sediments of the Lower Cook Inlet and to measure the concentration of bacteria found in the same samples using epifluorescent microscopy (Task A-27).

b. To study hydrocarbon degradation by psychrophilic hydrocarbon degrading bacteria (Task B-9).

c. To study the effects of crude oil on growth and metabolism of natural marine microbial populations.

d. To coordinate the above studies with Dr. Atlas and his associates (R U #29).

II. Field and Laboratory Activities

A. Field trip schedule

No field trips during this period; however, we did receive sediment samples from the Beaufort Sea Glacier cruise for analysis.

B. Scientific party

All of the personnel involved in this project are in the Department of Microbiology, Oregon State University. Ms. Steven started her employment with us on 8/16/77.

C. Personnel

Dr. Richard Y. Morita, Principal Investigator
Dr. Robert Griffiths, Co-Principal Investigator
Mr. Thomas McNamara, Technician (Research Assistant, Unclassified)
Ms. Sue Steven, Technician (Research Assistant, Unclassified)

D. Methods

The methods that have been used to analyze the sediment samples from the Beaufort Sea Glacier cruise are essentially the same as those described in our 1977 annual report. The methods that we have been evaluating during this quarter will be reported in the next quarterly report after a more extensive analysis has been completed.

III. Results

A. Laboratory studies

1. Two sets of experiments were completed on sediments that were returned to our laboratory at Oregon State University after the April, 1977 Lower Cook Inlet cruise. One set involved the study of the effects of crude oil on the growth of marine heterotrophic bacteria on agar plates and the other was a study of presumptive nitrogen fixing bacteria concentrations in many of the same samples.

In the first study, the effects of crude oil in the agar medium on the growth of heterotrophic bacteria were measured in 10 Cook Inlet sediment samples (Table 1). In 6 of the 10 samples, there was a reduction in the number of organisms that were capable of growth in the presence of crude oil.

In the second study there was a positive correlation of 0.47 between the presumptive nitrogen fixing bacterial concentrations and the relative nitrogen fixation rates observed in the same samples (Table 2). Work is continuing to give positive confirmation of nitrogen fixation by these organisms.

2. Eighteen chitinoclastic bacterial strains were isolated from Cook Inlet and Beaufort Sea sediments. These strains were screened for their ability to grow and produce chitinase activity in the presence of crude oil vapors. None of the strains tested appeared to show growth inhibition under these conditions but at least four strains showed reduced chitinase activity. The same type of study is currently underway using another technique which will produce more definitive measurements of the effects of crude oil on chitinase.

3. The effect of crude oil on nitrogen fixation rates in five sediment samples taken from Yaquina Bay was also studied. This is the same type of experiment that we conducted on four Cook Inlet samples that was reported in Table 9, page 26 of our last quarterly report. In all cases, there was some reduction in the amount of ethylene produced in the samples that were treated with Cook Inlet crude oil. In the samples that were treated with sucrose (used to increase ethylene production rates), crude oil treatment decreased ethylene production in three of the five samples studied. Further studies of this nature will be conducted on Arctic sediment samples in the future.

4. Three methods of determining rates of crude oil biodegradation are also currently being evaluated in our laboratory. The primary method being evaluated involves the use of gas chromotography in the determination of crude oil compositional changes. Preliminary results indicate that by summing the total area of a wide range of peaks, we obtain values that correlate well with gravimetric measurements. We are in the process of comparing the results of these studies with values obtained by measuring the respiration of ^{14}C labeled hexadecane and pristane in Cook Inlet crude oil.

5. We are also in the process of evaluating the relative biodegradative efficiency of a number of oil enrichment cultures obtained from sediments taken from both the Beaufort Sea and the Cook Inlet. We are studying these natural mixed populations under conditions where all known inorganic nutrient requirements are met. By studying these cultures, we hope to determine how crude oil might be degraded under idealized conditions.

It is also hoped that we will obtain a microbial population that might be unusually effective in degrading crude oil under the severe environmental conditions found in the Beaufort Sea. Future studies of these natural mixed populations should give us information about the dynamics of crude oil degradation under conditions that more closely approximate those found in the natural marine environment.

6. On September 8 we received a number of fresh sediment samples from the Beaufort Sea Glacier cruise. These were collected by Dr. Eugene Ruff (an associate of Dr. Andrew Carey) during the recent Glacier cruise and transported to us by Dr. Rita Horner. These samples are in the process of being subjected to the following experiments: (a) the effects of crude oil on both the uptake and respiration of ^{14}C labeled glucose and glutamic acid, (b) crude oil biodegradation potentials (c) the effects of crude oil on nitrogen fixation rates (d) total numbers of bacteria present using agar plate counts (e) the concentration of lipolytic bacteria present. In addition, we will be using these samples to obtain natural microbial populations that are especially effective in degrading crude oil. A report of these findings will be presented in the next quarterly report.

B. Data processing

We are in the process of placing all applicable data into the same data bank at NIH that Dr. Atlas is currently using. Soon after we received additional funds for that purpose, Dr. Krichevsky of NIH visited our laboratory and gave us a briefing on the procedures for incorporating our data into this data base. All data through the October, 1976 Cook Inlet cruise is now on file at NIH. All data collected in the Beaufort Sea and NEGOA area from August, 1975 to April, 1976 is in file number 100188. The data collected in the Beaufort Sea during the August, 1976 Glacier cruise is in file number 100236 and the data from the October, 1976 Lower Cook Inlet cruise is in file number 100237. These are the same file numbers that Dr. Atlas has used for his data from the same sources. Computer cards containing data collected during the April, 1977 Cook Inlet cruise will be submitted to Dr. Krichevsky during the next quarter.

As of this date, Dr. Griffiths is in Washington confering with Drs. Atlas and Krichevsky in an effort to optimize data formats for the integration of the data sets generated by both our group and Dr. Atlas. Discussions are also being conducted on the most efficient method of obtaining statistical analysis of the data being produced by these two groups.

IV. Preliminary interpretation of results

None available at this time.

V. Problems encountered, recommended changes, acknowledgements

A. Problems encountered: none

B. Recommended changes: none

C. Acknowledgements:

We would like to thank Dr. John Baross of our laboratory (not funded by NOAA) for his analysis of bacterial numbers, concentrations of nitrogen fixing bacteria and Vibrio sp. concentrations in the sediment samples taken during the Glacier cruise.

We would also like to thank Dr. Eugene Ruff with Dr. Andrew Carey's group (RU#7) for collecting sediment samples for us during the August, 1977 Beaufort Sea cruise. In addition, we would like to thank Dr. Rita Horner (RU#359) for transporting these samples from the field to our laboratory at Oregon State University.

Table 1. The effects of crude oil on the growth of marine bacteria plated on a marine agar medium. Dilutions were made from sediments taken from the Lower Cook Inlet during the April, 1977 Discoverer cruise.

		Plate counts x 10^6 per g dry wt.		
Sample number	Station number	No oil	Oil	Percent change
GB 412	V	3.3	3.3	0
GB 421	K	10.9	1.5	-86
GB 424	J	3.2	3.1	- 3
GB 425	229	0.9	0.9	0
GB 430	213	2.7	3.4	+26
GB 431	214	7.1	5.0	-30
GB 432	204	1.2	1.2	0
GB 436	212	9.3	5.5	-40
GB 440	395	1.5	0.8	-49
GB 444	388	3.5	2.8	-20

Table 2. Concentration of presumptive nitrogen fixing bacteria in sediments collected during the April, 1977 Lower Cook Inlet cruise.

Sample number	Station number	Counts x 10^3 per g dry wt.
GB 401	D	4.0
GB 410	242	<0.01
GB 411	U	2.4
GB 412	V	1.2
GB 420	227	340
GB 421	K	22
GB 424	J	1.3
GB 425	229	800
GB 430	213	0.02
GB 431	214	<0.01
GB 432	204	40
GB 434	212	--
GB 435	215	0.8
GB 436	212	0.2
GB 437	208	14
GB 440	395	56
GB 442	105	0.7
GB 444	388	<0.01
GB 445	378	0.2

Table 3. The effects of crude oil on nitrogen fixation rates in sediment samples taken from Yaquina Bay, Oregon. Quantities of ethylene production are given as pmoles ethylene produced during a 41 hr. incubation period at 24 C. Treatments used (1) no additives, (2) sucrose added, (3) crude oil added, (4) sucrose and crude oil added.

Sample	Treatment	pmoles ethylene
A	1	41
	2	2377
	3	33
	4	2535
B	1	72
	2	90
	3	71
	4	90
C	1	127
	2	1256
	3	109
	4	553
D	1	52
	2	492
	3	43
	4	231
E	1	43
	2	1428
	3	31
	4	1052

DETERMINE THE FREQUENCY AND PATHOLOGY OF MARINE FISH DISEASES IN THE BERING SEA, GULF OF ALASKA, AND BEAUFORT SEA

by

Bruce B. McCain*

Harold O. Hodgins*

William D. Gronlund*

Submitted as a Quarterly Report
for Contract #R7120817
Research Unit #332
OUTER CONTINENTAL SHELF ENERGY ASSESSMENT PROGRAM
Sponsored by
U.S. Department of the Interior
Bureau of Land Management

July 1 to September 30, 1977

* Principal Investigators, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Boulevard East, Seattle, Washington 98112

ABSTRACT

Increased emphasis has been placed on the health status of demersal fishes in the northern Gulf of Alaska (NGOA). During a cruise on the Polish research vessel, Professor Siedlecki, in this area from July 1 to August 8, 1977, four species of fish were found to have pathological conditions. The affected species, condition, and prevalence were as follows: Pacific cod (*Gadus macrocephalus*), pseudobranchial tumors (1.3%) and skin ulcers (1.0%); walleye pollock (*Theragra chalcogramma*), pseudobranchial tumors (0.1%); and Pacific ocean perch (*Sebastes alutus*) and sharpchin rockfish (*S. zacentrus*), opercular tumors (0.5 and 1.5%, respectively). In general, the frequencies of occurrence of pathological conditions in the NGOA were much lower than previously found in the above fish species in the Bering Sea.

OBJECTIVES

Determine the frequency, geographical distribution, and biological and pathological characteristics of demersal marine animals and macro-invertebrates in the Bering and Beaufort Seas, and the Gulf of Alaska. Also, characterize the micro-organisms isolated from diseased animals using standard micro-biological procedures.

FIELD AND LABORATORY ACTIVITIES

Ship or field trip schedule

Dates: July 1 to August 8, 1977.
Vessel: R/V Professor Siedlecki
Arrangement: A joint scientific investigation between the Polish and U.S. governments.

Scientific party

1. Field activities:

a. Professor Siedlecki, Leg I, July 1 to July 18, 1977.

William D. Gronlund, P.I., Party Chief, responsible for examining fish for pathological conditions, and collecting specimens and statistical data.

Sue Gazarek, electron microscope technician, aided in examination of fish and collection of specimens for electron microscopy.

b. Professor Siedlecki, Leg II, July 19 to August 8, 1977.

Bruce B. McCain, PhD, P.I., Party Chief, examined fish for pathological conditions, collected tissue specimens and bacterial isolates.

Mark S. Myers, assisted in the examination of fish and collected statistical data.

2. Laboratory activities:

Bruce B. McCain, PhD	P.I., coordinates field and laboratory activities, participated in histopathological, and microbiological analyses, and writes progress reports and manuscripts.
Harold O. Hodgins, PhD	P.I., supervises NMFS investigations and reviews all reports and manuscripts.
Mark S. Myers	Performs histopathological analyses of tissue specimens and participates in data processing.
William D. Gronlund	P.I., participates in data processing and analyses of biological data.
Katherine King	Invertebrate pathologist, participates in data processing, analyses of biological data, and histopathological examination of invertebrate tissue specimens.
S.R. Wellings, MD, PhD	Consultant, coordinates histopathological analyses of tissue specimens (Dept. of Pathology, School of Medicine, Univ. California, Davis).
Linda Rhodes	Histology technician.

Methods

1. Field activities:

Aboard the Professor Siedlecki, fish were examined for lesions and for overall appearance. Wherever possible, the fish samples examined were identical to those used by biologists from the RACE Division, NWAFC for collection of length, weight, sex, and age data.

Fish with pathological signs were weighed, measured for length, and aged. The lesion(s) and usually the major organs were preserved for histological examination. In cases of previously unreported or unusual pathological conditions, photographs of the fish were taken. Attempts were also made to isolate bacteria from some tumors and skin ulcers. Bacterial isolates were colony-purified and inoculated into tubes containing agar medium for storage until further tests can be performed at the NWAFC.

2. Laboratory activities:

Histological examination of fish tissues from the NGOA was continued.

Sample collection localities

Approximately 152° to 133° West Longitude by 54.5° to 58° North Latitude.

Data collected and/or analyzed

Number and type of samples

a. Field activities:

15,088 fish were examined for pathological conditions; 18 tissue specimens were collected for light microscope histology; 3 tissue specimens were collected for electron microscopy; 30 bacterial isolates were obtained.

b. Laboratory activities:

273 tissue specimens were processed for histology; 546 histological slides were prepared.

Number and type of analyses

250 histological slides were examined and interpreted; 80 statistical analyses of data on invertebrates from Norton Sound/Chukchi Sea.

RESULTS

Field activities:

A total of 15,088 fish in 56 trawl catches were examined aboard the *Professor Siedlecki*. Of the 28 species of fish examined, four species had pathological conditions involving 41 fish (Table 1). The affected species were Pacific cod, walleye pollock, Pacific ocean perch, and the sharpchin rockfish (*Sebastes zacentrus*). Pacific cod and walleye pollock had pseudobranchial tumors at frequencies of 1.3 and 0.1%, respectively. These tumors were located in the antero-dorsal region of the buccal cavity in a position surrounding the pseudobranchial gland. The Pacific ocean perch and sharpchin rockfish had epithelial tumors in the opercular region just posterior to the last (5th) gill arch on the translucent marginal

TABLE 1. *Summarization of fish pathology data from the R.V. Professor Siedlecki*

Common and scientific names	# of hauls examined	Total # of individuals	# with pathology	Frequency (%)	Condition
Walleye pollock,	46	3,558	5	0.1	tumor
Theragra chalcogramma					
Pacific cod,	35	1,050	14	1.3	tumor
Gadus macrocephalus	35	1,050	9	1.0	skin ulcer
Black cod,	19	454			
Anoplopoma fimbria					
Flathead sole,	32	1,271			
Hippoglossoides elassodon					
Rex sole,	29	1,373			
Glyptocephalus zachirus					
Dover sole,	23	660			
Microstomus pacificus					
Arrowtooth flounder,	22	2,215			
Atheresthes stomias					
Rock sole,	5	90			
Lepidopsetta bilineata					
Idiot,	25	603			
Sebastolobus alascanus					
Pacific ocean perch,	33	2,447	12	0.5	tumor
Sebastes alutus					
Rougheye rockfish,	27	525			
Sebastes aleutianus					
Harlequin rockfish,	9	288			
Sebastes variagatus					
Yellowtail rockfish,	4	211			
Sebastes flavidus					
Silvergrey rockfish,	7	72			
Sebastes brevispinis					
Sharpchin rockfish,	1	65	1	1.5	tumor
Sebastes zacentrus					
Dusky rockfish,	6	80			
Sebastes ciliatus					
Miscellaneous species (12) (<50 individuals/species)	--	126			

epithelium; the prevalence was 0.5 and 1.5%, respectively. In some cases, these tumors had spread over the roof of the buccal cavity onto the pharngeal aperture, and often solitary tumors were seen on the gill filaments. Pacific cod with skin ulcers were also found; however, fish from only two hauls had significant involvement.

Laboratory activities:

Intensive histopathological examination of tissue specimens from tumor-bearing and normal Pacific ocean perch was performed. Particular attention was paid to the tumor-specific X-cells, which have been described previously (OCSEAP Report RU 332, June 1977). These cells were variable in size with the smaller cells positioned adjacent to the basement membrane of both the collagenous and vascular stomal components. Although a clear demarcation between the X-cells and stroma was usually seen, in some cases these cells were present within the stroma. A lymphocytic infiltrate of variable intensity was often present in the nests of X-cells in the tumor. Such infiltrates are seldom observed in X-cell tumors from Pacific cod or flatfish.

One tumor-bearing Pacific ocean perch had a chondroma (benign tumor of cartilaginous tissue) of unknown origin in the spleen.

PRELIMINARY INTERPRETATION OF RESULTS

Field activities:

Most of the fish species examined during the cruise of the Professor Siedlecki in the NGOA were free of externally detectable pathological signs. Although tumors were found in Pacific cod and walleye pollock, and skin ulcers were seen on Pacific cod, the frequencies of occurrence were much lower than previously found in these species in the Bering Sea.

Previous to this cruise, opercular tumors had been found only in Pacific ocean perch (OCSEAP Report RU 332, June 1977). This new data contributes significantly to our knowledge of the prevalence and geographical distribution of opercular tumors in Pacific ocean perch. In addition, a new species of *Sebastes* (*S. zacentrus*) with these tumors was found. In one instance, a Pacific ocean perch was found with opercular tumors, which had spread to and completely covered the anterior portion of the esophogeal epithelium.

Laboratory activities:

Although the opercular tumors in Pacific ocean perch have many similarities to the skin tumor of flatfish and the pseudobranchial tumors of Pacific cod and walleye pollock, such as the presence of X-cells and their epithelial nature, some major differences exist. The most important of these differences is the presence of lymphocytic infiltration in the perch tumors, suggesting a more intense host response to the tumors by this species.

AUXILIARY MATERIAL

Bibliography of references

ALPERS, C.E., B.B. McCAIN, M.S. MYERS, AND S.R. WELLINGS. 1977. Lymphocystis disease in yellowfin sole (*Limanda aspera*) in the Bering Sea. J. Fish. Res. Board Can. 34:611-6.

Papers in preparation or in press

ALPERS, C.E., B.B. McCAIN, M.S. MYERS, AND S.R. WELLINGS. 1977. Pathology of pharnygeal tumors in Pacific cod, *Gadus macrocephalus*, of the Bering Sea. J. Natl. Cancer Inst. (In press).

McCAIN, B.B., S.R. WELLINGS, C.E. ALPERS, M.S. MYERS, AND W.D. GRONLUND. 1977. The frequency, distribution, and pathology of three diseases of demersal fishes in the Bering Sea. J. Fish. Biol. (In press).

McCAIN, B.B., M.S. MYERS, W.D. GRONLUND, AND S.R. WELLINGS. 1977. Baseline data on diseases of fishes from the Bering Sea for 1976. Fish. Bull. (Submitted).

MYERS, M.S., B.B. McCAIN, AND S.R. WELLINGS. Preliminary description of an epidermal tumor in *Sebastes alutus* from the Gulf of Alaska. (In preparation).

PROBLEMS ENCOUNTERED/RECOMMENDED CHANGES -- None

ESTIMATE OF FUNDS EXPENDED -- 53.6 K

Quarterly Report

Contract #03-5-022-56
Research Unit #427
Task Order #1
Reporting Period 7/1 - 9/30/77

ICE EDGE ECOSYSTEM
BERING SEA

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October 1, 1977

Quarterly Report for Quarter Ending September 30, 1977

Project Title: Phytoplankton Studies in the Bering Sea

Contract Number: 03-5-022-56

Task Order Number: 1

Principal Investigator: Dr. Vera Alexander
Professor of Marine Science
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I. Task Objectives

To study the dynamics of phytoplankton populations at the edge of the retreating ice pack in the Bering Sea in order to assess the significance of the ice edge in the productivity of the Bering Sea. Secondly, to assess the levels of phytoplankton productivity in the southeast Bering Sea during ice free conditions in order to compare seasonal activity, and also to look at the role of the shelfbreak and the Aleutian upwelling in Bering Sea production dynamics. The seasonal role of algae growing on the underside of the ice is also included in the study.

II. Field Activities

No field activities have been undertaken this quarter. Laboratory analyses and preparation of the final report covering the 1975 and 1976 data have been in progress. The status of samples collected during the three spring cruises is as follows:

1. Nutrient analyses for all cruises are complete and calculations are in progress.

2. Chlorophyll values have been calculated and the *in situ* flurometer calibrated.

3. Primary productivity values are complete for the two *Surveyor* cruises. Counting is complete and alkalinities have been determined for *Discoverer*, Leg VI but final calculations are not yet available.

4. Phytoplankton counts are in progress for all cruises.

III. Results

The three cruises this spring covered a time span which began with pre-bloom conditions showing very low chlorophyll concentrations through a well defined bloom associated with the retreating ice front on the last cruise. Chlorophyll profiles of the water column appear to show a tongue of chlorophyll-rich colder surface water sinking beneath the warmer oceanic water approaching from the south. This may explain the deep chlorophyll layer observed with discreet samplings in the past. The ice edge bloom appears while the water is uniformly mixed and cold. When the warmer ocean water encroaches from the south the colder productive water slips beneath. This phenomena could be of major importance for containing and transporting dissolved hydrocarbons downward to the benthic community.

IV. No major problems were encountered.

QUARTERLY REPORT

Contract #3-5-022-56
Research Unit 537
Task order 32
Reporting period: 3/1/77-10/1/77
Number of Pages: 2

NUTRIENT DYNAMICS IN NEARSHORE UNDER-ICE WATERS

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I. TASK OBJECTIVES

1) Establish mass balance relationships for particulate and dissolved nitrogenous nutrients beneath the winter ice cover in the nearshore Beaufort Sea.

2) Compare standing stocks of epontic algae in relation to under-ice circulation.

3) Begin data collection to delineate temporal and spatial variability in ice algae blooms in the nearshore Beaufort Sea.

The scope of the above objectives was restricted due to delays in project funding but work has begun on all aspects. The groundwork has been established for a more intense and complete study in conjunction with the LGL-Barrier Island study group for 1978.

II. FIELD ACTIVITIES

Two field trips were undertaken during spring 1977 from the Naval Arctic Research Laboratory at Barrow:

1) A trip to Dease Inlet was made using NARL fixed wing aircraft on 30 and 31 March 1977. Ice cores and water samples were collected at five stations on a transect of Dease Inlet from the head to outside of the barrier islands. Samples were processed for later chemical analyses upon returning to NARL.

2) A transect of Elson Lagoon between Plover Point and the mainland was made on 23 May 1977, using a NARL tracked vehicle. The slow travel rate and worsening weather limited sample collection to three stations. Ice algae samples, ice cores and water column samples were taken at each station.

III. LABORATORY ACTIVITIES

Filtration and processing of acquired ice and water samples was completed immediately after acquisition at the Naval Arctic Research Laboratory at Barrow. The analyses for nitrogenous nutrients has begun at the Institute of Marine Science. Inorganic nutrient analyses are now complete for all ice and water samples taken and data processing has begun. Further analyses for dissolved organic nitrogen and particulate nitrogen will be completed in the future.

IV. PROBLEMS ENCOUNTERED

Logistic problems arising from severe weather and competing needs for aircraft were the principle difficulties encountered. The March 1977 trip to Dease Inlet was hampered by winds and temperatures of -28°C which presented equipment handling problems. However, the basic sampling objectives of this trip were accomplished.

The May 1977 trip to Dease Inlet was not accomplished due to severe weather and whiteout conditions that prevented fixed-wing aircraft from being able to land on the ice. Helicopter support was unfortunately unavailable and the ice algae collections were made in Elson Lagoon utilizing a NARL tracked vehicle. The slow speed and rough surface of the ice limited sampling from this vehicle to the immediate vicinity of Barrow.

Overall, the field season provided a start for 1978 data collection and the basis for an effective late winter-spring sampling program to be conducted in conjunction with the LGL-Barrier Island study group.

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