ALASKA DEPARTMENT OF FISHERIES

JUNEAU, ALASKA

Annual Report for 1955

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ERRATA SHEET

Page

5—Change "Forward" to "Foreword"

34—Paragraph 3: Change "test" to "text"

60—Figure 19: Shade first bar of each pair of bars

75—Table 3: Change "gil" to "gill"

86—Table 13, week of August 14-20, catch of red salmon, 1954: Change 42 to 56

110—Paragraph 6: Change 227,000 to 285,000

111—Paragraph 3: Change 475,000 to 480,000

119—Paragraph 7: Change "August 1955" to "August 1954"

133—Table 4, Totals: Add "49,700 red salmon"

143—Table 1, 1950 silver salmon: Change 22,00 to 22.00

144—Table 3; Troll: Carry over figures 1,730 and 9 to "All Districts" column

144—Table 3, Total, chum, Central Alaska: Change 1,468,892 to 1,630,892

146—Table 5, Miscellaneous bottom fish, 1947: Change 63,261 to 68,261

152—Paragraph 3: Change "are progressing" to "is progressing"

1955
ANNUAL REPORT

Alaska Fisheries Board

and

Alaska Department of Fisheries

B. Frank Heintzleman
Governor

J. Howard Wakefield
Chairman

C. L. Anderson
Director

REPORT NO. 7

JUNEAU, ALASKA

To:

THE GOVERNOR OF ALASKA
MEMBERS OF THE TERRITORIAL LEGISLATURE
AND CITIZENS OF ALASKA

Herewith is submitted the Seventh Annual Report of the Alaska Fisheries Board, created by the 19th Territorial Legislature and approved March 21, 1949.

This report covers the activities of the Board and the Alaska Department of Fisheries based on the calendar year January 1 to December 31, 1955.

C. L. ANDERSON, Director

J. HOWARD WAKEFIELD, Chairman

KENNETH D. BELL, Member

ROBERT C. KALLENBERG, Member

NELS E. NELSON, Member

IRA H. ROTHWELL, Member

FORWARD

This annual report reviews the activities of the Alaska Fisheries Board and the Alaska Department of Fisheries for the calendar year 1955. The statistical tables included in the report cover the preceding ten year period, while the financial statement covers the fiscal year April 1, 1955, to March 31, 1956.

Although much of the material presented represents a continuation of work started in previous years, it has been possible with the increased funds made available by the 1955 Territorial Legislature to augment certain projects and to inaugurate some new ones.

In the Biological Research Division the construction of the hatchery, pipeline, and other facilities at the Kitoi Bay station have now reached the point where some well planned and coordinated experiments on the fresh water life of the red salmon can be started. Perhaps some of the questions that have "stumped" scientists for years can be solved at this station.

The Engineering Division, which was formerly a section under Watershed Management, has been given independent status. This is entirely logical since the engineering staff is called upon from time to time to assist all the divisions.

The Inspection Division has been reduced considerably for this biennium. This reduction was warranted since the U. S. Fish and Wildlife Service received vastly increased funds for enforcement work.

Marine Predator Control and Investigation has also been set up as a separate division, with a well qualified marine mammal biologist at its head. The investigational phase of the beluga program has proven most enlightening.

The Sport Fish Division has again demonstrated its ability to carry out a rehabilitation and stocking program that will result in better fishing for the recreational fishermen. One large lake of 370 acres (Lucille) was treated with rotenone in late 1955 and will be ready for stocking in the spring of 1956. This lake is conveniently located adjacent to a major highway and will serve the anglers in the Palmer-Anchorage area.

The Watershed Management Division was enlarged by the addition of a district biologist at Wrangell to cover the important Stikine River district. The Pauls Basin project showed concrete results by the appearance of 100 mature red salmon in Gretchen Creek on Afognak Island, where eyed red salmon eggs were planted in 1951. After a preliminary biological survey, eyed red salmon eggs and fry were placed in the Bakewell Lake system in Smeaton Bay near Ketchikan. This program will be similar to the one now underway in Pauls Basin. Silver salmon fry were introduced into several other blocked lakes and streams in the Ketchikan district on an experimental basis.

With the funds appropriated for Education and Information, a start was made on an educational film showing the activities of the Department.

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FISHERIES BOARD

Two regular meetings of the Alaska Fisheries Board were held during the year at the office of the Alaska Department of Fisheries in Juneau. A summary of each meeting follows.

REGULAR SPRING MEETING, APRIL 11-15, 1955

The 1955 Legislature confirmed the appointments of Robert C. Kallenberg and Kenneth Bell who had been acting on an interim basis. Mr. Kallenberg's term expires on March 31, 1959, and Mr. Bell's term on March 31, 1958. The name of Henry Denny of Saxman was rejected by the Legislature. Mr. Denny had also been serving on an interim basis. Governor Heintzleman submitted the names of Nels E. Nelson of Ketchikan (term expires March 31, 1957) to replace Mr. Denny, and Ira H. Rothwell was reappointed for a new term ending March 31, 1960. Since neither Mr. Nelson nor Mr. Rothwell were confirmed, nor were they rejected, by the Legislature, they have continued to act on an interim basis.

As the first order of business, the Board elected Mr. J. Howard Wakefield as Chairman to serve until the spring meeting of 1956. The Director's report covered general activities of the Department since the November 1954 meeting, supplemented by comments from members of the staff.

The Director then reviewed the fisheries legislation features of the 1955 Session of the Territorial Legislature, mentioning the various bills, memorials, etc., affecting the operations of the Department. Under the general appropriation bill, the following funds were allotted to the Department for the biennium April 1, 1953 - March 31, 1955:

Alaska Fisheries Board - Expenses	$ 9,000.00
Administration:	
Salaries of Director and personnel	45,000.00
General expenses and travel	16,500.00
Biological Research:	
Salaries	100,000.00
General expenses	67,910.00
Engineering	27,500.00
Inspection	
Salaries	20,000.00
General expenses	5,000.00
Marine Predator Control and Investigation	60,000.00
Sport Fish	95,000.00
Watershed Management	
Salaries	85,000.00
General expenses	54,050.00
Education and Information	8,000.00
Silver Salmon Research, S. E. Alaska	19,830.00
Construction of Fishways	60,000.00
Total	$672,790.00

In line with the allotments outlined above, members of the staff presented their proposed work programs for the ensuing biennium. These programs and that for the Board are as follows:

Alaska Fisheries Board: The increase in allotment from $7,500.00 to $9,000.00 will be sufficient to provide for expenses of the Board for the next two year period. Transportation and per diem of Board members are the main expenditures.

ADMINISTRATION: The operations of this division will be on about the same scale as during the last biennium, with no increase in personnel. The Legislature did include $1,500.00 for transportation and per diem expenses of the Director to attend the International North Pacific Fisheries Commission meeting to be held in Tokyo, Japan, in late October. The other items in the budget are of a regular routine nature as in the past.

BIOLOGICAL RESEARCH: With the extra funds provided by the Legislature, it will be possible to add two new men to the biological staff during the coming biennium. Most of the added effort will be expended at the Kitoi Bay Research Station where studies on the fresh water phases in the life history of the red salmon will be followed. The king crab and Taku River investigations will continue with some expansion, but a minimum of effort will be devoted to the troll salmon and blackcod fisheries.

ENGINEERING: This has now been organized as a separate division, whereas formerly it was a section under Watershed Management. The appropriation for the Engineering Division consists of two separate items:

Engineering (salaries and expenses)	$27,500.00
Construction of Fishways, etc.	60,000.00

The first item provides for the salary and expenses of supervision of construction work at the Deer Mountain and Kitoi Hatcheries, together with other routine duties. Included is a limited amount for purchase of materials, although most of this was supplied previously by the Biological Research and Watershed Management Divisions. The $60,000.00 allotment has been earmarked for construction of a fishway at Bakewell Lake near Ketchikan.

INSPECTION: While all the other divisions received increases over the 1953 appropriation, Inspection was asked to take a cut. Many of the legislators felt that enforcement should be the primary function of the Fish and Wildlife Service so long as control remains in the hands of the Federal Government. Now that the federal agency has received sizeable increases in funds for streamguards, it was felt that the Territory could reduce its assistance.

With funds available, it has been planned to place one man on the Kenai Peninsula and one in the upper Copper River district. Both of these men will be operating with trucks along the highway, covering streams that parallel the roads in their respective areas. Two or three streamguards will be assigned to other areas, where they can do the most good.

MARINE PREDATOR CONTROL AND INVESTIGATION: The Stikine, Taku and Copper River harbor seal programs will be continued on about the same scale as in the past. The additional funds will provide for the hiring of a full time man for research and control work on marine mammals. This investigational work will center largely on the beluga of the Bristol Bay area.

SPORT FISH: With an increase of only $5,000.00 over the last appropriation, the program for the Sport Fish Division will be on about the same scale as during the past biennium. No provision can be made for additional personnel, but it is expected that the output of the two hatcheries, especially the one at Anchorage, will be somewhat greater than in the past. Stocking rehabilitated lakes will continue on the present scale and several new ones in the vicinity of Fairbanks and Anchorage will be put into production.

WATERSHED MANAGEMENT: The increased appropriation for this division will provide for an increase of three men for this biennium. A full time specialist will be assigned to the Deer Mountain Hatchery at Ketchikan. A district biologist will be stationed at Wrangell at the start of the biennium; another biologist will start work at Dillingham the last half of the biennium. The stocking of salmon in waters barren of these species will be continued and expanded as facilities and personnel permit.

EDUCATION AND INFORMATION: With the limited funds available, it seemed advisable to concentrate on the production of an educational and informational movie depicting the work of the Alaska Department of Fisheries.

SILVER SALMON RESEARCH, S. E. ALASKA: Actually this should have been included under the biological research appropriation, but was set up as a separate item. Presumably, the legislators must have had in mind the eventual setting up of a research station for silver salmon similar to the one that the Department has at Kitoi Bay. Locating a suitable site may pose a problem. The Department was most fortunate in its selection of Kitoi Bay.

With minor adjustments in the programs as outlined by the Department, the programs were accepted by the Board. The financial report for the biennium April 1, 1953, to March 31, 1955, was read and adopted. The Director then presented, for the Board's consideration, a new personnel classification and salary scale for the ensuing biennium. After its adoption, the meeting was adjourned.

REGULAR FALL MEETING, NOVEMBER 7-12, 1955

Copies of the financial report for the period April 1, 1955, to October 31, 1955, were presented for the Board's consideration. The report was then adopted. The Director reviewed the status of the Saltonstall-Kennedy funds, explaining that the Department has made four requests to cover study programs. The only one granted was entitled "An Investigation of Predatory Animals and their Influence on

Prey Species of Fish with Commercial Importance''.

The staffs of the several divisions presented detailed reports covering their activities for the past season's operations. This material is covered quite thoroughly in other sections of this annual report.

After due study and consideration the Board adopted the following statement with regards to lake rehabilitation for guidance of the Department:

LAKE REHABILITATION PROGRAM

''The lake rehabilitation program entails the process of eradicating an undesirable fish population from a lake, thereby placing the lake in the exclusive production of desirable fish. It means making full utilization of the potential fish production of a lake by the elimination of scrap fish that compete for food or the elimination of predaceous fish that preclude the successful establishment of desirable fish. The lake rehabilitation program includes the eradication of all the fish in a lake and the subsequent restocking with desirable fish. The program could be compared to land farming; the farmer clears his land, plants seed and produces a crop. The purpose of lake rehabilitation is to provide maximum fish production for the benefit of the residents of Alaska.''

The Director explained the arrangements made with the Kodiak Conservation Club and the Fish and Wildlife Service for taking over of the sport fish program on the Naval Base at Kodiak. The Kodiak Conservation Club will furnish funds up to $500.00 per month for the salary of a biologist and, in addition, will provide suitable living accommodations. The money will be placed in the Fisheries Contingent Receipt Fund starting on or about April 1, 1956, and continuing for a period of one year.

Exploratory fishing by research boats in the offshore waters of the North Pacific Ocean has demonstrated the feasibility of capturing salmon in these waters by means of gillnets. The inauguration of such a fishery would be highly detrimental to the salmon fisheries of Alaska. Therefore, the following resolution was adopted by the Board and copies were mailed to interested parties:

''WHEREAS, all five species of Pacific salmon indigenous to Alaska, are susceptible to a high seas fishery; and

WHEREAS, the Japanese have had good success in the high seas fishery, having taken 50,503,069 salmon off the Aleutian Islands area and 13,537,176 salmon off the Okhotsk area during 1955; and

WHEREAS, the high seas fishery which took 12,163,949 red salmon off the Aleutian Islands area during 1955 may already have been reflected in the miserably poor red salmon catch and escapement in the Bristol Bay watershed this season; and

WHEREAS, exploratory fishing on the high seas off the coast of Alaska during 1955 by the Fish and Wildlife Service vessel JOHN M. COBB has demonstrated that a commercial off-shore fishery for salmon can be established; and

WHEREAS, continued and expanded exploitation of salmon on the high seas by American, Canadian and Japanese fishermen, without positive knowledge as to degree, time or location of intermingling, will undoubtedly result in the decimation and possible destruction of the commercial salmon stocks of Alaska; and

WHEREAS, the location and numbers of salmon of Alaskan and Asian origin intermingling on the high seas has not been determined; and

WHEREAS, the 175th meridian for Japanese salmon fisheries abstention to the Eastward is, at best, an arbitrary line; salmon of Alaskan origin may well utilize the high seas as feeding grounds west of this line; and

WHEREAS, the bulk of the salmon taken on the high seas are immature feeding fish, thus have not reached the size where they provide the greatest economic return; and

WHEREAS, the Alaska salmon fisheries has been fully utilized, conserved, regulated, and scientifically investigated for more than four decades; and

WHEREAS, the Alaska salmon fisheries has reached an all time low during the past five years; and

WHEREAS, Alaska's salmon fisheries have been regulated to obtain the optimum escapement of salmon in parent streams, by attempting to confine the commercial fisheries to localized areas where salmon are caught after segregation has occurred; and

WHEREAS, a high seas fishery without knowledge of the origin of the salmon stocks harvested precludes the successful management of the streams in Alaska on a maximum sustained yield basis,

NOW, THEREFORE, be it resolved by the Alaska Fisheries Board, the official representative of the commercial fishermen of Alaska, that the high seas fishery for salmon, except by trolling, in the North Pacific be prohibited until at least such time as research can determine, among other things, the degree, location and time of intermingling between salmon stocks of Alaska and Asia, thereby insuring that management principles can be intelligently applied to give the maximum sustained yield of salmon.

It is further resolved that a high seas fishery for salmon must be prohibited to insure that the commercial salmon fishery of Alaska be preserved; the Territory cannot afford to lose this, their most valuable single resource, whose harvest affects every single resident of the Territory of Alaska."

Since there seemed to be considerable interest in Congress concerning the transfer of fisheries to the Territory, the following resolution was adopted as the stand of the Alaska Fisheries Board on this vital question:

"BE IT RESOLVED BY THE ALASKA FISHERIES BOARD OF THE TERRITORY OF ALASKA:

WHEREAS, when the original Thirteen Colonies banded together to create a union of states and to formulate a constitution, certain powers were delegated to the Federal government, while others were retained by the States; and

WHEREAS, among those powers retained was the control of the fish and game resources, which were considered to be the property of the state and to be regulated for the benefit of all the people of the state; and

WHEREAS, every new state entering the union did so on an equal basis with the older states and accordingly retained control of its fish and game resources; and

WHEREAS, every territory, except one, was also allowed to control these resources **before** becoming a state, this one exception being Alaska; **and**

WHEREAS, repeated legislation has been introduced in the Congress of the United States by the delegates of the Territory of Alaska asking that the people of Alaska have extended to them the same right of control over these major natural resources as has been extended to all other territories; and

WHEREAS, the people of the Territory of Alaska have, by an overwhelming referendum vote of 20,544 to 3,479, recorded their wish for Territorial control of their fisheries; and

WHEREAS, Alaska's fisheries have, under Federal management, suffered alarming depletion showing a steady decline in volume from 932,343,000 pounds in 1936 to a mere 296,966,462 pounds in 1953; and

WHEREAS, in spite of the encroachments of civilization, which are well known to be deleterious to fish, the west coast states have, under their local control been able to stabilize their fisheries which in many cases are showing an upward trend; and

WHEREAS, the Territory of Alaska has prepared itself to assume the responsibility of control of its fisheries by the creation six years ago of the Alaska Department of Fisheries; and

WHEREAS, this department has been functioning in an orderly and efficient manner and is now in a position to readily expand and assume the duties and responsibilities incident to full control of the fisheries of Alaska with a minimum of delay and inconvenience;

NOW THEREFORE, be it resolved by the Alaska Fisheries Board, the official Territorial representative of the fishermen of Alaska, that the Congress of the United States recognize the shortcomings of distant control, and its harmful effect on Alaska's fisheries, by acting during the coming session of Congress to transfer control of fisheries to the Territory of Alaska."

The proposed changes in the fishing regulations for the 1956 season were discussed with officials of the Fish and Wildlife Service. Several fishermen appeared before the Board to present their views and numerous letters on the subject were read. Thereupon, the Board instructed the Director to prepare a brief to be sent to the Director, U. S. Fish and Wildlife Service, incorporating the Board's recommendations and thoughts for the coming season. This brief reads as follows:

In continuance of the procedure followed in past years, the Alaska Fisheries Board is herewith offering for your consideration its recommendations pertaining to the 1956 regulations for the protection of the commercial fisheries of Alaska.

In order that the Board might obtain the viewpoints of as broad a section of the industry as possible, members of the Board or Department representatives attended hearings in Alaska as well as in Seattle. Numerous letters were received and several persons appeared before the Board at its recent meeting in Juneau. At this same meeting, the tentative proposals of your Service were presented and explained by Donald McKernan, Administrator of Commercial Fisheries, and members of his staff. Their cooperation in meeting with the Board is appreciated.

The Board views with some concern the Service's proposals to prohibit the use of certain types of less effective salmon gear in areas in which the more effective type, namely traps, are permitted. In some cases this less effective type has been in use for a number of years, largely by resident fishermen. It would appear that these proposals are discriminatory on local residents.

PART 101 - DEFINITIONS

For several years the Board has been recommending that definitions for all legal types of gear be incorporated in the regulations, together with a clear statement as to what time in the process of setting each gear it is considered to be legally fishing and when it is considered to have ceased fishing. There still seems to be some misunderstanding on these points among the fishermen.

PART 102 - GENERAL PROVISIONS

After due consideration, the Board has taken a stand at this time in opposition to area licensing for salmon fishing in any form, largely on the grounds that it is un-American in principle and could very well lead to regimentation of all fishermen. Before such a drastic step is taken, it would seem advisable to explore fully every other method of approach such as regulating types and sizes of gear, time and places of fishing, setting of quotas and other restrictions.

The Board is in accord with the Service's proposal to prohibit offshore or pelagic fishing for salmon, except by trolling. The inception of such a fishery might well make it impossible to properly regulate and conserve the salmon fisheries not only of Alaska, but those of British Columbia and the West Coast states as well. A resolution in opposition to offshore salmon fishing was adopted by the Board and copies mailed to interested parties.

It has been noted that the depths and lengths of seines and seine leads varies somewhat from area to area, where such gear is legal. In some cases these variations may be justifiable. In view of this, it is recommended that a study be made of the several areas and insofar as possible uniform measurements be adopted.

It has been pointed out to the Board that in certain places a sport fishery for downstream salmon migrants, especially silvers, has been developing. While this has not been of any magnitude as yet, it might be well to add a section under the general provisions at this time, to prohibit the taking of downstream migrant salmon at all times and by all methods.

A sport fishery for landlocked salmon, both reds and silvers, has been developing in both Southeastern Alaska and the Anchorage-Palmer district. So far as known, these do not contribute to the commercial fishery, but it is believed that some kind of a bag limit should be placed on these fish. A suggestion is made that this be the same as now permitted for trout by the Alaska Game Commission. Perhaps the Commercial Fisheries section might cooperate with the Game Commission on this matter.

Ever since its creation in 1949, the Alaska Fisheries Board has repeatedly recommended to the Fish and Wildlife Service and to the Congress that salmon traps in Alaska be eliminated. This is in line with policies established in the three Pacific Coast states and in British Columbia. The people of Alaska have expressed an overwhelming opposition to this type of gear by memorials and by a referendum vote. The Fish and Wildlife have repeatedly claimed they do not have such authority, which statement may be subject to a difference of opinion. However, be that as it may, the Board was very pleased to learn that Secretary of the Interior McKay has informed the House Merchant Marine Committee that his department is now recommending favorable action along the general lines of a house bill introduced by Delegate Bartlett. Secretary McKay should be given every encouragement.

If this salmon trap problem is not settled by this session of Congress, the Board wishes to repeat its recommendation of previous years, that an opening in salmon trap leads be mandatory during all closed periods. It is our understanding that such an opening is required in the few remaining traps now legal in British Columbia.

In various times in the past, a recommendation has been made that the mesh of the webbing in trap spillers be set at a minimum of $3\frac{1}{2}$ inches in order to prevent the destruction of small salmon, herring and other small fish that are entrapped and unable to escape because of the small mesh now being used. The Board wishes to reaffirm this stand.

PART 104 - BRISTOL BAY AREA

In view of the uncertainties of the Service's proposals now being examined for promulgation in this area, the Board wishes to make only the following recommendations:

1. That the present boundaries of the several districts be retained as at present, except for such minor adjustments as may become necessary to meet the convenience of the enforcement agency and the fishermen.
2. Season to run from January 1 to December 1 as was the practice previous to 1954. The actual start and cessation of fishing will be

taken care of by Mother Nature and the economics of the processing operations. There is a possibility that one or more small packers might be interested in harvesting some of the races of salmon that enter the streams before June 1 and after August 31.

3. Last year the Board suggested a sustained closure during the peak of the run in the Nushagak River. However, since the Fish and Wildlife Service is in doubt as to the validity of this theory, it is suggested that a study of this problem be made in 1956.

4. In view of this proposed investigation, the Board is in accord with the Service's proposal for three days fishing per week with such additional on-the-spot closures as may become necessary, based on the fishing effort and size of the runs.

PART 105 - ALASKA PENINSULA AREA

In general, the Board is in accord with the proposals being made by the Fish and Wildlife Service for 1956, and that the matter of length of seines and seine leads be given special consideration in this area. A maximum of 250 fathoms for seines and 75 fathoms for leads is offered for your consideration.

PART 107 - CHIGNIK AREA

The Board was pleased to learn that the Service has closed all traps in the Chignik area, and trust that this closure continues indefinitely. The Chignik trap situation has been an eyesore for many years.

The long season with forty-eight hours fishing per week as proposed for Chignik Bay and Lagoon is agreeable, as are the proposals for the other districts in the Chignik area.

PART 108 - KODIAK AREA

While the Board does not object to the pink seasons as proposed for 1956, it still is of the opinion that a long season with shorter weekly fishing periods might give a better distribution of the various races comprising the Kodiak runs.

It is suggested, however, that the silver salmon season be opened somewhat earlier, say about September 1. It would appear that the silvers are not being properly harvested at the present time.

The Board will support the Service in its proposal for a 500 yard closure at the mouth of Karluk River. Along with this there should be staggered closures along the northwest shores during the red salmon runs. Every effort should be made to rehabilitate the Karluk reds.

The problem of length of seine leads should be given special attention in this area. It was reported that several boats returning from the Peninsula area used seine leads much longer than that prescribed in the regulations, namely 25 fathoms.

The king crab fishery should again be regulated by field announcement with closures on otter trawl fishing during the male and female moulting periods. The Department maintains a biologist stationed at Kodiak to study this relatively new fishery. The results of his investigations will be available to your local agent at all times.

PART 109 - COOK INLET AREA

In general, the Board is in accord with the seasons and weekly closures as proposed by the Service, with such additional closures or relaxations as conditions may justify. It might be possible to grant an extra day of fishing per week during the king salmon season.

It is recommended that a uniform opening date of June 25 be set for all traps in Cook Inlet.

It is also recommended that the bag limit of two salmon per day now in effect in streams on the east side of the Inlet be extended to include the west side as well. Reports have been received that excessive numbers of salmon have been taken on this side by "so-called" sportsmen and sold to the trade.

Some of the Kachemak Bay king crab fishermen have suggested increasing the number of pots allowed from fifteen to twenty-five. This relaxation would seem in order. The Board was, and still is, opposed to the extremely stringent regulations on king crab put into effect in 1954 and 1955. So far as known, no fishery of any consequence has taken place in Kamishak Bay, since it is not economically feasible to fish with so few pots in this location. It is, therefore, recommended that all restrictions on king crab fishing in Kamishak Bay be eliminated, except that no trawling be allowed during the moulting periods.

PART 111 - PRINCE WILLIAM SOUND

It is believed that the salmon runs of this area are still in a precarious condition and need special attention. It is also contended that area licensing, if applied, will not reduce the effort any appreciable extent.

The Board is, therefore, opposed to the Service's proposal of $5\frac{1}{2}$ days fishing per week from July 10 - August 3, which would allow $20\frac{1}{2}$ days fishing. As a counter proposal, it is suggested that the season run from July 9 to August 8 with only 3 days fishing per week. This would allow only a total of 15 days fishing. In addition, the Service should consider some decrease in number of traps permitted in this area. As a further precaution, it might be well to consider setting an overall quota of 175,000 cases as a stopgap measure.

The Board was quite surprised at the Service's proposal to eliminate drift nets, which has been an established fishery for a number of years. This is another illustration of discrimination against the small fishermen, usually residents, while no action is taken against the more effective gear.

The Board is opposed to the 125 pot limit for dungeness crab fishing in the ocean off the Copper River. No justification for this limitation was ever offered by the Service. Ocean crab fishing is hazardous at the best and should be encouraged, not hindered.

PART 112 - COPPER RIVER AREA

The Board is of the opinion that the May 1 opening should remain as is. There are only a few fishermen operating during the first week of the season and they cannot be jeopardizing the king runs occurring between May 1 and May 7. This proposed closure is not a conservation measure.

The 125 pot limit in the outside waters of this area should also be eliminated.

PART 113 - BERING RIVER AREA

There would be no objection to including the district from Icy Cape to Cape Suckling in the Bering River area, provided the salmon season in this new district continued until September 30, the same as in the Yakutat area. The runs and type of fishing are similar along the entire gulf coast from Cape Fairweather to Cape Suckling.

PARTS 115 - 124 - SOUTHEASTERN ALASKA AREA

The Board is in agreement that the curtailment program on traps and bay fishing that was instituted two years ago be continued for another two years. In fact, it might be advisable to close some additional fishing areas and also some additional traps. This has been recommended by some of the purse seine organizations, who have suggested additional closures in Union Bay and Tombstone Bay.

So far as seasons are concerned, the Board can only reiterate its recommendations made last year.

For all practical purposes, no opening or closing dates are necessary. The runs of fish and the economics of the processing operation will dictate when the fishermen will start and when the canneries will open. If dates are wanted, the following are suggested:

Monday, June 11 to Wednesday, October 24. Since the 1956 runs are not expected to be of any great magnitude, the weekly fishing period should be of limited duration, say from

12:00 noon on Monday to 6:00 p.m. on Thursday. The 12:00 noon opening is being proposed as a convenience to the enforcement agency and to the fishermen, many of whom have suggested this time.

During this long season, there should be several sustained closures to allow escapement to the spawning grounds. These should be made by field announcements based on conditions as they arise. Staggering of these closures from district to district should also be considered as being helpful. A sustained early closure in the district around Ketchikan to protect the early pink runs would seem in order. Apparently these particular runs are not recuperating the way they should.

At the hearing in Seattle, the Service proposed to reduce the depth of gillnets from four to three fathoms in Southeastern Alaska. So far as is known, this proposal was not made or discussed at any of the hearings in Alaska. In the meantime, some of the local fishermen have already purchased or ordered new gear for 1956 based on the four fathom limitation. It is, therefore, recommended that this proposal be held in abeyance for at least one year to allow time for the fishermen to adjust to the new conditions.

It is further suggested that the depth of all gillnets be measured by the number of meshes rather than by depth. Fishermen have recommended this in the past. It would also seem to be easier to enforce such a regulation.

Some of the fishermen in Haines have recommended that Lutak Inlet be closed and that the line of the northern section, north of Sullivan

Island be moved to the southern extremity of Sullivan Island. Although the Board has no definite recommendations on this, it is suggested that a serious study of this situation be made by the Service. The Board does, however, recommend again that the fall season in the Haines district be extended to the end of October to utilize the late runs of chum salmon. It is true, perhaps, that no sizeable run occurred in 1955, but in 1954 a considerable number of chums could very well have been harvested.

It is recommended that the long continuous season with shortened weekly fishing periods be continued in the Taku district. It is further recommended that consideration be given to a suggestion made on several previous occasions:

1. The weekly closed period to be 72 hours based on an average of 40 boats fishing per week. This would be computed over the actual fishing days per week.

2. During any weekly fishing period that the average exceeds 40 boats per day, further closed time would be added starting at Noon on the following Monday. This additional time to be alloted on the basis of six hours for each five boats over the norm of 40.

If this or some similar formula were printed in the regulations previous to the season, the necessary changes during the season would become automatic and would obviate the necessity of continually changing field orders.

It is believed that formulas of this nature would work in other gillnet districts, but the Board is not in position to offer concrete suggestions as yet.

The biological staff of the Department does have considerable data on the Taku River salmon runs and would be pleased to discuss this with representatives of your service at your convenience.

The situation on the Stikine might also warrant close watching so that the number of days fishing be regulated by the fishing effort. During the past years, silting at the river mouth has eliminated considerable gillnetting area. It might, therefore, be advisable to allow a modest extension of the boundaries as proposed by the fishermen.

When the Burroughs Bay fishery was reopened a few years ago, it was done on the supposition that only a few fishermen (old timers) would participate. However, it now appears that there has been a considerable influx of new fishermen. In view of this, it is recommended that this gillnet fishery be restricted to two or three days per week; furthermore, surveys in this district indicate a poor escapement of pink salmon.

In view of the controversial nature of the herring problem in Southeastern Alaska, it is recommended that no additional quotas for reduction purposes be given until such time as justified by a complete and thorough study.

As in the past, we assure you that these suggestions and recommendations are given in a spirit of cooperation and helpfulness, and trust that they will be received in the same spirit.

Respectfully submitted by,

/s/ C. L. ANDERSON

C. L. ANDERSON, Director
for the Alaska Fisheries Board:

J. H. WAKEFIELD, Port Wakefield, Chairman
KENNETH D. BELL, Fairbanks
ROBERT C. KALLENBERG, Dillingham
NELS E. NELSON, Ketchikan
IRA H. ROTHWELL, Cordova

Hauling in king crab pot, Kodiak area.

ADMINISTRATION

In addition to routine administrative duties, the Director represented the Territory at several important meetings during the past year. Most important of these were the sessions of the International North Pacific Fisheries Commission. Two conferences of the American Section of this Commission were held during 1955; one on April 8 at Seattle, Washington, and the other on September 6-7 at Juneau, Alaska. A full meeting of the Commission took place on October 24 - November 5 at Tokyo, Japan. Mr. J. H. Clawson is now the Alaskan representative on the Commission, having replaced Governor B. Frank Heintzleman, who resigned. The advisors to the Commission from Alaska are Larry Fitzpatrick, fisherman, Juneau; Robert C. Kallenberg, fisherman, Dillingham, a member of the Alaska Fisheries Board; and C. L. Anderson, Director, Alaska Department of Fisheries. Robert R. Parker, Senior Biologist, Alaska Department of Fisheries, is a technical advisor to the Committee on Biology and Research.

Mr. Anderson and Mr. Parker also attended the annual fall meeting of the Pacific Marine Fisheries Commission at Seattle on December 6, 7, and 8. At this meeting, progress reports on the research programs concerning the troll salmon and blackcod fisheries were presented.

During the fall of 1955, the United States Senate Committee on Interstate and Foreign Commerce conducted hearings in both Anchorage and Juneau, and the House Committee on Interior and Insular Affairs conducted hearings in Juneau. These hearings were relative to Alaska's statehood movement, fisheries, transportation and other problems. The Director appeared before both committees and presented the position of the Alaska Fisheries Board and the fishermen of Alaska relative to the transfer of control of Alaska's fisheries from the Federal Government to the Territory.

While the 1955 session of the Territorial Legislature was in session, the Director was called upon for information and assistance in legislative matters pertaining to fishery subjects and was asked to explain the proposed Departmental budget to the House Ways and Means Committee and to the Senate Finance Committee. Opportunity is taken here to thank members of the Legislature for their confidence in the Department and for their support in the general appropriation bill.

Routine field trips were made to the various parts of the Territory, as in the past and the customary meetings were held with fishermen's groups. Among other routine duties was the preparation of minutes of the board meetings, the writing of a brief to the Director of the Fish and Wildlife Service on the proposed 1956 fishing regulations and the preparation of material for the Department's 1954 Annual Report together with the compiling of information and data requested by various governmental and private agencies.

A number of requests had been received from local residents of the Bristol Bay area asking that the Department make a survey of the possibility for a commercial fishery in the large lakes of that area. It became possible, within the limited funds available in the Administration division, to make at least a preliminary examination of these potentials. This survey was carried out by Mr. James W. Brooks. The following gives an account of the results:

A SURVEY OF FRESH WATER COMMERCIAL FISHERY POSSIBILITIES IN THE BRISTOL BAY REGION

The depletion of salmon runs in Bristol Bay has created much hardship among residents of that area. Economies have collapsed to the extent that government relief in the forms of food and money was necessary to ward off the prospect of actual starvation. To learn whether or not fresh water commercial fisheries could be developed in the region as a constructive means of bolstering the welfare of the people, a survey of conditions and the availability of marketable fish was conducted by a Department biologist in February and March of 1955.

A preliminary step was to ascertain the market for fresh fish in Alaskan towns. It was found that a market suitable for trial sales, at least, did exist in Anchorage. Merchants dealing at the wholesale level agreed to handle whitefish and lake trout if the fish were of good quality. They were reluctant to deal in smelt, dolly varden trout, or northern pike.

Because little winter fishing is done with under-ice nets in the lakes of the Bristol Bay region, the quantity and type of fish available was but scantily known. Therefore, exploratory fishing with nets was undertaken in both Lake Iliamna and Lake Aleknagik. In the former, fishing was conducted at Newhalen, Igiugig and Kokhanok Bay, centers of the Lake Iliamna native population. Commercial quantities of fish were not revealed. Dolly varden trout and round whitefish were taken in sufficient numbers, however, to show their potential usefulness in the winter subsistence economies of the people. Rainbow trout, grayling, cisco and suckers were also caught, but in smaller numbers. Lake trout and lake or humpback whitefish, known to be present in Lake Iliamna, were not taken in the nets. Most fish examined were so heavily infested with parasites that they appeared to be unsuited for market.

In Lake Aleknagik, sufficient fishing was not done to show clearly what was available. Smelt, dolly varden trout, and lake whitefish were taken, the latter being of excellent quality.

It was concluded on the basis of this exploratory fishing and interviews with residents, that the dolly varden trout is the most readily available fish in winter, but that the superior quality of whitefish makes it the most desirable commercial fish.

Several localities, listed below, are known for their abundance of whitefish during the month of November.

Lake Iliamna area:
- Igiugig
- Outlets of Tularik Lakes
- Outlet of Gibraltar Lake

Nushagak area:
- Inlet of Snake River Lake
- Nushagak River from Ekwok upstream

Undoubtedly, there are numerous other places where whitefish are abundant during fall spawning runs, but these are presently little known or frequented by native fishermen.

While the results of this survey are inconclusive, it appears probable that a fall-season whitefish fishery and market could be developed. Perhaps the greatest technical problem would be the securing of cheap, dependable air transportation from fishing sites to markets.

BIOLOGICAL RESEARCH

The 1955 research program of the Division of Biological Research was divided into three main projects. Research on the early life history of red salmon was carried out at Kitoi Bay under the leadership of Quentin Edson, with the assistance of Robert Vincent. Construction of the hatchery at the station was supervised by Leo Thompsen, Engineer, and M. L. MacSpadden, Construction Supervisor.

Taku River studies on the population dynamics of king salmon and catch and escapement indices of red, pink, chum and silver salmon were under the direction of Clarence Weberg, assisted by Paul Garceau, both new employees of the Department.

The study of the king crab at Kodiak was also continued under the leadership of H. Reed Stevens, also new to the staff.

After a long period of search the Department gained the services of a Research Librarian, Dan Gittings, to organize the research library and to maintain it as one of the most useful tools of the entire organization.

BIOGRAPHICAL SKETCHES

Paul Garceau was born in North Attleboro, Massachusetts, on April 4, 1930. Pre-college training was received in his home town, and he served in the U. S. Navy in 1949 and 1950. After receiving an honorable discharge from the Navy, Paul enrolled in the Wildlife Management course at the University of Alaska at College and was graduated in May, 1955, with a B. S. degree. While in college he worked one summer with the Fish and Wildlife Service on water fowl research, and three summers with the Alaska Department of Fisheries on red salmon studies at Kodiak. Upon graduation, he joined the Department as a Junior Biologist.

Dan Gittings was born in San Diego, California, on August 30, 1914. He received his undergraduate training in San Diego and spent a number of years in the U. S. Army prior to college training. Dan entered San Diego State College and obtained a B. A. in Economics in 1949. He then attended the University of Southern California and obtained a Master of Science in Library Science in 1950. He worked for the Los Angeles County Library for two years and for the California State Department of Mental Hygiene for two years. Dan then joined the California Department of Fish and Game and reorganized their fish and game library at Sacramento. He joined the staff of the Alaska Department of Fisheries in June 1955 as Research Librarian.

Clarence A. Weberg was born in Denver, Colorado, on September 19, 1926. He received his pre-college training in Denver. "Bud" entered the Navy in 1944 and was discharged in 1946. Upon discharge he joined the Colorado Fish and Game Department and worked until 1949 as a game and fish technician. In 1949, Bud entered Denver University and transferred to Colorado A. and M. in 1950, receiving a B. S. in Zoology in 1953. While in college he worked part time for the Colorado Fish and Game Department and full time after graduation. He joined the staff of the Alaska Department of Fisheries in July 1955 as a Junior Biologist.

H. Reed Stevens was born in Randolph, Nebraska, on January 25, 1920. He was graduated from high school at Lakewood, Colorado, and entered Wheaton College in Illinois in 1940. Reed served in the Navy from 1941 to 1945 and entered the University of California at Los Angeles in 1946. His college training, accompanied with part time work with the California Youth Authority and with private industry, culminated in graduation in 1952 with a B. S. degree in Bacteriology. After graduation, Reed worked first as a Research Biologist at Scripps Institute of Oceanography (University of California) and then entered the Graduate School at Scripps as a Research Assistant and was at that status until 1955. He joined the staff of the Alaska Department of Fisheries in August 1955 as a Junior Biologist.

PROGRESS REPORT ON RESEARCH STUDIES AT THE KITOI BAY RESEARCH STATION

by

ROBERT R. PARKER and ROBERT E. VINCENT

INTRODUCTION

Salmon are a product of their environment as are all living things. The environment they live in controls their numbers, their kinds and their condition. As in other crops, both vegetable and animal, increasing the amount of favorable environment or improving the existing environment will increase the production. But environments differ. For every organism, conditions shade from totally unsuitable - to poor - to good - to excellent.

The salmon runs of Alaska have shown wide fluctuations. Sometimes these fluctuations are gradual and sometimes they are abrupt. They may be caused by over fishing, by the super-abundance of the species, or they may result from environmental changes. The exact cause and effect relationships are not known, but have been the subject of observation and study for many years. It has been demonstrated, however, that a larger crop of salmon can be realized from an expanded or improved environment.

Two species of salmon, the red salmon (Oncorhynchus nerka) and the silver salmon (O. kisutch), are peculiar in that after hatching they generally spend a year or more in fresh water. It is generally accepted that the fresh water environment limits the numbers of these species. This assumes that a habitat exists in the sea that will accept and nurture numbers far larger than it is accommodating at present. This condition may, of course, not always be the case, but studies have shown quite consistently that numbers of returning adults are generally dependent upon numbers of smolts produced. To state this more concisely: Produce more red and silver salmon seaward migrants, and a larger return of adults may be reasonably expected.

FRESH WATER LIMITING FACTOR

The amount of fresh water that produces red and silver salmon in Alaska is great, but the amount that does not produce these species is enormous. An example from the Kodiak region will not be atypical of the coastal fringe of the entire Territory. Lake Karluk, which possesses an estimated fifteen square miles of surface area, is a well known and productive red salmon habitat. It is also the largest lake on Kodiak Island. Frazer Lake, which has an approximate surface area of eight square miles, and Lake Spiridon, which has approximately five square miles of surface area, are the second and third largest lakes on the Island. These latter two lakes produce no salmon. Why? An obvious reason is that salmon cannot ascend their outlets because of impassable falls. Other than this, they differ little, and only in degree, from other habitats producing red salmon on Afognak Island.

ALASKA'S NON-PRODUCING WATERSHEDS

The area immediate to the Kitoi Bay Research Station will serve as another example (Figure 1). In this area there are ten lakes, ranging in size from fifteen to 400 surface acres, with outlets close to salt water and with suitable depths, neutral water, dissolved oxygen, food and other characteristics of the fresh water environment favorable for the production of red and silver salmon. The total lake surface amounts to approximately 1,000 acres. Of these only Lake Kitoi, which has approximately ninety surface acres, produces salmon. For an approximate estimate, the potential for the area would be in the magnitude of ten times the Lake Kitoi production. Lake Kitoi has produced, as returning adult red and silver salmon approximately 3,000 fish per year in 1954 and 1955. The expected production for the area then might be about 30,000 fish. At current first wholesale prices, these would be worth about 60,000 dollars per year. In terms of cash in hand, this is impressive; however, in terms of the Territory of Alaska's annual production of salmon (21.5 million dollars in 1953), it is hardly a drop in the proverbial bucket. Why bother, then?

KITOI BAY AREA

DISCUSSION OF THE KITOI BAY FISHERIES RESEARCH STATION AND ITS PROBLEMS

Kitoi Bay was selected primarily as a research site and not as a production station. This does not mean that Kitoi Bay Research Station will not produce salmon for the fishery. It will. But it will also produce a solid fund of information from basic research that will answer questions on (1) planting barren areas: how to, how much to, what to and where to, and (2) on environment, such as the compatibility of species (predation and competition), fertility and <u>what to do about it</u>.

KITOI BAY RESEARCH STATION

Realizing the problems and the necessity of obtaining their answers, the Alaska Fisheries Board secured funds from the Alaska Legislature to provide research facilities at Kitoi Bay. Construction of a laboratory began in the fall of 1953 (Figure 2) and was completed in 1954. A downstream fish collecting trap was installed in 1954 in the outlet of Kitoi Lake (Figure 3) which provides absolute control over both downstream and upstream movement of fish. Late in 1954 an eighty-five foot by

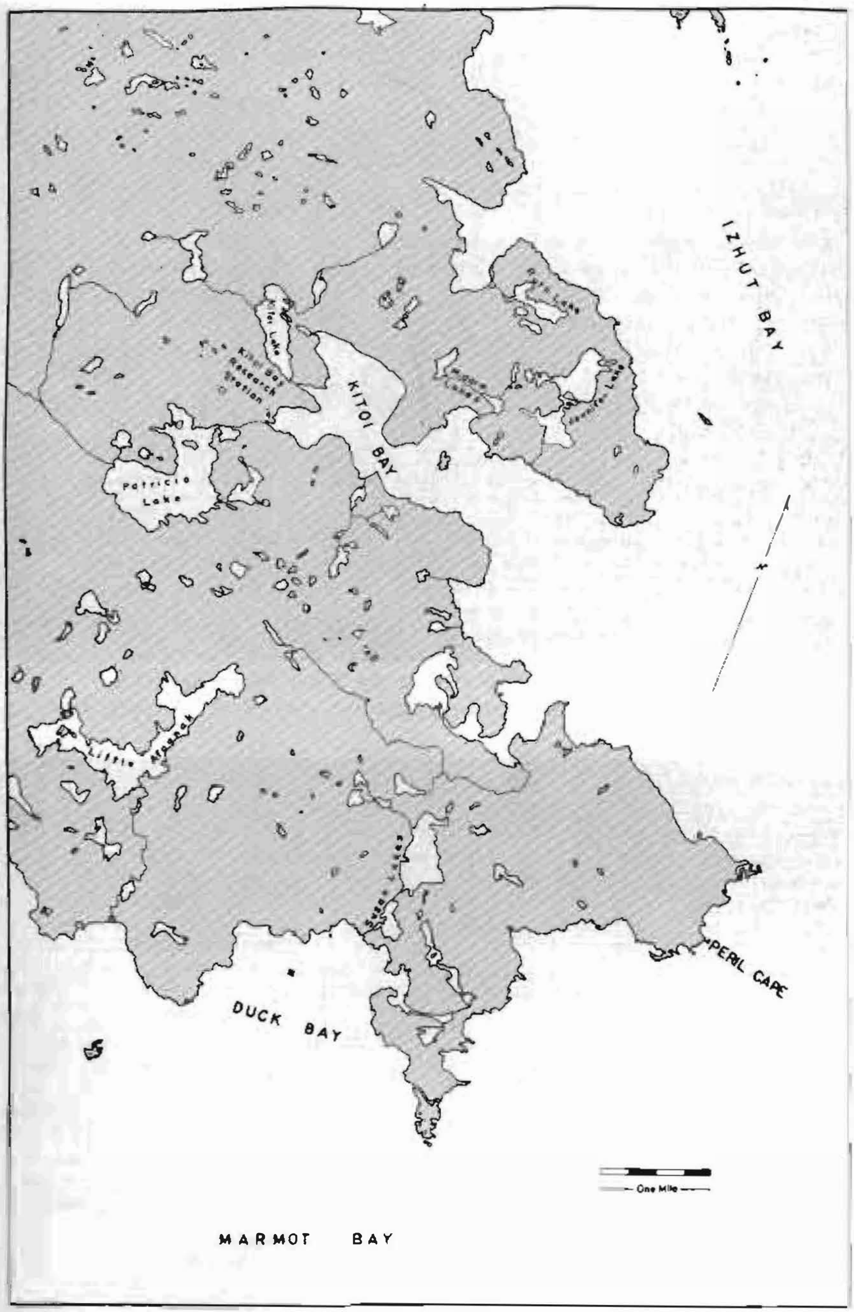

Figure 1. Map of the Kitoi Bay Area, Afognak Island, Alaska.

Figure 2. Construction site of the Kitoi Bay Research Station October 1953.

Figure 3. Lake Kitoi downstream migrant weir.

Figure 4. Hatchery building under construction in 1955.

Figure 5. Kitoi Bay hatchery and laboratory building.

twenty-four foot hatchery was started, adjoining the laboratory, and it was put in operation with the installation of a pipe line in 1955 (Figures 4 and 5)

The Alaska Department of Fisheries is interested, at Kitoi Bay, not in simply producing some salmon, but in producing the maximum possible return of adult fish. It is equally interested in the cost of this production and whether or not the product is worth the cost to the taxpayer. These two statements generalize the underlying function and the reason for the existence of the project.

It was mentioned above that ninety out of 1,000 acres are producing salmon. What can be done about the remaining 910 acres in the other nine lakes? They are all inaccessible with falls in the outlets. Some do not appear to have spawning ground available, even if made accessible. However, all appear to constitute a suitable habitat for young salmon and are coinhabited by trout, char, stickleback and sculpins. Lake Patricia is known to contain a land-locked population of red salmon, which is probably the remnant of a run in the past when the lake was accessible from the sea. The distribution of these lakes, their accessibility, and their size led to the choice of the area as a research site.

It is not known how many fish these bodies of water will maintain; it is certain that they will all maintain and grow some salmon to a seaward migration size. The problem, for this reason, takes on added scope. For any given body of water, there exists an upper limit for the standing crop of fish. This may vary with change of species composition, but since this problem concerns salmon, they are emphasized by the following discussion. In most lakes concerned in fisheries management in the Territory of Alaska, there are indigenous populations of trout, char, stickleback and sculpin in various combinations. Management will attempt to introduce a population of salmon in with these indigenous fishes, assuming that there is an ecological niche available to it. Similar work has been carried out with some success in Laura Lake with salmon and also in lakes in the Anchorage area with rainbow trout. The Alaska Department of Fisheries, as well as many other research agencies, has found in repeated tests that, in lakes that have been cleaned of indigenous fishes, introduced rainbow trout do much better than if they were superimposed upon the original populations. Phenomenal growth has been attained under such circumstances by limiting the numbers of introduced trout. Such a technique will undoubtedly be a tool in salmon management, but at present its use is restricted to small lakes with certain favorable conditions. We are faced first with defining the ecological niche available to salmon in lakes and second with improving or enlarging this niche.

THE PROBLEM

Since the fishery production of a body of water is limited by its particular environmental complex and this limit is the weight of fish life sustained, it is possible to control the growth rate of the individuals by varying the numbers of fish introduced. On one extreme, by introducing a large number of fish their growth can be all but halted. The available nutrient material will all go into simply sustaining the population; none will be available for growth of the individuals until some die. On the other extreme, the introduction of only a few fish will give each individual an abundance of nutritive matter resulting in a very rapid growth.

The problem is to maximize the numbers of returning adults; however, there is the danger of operating too close to either of opposing extremes. Too large a salmon population will result in poor growth and the fish at the end of a year's lake residence will not have reached a migratory size. The seaward migrants will be small and possibly suffer a heavier mortality than would larger fish. The most desirable size for seaward migration is not known at present. Under these conditions it may take two or more years to produce smolts from a single plant. This would severely curtail the annual production of smolts, which necessarily would result in a smaller return of adults. Too small a plant, on the other hand, may result in very fast growth of the individuals and a quick output of smolts. However, the number would again be too few to maximize numbers of returning adults. A further possible result of this condition could be the production of grilse. These are fast growing males that return from the sea one or two years earlier than normal. They are small and of no commercial value. We must discover the median range for optimum numbers of salmon in order to attain maximum numbers of returning adults. This information is necessary, both where the salmon production of lakes is maintained by annual introduction by man and where it is maintained by providing a natural run of spawning adults. The latter includes lakes with both naturally occurring spawning areas and those created by stream improvement.

Thus far a simplified statement of the problem has been given. It is complicated by the inherited racial characteristics of the various stocks of salmon concerned. Whether or not a given migrant moves seaward in the second, third or fourth year of lake residence appears to be a function of race as well as of size.

There are several different methods of introducing salmon into a given watershed. If suitable spawning gravels are available, the introduction may be made either with naturally spawning pairs of adults or by artificial means, such as either planting fertilized green eggs or eyed eggs or by releasing fry. If no suitable spawning location is found, the plants must be made with fry releases. In some cases it will be feasible to construct artificial spawning beds.

The timing of introductions, which again involves racial characteristics of the parent stock may well be the key to success or failure. Fry emerging under a blanket of ice will not have the same survival rate as fry emerging or released at a time of abundant food supply. The time of fry emergence is determined by both the time of planting and the amount of heat received during incubation of the eggs. The amount of heat received depends upon the characteristics of the weather at the planting site. Thus the total environment is important.

The problem of improvement of the environment involves use of a number of methods. Included are complete lake rehabilitation which eradicates inter-species competition and fish predation, partial elimination of predation or inter-specific competition, fertilization of the water through the addition of deficient chemicals and introduction of fauna and flora to improve production of food organisms.

It will be readily appreciated that the problems are great, but it will be equally appreciated that the answers are necessary, not only as contributions to our store of scientific knowledge, but as specific tools for fisheries management biologists to use in the improvement of Alaska's greatest renewable resource -- its salmon.

ACKNOWLEDGMENTS

We owe our thanks and express our gratitude to the members of the Alaska Legislature, who farsightedly furnished the funds; and to the Alaska Fisheries Board, who first realized the need; and to the field men, particularly M. L. ''Molly'' MacSpadden, Construction Supervisor; Quentin Edson, Biologist and Walter Kirkness, Biologist, who worked hard without regard to day or time in making the Kitoi Research Station a reality.

THE AREA

Kitoi Bay is situated on the southeast corner of Afognak Island, twenty-eight miles north of the city of Kodiak. The surrounding territory is low, mainly less than 500 feet above sea level and is dotted with ponds and small lakes. The greatest part of the land is covered with a dense mature spruce (<u>Picea sitchensis</u>) forest, with sparse undergrowth consisting mostly of devils club (<u>Oplopanox horridum</u>) and blue huckleberry (<u>Vaccinium sp</u>.). A few alders (<u>Alnus tenuifolia</u>) are found on steep slopes and creek deltas. The forested ground is largely covered with moss while open ground is thickly sodded with sedge grasses. The thick layer of moss on the ground serves well as a sponge to absorb the frequent hard rains; flooding conditions in the streams are infrequent. Silting occurs only under unusual conditions.

The eruption of Mount Katmai in 1912 deposited pumice over the entire area which has compressed into a layer from four to eight inches thick. Pumice was also caught in the crotches and large limbs of the spruce trees providing a suitable stratum for the formation of large mats of moss. The effect of the pumice-fall on flora and fauna in the lakes is not recorded. The wetted perimeter is largely covered with a layer of pumice, as on land, and the rooted water flora is very sparse with the exception of the pond lily (<u>Nymphaea sp</u>.) in the protected shallows (less than ten feet deep). The effects of the pumice fall on the conifers is aptly recorded by the trees themselves. A cross section, revealing the growth rings, indicates nearly a complete cessation of growth prior to the pumice fall and a stimulated growth immediately following. Growth has slowed since, until at present it is again very slow.

CLIMATE

The regional climate has been aptly summarized by Capps (1935), who wrote: ''The Kodiak group of Islands lies in the path of the Japan current, which sweeps northeastward along the coast of the Alaska Peninsula into the Gulf of Alaska, and its climate is much more equable than that of island areas of similar latitude. The following table (Table 1), compiled from data collected by the United States Weather Bureau, gives in condensed form the salient features of the climate at the town of Kodiak, where records have been kept more or less continuously for over forty years. Kodiak is the only locality in the island group where such records have been collected for a continuous period long enough to yield reliable averages, and the weather there is believed to be fairly representative of the island group as a whole.

Table 1. Weather records for Kodiak, Alaska.

	Length of Record (years)	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Temperature (°F.)														
Monthly mean	38	29.5	31.3	33.4	36.4	43.0	50.0	54.3	54.3	49.8	42.0	35.0	30.7	40.8
Monthly mean maximum	15	34.3	36.5	38.5	42.0	47.8	56.1	60.0	59.4	55.6	47.6	39.7	35.7	46.1
Monthly meao minimum	15	24.8	26.5	26.7	31.2	31.1	43.5	47.4	48 1	43.6	36.9	30.3	26.4	35.4
Lowest recorded	46	-9	-3	2	5	20	30	32	34	26	7	-3	-12	-12
Highest recorded	36	53	60	65	61	74	82	82	85	77	66	60	61	85
Precipitation														
Monthly mean (in.)	44	4.69	4.64	3.93	3.82	5.76	4.85	3.46	5.27	5.16	7.32	5.63	6.08	60.61
Monthly mean snowfall	29	9.7	11.2	9.2	5.8	.4	T	0	0	.1	.8	3.3	8.0	46.3
Av. No. of days with 0.01 inch or more		14	12	13	13	18	12	12	15	12	16	14	14	163
Winds														
Prevailing direction		N.W.	N.W.	N.W.	S.E., W.	N.E.	N.E.	N.E., S.E.	S.E.	S.E.	N.W.	N.W.	W., N.W.	N.W.
Average velocity (m.p.h.)		13.4	10.6	8.3	9.9	7.9	7.4	5.9	6.0	7.7	8.8	8.3	9.9	8.7

Source: Capps, Stephen R., 1935, Kodlak and Adjacent Islands, Alaska Bulletin 880-C, U. S Geological Survey

"Many summers pass in which the temperature in the shade fails to rise to 75° F., and in only eight winters out of forty-six years during which records have been kept has the temperature fallen below zero. The average yearly precipitation of about sixty inches is rather evenly distributed throughout the year, though nearly half of the total falls in the last five months. The average of 163 days a year on which 0.01 inch or more of rain falls indicates an even larger number of overcast days. Most of the harbors and bays remain ice-free through the winter, though during exceptionally cold spells winter ice may form in enclosed bays, particularly in those that receive considerable fresh water from tributary streams."

WEATHER

An old adage is that "Climate is what you should have and weather is what you've got." What "we've got" is, of course, of primary interest. Weather observations were begun in the fall of 1954 with equipment provided by the U. S. Weather Bureau. The 1955 precipitation was well distributed throughout the year. with peaks in May and October and a total precipitation recorded as 61.18 inches. Precipitation was largely in the form of snow from October to April; the total snowfall was eighty-seven inches. Precipitation fell on sixty-four percent of the days. The coldest month was December, with February running a close second; while August was the warmest month, with July second. Monthly mean maximum temperatures fluctuated between 30.6° F. and 59.9° F., about a yearly mean of 43.4° F. Monthly mean minimums fluctuated between 19.7° F. and 47.3° F., about a yearly mean of 31.2° F. The minimum temperature experienced was 6° F. and the maximum 78° F. Putting it as gently as possible, the weather at Kitoi was cool and damp.

What has surface weather to do with the problem? Besides making the people miserable, it is responsible for the environment in which the fish must live. The watershed runoff from precipitation causes the lake level to fluctuate. The more extreme the runoff, the wider the fluctuation. In testing the effects on Lake Kitoi, the effects of a period of minimum rainfall are felt in lake level after a time lag of 4.5 days. The effects of maximum rainfall are reflected by surface height 3.5 days later.

The long cold winter resulted in ice cover from December 4, 1954, to May 13, 1955, a period of five months and nine days. The snowfall resulted in a snow cover over the ice for the duration of the ice cover.

HOW WEATHER AFFECTS FISH

The combination of snow and ice cover results in a long continuous period of low metabolic rate in the fish. Growth processes slow or even stop for almost half of the year. Stream flows are reduced, gravel bars are exposed and frozen, thus limiting the carrying capacity of the water environment. This doesn't sound like a good fish growing environment and it isn't by some standards, but it does and will produce some fish. It will produce even more fish if the populations are properly balanced with the environment. This is not just a theory; it has been done many times in many countries.

Consider the weather the fish feel. Physical and chemical observations were taken at frequent intervals in Lake Kitoi throughout 1955 and are being continued. Similar phenomena have been studied by many scientists and their findings have been condensed into several textbooks. The test, Limnology, by Paul S. Welch is used here as a general guide.

The thermal conditions in Lake Kitoi were recorded by means of a bathythermograph, which records temperature at depth. Figure 6 presents a series of graphs in which

WEATHER IN LAKE KITOI

temperature is plotted against depth. Inspection of these graphs shows the temperature in the first observation (April 13, 1955) to be 33° F. immediately under the ice and then to slowly warm with depth until a temperature near 40° F. is reached at the bottom. A week later the temperature under the ice has warmed to 35° F. and the temperature again increases with depth to a maximum of about 40° F. About three weeks later, the ice cover was largely gone; the temperature immediately on the surface among the broken ice floes was 38° F. At six feet it was near 40° F. and was the same (homothermous) completely to the bottom. The next graph shows two homothermous layers, one from the top to a depth of twenty feet at 43° F., and another from forty-eight feet to the bottom at 41° F.

If a block of iron that weighs a pound is heated, it expands, i.e., its gross size enlarges, but it still weighs a pound. It becomes less dense with increase in temperature. The converse is also true; the more the iron is cooled, the more dense it will become or the more it will weigh per cubic inch. For any given volume the weight will be more, the colder the temperature. Water is unique in that while in its liquid form it becomes more dense with a decrease of temperature, but only to a point of maximum density at a temperature greater than its freezing point. It becomes less dense as it is further cooled, otherwise ice would not float. The point of maximum density is reached at 39.2° F. in pure water. At this temperature water is in its heaviest state.

In the first two graphs the water at maximum density was shown to be at the bottom, the lighter but colder water was on top. As the top layer warmed, it sank until (observation taken on May 17) the whole water mass was nearing maximum density. At this point the lake is

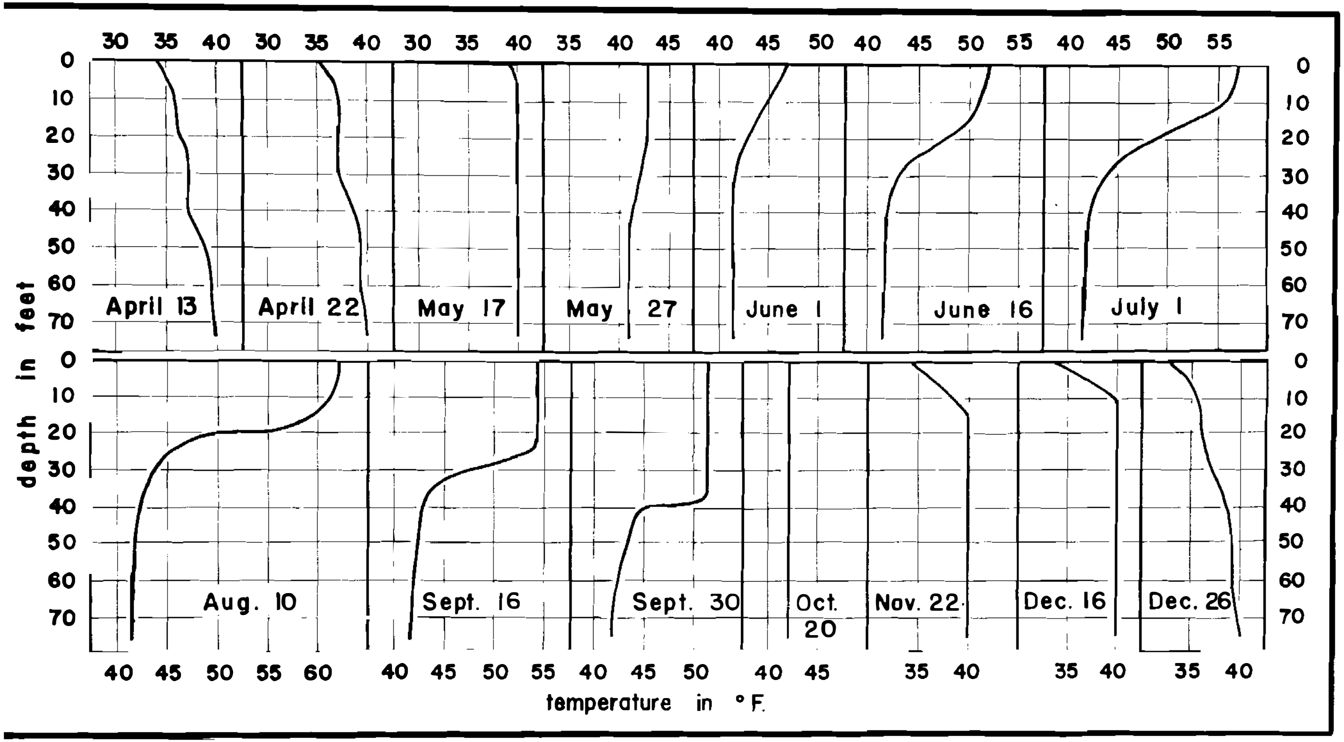

Figure 6. Temperature plotted against depth from Bathythermograph casts in Lake Kitoi, 1955.

homothermous and in ordinary lakes a slight breeze will circulate the water mass from top to bottom. It is in perfect balance and very little energy will roll it over. This phenomenon is called the spring turnover.

The spring turnover at Lake Kitoi was of very short duration, beginning and terminating during the period between May 17 and 27. It resulted in raising the temperature of the whole water mass only by 1^{o} to a total of 41^{o} F. Past this point mixing became incomplete, resulting, May 27, in a completely mixed homothermous 43^{o} F. layer at the top twenty feet, a zone of transition and incomplete mixing to forty-eight feet and a homothermous layer of 41^{o} F. water below that depth. The surface weather from the 17th to the 25th of May was windy, with rain and a small daily temperature range from 37^{o} to 46^{o} F. with complete cloud cover.

On the 25th the winds died, the maximum air temperature rose to 48^{o} F. and the cloud cover dispersed, giving direct solar radiation. This situation continued on the 26th with a maximum temperature of 50^{o} F.; on the 27th the temperature rose to 55^{o} F. Thus we see that the complete circulation was halted by a combination of no or very light wind and of direct solar radiation, resulting in excessive surface temperature with not enough energy (wind) for complete mixing.

The pattern of the temperature relationship to depth becomes increasingly stratified to the formation of a definite thermocline by the middle of June. Thermocline is a limnologist's term for the layer of water between the surface warm water and the homothermous bottom layer. It is defined as the layer of water where the temperature drops one degree centigrade or more per meter of depth. The area above the thermocline is technically called the epilimnion and the area below the thermocline is called the hypolimnion. The thermocline forms a sheer-plane of circulation, i.e., the epilimnion will circulate and be relatively homothermous. The thermocline exhibits other related influences on the lake, as will be brought out later.

For the present, it is pointed out that as summer advanced the epilimnion warmed and increased in depth. The maximum heat was reached about the 10th of August with a surface temperature of 62^{o} F. and an epilimnion depth of about fifteen feet. The observations after this date show the temperature of the epilimnion cooling but the depth constantly increasing. At this same time the thickness of the thermocline is decreasing and it is being driven lower. The hypolimnion slowly but perceptibly warmed during the summer period through convection or weak secondary circulation and reached a maximum of 42^{o} F., or one degree over the spring overturn. As the air temperature dropped, the epilimnion cooled and by the 20th of October the lake was a homothermous 43^{o} F. This was the fall overturn.

Fall winds circulated the water mass from top to bottom until maximum density was reached about November 1. Past this point only surface-waters cooled and the formation of ice occurred on the 12th of November. This event started the cycle all over again. It will be noticed that when the ice first formed, the beginning of the homothermous 40^{o} F. water was close to the surface. As winter progressed, this layer was driven deeper, but it was a slow process brought about by conduction and not by circulation.

Figure 7 graphically shows the relationship between surface weather

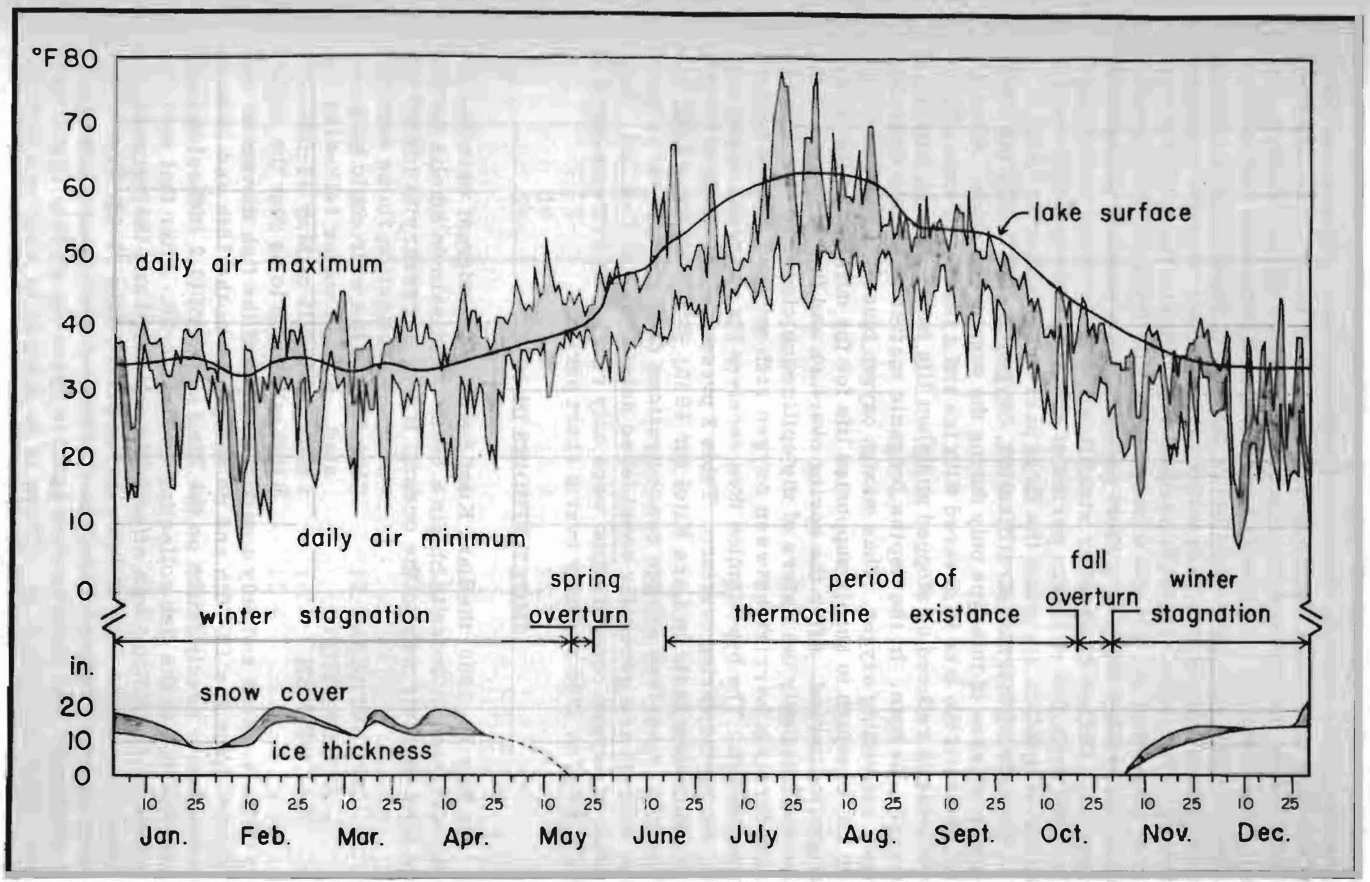

Figure 7. Graphic presentation of thermal relationship between air and Lake Kitoi, 1955.

and the cyclic water temperature changes in Lake Kitoi. It will be noted that, after periods of high air maxima, the temperature at the lake surface is warmer than the air temperature. This is explained by the fact that water absorbs heat by direct solar radiation many times faster than by any other means and more efficiently than does air. In summation, we classify Lake Kitoi as a temperate lake (surface temperatures vary above and below maximum density) of the second order (temperature of bottom water varies but not far from maximum density, with two circulation periods - spring and fall). The annual cycle consisted of: (1) the winter stagnation from early December 1954 to mid-May 1955; (2) a short period (about a week) of spring overturn; (3) a period of summer stratification from latter May to mid-October; (4) a fall overturn period of about two weeks. The start of winter stagnation occurred the first part of November in 1955.

Because of thermal stratification, oxygen is supplied to the lower waters of lakes of this type only during the overturn periods. After the fall overturn the lake is covered with ice and a blanket of snow. Photosynthesis is reduced or stopped and plant life may consume, instead of produce, oxygen. In the depths, organic matter is slowly decaying, again consuming oxygen. Thus enough oxygen must be absorbed during the fall overturn to supply supported life for the duration of the winter stagnation period. After the spring overturn and the formation of the thermocline, only the waters of the epilimnion circulate; the thermocline forms a barrier between oxygen rich surface waters and the hypolimnion. The hypolimnion then receives its summer oxygen supply during the spring overturn. Table 2 presents the results of oxygen determination tests in Lake Kitoi for 1955. Although not a hard and fast rule, dissolved oxygen concentrations falling below three parts per million are generally considered deleterious to fish life. Such levels of oxygen concentration were only reached in extreme depth of Lake Kitoi in 1955 and only over a short period.

SMOLT STUDIES IN 1955

DOWNSTREAM COLLECTION OF FISH

On May 10, 1955, the Lake Kitoi downstream migrant weir was put into operation in order to obtain a count of the salmon smolts leaving the lake on their way to the ocean. It was necessary to install the screens, collection flume and live box before the weir could be operated. A high water following the heavy rainfall of May 13-15 (1.82 inches) proved to be over the capacity of the screens and only a partial sample of the fish movement was obtained from the 13-16th and no sample from the 18th and 19th. A second heavy precipitation on the 22nd and 23rd (2.2 inches) brought a second halt to the fish collecting on May 23-26. After that date, the outflow of Lake Kitoi was effectively screened and the records are complete until the 10th of July. In the period July 10-14, first a high water and then destruction of the live box by bear caused a cessation of sampling. The screens were again in operation on July 15 and were operated until August 15. There is no method of making a positive assessment of the magnitude of the migration during the high water periods. Table 3 contains the daily observations made before, during

Table 2. Dissolved oxygen concentration at various depths in Lake Kitoi in 1955, given in parts per million.

Date		Depth			
		12'	36'	72'	82'
Jan.	7	12.0	10.3		4.6
	21	10.4	10.0	7.9	4.8
	26	10.1	9.6	8.1	4.4
Feb.	7	12.5	11.1	8.6	4.3
	12	12.2	10.9	10.7	5.3
	17	12.5	10.4	8.0	4.3
	24	11.7	10.6	7.9	4.4
March	4	11.0	10.3	8.3	4.4
	14	11.8	10.7	7.7	3.8
	19	13.1	10.3	7.8	3.6
	23	13.5	10.3	7.5	4.2
	30	12.4	9.9	7.9	3.4
April	7	12.0	9.9	7.2	2.9
	13	11.7	10.0	6.9	4.2
	22	12.2	9.9	6.7	1.9
May	17	12.0	11.9	12.0	11.8
	27	12.7	12.8	12.2	
June	1	14.5	14.3	14.2	
	9	14.5	14.2	13.9	
	16	13.8	13.9	13.6	
	25	13.3	13.9	13.2	
July	1	12.8	13.6	13.1	
	21	12.3	13.4	12.9	
	28	11.5	13.2	12.1	
Aug.	10	11.6	12.5	12.2	
Sept.	3	11.7	12.4	11.3	
	16	12.7	12.6	11.4	
	30	13.2	12.5	11.4	
Oct.	20	12.5	12.3	12.0	
Dec.	16	12.2	10.5	9.5	
	26	11.4	11.1	9.5	

and after the early high water periods. A consideration of these data will allow the deduction that the probable migration during the gaps insignificantly affects the totals.

Table 3. Downstream migrants from Lake Kitoi, 1955. (partial table) *

Date		Reds	Silvers	Dolly Varden	Stickle-back	Cottus	Remarks
May	10	1	0	2	0	0	
	11	5	1	4	0	0	
	12	2	0	22	2	0	
	13	13	6	46	13	0	Partial sample,
	14	4	3	36	25	1	high water
	15	4	0	59	3	1	P.S., high water
	16	1	0	16			"
	17						No sample, h.w.
	18						" "
	19	23	0	14	0	0	
	20	12	0	37	0	0	
	21	38	0	71	8	0	
	22	26	0	0	2	0	
	23						No sample, high
	24						water
	25						"
	26						"
	27	123	9	32	3	0	
	28	170	23	11	3	0	
	29	98	28	14	4	0	
	30	2	11	7	3	0	
	31	70	13	12	3	0	
June							
	1	146	20	32	10	0	
	2	352	29	21	2	0	
	3	818	29	37	12	0	
	4	2059	62	14	2	0	

* See Table 4.

In addition to red and silver salmon smolts, dolly varden (Salvelinus malma), three-spined stickleback (Gasterosteus aculeatus) and the Aleutian sculpin (Cottus aleuticus) were captured with regularity. Steelhead smolts (Salmo gairdnerii) were captured only occasionally. These data are grouped into five day periods and presented in Table 4.

Samples of the migration were drawn during each period for use in length measurement and age analysis. The samples for size were treated with urethane to anesthetize the fish. Fork length measurements were obtained by orientating the stunned fish on millimeter paper covered with wax paper. The tip of the nose of the specimen was set against a stop on the zero line and a pin prick, made at the end of the center of the caudal fin, recorded the length. The data were then recorded directly as a grouped length-frequency from the millimeter paper (Figure 8). The stunned fish were allowed to recover in a holding pen and released back into the outlet below the weir. Samples for age analysis were preserved in alcohol for future study. From these preserved specimens, age and length data are available.

For statistical convenience, the period of red and silver smolt migration has been divided into cells of five days each, starting with

Table 4. Total downstream movement of fish from Lake Kitoi in period May 10 to August 15, 1955.

Designation	Period	Reds	Silvers	Dolly Varden	Steelhead	Stickleback	Sculpin
	May 10-15 (2)	29	10	169	0	43	1
	16-20 (2)	36	0	67	0	9	4
	21-25 (2)	64	0	71	0	13	4
I	26-30	392	71	64	0	12	1
II	May 31-June 4	3,453	153	116	0	17	16
III	June 5-9	11,053	703	257	0	22	19
IV	10-14	7,084	1,391	269	0	30	9
V	15-19	3,109	769	53	1	17	11
VI	20-24	1,462	509	6	0	11	65
VII	25-29	914	329	3	3	16	51
VIII	June 30-July 4	1,020	232	5	5	9	7
IX	July 5-9	499	65	0	5	12	2
X	10-14 (3)	2	0	0	0	0	0
	15-19	10	121	2	1	36	0
	20-24	0	99	0	0	77	11
	25-29	8	25	0	1	47	0
	July 30-Aug. 3	13	0	0	0	183	11
	Aug. 4-8	0	0	0	0	20	0
	9-13	0	0	0	0	98	0
	14-15	0	0	0	0	150	1
Total season		29,148	4,477	1,082	16	822	213

(1) Includes both smolts and kelts.
(2) High water conditions caused only partial counts to be obtained in these periods.
(3) Combination high water and bear damage to holding box gave only a partial sample on the 12th and no sample the rest of the period.

period I, May 26-30, with the exception of period X, July 10-28, which contains eighteen days.

RELATIONSHIP OF TEMPERATURE TO SALMON MOVEMENT

The movement of the salmon smolts may be described in terms of thermal characteristics of the lake and the outlet stream. As has been noted, the entire lake reached maximum density (40^{o} F.) about the 17th of May. The spring overturn was of short duration, or until about the 27th of May, and the temperature of the entire water mass rose to 41^{o} F. After that date only surface waters increased in temperature. Thus, before the spring overturn, a layer of colder water overlaid or blanketed the warmer water of the depths. After the spring overturn the situation was reversed; a warm layer of water on top of a colder layer.

The temperatures of the outlet streams were recorded daily and are presented in Figure 9. These data show that maximum density was reached on the 19th of May. Referring to data presented in Table 3, the event of homothermous lake water and, consequently, outlet water may have triggered the first appearance of red smolts in significant numbers. The migration increased with rise in temperature and the

Figure 8. Obtaining fork length measurements of red smolts, Lake Kitoi, 1955.

major portion of the smolts passed through the outlet in water temperatures between 44° and 50° F. When the temperature of the outlet rose to over 55° F., the migration was apparently over.

Outlet temperatures most nearly correspond to the temperatures at the twelve foot level in the lake. When the migration was slowing, the thermocline was formed and a surface layer of water approximately ten feet deep was rapidly warming. When surface waters warmed to a temperature of 55° F. or above and to a depth of sixteen feet the migration ceased. These observations are graphically presented in Figure 10. These considerations lead to a general hypothesis about the behavior of young red salmon in response to temperature. They apparently avoid temperatures below maximum density (40° F.) and above 55° F. Similar observations have been made upon the responses of young red salmon to temperature by Foerster in 1937 on the Frazer River and Chamberlain in 1907 on the Karluk.

Young silver salmon appear to have similar responses, although with broader limits. During the summer months, silver fry and finger-

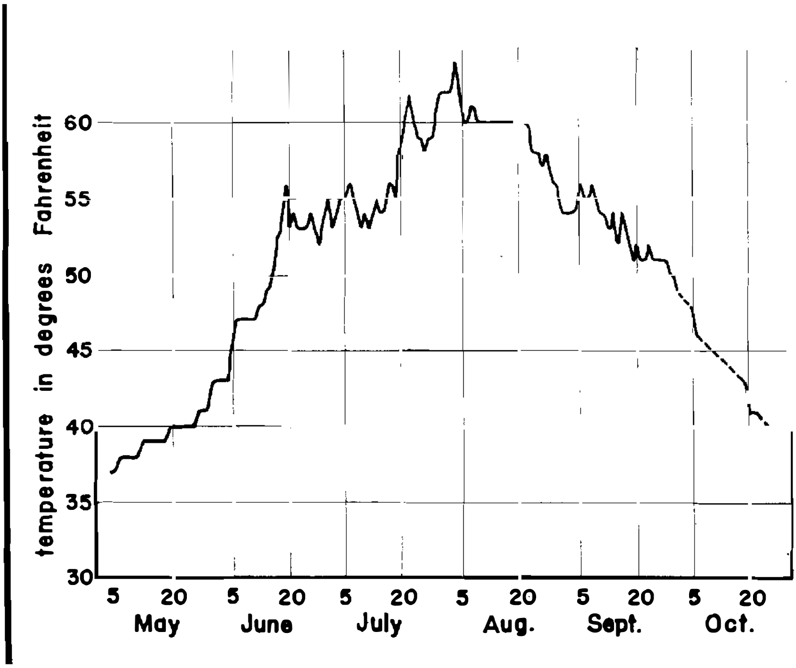

Figure 9. Daily outlet temperatures of Lake Kitoi, 1955.

ling may be observed in the warm shallows of the lake, while the young reds have not been seen. During the winter months silver fry will appear in holes chopped in the ice, but not reds. These observations would point toward limiting environmental factors for reds, much broader limitations for silver and perhaps even the prospect of ''peaceful coexistence''.

Red Smolt Studies

The size of the red smolt migration and samples drawn from it for length and age are presented in Table 5. The samples are considered large enough to apply directly to the population as estimates of the population length frequency.

RED SMOLT MIGRATION

The raw data were first smoothed by a moving average, using the formula $(a+2b+c)/4$ where a, b and c are any three consecutive values of length frequency of the sample. The smoothed frequencies were then weighted by the period-population value and the resultants are the values given in Table 6. It becomes immediately apparent that the average size of the fingerling smolts shifts during the season. In periods I and II, the modes are at 81 and 82 mm., respectively. In period III, which corresponds with the height of the run, two modes are in evidence at 79 and 83 mm., respectively. In periods IV, V and VI, the modal values decline to 75, 74 and 73 mm., respectively. After period VI the modal values rise, being 75 mm. at

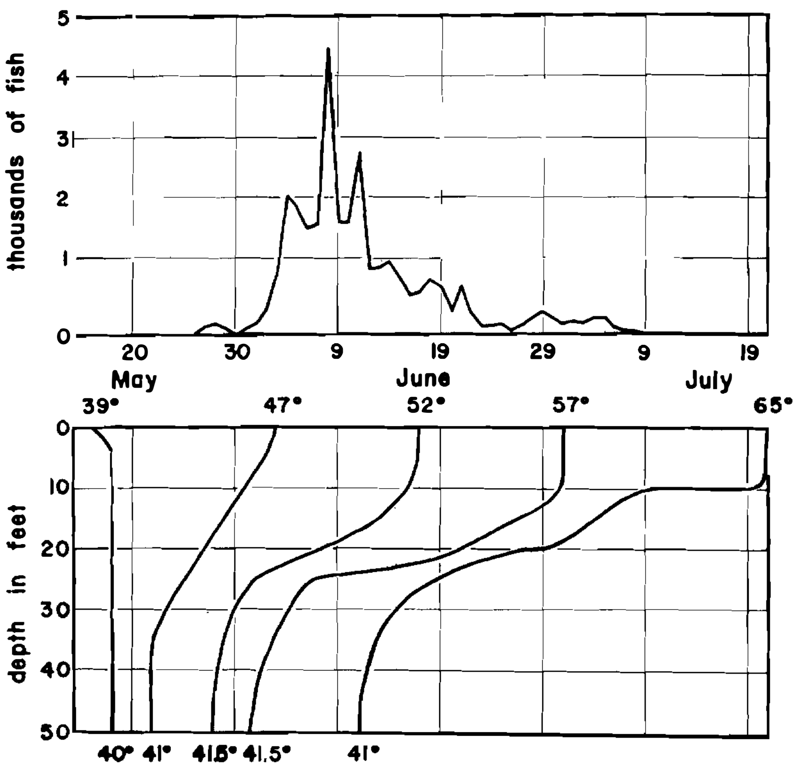

Figure 10. The relationship of red smolt migration to lake temperature. Lake Kitoi, 1955.

Table 5. Samples drawn for length and age from the original Kitoi red smolt population. Periods I through IX, 1955, live fingerlings only.

Period	Population	Length Sample	Age Sample (1)
I	374	310	24
II	3,438	566	37
III	11,010	468	56
IV	7,063	557	55
V	3,085	487	74
VI	1,457	506	57
VII	913	483	0
VIII	1,019	528	0
IX	495	323	0
Total	28,854	4,228	303

(1) 332 specimens were preserved; however, only 303 had useable scales due to a combination of faulty preservation and regeneration.

Table 6. Computation of the length frequency of the red smolt population, 1955. Live fingerlings only.

Fork length (mm)	Period I	II	III	IV	V	VI	VII	VIII	IX	Total
59		1.5								1.5
60		3.0								3.0
1		1.5			1.6					3.1
2		0		3.2	4.8					8.0
3		0		15.8	4.8		0.5			21.1
4	0.3	0	5.9	28.5	3.2	1.4	1.0	0.5		40.8
5	0.9	1.5	11.8	25.4	3.2	4.3	0.5	1.0		48.6
6	0.9	6.1	17.6	44.4	4.8	8.6	1.0	1.0	0.4	84.8
7	0.3	9.1	29.4	101.4	25.3	24.5	3.8	1.4	1.2	196.4
8	0.3	12.1	70.6	158.5	77.6	53.3	8.0	2.4	1.2	384.0
9	2.1	24.3	129.4	247.6	139.4	82.1	17.5	7.7	0.8	650.9
70	3.6	34.9	158.8	342.4	198.0	115.9	41.1	16.9	2.7	914.3
1	3.9	39.5	176.4	396.3	255.0	158.4	70.9	28.5	6.5	1,135.4
2	6.0	53.1	205.8	443.8	324.7	198.0	89.3	45.4	12.3	1,378.4
3	8.7	69.9	247.0	500.9	375.3	209.5	99.2	56.9	18.0	1,585.4
4	10.2	95.7	399.9	583.3	378.5	190.8	112.5	66.1	21.1	1,858.1
5	12.4	124.5	623.4	624.5	351.6	159.8	113.4	80.6	28.0	2,118.2
6	16.6	121.5	699.9	615.0	262.9	108.7	90.3	89.7	37.6	2,042.2
7	19.3	121.5	752.8	570.6	179.0	61.9	71.4	95.5	47.1	1,919.1
8	20.5	165.5	835.2	485.0	144.1	36.7	59.1	98.9	54.4	1,899.4
9	27.4	236.9	876.6	427.9	98.2	19.4	42.1	97.5	55.6	1,881.6
80	36.7	299.1	864.6	355.0	61.8	10.1	30.2	95.5	52.1	1,799.1
1	40.1	328.0	846.9	275.8	47.5	5.0	22.7	85.9	44.4	1,696.3
2	37.9	350.8	841.0	240 9	36.4	2.3	16.1	64.7	37.2	1,627.3
3	32.8	318.9	864.6	196.5	28.5	1.4	9.9	42.9	29.5	1,525.0
4	26.2	261.2	811.6	139.5	20.6	1.4	4.7	25.6	19.5	1.310.3
5	19.3	224.7	599.9	101.4	17.4	1.4	2.8	10.6	10.7	988.2
6	12.6	182.2	323.5	66.6	17.4	1.4	2.1	2.4	6.5	615.0
7	9.0	129.1	176 4	34.9	11.1	0.7	1.4	1.0	5.0	368.6
8	7.2	82.0	199.9	22.2	4.8		1.0	0.5	2.7	320.3
9	4.5	56.2	82.3	12.7	3.2		0.5		0.8	160.2
90	3.3	47.1	35.3	3.2	3.2					92.1
1	3.3	28.9	41.2		1.6					75.0
2	2.4	10.6	35.3							48.3
3	1.5	3.0	17.6							22.1
4	0.6		5.9							6.5
5	0.3		.0							0.3
6	0.6		.0							0.6
7	0.6		.0							0.6
8	0.6		5.9							6.5
9	0.3		11.8							12.1
100			5.9							5.9
Total	373.2	3,437.9	11,010.1	7,063.2	3,085.5	1,457.0	913.3	1,019.1	495.3	28,854.6

period VII, 78 mm. at period VIII, and 79 mm. at Period IX. The period length frequency values have been transformed into percent of total period sample values and are presented as histograms in Figure 11. The theoretical length frequency curve of the entire population of red fingerling during periods I to IX is presented as a bar graph in Figure 12. Since periods I to IX contain 99.44 percent of the total downstream count of fingerlings, the frequency is descriptive of the entire run.

It is well at this point to record possible sources of error. First, in period III, the length sample amounted to only four percent of the total migration. (See Table 5.) Other samples were in much larger percentage of the total. The length samples were taken from the first one-hundred (approximate) fish dipped by scaff net from the live box. Other investigators, working with other species of fish, have discovered a weakness in this tactic, viz., weaker and smaller fish are more susceptible to capture. Where the present samples are non-representative is not known. For the present analysis the length samples have been treated as representative of the population from which they were drawn.

SOURCES OF ERROR

A smear of scales, taken from the area above the lateral line and below the insertion of the dorsal fin, was mounted from each preserved

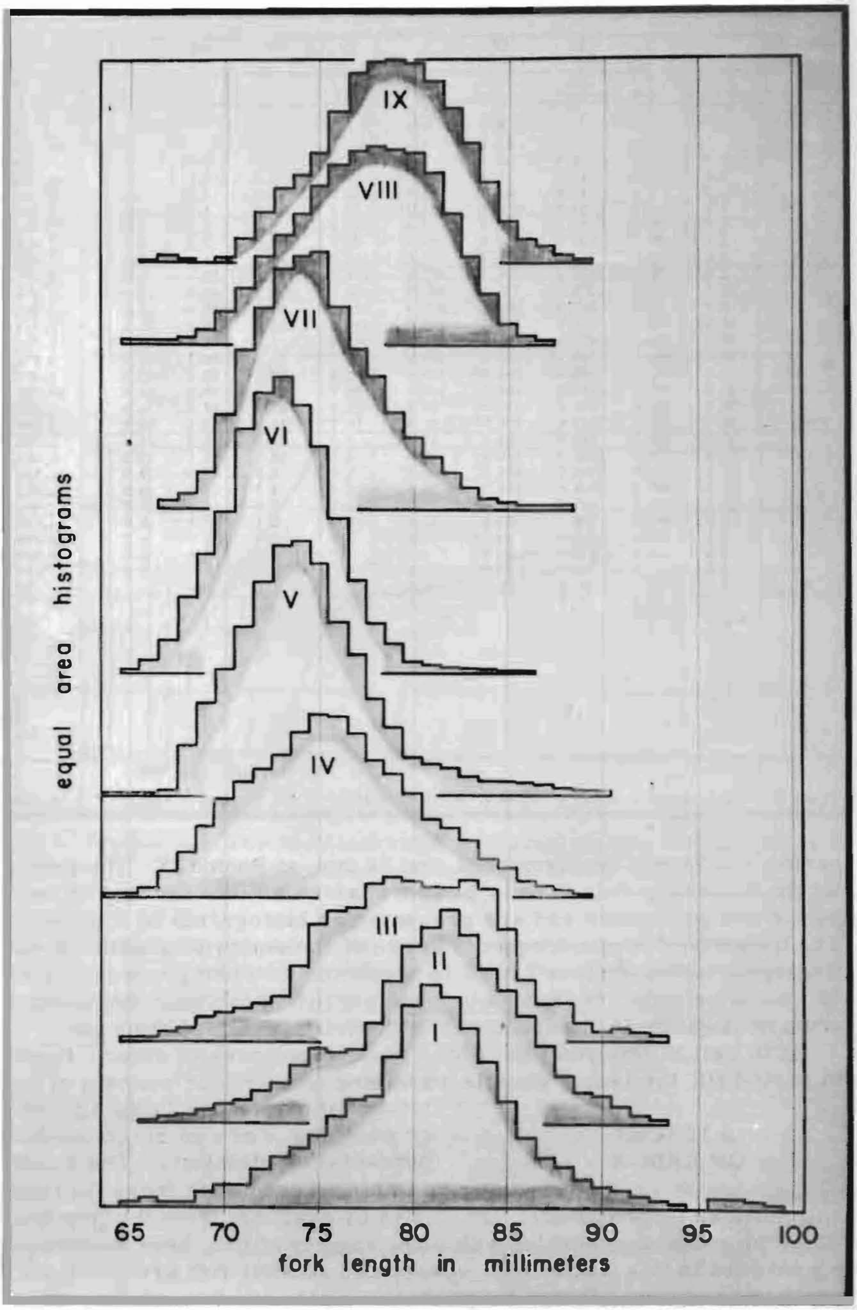

Figure 11. Length frequency of Lake Kitoi red smolts by time period, 1955. See Text.

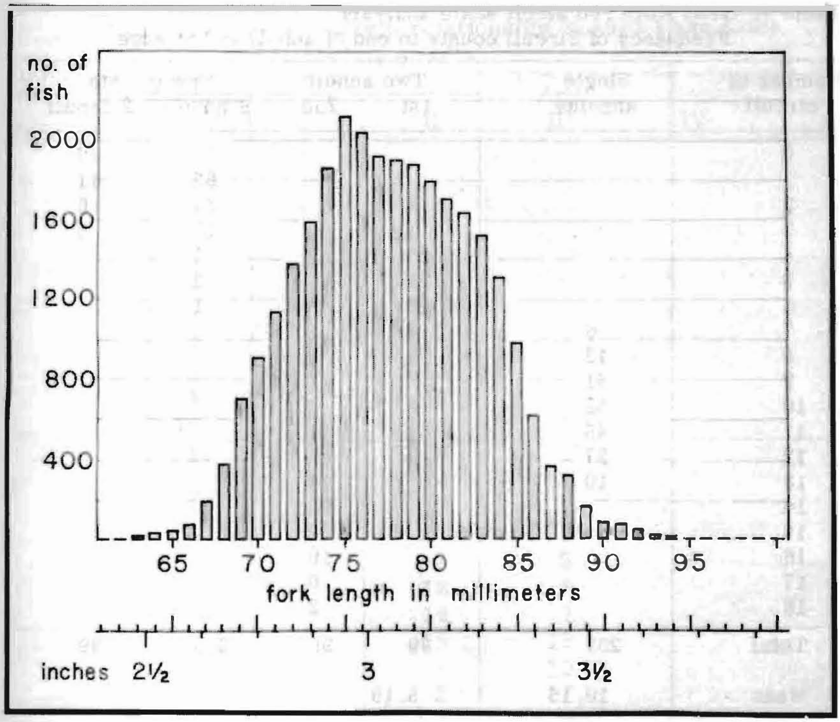

Figure 12. Theoretical length frequency of Lake Kitoi red smolt population, 1955.

RED SMOLT AGE

specimen. These scales were mounted in clear Karo syrup on glass slides under glass cover-slips and read under 25 X magnification. The smear was first searched for the oldest scale (most circuli) and then circuli counts were made from the focus to include the annuli. The number of circuli at the margin of the scale were recorded as a measure of new growth, but this statistic is highly subject to error. From the entire sample of 303 fish, 203 were found to be migrating in their second year, ninety-nine were in their third year and one was in its fourth year of life. Table 7 contains these total sample data and the frequency count of circuli.

It will be appreciated that there is little over-lap between the circuli counts to include the first annulus of fish in their second and third years. Neither is there appreciable over-lap in the frequency of circuli counts to include the first annulus of fish in their second year and to include the first annulus of fish in their second year and to include the second annulus of fish in their third year. The year classes may then be characterized by a general statement. Fish migrating in their second year belong to a group showing a high number (10.15 ± 1.80) of circuli laid down during the year of lake residence. Fish migrating in their third year came from a population showing a low number of circuli (5.19 ± 1.13) during the first year of lake residence. The question now

Table 7. 1955 Kitoi red smolt scale analysis.
Frequency of circuli counts to end of annuli and at edge.

Number of circuli	Single annulus	Two annuli 1st	Two annuli 2nd	New growth 1 annuli	New growth 2 annuli
0				57	77
1				62	11
2				57	6
3		1		17	5
4		25		7	
5		38		2	
6		25		1	
7	6	9			
8	12	1	1		
9	51				
10	52		1		
11	45		1		
12	27		9		
13	10		14		
14			22		
15			22		
16			19		
17			8		
18			2		
Total	203	99	99	203	99
Mean	10.15	5.19	14.49		
Standard deviation	1.80	1.13	1.65		

becomes: Are these two populations consistent from year to year, caused by timing, inherent growth abilities, spawning sites or a combination of these factors, or is the pattern actually one of a single population where the largest individuals migrate in one year and the smaller individuals hold over? A third possibility is a combination of the two. Our samples from a single year involve the circuli counts of two spawning years and no deduction can be made at the present.

An inquiry was made into the relationship between size of fish and number of circuli. Three groups of fish lend themselves to such analysis, but only one group, those migrating in their first year and showing no circuli past their check, have been used. Fifty-seven fish of the sample fall in this group. Circuli counts vary from nine to thirteen and lengths range from 64 to 79 cms. The regression of number of circuli on the length is described by $y = 7.681 + 0.0473X$ and the resultant straight line is nearly without slope. The scatter of empirical points about this line of regression is very broad and the coefficient of correlation (r) is $+0.16$, indicating only a casual relationship. Samples of resident fry and fingerlings are needed to describe the relationship in terms of the two populations, if such exist.

AGE ANALYSIS

The age-length relationship data of 1955 Kitoi red fingerling smolts are presented in Table 8 and graphically in Figure 13. It is quite ap-

Table 8. The age-length relationship of 1955 Lake Kitoi red fingerling smolts.

Fork length mm.	Age II	Age III	Age IV
60			
1			
2			
3			
4	2		
5	2		
6	2		
7	7		
8	13		
9	13		
70	34		
1	18	1	
2	14		
3	12	2	
4	17	1	
5	9	3	
6	12	5	
7	14	7	
8	15	10	
9	9	10	
80	3	17	
1	2	9	1
2	2	5	
3	1	10	
4		5	
5	1	5	
6	1	3	
7		1	
8		3	
9			
90		1	
1			
2			
3		1	
4			
5			
Total	203	99	1

parent that the sample of fish in their second year (II) depart from normal distribution, which is entirely contrary to expectation. A test of this apparent departure is to fit a normal curve to the data and calculate chi-square, the index of dispersion of the empirical data from the theoretical. A chi-square value of 25.612 with eleven degrees of freedom was obtained which means, simply, that in less than one out of 100 samples drawn from the theoretical population would the values depart from normal as much as the age II group in Figure 15. The

AGE-LENGTH RELATIONSHIP

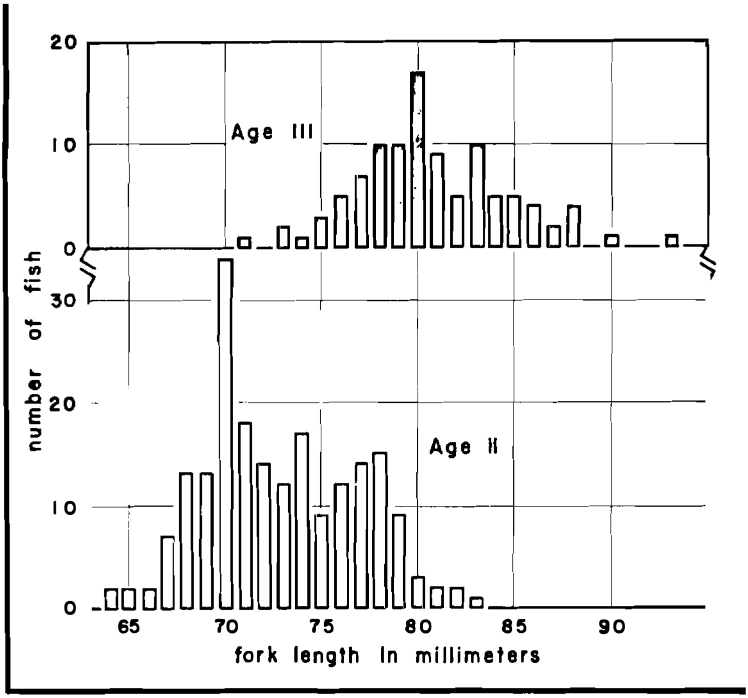

Figure 13. The relationship of length to age of the 1955 Lake Kitoi red fingerling smolts.

population of yearling smolts is, then, not normally distributed about a mean in regards to length of individuals. The evidence suggests two populations, with separate but overlapping length frequency characteristics, and whose circuli counts are approximately the same or extremely overlapped. This phenomenon, if true, could obliterate any expected circuli count-size relationship. The answer may be something simple like a sex-difference. The keys to the puzzle will only come with time, but it is highly desirable to know because inherited racial characters may be involved which would be important in selecting a desirable brood stock.

The timing of the migration of year classes is the apparent explanation for the declining average size as the season progresses from Period I to VI. Table 9 presents these data and a regression from a high percentage of III's to 100 percent II's is seen. No age samples are available for periods VI to IX and no evidence is available to explain the upward and abrupt shift in average size during this period (See Figure 11). Another undescribed group is possible.

The simplest and probably most accurate means of estimating the age composition of the migrating population is to make use of this regression and calculate the age composition of the fingerling smolts, period by period. These calculations are set forth in Table 10. It is not known whether or not the appearance of fry has any significance. They and those fingerlings in their fourth year are but a small fraction of the production. Percentage-wise, the run was probably divided as

Table 9. Change in age-ratio by period, Kitoi red smolts 1955. Data from scale samples.

Period	Number of II's	%	Number of III's	%	Number of IV's	%	Total	% Run total
I May 26-30	4	16.7	20	83.3	0		24	6.4
II May 31-June 4	7	18.9	29	78.4	1	2.7	37	1.1
III June 5-9	20	35.7	36	64.3	0		56	0.5
IV June 10-14	44	80.0	11	20.0	0		55	0.8
V June 15-19	71	95.9	3	4.1	0		74	2.4
VI June 20-24	57	100.0	0		0		57	3.9
VII-X no sample								
Total	203		99		1		303	

Table 10. Calculation of age composition of 1955 red smolt migration from Lake Kitoi.

Period (2)	Number of fingerling (1)	% II's	% III's	% IV's	Number fry (1)	Number II's	Number III's	Number IV's	Total
Prior to May 26, May 26-30, May 31-June 4	3, 800	18.0	80.4	1.6	0	684	3, 055	61	3, 800
June 5-9	10, 953	35.7	64.3	0	0	3, 910	7, 043	0	10, 953
10-14	6, 986	80.0	20.0	0	151	5, 589	1, 397	0	7, 137
15-19	3, 011	95.9	4.1	0	0	2, 888	123	0	3, 011
20-24, After June 24	3, 816	100.0	0	0	0	3, 816	0	0	3, 816
Total	28, 566				151	16, 887	11, 618	61	28, 717

(1) Live fish, released below the weir only.

(2) For simplicity, periods have been combined to include those for which no data is available, and to include the one observation of an age IV fish in the entire early part of the run.

follows: 0.5 percent I's, 58.8 percent II's, 40.5 percent III's and 0.2 percent IV's.

On the basis of the 1955 data it is possible to advance a working hypothesis, which serves to point up the possibilities but lacks confirming data.

A WORKING HYPOTHESIS

The evidence seems to indicate two races of red salmon in Lake Kitoi. One race is either late in hatching or inherently slower growing. Largest individuals of the group form a fraction which migrate in their second year of life. The remainder of the group migrates in its third year. This group is designated as A. The second group is either earlier hatching or inherently faster growing and migrates in its second year. This group is called B. The migration starts (period I, II) with a preponderance of Group A-III. They are joined by Group A-II and B. By periods V and VI the migration is largely of Group A-II and B fish. In period VII the swing is toward B fish and in periods VIII and IX the migration is almost entirely of Group B. This hypothesis is advanced as being acceptable to the recorded data. There is, however, a paucity of important segments of data, viz., (a) samples from the entire migration for age analysis, (b) sex-ratio studies of the migrants, (c) studies on emergence, (d) samples from the entire year of fry and fingerlings for study and (e) studies and analysis of life history and spawning habits of the adults.

Silver Smolt Studies

KITOI SILVER SMOLTS

The 1955 smolt migration of silver salmon (O. kisutch) took place in the period from May 27 to July 28. Other than in this period, negligible numbers passed downstream. The migration data have been grouped into the cells, as given in Table 4. Table 11 presents the numbers of silvers migrating during each period, divided into fingerlings (fork length 75-180 mm., approximately 3-7 inches) and fry (fork length 35-40 mm., approximately 1.5 inches), together with the number of fish measured, the sample mean and the standard deviation.

Table 11. Numbers of live fingerlings and fry silver smolts from Kitoi Lake, 1955, with sample drawn for length frequency, mean and standard deviation.

Period	Total Migration		Number Measured	Fingerling Sample		
	Fry	Fingerling		No.	Mean (mm)	Standard deviation (mm)
I May 26-30	8	62	59	51	144.6	±15.0
II May 31-June 4	27	119	147	119	136.6	±14.6
III June 5-9	1	702	229	228	135.4	±14.2
IV June 10-14	1	1,388	522	520	130.0	±16.3
V June 15-19	70	697	438	405	114.9	±12.9
VI June 20-24	337	172	195	172	115.6	±11.3
VII June 25-29	154	175	177	175	114.8	±7.4
VIII June 30-July 4	140	92	90	90	113.2	±7.6
IX July 5-9	32	33	42	53	112.7	±9.3
X July 10-28	220	20	25			
Total	990	3,460	1,924	1,813		

The length frequency data from the samples of fingerlings were grouped directly from the raw data into 5 mm. groups. These frequencies were then smoothed by a moving average, using the formula $(a+2b+c)/4$. (Where smoothed data appear in the tables the symbol ∿ has been used.) The smoothed data were then weighted by the total-period migration and combined to an estimate of the length frequency of the total migration. These data are presented in Table 12 and Figure 14. The square roots of the ordinants (frequency) are plotted on the abscissa (length) to facilitate interpretation of the groups containing small samples.

Table 12. Smoothed length frequency, weighted by period migration and combined into total migration. Kitoi live silver fingerling smolts, 1955.

Length mm.	Period I	II	III	IV	V	VI	VII	VIII	IX and X	Total fx
70										
75					0.4					0.4
80					2.2	0.5			0.5	3.2
85		0.2		1.3	3.9	1.5		0.2	1.0	8.1
90		1.0		8.0	8.2	2.2	0.2	0.5	1.0	21.1
95		2.0		17.4	24.1	4.2	2.0	1.8	1.5	53.0
100	0.6	2.2	3.1	34.1	62.5	10.5	7.2	5.8	2.2	128.2
105	1.2	2.0	12.3	70.8	107.7	21.8	22.0	13.0	6.2	257.0
110	.9	2.2	26.9	110.9	126.7	30.2	39.8	21.5	11.8	370.9
115	1.2	3.0	39.2	125.0	118.1	30.0	42.0	22.2	12.0	392.7
120	1.8	5.0	46.9	110.9	87.5	25.8	31.2	14.2	9.2	332.5
125	1.8	9.8	66.9	118.3	52.1	19.8	18.8	6.5	5.2	299.2
130	2.7	14.0	92.2	148.4	34.5	12.2	8.5	3.0	1.5	317.0
135	4.6	15.8	99.9	151.0	22.8	6.0	2.8	1.0	0.5	304.4
140	7.6	17.5	92.2	147.0	13.4	3.2	0.5	0.2	0.2	281.8
145	10.3	16.2	77.6	135.0	12.1	2.5				253.7
150	9.4	12.2	63.0	96.2	12.1	1.2				194.1
155	7.6	8.2	45.3	58.1	7.8	0.2				127.2
160	5.8	4.2	23.8	32.1	2.2					68.1
165	3.3	1.8	9.2	16.0						30.3
170	2.1	0.5	2.3	7.4						12.3
175	.9	0.3		2.0						3.2
180		0.5								0.5
185		0.2								0.2
Total	61.8	118.8	700.8	1,389.9	698.3	171.8	175.0	89.9	52.8	3,459.1

From a consideration of these data, three facts are clearly demonstrated:

(1) The migration peaked in period IV, while the peak migration of the red smolts came in period III.

(2) The fry smolts did not make their appearance until the week after the fingerling peak and the fry peaked in period VI.

(3) The size of the migrants, as taken in fork length, was largest as the migration season progressed.

It is immediately apparent that the fingerling smolts may be divided into two groups on the basis of size. The group containing the smaller fish appears to be normally distributed; the arithmetic mean will lie close to but above 110 mm.; the range in size will likely be from 75 to 145 mm.; and the standard deviation may be estimated at approximately $\pm$ 11 mm. This group is designated as Group II. The group containing the larger fish appears to be normally distributed about an arithmetic mean close to 135 mm., with a range from 90-180 mm. and with a standard deviation value estimated as approximately $\pm$ 15 mm. This group is designated as Group III. There is good possibility of a third group present in the population, as shown by the curve for period I (Figure 14). Assuming normal distribution,

SIZE GROUPS

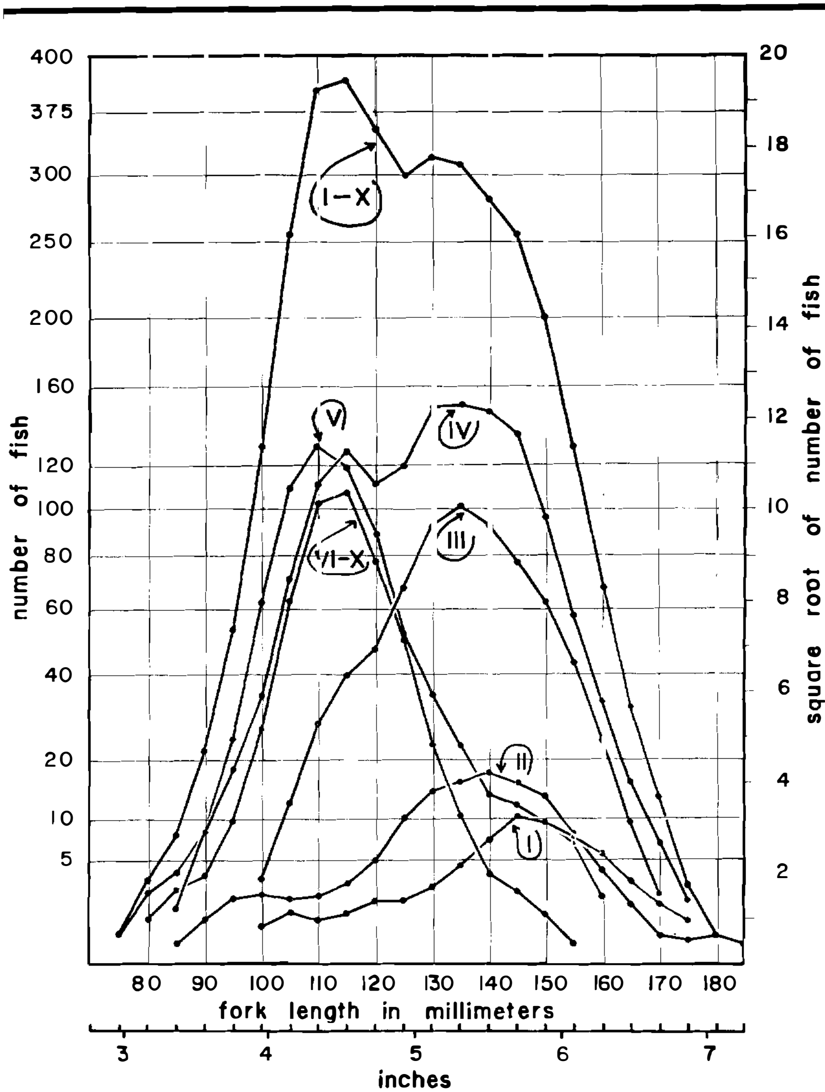

Figure 14. Values of smoothed length frequency data for 1955 Lake Kitoi silver smolts. Numbers of fish plotted on square root scale.

this group would have an arithmetical mean at approximately, or above, 145 mm., a probably range of 110-180 mm. and an estimated standard deviation of one-sixth of the range or $\pm$ 11.7. This tentative group has been designated as Group IV. Some generalities of the three groups may be stated as:

1. Group II contains the smallest and the latest appearing individuals. Maximum numbers were reached in the IV and V periods.

2. Group III contains larger fish than Group II and they appear earlier in the run. Maximum numbers were reached in the III and IV periods. Group II and Group III form the bulk of the migration and are of approximately equal size.

3. Group IV contains comparatively few individuals; they are the largest of all and run the earliest. Maximum numbers are probably reached in the II and III periods.

AGE ANALYSIS

No planned program of scale sampling of the fingerling smolts was carried out in 1955. Individuals, totaling 110, were drawn from the migration between the dates of May 28 and June 23 and preserved for further study. The sample size is small and there is good reason to suspect selectivity. The scales from these preserved fish were examined microscopically for age analysis and circuli counts. These data are presented in Table 13. As was the

Table 13. 1955 Kitoi silver smolt scale analysis.
Frequency of circuli counts to end of annuli and at edge.

Number of Circuli	Circuli Count II	III 1st	III 2nd	IV 1st	IV 2nd	IV 3rd	New Growth II	New Growth III	New Growth IV
0								1	2
1							1	1	1
2							2	6	1
3							5	7	2
4							5	5	
5				1			18	6	3
6		1		3			15	2	
7		2		1			4	1	
8		11		2			11		
9	1	3					4		
10	8	3		1			2		
11	5	3		1			2		
12	21						1		
13	12	3			3		1		
14	17	3	1		1				
15	4		2						
16	2				1				
17	1		4						
18					2				
19			3		1	1			
20			7						
21			3						
22			5			1			
23			1		1				
24			1			2			
25			2			1			
26						2			
27						1			
28						1			
Total	71	29	29	9	9	9	71	29	9

case for red smolts, the tendency is for the individuals with smaller circuli counts to remain over in the lake an additional year or more.

The small size of the sample does not lend itself to detailed analysis, yet the suggestion of two groups with either different growth rates or time of emergence is apparent. A further observation, which coincides with the length frequency - time of migration data, is shown by the circuli counts at the edge of the scale representing new spring growth. The younger fish tend to show more spring growth, indicating a delayed migration.

The small size of the age sample does not allow direct calculation of the age composition of the entire migrating population. From a consideration of the length frequency curves shown in Figure 12 and from the age analysis data, approximations of the arithmetic mean and standard deviation were obtained.

AGE GROUPS

These statistics were used to fit three normal curves to the smoothed length frequency data of the population and approximations of the age composition were obtained. The resultant theoretical curve was compared with the weighted and smoothed empirical curve and, as evidenced in Figure 15, a close fit was obtained. A chi-square test gives a value of 10.798 for 17 degrees of freedom, indicating a probability that more than eighty samples out of 100 drawn from the theoretical

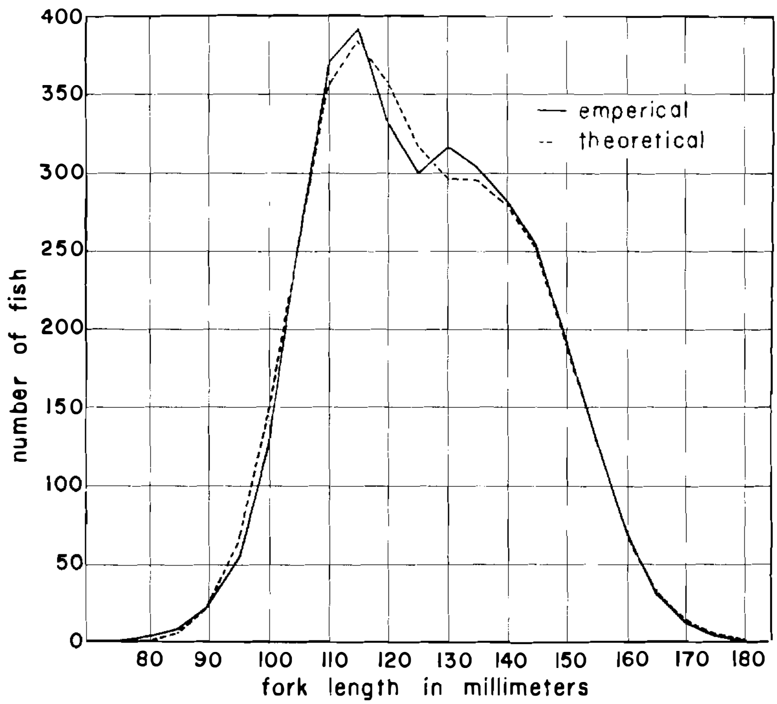

Figure 15. Comparison of theoretical curve of Lake Kitoi 1955 silver smolt length frequency with smoothed and weighted curve of population.

population would vary as much as ours. The data indicate, then, that the 1955 Kitoi silver smolt population was composed of approximately 1000 I's (fry), 1400 II's, 1700 III's, and 400 IV's.

As is the case with the red smolts, a carefully planned sampling program will be set up to determine the existence or nonexistence of separate groups or races. We may be dealing with a single highly variable race or with separate races. The present data do not allow a decision.

Migration of Other Species

The movements of the dolly varden smolts was similar to that of the salmon. The sculpin migration appeared heaviest after the peak salmon migration and the stickleback appeared in largest numbers at peak summer temperatures. (Table 4)

DOLLY VARDEN SCULPIN AND STICKLEBACK

SPAWNING ADULT STUDIES IN 1955

Upstream Migration

Under primitive conditions the upstream movement of adult salmon into Kitoi Lake was undoubtedly erratic. A log jam at the lake outlet (Figure 16) seemed like an impassable barrier. A short section of

Figure 16. Outfall of Lake Kitoi in 1953.

stream below this (at least) partial barrier was filled with large boulders and offered fairly deep water, but a fifty yard stretch of stream below this in the inter-tidal zone was and is extremely shallow (Figure 17), not offering enough water to swim or hide in except at high tide intervals. Thus it took a combination of high stream levels, plus high tide, to gain entrance into the lake. Yet the run has maintained itself successfully. The debris clogging the outlet was removed in 1953 and the smolt-collection weir was installed in 1954. This weir (Figure 3) serves as a total block to ascending salmon. A pool is provided below the weir from which the adults are dip netted into a live box where they are sexed (from external characteristics), measured (fork length), and a scale sample is obtained for age analysis. The fish are allowed to ascend the stream to the pool in a normal manner. They are introduced directly into the lake from the live box, thus a complete account of their migration is possible.

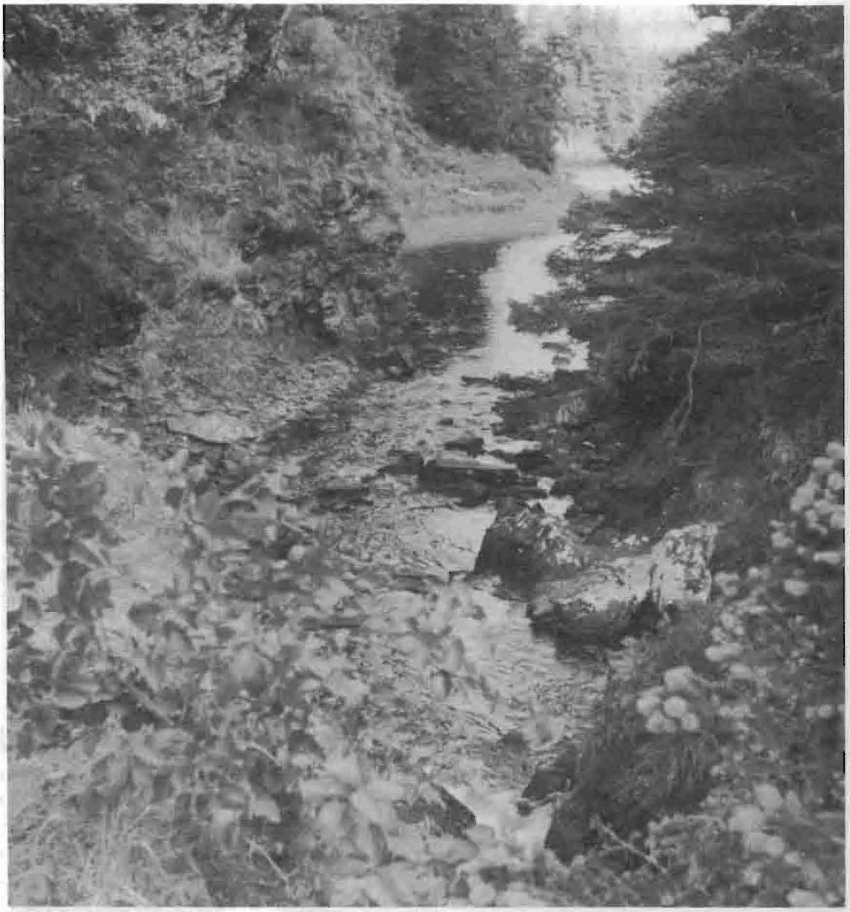

Figure 17. Outlet stream of Lake Kitoi, looking toward Kitoi Bay, in 1953. Tide about one-half flood.

The adult red salmon make their appearance at Kitoi Bay early in June. Many red salmon congregate off the mouth of Patricia Creek, but eventually make their way to Kitoi Creek where they appear to accumulate and ascend the stream in waves. This wave effect may be seen in Figure 18 where the daily number of red salmon put into Lake Kitoi is plotted as a histogram. Two characteristics of the run are readily apparent: (1) the ascension of groups of fish in periodic intervals and (2) the definite separation of the total run into early and late components.

RED SALMON

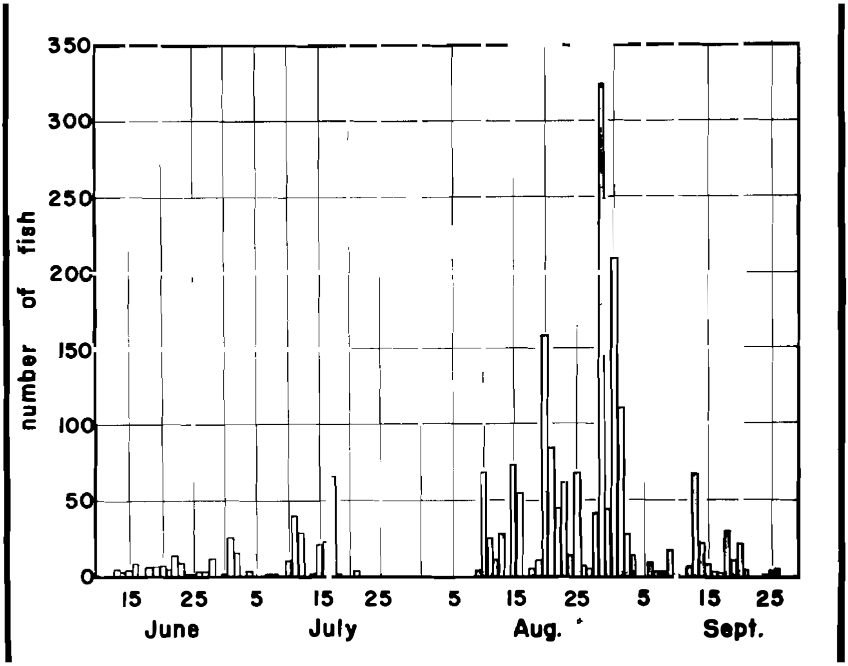

Figure 18. Daily appearance of adult red salmon in Kitoi Creek, 1955.

The characteristic ascension pattern of groups of red salmon on a cycle that seems to encompass five or six days seems unexplainable from physical data, i.e., height of stream, occurrence of high tides, etc. The answer appears to lie in the behavior pattern of the fish. The race has apparently developed a "safety in numbers" complex that causes individuals to seek entrance into fresh water in a group rather than singly. That such behavior is in keeping with the stream conditions, which expose the individual fish to predation, is apparent.

The separation of the total adult migration into two distinct runs is quite apparent. If one considers the early run as those fish entering up to July 21[1], and the late run as those entering after August 9, a

(1) Fifty adults were put into the lake between July 25 and August 8, but no specific data are available. This does not seriously affect these considerations.

further comparison of characteristics may be made:

1. The size of the individuals: The early fish average larger than the late fish (Figure 19) and a dominance of an older year class is suspected.

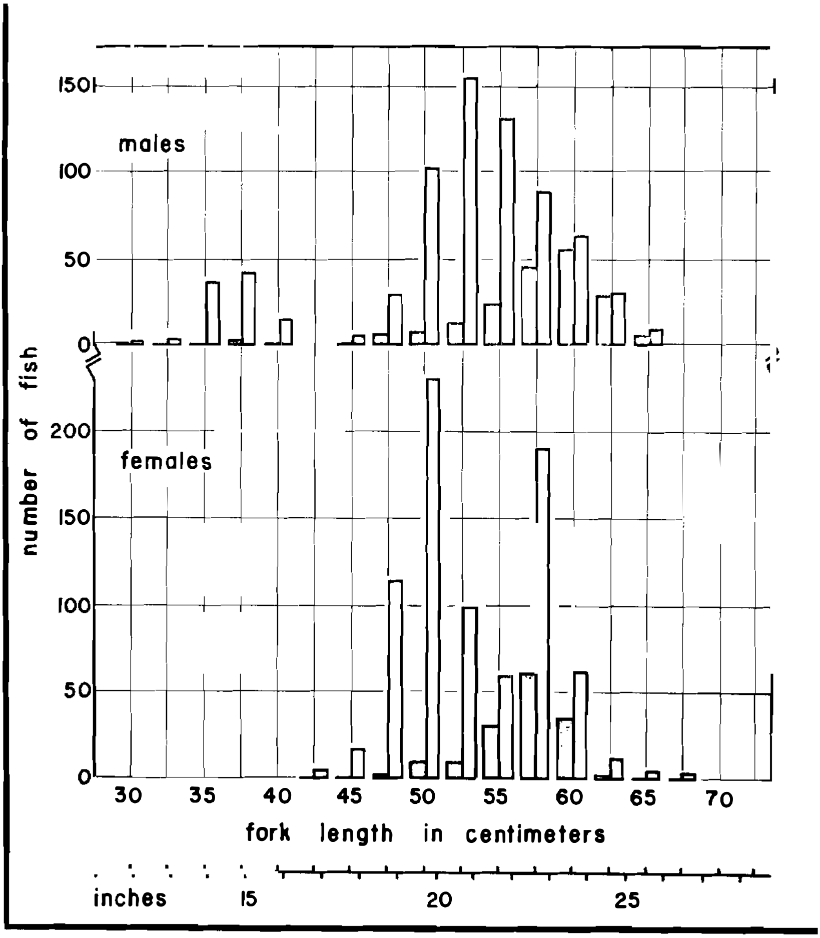

Figure 19. Comparison of length frequencies of early and late segments of the adult Lake Kitoi red salmon population, 1955. (Shaded bars are the early run.)

2. Sex ratio: The early run was composed of .517 males to .483 females. Only one male was a grilse (precocious). The late run was composed of .413 males and .587 females and the males were .136 grilse.

The ages of the adult salmon have not been ascertained from the scale collection at this writing, yet it appears that three salt water growth years are certain. The length frequency data are presented as histograms in Figure 19 and in Table 14.

SIZE FREQUENCY

Table 14. Length frequency of adult red salmon entering Lake Kitoi, 1955. Lengths grouped in 2.5 centimeter cells.

Length cell, mm.	Early run		Late run	
	Males	Females	Males	Females
30.0			1	
32.5			3	
35.0			37	
37.5	1		41	
40.0			14	
42.5				4
45.0			5	16
47.5	5	2	28	114
50.0	7	9	101	231
52.5	13	9	155	199
55.0	23	31	130	160
57.5	45	69	88	190
60.0	56	39	64	63
62.5	28	1	30	11
65.0	6		9	4
67.5				3
Total	184	160	706	995

THERMAL RELATIONSHIP

It is interesting to note that the period of separation of the early and late runs corresponds with the period of maximum lake surface temperature, as if a thermal block were established. Daily outlet stream temperatures are plotted in Figure 9 and the period of cessation of migration coincides with a period of high (above 60^{o} F.) stream temperature.

The hypothesis that the run of adult reds is separated into two components by a mid-summer thermal block appears tenable. That the early and late runs possess different characteristics, viz., sex-ratio and age, is demonstrable. Research efforts will be directed toward evidence on whether or not these runs are separate races or simply segments of the same race which has a broad span in time of appearance.

SILVER SALMON

The first arrival of an adult silver salmon was during 1955, on August 18, and the last arrivals appeared on the 6th of October. Throughout the period the movement of fish from salt into fresh water was cyclic with four peaks occurring at approximately twelve day intervals. The peaks correlate with two unrelated phenomena, a series of high tides and darkness. When a series of high tides occurs, and high water comes during the dark hours, an entrance of silver salmon may be expected. Unlike the reds (which are smaller) the silvers are unable to hide well in the stream and are more exposed to animal predation.

The daily numbers of silver salmon put into Lake Kitoi are presented in Figure 20. Time of appearance of the run as a whole co-

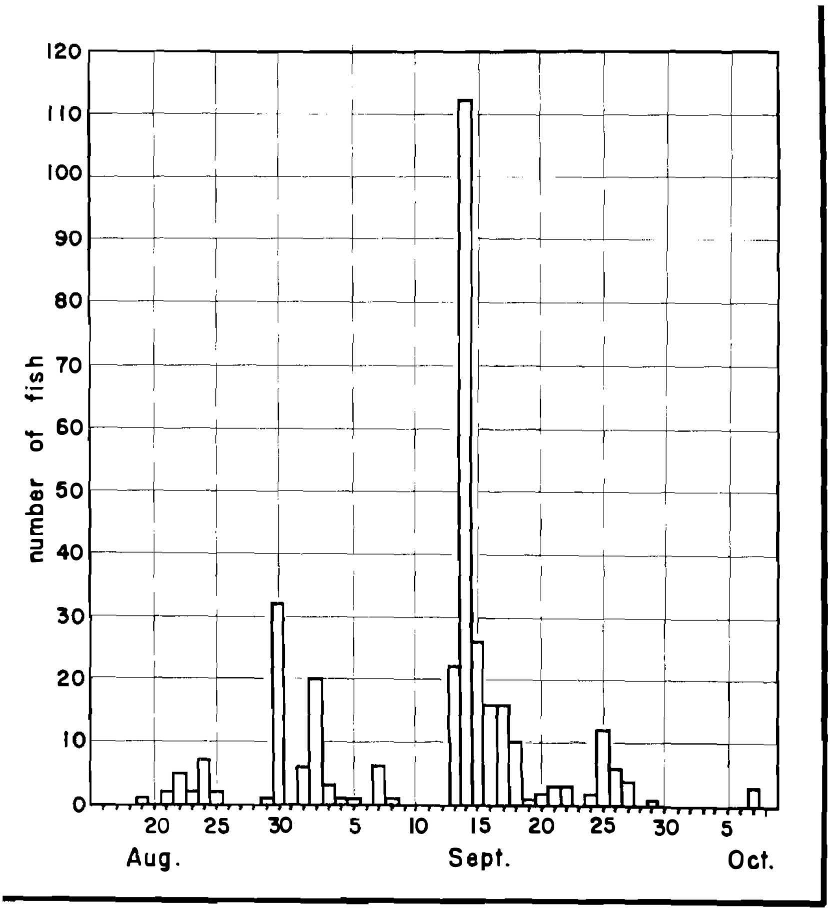

Figure 20. Daily appearance of adult silver salmon in Kitoi Creek, 1955.

incided with the cooling of the outlet stream after the summer maxima.

SIZE FREQUENCY

The length frequency of the adult silver salmon is presented in Table 15 and Figure 21. As was the case for the reds, three year classes are suspected but age analysis of the scales has not yet been done. The males have a much larger spread in size frequency than the females.

PINK SALMON

An adult run of pink salmon (O. gorbuscha) entered Lake Kitoi in 1955. First arrivals were on August 29 and the migration continued until September 16. The run amounted to 237 individuals: 111 males and 126 females. Spawning ground surveys in 1953 did not indicate the presence of pink salmon and the 1955 run is thought to be composed of strays from Patricia Creek.

Table 15. Length frequency of adult silver salmon entering Lake Kitoi, 1955. Lengths grouped in 2. 5 centimeter cells.

Length cell, mm.	Males (1)	Females (1)
30. 0	6	
32. 5	13	
35. 0	5	
37. 5	4	
40. 0		
42. 5		
45. 0	1	
47. 5		
50. 0	3	1
52. 5	16	2
55. 0	8	3
57. 5	18	13
60. 0	17	16
62. 5	32	10
65. 0	39	26
67. 5	37	19
70. 0	21	6
72. 5	11	1
75. 0	1	
Total	232	97

(1) Three males measuring 32. 5, 37. 5 and 67. 5 mm. and seven females measuring 57. 5, 62. 5, 65. 0, 65. 0, 67. 5 70. 0 and 70. 0 mm. were found stranded and should not be considered in the spawning population.

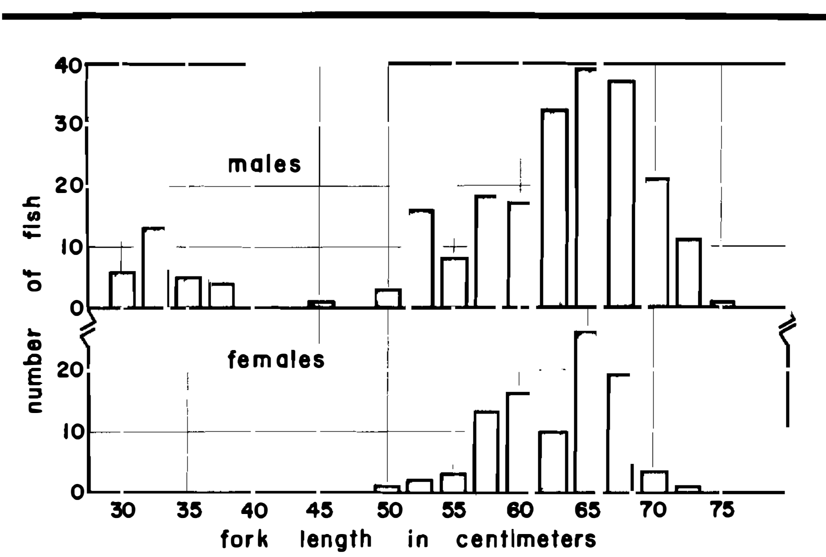

Figure 21. Length frequency polygons of adult silver salmon population, Lake Kitoi, 1955.

DOLLY VARDEN TROUT

A total of 672 dolly varden were also passed upstream in 1955. Each individual was marked, by clipping the adipose fin, to check on their future movements.

Spawning Ground Observations

The main spawning grounds of the red salmon are along the lake shore, in specific locations adjacent to steep sloping hills or to the main inlet stream delta. Reds rarely ascend the inlet stream to spawn and none were observed doing so in 1955. Spawning activity began on August 16 and continued to November 27. Reference to Figure 7 will indicate that spawning continued under the ice cover for twenty-one days. Nests were seen as deep as fourteen feet from the surface and deeper spawning is a likely possibility.

RED SALMON FECUNDITY

The relationship between the size of female red salmon (as measured by fork length) and the number of eggs contained was examined. Nineteen females, measuring from 45.8 cms. to 61.4 cms., were collected. The ovaries, which were all fairly mature, were removed, wrapped in cotton muslin, labeled and preserved in a ten percent solution of formalin and water. Each pair of ovaries was measured by volumetric water displacement in a graduated cylinder. A sample (15 to 25 percent of the ovary) from the posterior end was then volumetrically measured and the number of eggs counted. From these data the number of eggs per female was calculated. As a check, the entire contents of ovaries from seven fish were counted and were also estimated by the Von Bayer method. The volumetric method was found to err only ±0.0015 from actual, while the Von Bayer method yielded consistent under-estimates averaging 0.25 in error.

The estimated number of eggs plotted against the lengths of the females is presented in Figure 22. The relationship seems to be of the type $Y = a + bX$ and a straight line was fitted to the empirical data showing the average regression of number of eggs on size. The values of the average regression were computed for 2.5 cm. size groups and the egg potential of the run calculated. These data are presented in Table 16.

TOTAL EGG SUPPLY

The smallest fish (45.8 cms.) contained 1,644 eggs and the largest (61.4 cms.) contained 3,165 eggs. The fifty fish for which length and sex data are missing were included at an average of 2,340 eggs per female and fifty-three females which died from a number of causes were excluded. Thus the total estimated eggs available was approximately 2,652,000 of which 498,000 were taken for the hatchery. The total estimated number of eggs available for natural reproduction was approximately 2,154,000.

SILVER SPAWNING

A large portion of the silver salmon spawned on the lake shore in the proximity of the delta of the inlet stream. Observations were periodically taken along the stream and these are presented in Table 17. Two features are apparent: First, the pink spawning period preceded the silvers with no apparent over-

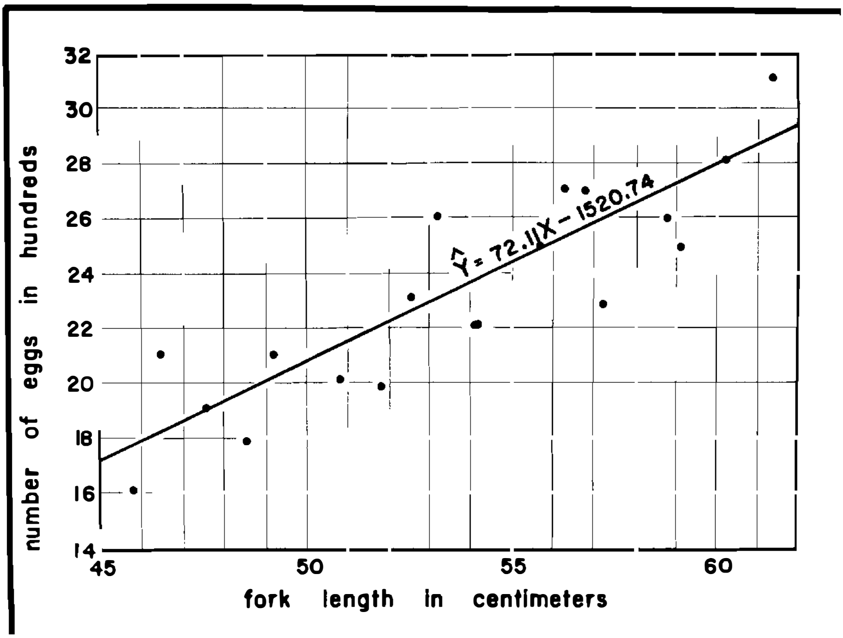

Figure 22. Relationship of the number of eggs contained in ovaries of Lake Kitoi red salmon to the size of the female as measured in fork length.

Table 16. Calculation of the potential red salmon egg deposition in Lake Kitoi, 1955.

Length cell cms.	Number of females. (live)	Average Number of eggs.	Total Number of eggs.
42.5	4	1,544	6,176
45.0	15	1,724	25,860
47.5	108	1,904	205,632
50.0	233	2,075	483,475
52.5	197	2,265	446,205
55.0	185	2,445	452,325
57.5	252	2,625	661,500
60.0	95	2,806	266,570
62.5	11	2,986	32,846
65.0	4	3,166	12,664
Total	1,104		2,593,253
Total calculated available eggs			2,593,253
Plus 25♀ (1)	2,340 (average)		58,500
Total			2,651,753
Less eggs taken for hatchery			498,029
Total available for natural seeding			2,153,724

(1) One half of the 50 put upstream July 25-August 8.

Table 17. Observations on spawning activity in the main inlet stream to Kitoi Lake, 1955.

Date		Creek Temperature °F.	Water Level	Number of Fish	Bear Kill
September	3	--	low	20 pinks	0
	8	--	low	49 pinks	2
	16	48°	--	10 pinks	19
	30	48°	high	none	0
October	20	37°	medium	36 silvers	0
November	5	34°	medium	none	0
	22	33°	low	4 silvers	0

lapping. Second, while 237 pinks and 319 silvers were put into Lake Kitoi, the spawning ground observations could account for only a small fraction of them. Further, the silvers entered as 90 females and 229 males. The observation of the stream spawning on October 20 indicated a paucity of males; several females were unattended and others were with small precocious males.

Hatchery Spawning Operation

Near-ripe fish for the hatchery egg supply were seined on the spawning grounds and held in a floating live box in the lake to protect them from bear predation. These were spawned when ripe and the fertilized eggs placed in the hatchery. The resulting fry will be used in predator-competitor study in a rehabilitated lake.

SUMMARY

The collection and analysis of data on the Lake Kitoi indigenous fishes has shown us that:

(1) The red smolt migration was composed of four year classes. Numbers totaled 29,148 of which 0.5 percent were fry; 58.8 percent in their second year, 40.5 percent in their third year and 0.2 percent in their fourth year. The size range was from fry, 1.5 inches, to fingerling smolts, 3.5 inches fork length.

(2) The silver smolt migration was composed of four year classes. Numbers totaled 4,477 of which approximately 1,000 were fry; 1,400 in their second year, 1,700 in their third year and 400 in their fourth year.

(3) The smolt migration seems to be closely correlated to the temperature in the lake.

(4) The adult reds return in two groups, early and late, and the separation seems to be caused by a thermal block, resultant of mid-

summer water temperatures. The appearance of both adult reds and silvers in the outlet stream occurs in cycles, which appears to be a protection device against predation in the exposed stream.

Many sources of error in the collection of data were discovered and their elimination points the way toward obtaining a clearer understanding of the species in its native habitat. The ultimate goal is an efficient method of planting fresh water that is barren to salmon so that the return in adult salmon may be maximized.

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Adult salmon are measured at the Kitoi weir for age and growth studies before they enter the lake to spawn.

PROGRESS REPORT ON THE TAKU RIVER INVESTIGATIONS

by

C. A. WEBERG and PAUL M. L. GARCEAU

In order to properly manage a fishery it is necessary to have certain basic facts upon which to predict, within reason, the highest sustained number of fish that may be taken from any stock without detrimental effects on future populations. Therefore, it is essential that information on; (1) the amount of exploitation by the fishery, (2) numbers and composition of the escapement, (3) spawning success, and (4) natural mortality be made available before a salmon fishery can be efficiently managed. If these factors are known, it is possible to arrive at the proper balance between utilization by the fishery and escapement of parent stock.

The Taku River Research Program was initiated in 1951, with emphasis on the king salmon, (Oncorhynchus tshawytscha), and expanded the following year to include preliminary studies on red salmon, (O. nerka); pink salmon, (O. gorbuscha); chum salmon, (O. keta); and silver salmon, (O. kisutch).

Portions of the following report are based on incomplete data and may be revised in future publications. However, they are considered to be substantially correct, as regards the data available at the present time.

DESCRIPTION OF STUDY AREA

The Taku River originates in the high plateau country of Northwestern British Columbia with two separated clear water tributaries, the Nakina and the Nahlin Rivers. The Nahlin River is joined by the glacial Sheslay River to form the Inklin River. The Inklin River combines with the Nakina River to form the Taku River. The Taku River then penetrates the Coast Range through a narrow canyon and empties into Taku Inlet, an arm of Stevens Passage located a few miles southeast of Juneau, Alaska (Figures 1 and 2).

The Taku River drains an estimated 6,400 square miles of virgin territory. Upstream from the town of Tulsequah, which is located approximately ten miles northeast of the Canadian Border, the area is uninhabited except for an occasional trapper, prospector, or surveyor.

The discharge of the Taku River is approximately 2,500 cubic feet per second, or 1,125,000 gallons per minute, normal summer flow. The clear water Nahlin and Nakina Rivers contribute less than one-fifth of the total discharge, with the remainder originating from the ice fields lying on both the eastern and western slopes of the Coast Range.

Since the bulk of the water originates on the eastern slope of the Coast Range, the heavy coastal precipitation has little effect on the water level. Normally, the volume of water will increase in direct correlation to the amount of sunshine received during the summer months in the interior.

The Tulsequah River is the main exception to the normal pattern of summer flow. Situated on the headwaters of this River is Tulsequah Lake, which is formed by a dam of ice. About once a year, the pressure

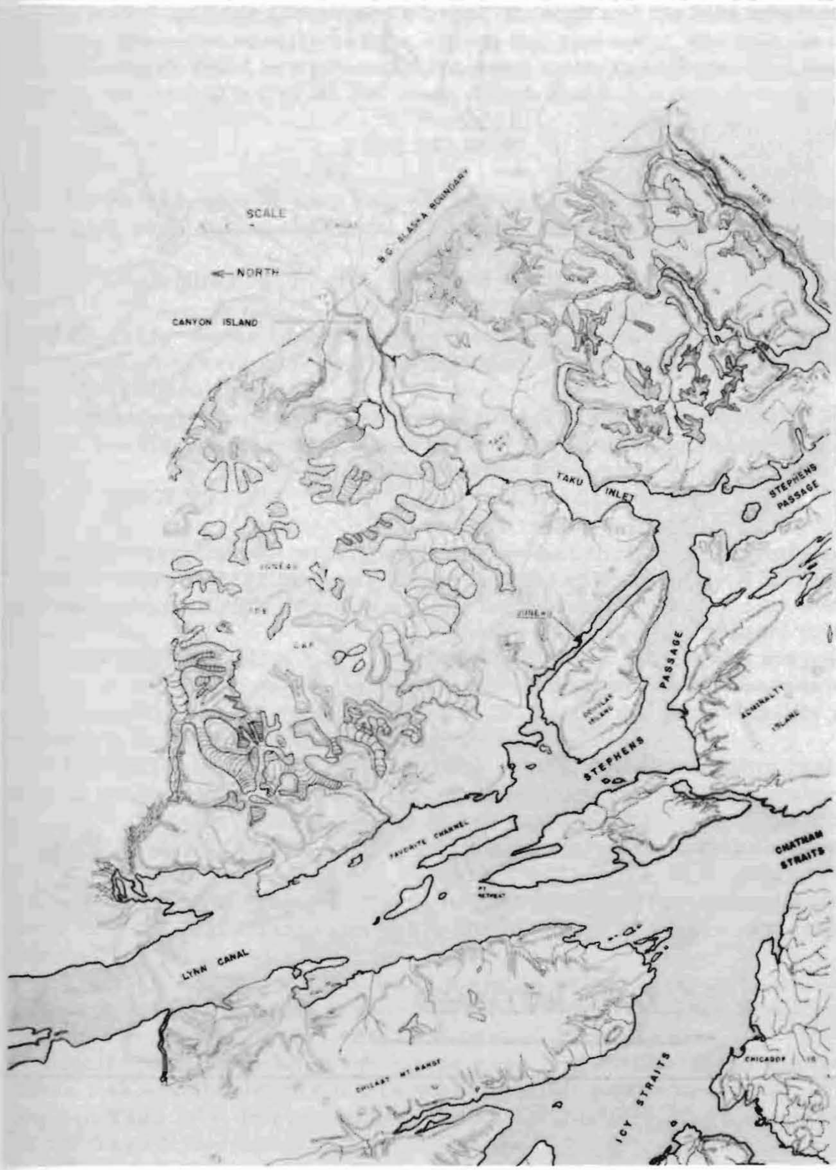

Figure 1. A map of the water approaches to the Taku River showing Lynn Canal, Chatham Straits, Stephens Passage, Taku Inlet, Taku Point and the location of the Canyon Island Research Station.

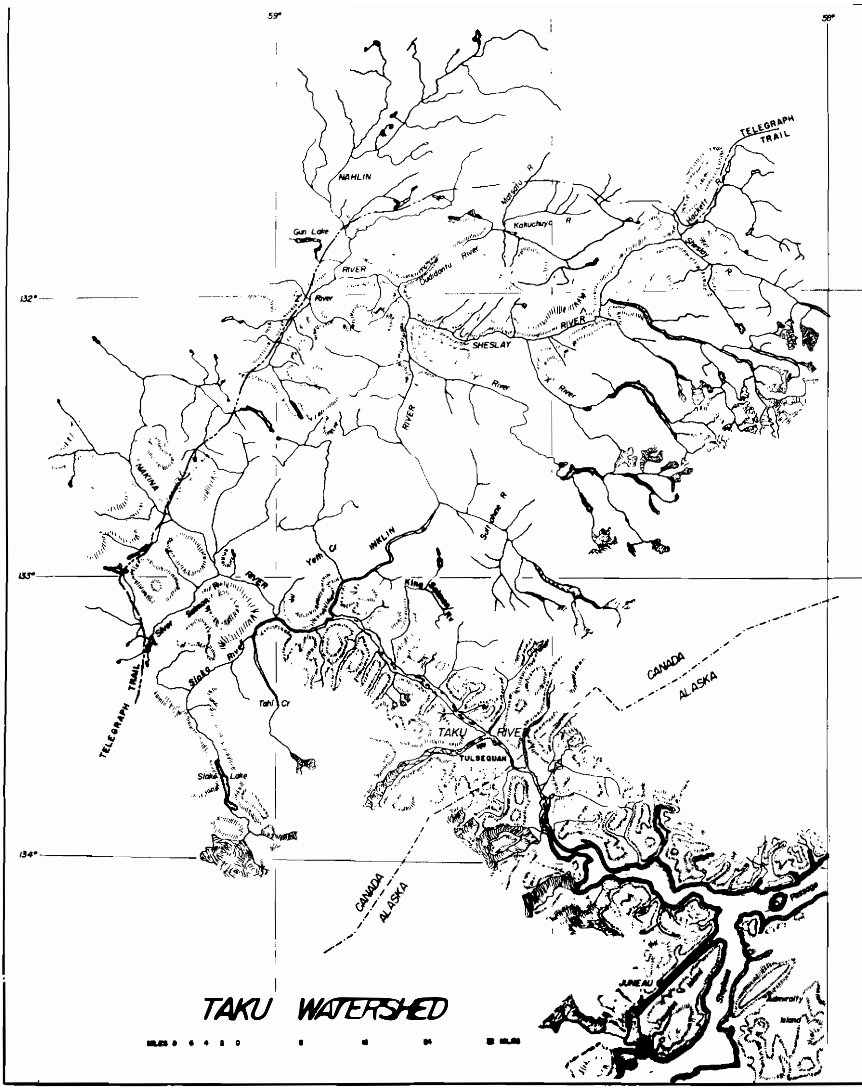

Figure 2. A map of the Taku River watershed.

of the water upon the ice causes a break-through and the lake empties. This phenomenon usually occurs during the summer. The effects of the Tulsequah flood are profound upon the main Taku River and may double the flow of water at the crest of the flood.

KING SALMON

Fertilized eggs of king salmon are deposited in the clear water spawning beds during the month of August, with the peak of spawning activity occurring during the middle of the month when the mid-day water temperature range is 54° to 57° F. During 1955, water temperatures were approximately 9° F. below average and spawning activity was spread over the entire month with no apparent peak.

SPAWNING

It is thought that the king salmon fry descend the river to salt water in the spring, after only a few weeks of fresh water residence and growth. Preliminary scale analysis has indicated that only a negligible number remain a year in fresh water.

SMOLTS

After reaching salt water, little is known of the movements of king salmon. Several tagging experiments have failed to show any sustained concentration of this stock in waters adjacent to Taku Inlet or even within the range of the present troll fishery. This assertion may be further supported by the absence of healed hook scars on returning adults, indicating the unavailability of the stock to the troll fishery as immature fish.

IMMATURE FISH

The males of the Taku River stock exhibit wide variability in the age at which they will mature. Some individuals in this group mature at two years of age, while others do not attain maturity until their sixth year. The females, in contrast, attain maturity in either their fourth or fifth years. Therefore, mature runs of Taku River king salmon are the products of several spawning runs.

AGE AT MATURITY

Adult Taku River king salmon make their appearance in waters adjacent to Taku Inlet as early as April and their entrance into fresh water is from late April to the first part of July.

While passing through the inside waters of Southeastern Alaska, these fish are thoroughly mixed with other king salmon stocks. The nearer Taku Inlet is approached, the higher becomes the percentage of the Taku River stock.

The adult run is first fished primarily in northern Chatham Strait, lower Lynn Canal, and Stephens Passage by the trolling fleet. When the run enters Taku Inlet, it is beyond the effective use of troll gear as the water becomes turbid from the discharge of the Taku River. The gill net fishery, which is concentrated in the Inlet below the mouth of the River, then takes its share of the run.

THE FISHERY

The king salmon proceed up-river to their spawning grounds, arriving during June and July with a few stragglers in August. After deposition of the sex products, the mature fish die and the cycle is complete.

In order to properly evaluate the exploitation of these king salmon, it is necessary to procure data on the numbers, size, age and sex composition of the catch by the two fisheries utilizing them.

Suitable statistics of the Taku River king salmon troll catch are not available; therefore, it became necessary to sample the catches of a portion of the trollers and to obtain observations on the total fishing intensity throughout the season.

TROLL FISHERY CATCHES

From these data it was possible to extrapolate the total estimated troll catch in the vicinity of Taku Inlet for the various years (Table 1).

Table 1. Estimated troll catches of mature Taku River king salmon by age groups for the years 1951-1955.

Year	Age Groups II	III	IV	V	VI	Total	Estimated total percentage of removal*
1951	50	470	1,390	3,740	100	5,750	0.25
1952	(Cold storage strike, no data)						
1953	30	900	4,490	3,420	180	9,020	0.24
1954	190	1,260	2,060	3,860	125	7,500	0.24
1955						3,250	0.17

*Total troll catch (Col. 7) divided by by the estimated total run (Table 7).

The 1951 troll fishery is estimated to have removed about 5,750 mature Taku River king salmon. The bulk of the catch was taken during the interval May 10-31 and by a fleet averaging about twenty-eight boats with a high number of sixty on any single day.

Due to a cold storage strike, no troll landings were made in 1952 until May 26. As the season officially closed on the 31st of May, no attempt is made at estimating the withdrawals by the troll fleet and the catch, which was undoubtedly small, is ignored.

The troll catch of mature Taku River king salmon in 1953 was estimated at 9,020 fish. The size of the fleet varied from twenty to seventy boats, with the average being approximately fifty boats fishing per day during the period between May 14 and June 12.

Estimation of the 1954 troll catch was based on the landings of nine trollers. The size of the fleet was calculated from two to five observations of the total number of trollers fishing each week. The number of Taku River king salmon taken by trollers during 1954 was approximately 7,500.

The 1955 troll catch of mature king salmon was approximately 3,250 fish, a considerable decrease from the catch of the previous two years. A total of 234 catches were examined in the period May 4 to

June 16, 1955, with an estimated 551 troller-fishing days during this period. The boats censused had caught 870 kings of which 75.34 percent were mature and 24.66 percent were immature (spawning apparently not imminent). Mature fish had a sex ratio of forty-four males to fifty-six females. The sex ratio of immature fish was thirty-four males to sixty-six females.

In addition to the fish taken by the troll fishery, a considerable sport fishery utilizes the Taku River king salmon stock. The fishing pressure was estimated at 113 boat days during the period that the troll fishery was being checked. By extrapolation of data collected from eighteen catches, a minimum total catch of 170 king salmon was calculated.

Estimated catches by age groups are given in Table 1 for the years 1951, 1953 and 1954. Age composition of the 1955 catch has not as yet been determined.

Troll gear is definitely selective in the size of individuals taken. Fish above 20.0 inches fork length are probably removed without selection, but individuals smaller than 20.0 inches are not effectively sampled. The result, in terms of age classes, is a far greater relative escapement of the two year olds than of the remaining age groups. As the two year olds are thought to be entirely males, this may lead to a surplus of males on the spawning grounds.

TROLL SELECTIVITY

Data given in Table 1 also shows that an estimated seventeen to twenty-five percent of the available mature king salmon stock is annually removed by the troll fishery.

The Taku River gill net fishery concentrated below Taku Point has started fishing during the first week of May since 1946. The king salmon catch extends from the opening day until the week of June 19-25 when it tapers off. During the king period, the majority of the fishermen use nets of eight inch stretch mesh or larger. These nets are all of the single wall, floating type and are about 150 fathoms in length. A few king salmon are taken during the entire salmon fishing season.

GILL NET FISHERY CATCHES

During the middle of June, there is a general change-over to red salmon gear, nets about six inch stretch mesh. The red salmon catch peaks during the latter part of June. The majority of the pink salmon are taken during July, and the chum and silver salmon in September.

Gill net catches of Taku River king salmon for the past five years are given in Table 2. These data show a fluctuation in the numbers of fish of approximately 7,000 fish from the catch of 1951 (9,792) to the peak year catch of 1953 (16,766).

The collection of catch data over relatively long periods is important in that it can yield an index to the magnitude of the run, and should reveal a general trend over a period of years.

To properly evaluate the catch, it is necessary to compare other factors which may effect the fishery. Consideration must be given to the number of days that fishing is allowed, the number of units of gear, and the type of gear used in any one period.

CATCH PER UNIT OF EFFORT

Table 2. Catches of king salmon by seven day periods, Taku River gill net fishery, 1951-1955.

	1951	1952	1953	1954	1955
May 1-7	183	403	681	1,054	718
8-14	1,422	2,523	1,642	2,183	1,840
15-21	1,402	3,488	1,818	1,696	1,842
22-28	4,737	3,210	4,002	3,239	1,833
29-4	1,315	537	5,111	1,775	1,083
June 5-11	0	0	1,938	1,211	1,350
12-18	0	205	492	1,605	1,006
19-25	60	1,446	558	901	449
26-2	287	672	92	309	317
July* 3-9	135	296	292	208	114
10-16	131	71	46	81	63
17-23	100	68	65	25	11
24-30	13	11	14	29	10
31-6	6	11	3	11	7
August 7-13	0	0	1	4	6
14-20	1	0	2	3	3
21-27	0	0	0	1	2
28-3	0	0	1	2	13
Sept. 4-10	0	0	1	2	7
11-17	0	0	6	9	2
18-24	0	0	1	0	4
25-1	0	0	0	0	6
	9,792	12,941	16,766	14,348	10,686

*The majority of the king salmon taken after this period are immature fish.

Catch per unit of effort figures, as shown in Tables 3 and 4, are based on the average number of fish taken per boat in a twenty-four hour period. The general tenor of the catch per unit of effort follows the gill net catch figures. Close examination of data will show that catch per unit of effort for 1953 was good, not only because there were more fish available, but also because the estimated escapement for the year was not as high as in the previous year. The estimated escapement, Table 8 for 1952, was 13,490 as compared to 12,310 for 1953, although the catch in 1953 was much higher than that of 1952.

Table 3. The average catch per unit of effort for king salmon taken by the gil net fishery for the period May 1 to July 30, 1951-1955.

Date	Days of fishing	Average units of gear	Total number fishing days-units of gear*	No. of fish	Average catch per unit effort
1951	46¼	34.6	1,600.25	9,785	6.1
1952	43	38.5	1,655.50	12,930	7.8
1953	49½	31.7	1,569.15	16,751	10.7
1954	41	44.8	1,836.80	14,316	7.8
1955	38	39.5	1,501.00	10,636	7.1

*Computed by multiplying days of fishing by average units of gear.

Table 4. Catch statistics of the Taku River gill net fishery 1951 - 1955, King salmon only

Period	Days of Fishing					Average units of gear					Catch, numbers of Fish					Catch per unit effort (2)				
	1951	1952	1953	1954	1955	1951	1952	1953	1954	1955	1951	1952	1953	1954	1955	1951	1952	1953	1954	1955
May 1-7	½	5	3½	4	2	22.0	11.1	22.0	28.0	22.3	183	403	681	1054	718	16.6	7.3	8.8	9.4	16.1
8-14	5½	5½	4	4	3	31.7	33.5	37.8	44.6	37.8	1422	2523	1642	2183	1840	8.2	13.7	10.9	12.2	16.2
15-21	5½	5½	4	4	3	30.0	52.5	34.2	48.0	50.7	1402	3488	1818	1696	1842	8.5	12.1	13.3	8.8	12.1
22-28	5½	3½	4	2½	3	40.3	57.8	46.2	65.0	49.3	4737	3210	4002	3239	1833	21.4	15.9	20.8	19.9	12.4
29-4 June	3¼	1	4	2	3	39.0	52.0	49.0	60.0	44.0	1315	537	5111	1775	1083	10.4	10.3	26.1	14.8	8.2
5-11	0	0	4	2½	3	0	0	51 0	54 3	45.0	0	0	1938	1211	1350			9.5	8.9	10.0
12-18	0	½	2	2½	3	0	18.0	16.3	51 7	42.5	0	205	492	1605	1006		5.7	15.1	12.4	7.9
19-25	½	4	4	2½	3	31.0	40.6	42.4	74 0	40.8	80	1446	558	901	449	3.9	8.9	3.3	4.9	3.7
26-2 July	5½	4	4	2½	3	36.1	35.8	30.0	60.7	45.0	287	672	92	309	317	1.4	4.7	0.8	2.0	2.4
July 3-9	5	3½	4	2½	3	34.5	35.8	26.8	41 3	42.0	135	296	292	208	114	0.8	2.4	2.7	2.0	0.8
10-16	5	3½	4	4	3	44.8	44.8	15.4	24.8	33.2	131	71	46	81	63	0.6	0.5	0.7	0.8	0.6
17-23	5	3½	4	4	3	35.1	41.0	20.0	25.4	23.3	100	68	65	25	11	0.8	0.5	0.8	0.3	0.2
24-30	5	3½	4	4	3	36.5	39.5	18.4	42.0	31.8	13	11	14	29	10	0.1	0.1	0.2	0.2	0.1
TOTAL	46½	43	49½	41	38						9785	12930	16751	14316	10636					
AVERAGE						34.6	38.5	31.7	44.8	39.5						8.1	7.8	10.7	7.8	7.1

(2) Catch per unit of effort is the average catch in numbers of fish of one gill net for a 24 hour period

Nylon nets were first used in the 1953 gill net fishery, making it more efficient. This fact is further substantiated by comparison of the total fishing pressure for 1952 (1,655.50) and 1953 (1,618.65), the catches and escapement figures for the two years.

A weekly breakdown of the Taku River king salmon gill net catches, average units of gear, days of fishing, and the catch per unit of effort is given in Table 4.

The large sized gill nets used for king salmon during 1951 and 1952 were extremely selective to larger fish. With the introduction of the nylon net and smaller mesh sizes, formerly averaging nine inches and now averaging about eight and one-half inches, selectivity for these larger fish has been somewhat reduced. In addition, a small number of transient fishermen use red and silver salmon gear during the king salmon season, thus decreasing the selectivity for the larger fish.

GILL NET SELECTIVITY

Table 5 serves to illustrate the increased efficiency of nylon nets and their reduced selectivity for larger fish. The average weight of king salmon taken by the eight inch nets was 20.95 pounds, as compared to 23.56 pounds for the nine inch nets. The nylon nets also catch more fish per unit of time than do the linen nets, although there is probably some bias relating to the efficiency of the individual fisherman.

Figure 3 illustrates the length frequencies of fish taken by nets of larger than eight inch stretch mesh. The average weekly fork length measurements for males ranged from 30.8 inches during June 5-11, to 33.6 inches during May 8-14. Average weekly fork lengths of females varied from 32.7 inches, May 1-7, to 35.5 inches during the third week of the season, May 15-21.

Red and silver gear used for king salmon ranged in size from 5-9/16 to 7 inch stretch mesh. The average weekly fork length of the male king salmon, taken by these mesh sizes, varied from 27.9 inches to 31.1 inches and the females from 31.4 to 33.6 inches.

Knowledge of the sex composition of any particular run is important and necessary if we are to estimate the spawning potential of the run. In terms of total escapement, one year may be much better than another, as in 1952 when the estimated total escapement was 13,490 as compared to the 1953 run of 12,310 (Table 8). However, there were an estimated 3,480 females in the 1952 run as compared to 5,720 females in the 1953 run.

SEX RATIO

It seems logical then that, within limits, the more females in the escapement, the better the reproductive capacity of the run. Observations of the spawning habits of these king salmon show: (1) that the female assumes almost the entire duty of the preparation of the redd (nest); (2) more than one female may occupy the same redd; (3) males have been observed to move from one redd to another and back again, and; (4) the sole function of the male in the project of nest building and subsequent coverage of the fertilized eggs seems to be limited to the fertilization of the eggs.

From these observations, it would seem tenable that a 50-50 sex ratio, or even a higher female ratio, would furnish the most efficient spawning composition. Obviously, no more than one male is needed for each female on the spawning grounds.

The 1955 king salmon sex ratios as sampled in the gill net fishery were 48.74 males to 51.26 females (Table 6). As the gill nets catch very few of the smaller fish in age groups II and III, it is seen that even though the gill net catch sex ratio is approximately fifty males to fifty females, these two age groups which are predominantly males will swing the escapement ratio heavily in favor of the males.

The Alaska Department of Fisheries purchased two, eight inch nylon experimental nets to determine if fish in age groups II and III could be taken without being detrimental to the catch of larger and, therefore, more valuable fish. These experimental nets caught smaller king salmon than the larger nets (Table 5), but indications are that there is no significant increase in the catch of fish in the II and III year old age groups.

Table 5. Catch per unit of effort and average weights, of Taku River king salmon, taken by eight inch nylon and nine inch linen nets in the gill net fishery during 1955.

Eight inch nylon nets *

Date	Number of fish	Average weight	Number of 24 hour periods	CPUE
May 1-7	102	20.13	8	12.7
8-14	177	21.00	15	11.8
15-21	122	22.88	15	8.1
22-28	125	19.53	15	8.3
29-4	63	21.88	15	4.2
June 5-11	108	20.60	15	7.2
	697	Av. 20.95	83	Av. 8.4

Nine inch linen nets *

Date	Number of fish	Average weight	Number of 24 hour periods	CPUE
May 1-7	2	29.00	2	1.0
8-14	22	21.75	6	3.7
15-21	44	21.42	15	2.9
22-28	73	23.47	15	4.9
29-4	58	23.76	15	3.9
June 5-11	52	25.83	15	3.5
	251	Av. 23.56	68	3 7

* Five net samples

Figure 3 illustrates the length frequencies and sex composition of the king salmon taken in 1955 by gill nets over eight inches in size. It is seen that these nets caught practically no II year old fish, which average about fifteen inches fork length, and only a small portion of III year olds, which are approximately twenty-six inches fork length.

Table 6. Taku River King Salmon sex ratios taken in the gill net fishery during 1955.

Date	♂	♀	Total ♂ and ♀	% ♂	% ♀
May 1-7	133	168	301	44.19	55.81
8-14	224	260	484	46.28	53.72
15-21*	113	168	281	40.21	59.79
22-28**	359	364	723	49.65	50.35
29-4	31	30	61	50.82	49.18
June 5-11	74	80	154	48.05	51.95
12-18					
19-25	20	4	24	83.33	16.67
26-2	91	25	116	78.45	21.55
Totals	1045	1099	2144	48.74	51.26

* Includes 55 males and 98 females not measured.

** Includes 68 males and 96 females not measured.

They did, however, take a large portion of the IV, V and VI year old groups, that is the portion of the run that contained mature females.

The age composition of the mature Taku River king salmon has been calculated for the years 1951-1954 and is presented in Table 7.

AGE COMPOSITION OF MATURE TAKU RIVER KING SALMON

It is shown that the 1949 brood year was exceptionally "good". Progeny of this spawning run contributed 18,460 fish to the 1953 run as IV year olds and 18,340 as V year olds to the 1954 run. The reason for the success of this "good" brood is not known; spawning ground observations are not available before 1951.

In July of 1951, a general survey was initiated to determine the extent of the spawning grounds of the Taku River king salmon. It was found that the Nahlin and Nakina Rivers were the main spawning areas, with the latter by far the most important. Observations during 1955 indicate that a certain amount of spawning occurs in some of the turbid streams, such as the Sloko. The extent of this spawning population, while not known, is thought to be small.

SPAWNING GROUND COUNTS

Spawning ground observations have been made on the Nakina River every year since 1951 in order to evaluate the numbers and population composition. The Nakina River is estimated to support between eighty and ninety percent of the spawning population.

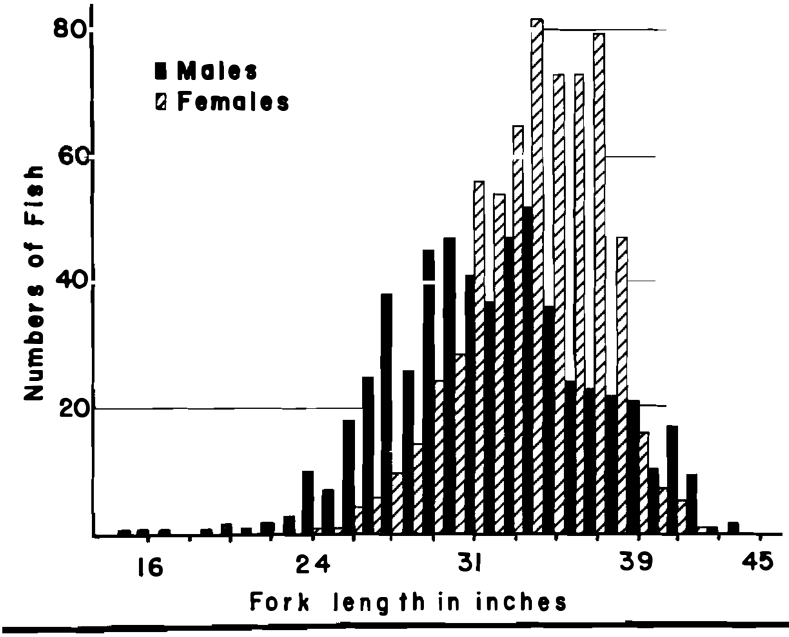

Figure 3. Length frequencies and sex composition of king salmon taken in gill nets eight inches and larger during 1955.

Table 7. Estimated numbers of mature Taku River king salmon by age groups, 1951-1954.

Year	II	III	IV	V	VI	Total	Estimated percentage of escapement
1951	1,430	2,430	4,980	14,220	330	23,390	33.6
1952	880	6,990	7,590	10,540	420	26,420	51.0
1953	970	3,920	18,460	14,030	730	38,110	32.3
1954	1,220	4,110	7,000	18,340	580	31,250	30.1
1955						18,625	25.2

The estimated numbers of spawners on the Nakina River, total estimated escapement, and numbers of females are given in Table 8.

The estimated escapement on the Nakina River has ranged from a high of 9,000 in 1952 to a low of 3,000 during 1955. With this wide range of escapement it should be possible in future years to determine, within reason, which spawning intensity gives the best returns; this is the ultimate goal of this research program.

In addition to estimating the numbers of fish on the spawning ground, sex ratios, and length frequencies for age determinations are collected.

Table 8. Estimated escapement of Taku River king salmon during the periof 1951-1955.

Year	Estimated numbers on the Nakina	Estimated escapement	Estimated number of females
1951	5,000	7,860*	
1952	9,000	13,490	3,480
1953	7,500	12,310	5,720
1954	6,000	9,380	5,290
1955	3,000	4,690*	2,400

*The estimated escapement for these years was established from the relationship between the estimated numbers on the Nakina River and the estimated escapement for the years 1952 and 1953.

Figure 4. Biologist examining dead king salmon on the Nakina River.

Information on the smolts is noticeably lacking. An ideal method of collecting data on the migrants would be to obtain a total count on the Nakina River by the use of a counting device, such as a weir and trap. Since this is impractical, we must try to get a representative sample by some other means. For this reason, an attempt will be made during the spring of 1956 to capture migrants as they pass downstream in the vicinity of the Canyon Island Research Station (Figure 1). If these fish can be captured in significant numbers, they may serve as an index to the numbers, migration patterns and the survival from egg to migrant. In addition, it may be possible to ascertain the magnitude of natural mortality from smolt to mature fish.

OTHER SPECIES

Preliminary studies on pink, red, chum and silver salmon have been concerned mainly with the catch statistics of the gill net fishery and methods of sampling the escapement.

GILL NET CATCHES

Catch data for the years 1951 through 1955 is given in Tables 9, 10, 11 and 12. These data show that red salmon catches had a sharp decline during 1955, while the silver salmon catch increased approximately fifty percent over the previous three year period, during 1954 and 1955. Chum and pink salmon catches have fluctuated considerably during the five year period and show no obvious trends.

Figure 5. Trolling boat fishing outside of Taku Inlet.

Table 9. Catches of red salmon by seven day periods, Taku River gill net fishery, 1951-1955. *

	1951	1952	1953	1954	1955
May					
1-7	0	0	0	0	0
8-14	0	0	0	0	0
15-21	0	0	0	0	0
22-28	0	0	0	0	0
29-4	0	0	0	0	0
June					
5-11	0	0	36	32	2
12-18	0	996	3,733	1,975	1,901
19-25	1,518	9,724	13,442	6,277	3,754
26-2	12,394	4,007	3,380	5,307	4,288
July					
3-9	8,848	5,913	3,460	4,985	3,114
10-16	9,680	6,290	3,056	5,675	3,846
17-23	6,198	8,908	9,331	8,826	3,386
24-30	12,482	5,178	6,707	14,628	3,884
31-6	9,901	3,109	6,055	4,083	2,738
August					
7-13	2,383	593	1,949	1,780	773
14-20	261	387	255	551	657
21-27	0	74	48	81	302
28-3	3	35	66	38	87
Sept.					
4-10	7	11	26	12	22
11-17	7	5	14	8	5
18-24	5	2	12	2	6
25-1	0	1	0	0	0
	63,687	45,233	51,570	54,260	28,765

* Data by courtesy of the U. S. Fish and Wildlife Service, Juneau office.

Due to the glacial origin and resulting turbidity of many of the streams in the Taku River drainage, it has been impossible to accurately locate the spawning grounds of the different species of salmon. Therefore, a direct count on the spawning grounds for determination of escapement has been impossible.

Because the physical characteristics of the Taku River preclude the possibility of counting the escapement by the use of weirs, a rather unique device has been used for this purpose.

A fish wheel was installed at the Canyon Island Research Station located about seventeen miles upriver from Taku Point (Figure 1). The wheel, based on the Indian fish wheel pattern, has wings like a paddle wheel which are turned by the current; fish are caught in the scoop-like wings and lifted from the river. Captured fish then fall into the live tanks located in each of the two pontoons (Figure 6).

Prior to their release, the captured salmon are measured and a few of their scales are taken for future age analysis and racial studies.

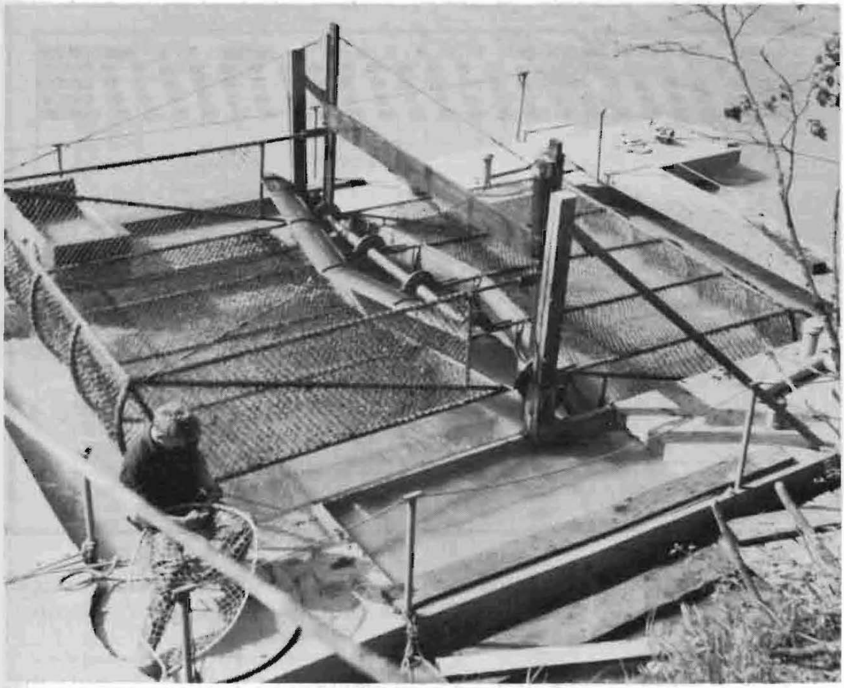

Figure 6. Fish wheel used for sampling escapement on the Taku River.

All salmon taken in the wheel are counted and their numbers are recorded by species, sex, and day of capture.

Measurements of the escapements must be taken close to the fishery in order that these apply to the specific segment of the run that is under fishing pressure. This makes immediate remedial action possible should the escapement fall below or rise above optimum limits set for that segment of the run.

ESCAPEMENT INDICES

In a study of optimum levels of escapement for any species of salmon, it is necessary to evaluate various levels of escapement in terms of success of the year class, i.e., how many returning adults have resulted from a certain seeding of the spawning grounds. For instance, if an escapement at a certain level results in 5,000 adult salmon returning after three years, 5,000 returning after four years, and 5,000 returning after five years, all resultant of the one spawning, then the success of that spawning will be measured as 15,000 returning adults. Obviously, the success of any level of spawning will be affected by natural conditions beyond our control, but we seek optimum levels - given average conditions that will provide the greatest yield.

Fish wheel catches of red, pink, silver and chum salmon by weekly periods for the years 1952 through 1955 are given in Table 13.

Figure 7 shows the salmon runs in the Taku as sampled by the fish wheel during the years 1952 through 1955. Each base line covers the duration of its respective run over a four year period. Any vertical

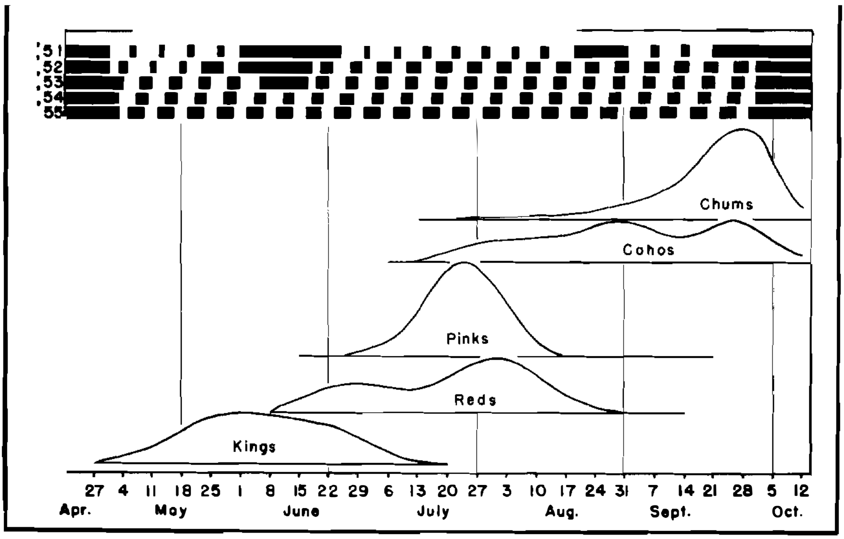

Figure 7. Graphic presentation of the five species of salmon as sampled by the fish wheel at Canyon Island. Black bars indicated closed periods.

distance in these curves indicates the percent of the total sample that was taken in the fish wheel at that date. In other words, the areas under the curves are equal to 100 percent of the total fish wheel catch of each species, and actual numbers of fish cannot be obtained from these graphs.

This graphic representation of the runs of salmon peculiar to the Taku River, when compared with similar graphs of future runs, will show any changes in subsequent runs (with regard to peaks of migration, comparative numbers at specific times during migration, and the effects of closed periods in the gill net fishery).

Relationships between escapement and fish wheel catches must be fully understood if we are to use the fish wheel catches as an index of escapement. To investigate this relationship, a catch per unit of effort for the fish wheel based on a twenty-four hour period was computed for red, pink, silver and chum salmon. Then comparison of the fish wheel and gill net fishery catch per unit of effort was made for the years 1952 through 1955. From these data the amount of correlation between the two factors was computed. In ten of sixteen instances, the fluctuations in the fish wheel catch are in rhythm with the gill net catch. Thus, the hypothesis that the fish wheel catches are in some measure related to the abundance of the species is likely. Of the six cases that do not fluctuate with the gill net catch, five are concerned with pink and red salmon which migrate past the fish wheel when water levels are generally high. High waters are known to affect the fish wheel catch of these species so that correction factors are essential (See Annual Report for 1953).

At the present, this method of indexing the escapement looks promising as a management tool for a river of this type, but further analysis is necessary to demonstrate its reliability.

Table 10. Catches of pink salmon by seven day periods, Taku River gill net fishery, 1951-1955. *

	1951	1952	1953	1954	1955
May					
1-7	0	0	0	0	0
8-14	0	0	0	0	0
15-21	0	0	0	0	0
22-28	0	0	0	0	0
29-4	0	0	0	0	0
June					
5-11	0	0	0	0	0
12-18	0	0	8	1	1
19-25	264	83	271	225	21
26-2	4,913	415	143	103	581
July					
3-9	20,391	1,490	1,589	1,479	945
10-16	29,885	8,348	932	4,020	4,128
17-23	11,431	15,339	1,969	6,609	1,959
24-30	4,810	7,730	1,241	8,777	3,977
31-6	2,728	5,519	561	993	3,189
August					
7-13	472	45	154	842	863
14-20	30	228	24	377	350
21-27	0	7	10	315	74
28-3	91	6	5	301	26
Sept.					
4-10	4	83	3	194	15
11-17	4	0	2	41	0
18-24	4	0	2	4	0
25-1	0	0	0	1	0
	75,027	39,293	6,914	24,282	16,129

* Data by courtesy of the U. S. Fish and Wildlife Service, Juneau office.

Table 11. Catches of silver salmon by seven day periods, Taku River gill net fishery, 1951-1955. *

	1951	1952	1953	1954	1955
May					
1-7	0	0	0	0	0
8-14	0	0	0	0	0
15-21	0	0	0	0	0
22-28	0	0	0	0	0
29-4	0	0	0	0	1
June					
5-11	0	0	0	0	17
12-18	0	0	0	0	0
19-25	0	0	0	0	6
26-2	47	4	0	0	43
July					
3-9	21	40	3	11	72
10-16	60	77	6	34	328
17-23	243	359	267	89	234
24-30	1,089	440	363	474	376
31-6	1,214	488	357	454	499
August					
7-13	1,283	626	206	503	606
14-20	383	761	86	2,895	3,785
21-27	0	2,361	705	1,736	5,302
28-3	756	3,483	1,414	9,132	5,154
Sept.					
4-10	6,218	5,131	3,947	5,412	4,422
11-17	9,857	4,687	3,352	7,969	10,594
18-24	6,369	6,732	8,494	6,648	6,283
25-1	0	4,676	1,302	7,188	2,748
	27,540	29,865	20,502	42,545	40,470

* Data by courtesy of the U. S. Fish and Wildlife Service, Juneau office.

Table 12. Catches of chum salmon by seven day periods, Taku River gill net fishery, 1951-1955. *

	1951	1952	1953	1954	1955
May					
1-7	0	0	0	0	0
8-14	0	0	0	0	0
15-21	0	0	0	0	0
22-28	0	0	0	0	0
29-4	0	0	0	0	0
June					
5-11	0	0	0	2	1
12-18	0	0	1	2	0
19-25	0	9	28	19	5
26-2	9	15	52	344	57
July					
3-9	15	50	39	313	217
10-16	31	74	179	467	475
17-23	32	181	159	334	291
24-30	106	106	383	448	138
31-6	90	224	143	139	111
August					
7-13	75	26	60	122	19
14-20	12	57	28	241	20
21-27	0	101	189	1,230	287
28-3	84	442	1,193	6,076	832
Sept.					
4-10	877	1,669	2,440	10,964	1,096
11-17	3,120	6,542	4,329	15,124	4,342
18-24	3,131	6,489	7,601	12,816	4,894
25-1	0	7,960	1,680	14,377	2,567
	7,582	23,945	18,504	63,018	15,352

* Data by courtesy of the U. S. Fish and Wildlife Service, Juneau office.

Table 13. 1952-1955 fish wheel catches of pink, red, silver and chum salmon. Data adjusted to a standard unit of effort equal to 24 hours fishing per day.
fishing per day

Week	Reds 1952	Reds 1953	Reds 1954	Reds 1955	Pinks 1952	Pinks 1953	Pinks 1954	Pinks 1955	Silvers 1952	Silvers 1953	Silvers 1954	Silvers 1955	Chums 1952	Chums 1953	Chums 1954	Chums 1955
June																
5-11	5	3	(1)				(1)				(1)				(1)	
12-18	77	53	182	30			56									
19-25	281	61	330	34	1	8	82									
26-2	208	(1)	338	6	113	(1)	10	1								
July																
3-9	151	55	185	7	815	102	500	4			2					
10-16	125	24	66	13	286	58	3,188	690	22		4	3			2	2
17-23	277	151	75	46	6,290	1,411	5,119	538	75	23	49	8	7	2	0	0
24-30	318	260	66	65	2,583	459	9,320	147	77	57	76	10	4	0	10	2
31-6	255	180	442	137	2,964	40	2,823	108	117	52	105	23	4	18	1	3
August																
7-13	47	142	350	93	149	7	638	23	67	46	158	77	10	17	41	0
14-20	38	85	42	26	33	2	76	3	118	47	63	64	23	5	32	16
21-27	10	39	14	9	7	3	11	0	169	122	84	57	46	47	38	27
28-3	4	20	6	5	4	5	6	2	268	226	127	58	80	75	133	18
Sept.																
4-10	2	2	0	(1)	0	2	3	1(1	83	62	87	40(1	139	58	347	26(1)
11-17	0		1		0		1		32	60(2)	81	53	38	155(2)	504	78
18-24	1				8				401	45	81	17	571	500	395	231
25-1									514	30	114	16	1,165	805	1,004	115
Oct.																
2-8									(1)	20	120		(1)	155	190	5
9-15										7	(1)			30	(1)	
16-22										2				8		
Total	1,777	1,075	2,114	471	13,263	2,095	21,833	1,515	1,943	799	1,131	426	2,087	1,874	2,697	523

(1) Wheel inoperative.

(2) Approximations after September 11.

PROGRESS REPORT ON KING CRAB RESEARCH

by

HIRAM REED STEVENS, JR.

For the economy of the Territory of Alaska, and specifically the city of Kodiak, the king crab fishery is rapidly becoming of great importance. In Kodiak, this fishery strengthens and stabilizes the economic welfare of the community by extending the period of employment for many seasonal workers, as well as providing an income to others associated with this industry. Crab fishermen working in the Kodiak region during 1955 earned approximately $200,000. The rise of this fishery from a modest post-war beginning is exemplified in Table 1, which presents the annual catches of king crab from 1951 to 1955.

THE FISHERY

The rapid rise of king crab catches has been startling from another aspect, that of conservation. At present, it is not known how big an annual yield this resource will sustain. The Industry was first to grasp the significance of the problem and asked that research be undertaken to provide the answer. The Alaska Department of Fisheries, first through a Research Grant from Deep Sea Incorporated, and presently financed by the Alaska Legislature, seeks to establish that level of fishing intensity which will assure the maximum sustained yield of crabs to the fishery. The maximum sustained yield is that point where mortality (both fishing and natural) is balanced by recruitment and growth, and at the stock level of abundance that maximises the annual catch by fishing. Thus the problem entails, first, separation of the races and then growth, recruitment and life expectancy studies for each race.

THE PROBLEM

It is believed that the crab stocks in Kodiak waters are made up of various populations. Because the crabs are taken in a number of different localities it is likely that several distinct populations are affected by the fishery. It is for this reason that a study of these separate populations is desired. Although it is beyond the scope of the present crab study program to seek out every distinct population and make a thorough study of it, it is likely that useful information may be obtained about some of the populations inhabiting those areas which are frequently fished.

POPULATION STUDIES

Several approaches are now used or will be used as aids in distinguishing between populations:

(1) Average weights, as determined from catch data, indicate that weight differences in the various fishing areas do exist. There is an increase in average weights of the males as the crab catch proceeds from Alitak Bay in the south to Tonki Cape and Perenosa Bay in the north. Marked differences in the average weights of catches from different areas in Marmot Bay have also been noted. Figure 1 shows the location of these main fishing areas.

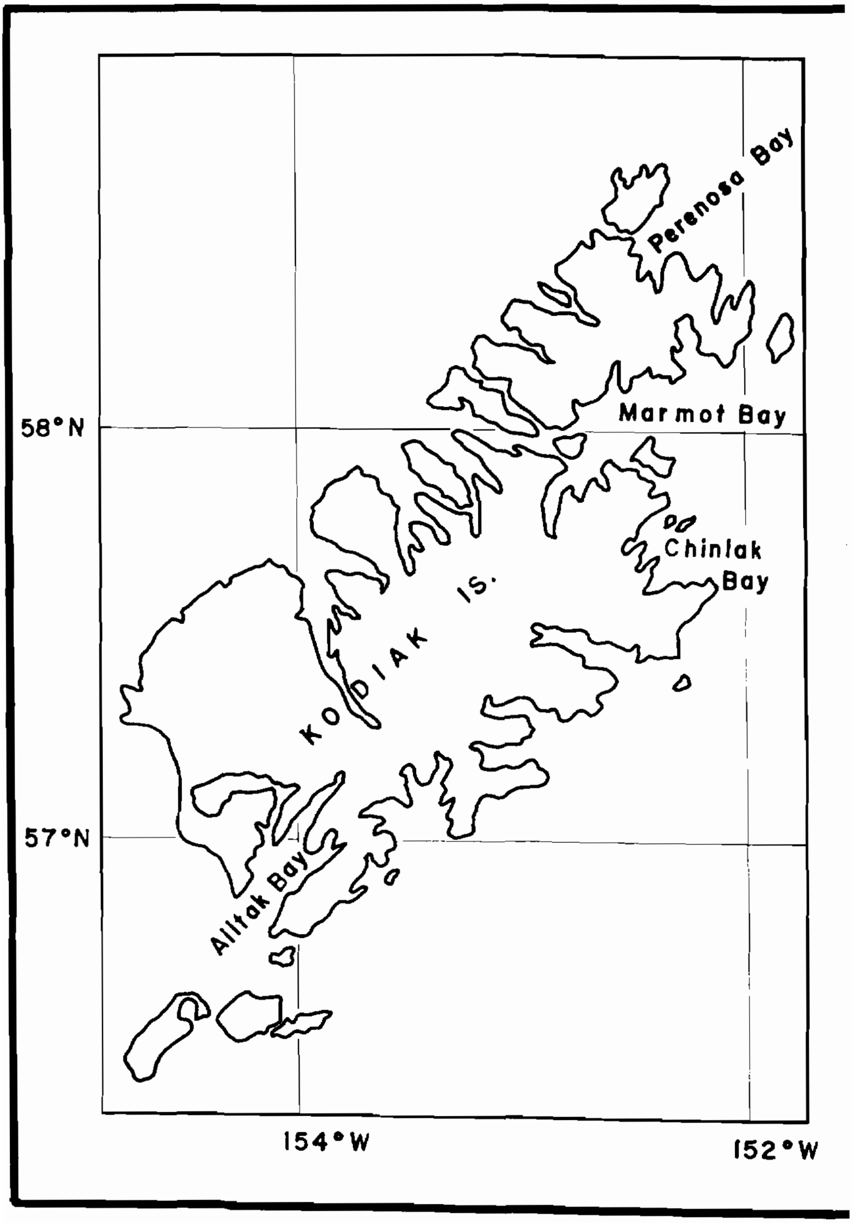

Figure 1. Map of Kodiak Island group, showing location of principal crab fishing areas in 1955.

(2) Measurements of the carapace length and width are also being collected as a possible population identification method.

(3) Growth rates as determined from tagging data may aid in the recognition of populations.

(4) Studies of morphology and physiology of the crabs not only may reveal differences between populations, but may offer means of determining the age of a crab by visual examination.

Table 1. Annual catches of king crab from 1951 to 1955 for the Kodiak area. Catch in pounds of round live crab.

Year	Catch
1951	92,948
1952	538,115
1953	817,397
1954	4,764,315
1955	2,394,611

Source: U. S. Fish & Wildlife Service, Juneau

POPULATION SIZE

The determination of a population size may be approached by using catch per unit of effort data, tagging data, and noted changes in stock characteristics such as size and sex ratios, which may be brought about by selective fishing. Where larvae are found, their abundance may be used as an index to a breeding population.

The schooling characteristics of the crabs may give information as to a population's extent and size if information about the degree of male and female separation is known.

The composition of the population in year classes offers a means of determining whether or not a fishery is being excessively exploited. The analyses of year classes can also yield information as the abundance of the next year's catch. This method cannot be used, however, unless the age of the individual can be determined. There is at this time no known way that the age of an individual adult crab can be determined by visual examination.

The numerical strength of the incoming year classes constitutes the recruitment of a population. One means of approaching the study of recruitment is to determine the numbers of undersized males which are discarded by the fishermen. Working out some method of sampling the juvenile population with specialized gear and thus obtaining an index to their numbers is also being considered.

Some of the factors that bring about a variation in recruitment may be revealed as information about the breeding habits and fecundity of the crabs is accumulated.

MATING HABITS

Live-box observations have indicated that the adult males are polygamous, but it is not known if females with unfertilized eggs are prevalent in a population, nor is it known at what size and/or age the king crabs commonly found in Kodiak waters reach maturity, how many eggs are released by the female, or what is the percentage of larvae survival.

A knowledge of the natural mortality and the fishing mortality is necessary in order to obtain a picture of changes in stock abundance. Landed catch data is available through fish tickets and cannery records. Discard and natural mortality may be estimated from field trip observations. The natural mortality is affected by predation, competition, disease, parasitism and also by fishing mortality. Analyses of year class data, when this is available, and tag returns are two sources which can aid in the determination of natural mortality.

It is well to mention now important environmental factors upon which the life of the individual king crab and certain aspects of crab behavior depend.

(1) An optimum salinity is important to the life processes of the crab. Salinity also influences larval distribution and therefore affects the ultimate fate of the larvae.

(2) Besides bringing about physical changes in a water mass, temperature affects the metabolism and reproductive cycles of marine animals. Crab migrations may be due in part to adjustments to changing temperature conditions.

(3) The bottom topography allows and prevents migrations, presents an environment which may or may not be suitable for protection against predators and affects the available food supply.

(4) The king crab is found only in those areas that support an abundant marine life and it is reasonable to expect that the availability of food influences size, growth and migrations.

(5) Currents and wave action disturb and distribute the larvae of many marine animals, and the size and location of a particular population may be affected in part by these environmental factors.

The king crab study program is at present concerned with several activities:

(1) Data has been, and is being, processed into graphs and tables from the information obtained from tag recoveries, size measurements, length frequency measurements, cannery records and fish tickets.

(2) A tagging program is being carried on by the Department. By this means it is hoped that answers will be obtained to questions related to the direction, time, and magnitude of migrations (where such migrations occur), size of population, separation of races, rate of growth, frequency of molt and age of the crab.

TAGGING

The success of the tagging program will depend greatly upon the fishing intensity and the cooperation of the fishermen in returning the tags with the requested information. In order to encourage tag returns, a reward of two dollars is paid when crab and tag are returned intact together with information on date, place of capture, depth, gear used, and the name of the boat. A reward of one dollar is paid when the tag only is returned with the desired information.

More males than females are now being tagged since the males are the object of the fishermen and, therefore, a greater opportunity for male tag recoveries exists. Because the majority of crabs are taken from Marmot Bay and Alitak Bay, the tagging program is, and will be concentrated for the most part, in these waters. Crabs will be tagged in other main fishing areas, however. (See Figure 1)

Table 2 presents the summary of results of the 1955 crab tagging program. Of interest is the greater percentage of return of females than of males, in spite of the male being the commercially valuable component of the catch. While numbers are small, this could indicate a sex-differential mortality in tagging or a difference in migration habits.

Table 2. Tagging program in Marmot and Chiniak Bays from December 1954 to December 1955.

	Males	Females
Number tagged	308	803
Recoveries	14	67
Percentage of total recovered	2.6	4.2
Percentage of recoveries used for growth studies (1)	57	51
Months free, used for growth study	8.5 - 10.5	7.5 - 12.0
Arithmetic mean of growth of carapace (2)		
Width	20.9	5.4
Length	16.5	4.6

(1) Only recoveries of tags intact on crabs were used in this study.

(2) Measurements taken were in millimeters, 25.4 mm. = one inch.

CRAB GROWTH

The growth characteristics of the tagged crabs after seven or more months of freedom is graphically presented in Figure 2. The length has been plotted on the width at time of release and again at time of recapture. A straight line connects these two points for each individual crab. Most apparent is the sex-differential rate of growth; the males are much faster growing than the females. Only one case of growth in the females equals that of the males and for this reason a mis-sexing of the animal is suspected. The slope of the lines in Figure 2 is dependent upon the growth in both width and length of the carapace. In the males, width and length appear to be maintained in fairly constant proportion. In the females, a much greater diversity in proportion of width and length is apparent. All males grew, while two females showed no growth and one grew only in length. Whether or not ecdycis occurred on these three specimens is not known.

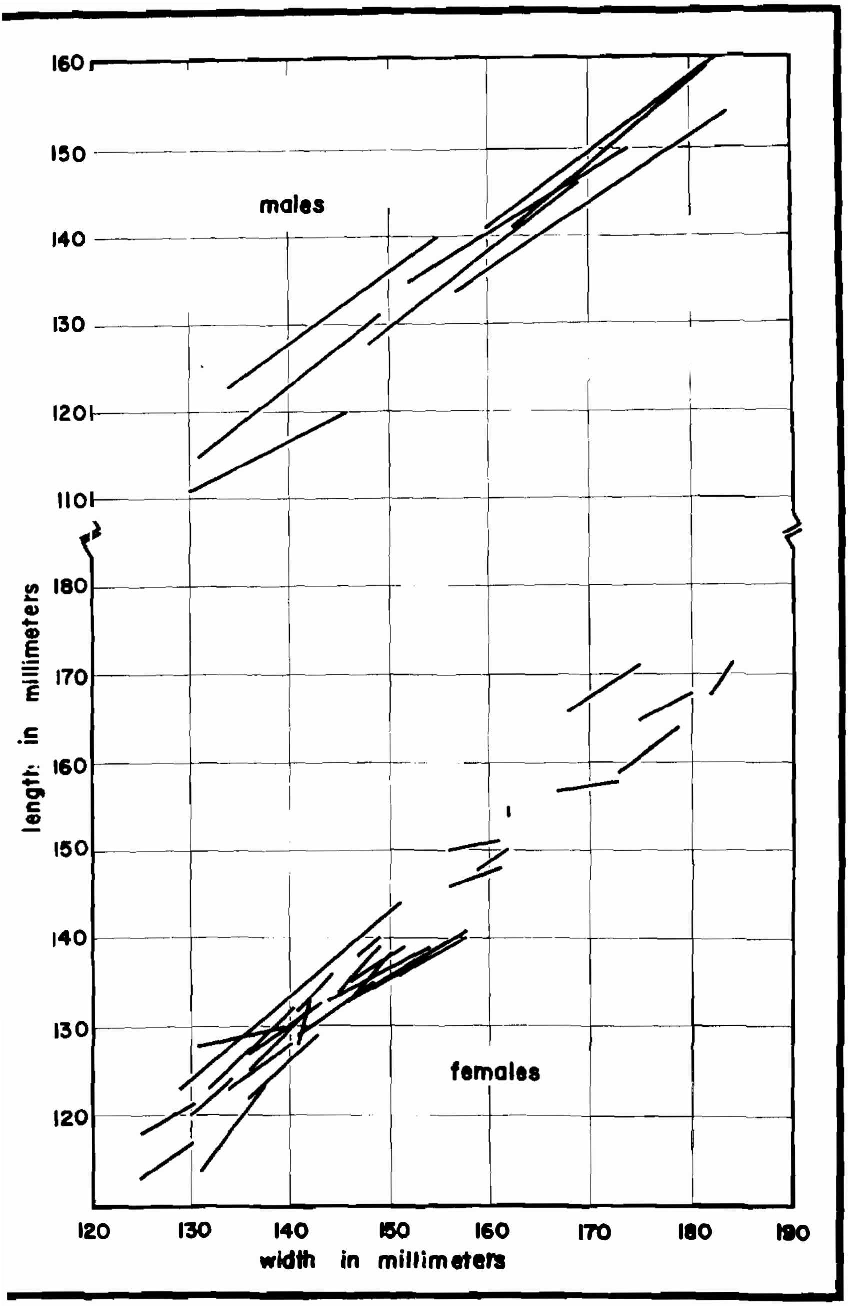

Figure 2. Graphic presentation of the growth of the carapace in length and width of king crabs in a single molt, Kodiak, 1955.

(3) A moderate sized aquarium is being set up at Kodiak for the purpose of studying molting, mating, rate of growth, larval stages (if obtained), and crab behavior and crab behavior and response to different stimuli and foods.

AQUARIA AND LIVE BOX STUDIES

(4) A submerged crab pen will be used in the study program. Marked crabs in the pen will be placed in a natural environment and yet be available to periodic observation. Information concerning the frequency of molt, amount of growth and food requirements of the crab will be sought by this method.

(5) Because the size and/or growth rings of the barnacles which are commonly found on the legs and carapace of the king crab may offer a clue to the frequency of molt and the minimum age of the carapace, a study of the barnacles is a proposed part of the crab research program. Two species from Kodiak king crabs have been identified by Dr. Dora Henry of the Department of Oceanography of the University of Washington; these species are Balanus crenatus and Balanus hesperius.

(6) Log books are to be issued to those fishermen who are willing to use them. Information concerning areas and dates fished, gear used, depth, catch, and duration of fishing operations obtained from this source will be useful to the crab study. The field work is concerned with obtaining information about fishing intensity, catch per unit of effort, discard of undersized males, sex ratios, discard mortality, the natural enemies of crabs, fishing gear and methods.

WATER TEMPERATURE

A knowledge of water temperatures may well be the key to certain aspects of crab behavior and fishing success. A bathythermograph will be employed to obtain data on temperature as a function of depth.

It is clear that many problems must be solved before really confident management of the Alaska king crab resource is possible. It is equally certain that the economic health of the Territory as a whole, and of the Kodiak region in particular, will be benefited by such management.

King crab.

INSPECTION

Continuing its policy of assisting the U. S. Fish and Wildlife Service in the enforcement of Alaska's commercial fisheries regulations, the Department provided one fisheries inspector for each of the following areas during the 1955 salmon season:

Southeastern Alaska - Taku Inlet.
Upper Copper River drainage.
Kenai Peninsula area.
Afognak Island - Kitoi Bay.
Afognak Island - Pauls Bay.

The inspector in Taku Inlet, in addition to his enforcement duties, served as a predator control man since his continued presence on the fishing grounds acted as a strong deterrent to commercial fisheries violations in this rather restricted area. The predator control work involved the eradication of seals on the immediate fishing grounds. Through his serving in the above dual capacity, the Territory benefited from the maximum utilization of the Taku Inlet inspector.

The Upper Copper River and Kenai Peninsula inspectors patrolled their respective areas by truck and on foot. The road systems, to a large extent, parallel the salmon producing rivers in these two areas so the stream could efficiently be checked by highway travel. Salmon protection during the spawning migration was the primary duty of these men. Their other duties included the enforcement of the Territorial Sport Fish License.

The Afognak Island inspectors, in addition to their primary duty as enforcement agents, assisted the Watershed Management and Biological Research Divisions in egg planting and hatchery construction.

The enforcement of the Territorial Sport Fish License Act as stipulated in Chapter 93 of the Sessions Laws of Alaska - 1951, has been a problem since the passage of the Act. Prior to 1955, there was no enforcement of this act. This was generally known throughout the Territory; hence, the collections that resulted could be called contributions.

During the spring of 1955, an intensive campaign was launched by Department employees, in all divisions, publicizing the Sport Fish License Act and notifying anglers that Alaska Department of Fisheries men had been deputized and instructed to rigidly enforce the Act. Following this, offenders were apprehended and cited into the nearest U. S. Commissioner's Court for violation of the Act. The 1955 enforcement resulted in a surge in license sales that is readily apparent from the following table:

Calendar Year	Income from Sale of Territorial Sport Fish Licenses
1951	$ 9,967.00*
1952	14,021.00
1953	25,099.00
1954	32,373.00
1955	64,673.00

*Includes only a six month period since the Act didn't go into effect until July 1, 1951.

PREDATOR CONTROL AND INVESTIGATION

The establishment of a Division of Marine Predator Control and Investigation during 1955 greatly advanced the operational efficiency of the Department of Fisheries. This action makes possible the use of funds and personnel for predator investigations preliminary to undertaking actual control as a fishery management tool.

The permanent division staff is listed below; temporary employees are named and credited in appropriate places in the following report.

James W. Brooks, Biologist
Archie S. Mossman, Associate Biologist
Harold Z. Hansen, Special Deputy Seal Hunter

BIOGRAPHICAL SKETCHES

James W. Brooks was born August 6, 1922, in Erie, Pennsylvania. He received his pre-college schooling in Detroit, Michigan. In March, 1940, he came to Alaska where he worked at several things, including fishing and trapping, before entering the Army Air Force in October, 1942. Commissioned a 2nd Lieutenant in August, 1944, he was separated from service with that rank in November, 1945. Returning to Alaska in December 1945, he worked as a commercial pilot and weather observer. He married Bertha Schaeffer in August 1946, and now has one child. In September 1949, he entered the University of Alaska, being granted the B. S. degree in May 1953 and the M. S. degree in May 1954, majoring in Wildlife Management. Immediately upon completing college training, he joined the staff of the Alaska Department of Fisheries.

Archie S. Mossman, born February 5, 1926, in Madison, Wisconsin, attended grade and high schools there and in Baltimore, Maryland. He served in the United States Navy from 1944 to 1946. Following this, he entered the University of Wisconsin and received his B. S. degree in 1949. He married Mildred L. Johnson in 1949, and now has three children. He entered the University of California in 1949 where he majored in Zoology, and was granted the M. A. degree in 1951. Returning to the University of Wisconsin, he earned the Ph. D. degree with a joint major, Zoology-Wildlife Management, in the summer of 1955. Thereupon, he accepted employment with the Alaska Department of Fisheries, being assigned to an investigation of predaceous birds and their relationship to salmon.

The Department of Fisheries is especially pleased to acknowledge the excellent cooperation and assistance extended by the Cordova Seal Committee, the Alaska Packers Association and particularly Superintendent Fred Butler of the Kvichak and Clarks Point Canneries in Bristol Bay.

A discussion of principles which guides the Department of Fisheries predator control program may be found in the 1954 Annual Report. These principles, constituting policy, warrant brief restatement.

1. Control shall be restricted to types of predators which, to the best of our knowledge, are genuinely detrimental to man's interest.

This rule is a necessity because of the extreme variety of animals including birds, fish, whales, and seals that are known to prey upon, or compete for food with, commercially valuable fish. Aside from the physical and economical impossibility of reducing the numbers of all known predators, it would be highly undesirable in many cases because these animals frequently prey on one another, and so a natural and very satisfactory limitation of their numbers is effected. When the 1955 predator control activities were planned, the harbor seal was the only predator known with certainty to be excessively harmful to a commercial fishery, though a pall of suspicion lay on sea lions, belugas, gulls, and certain fishes. Therefore, control was limited to the harbor seal, while studies were initiated or continued in an effort to learn more about the influence of these other predators on commercial fish.

2. Control shall be restricted to those localities where serious predation or depredation occur.

Confining predator control to problem areas is economical in both money and animal life. Most predators occupy a very wide range in Alaska with only a small minority of the population being harmful. Controlling even this minority is often more than can be done with available resources.

3. Control shall be restricted in time, whenever the nature of the problem permits, to the periods immediately preceding and during which predation or depredations occur. For example, removal of a given number of seals from an area where salmon are being gillnetted may prevent the loss of many fish. The same number of seals removed after the fishing season would have little or no benefit to man. Experience has shown that predators continually move from adjoining areas into places from which their fellows have been removed. The task of keeping them out becomes excessively expensive in relation to the benefits. While there is good evidence that the seal population in all of Southeastern Alaska has been slightly reduced after years of control, the benefits already enjoyed probably have been due almost entirely to the selective nature of the Department's control program.

There may be cases where a predator is susceptible to control only at a certain time of year, which may or may not correspond to the periods of its harmful activities, as perhaps sea lions when on breeding rookeries. When situations of the above nature are found to exist, this requirement of synchronizing control with the occurrence or imminent occurrence of predation will be modified.

4. Control shall not be so intensive or widespread as to threaten with extinction or extirpation in a sizeable area any form of animal life.

SEAL CONTROL

Predator control in 1955, as in past years, dealt mainly with harbor seals in three different localities: The Stikine River, the Taku River, and the Copper River Flats. These three places support gillnet salmon fisheries, which suffer serious trouble from the net-robbing activity of seals when the animals are not controlled. There are probably other gillnet fisheries that would benefit from seal control, but budgetary limitations and the present lack of knowledge concerning the nature and magnitude of these other problems prevented the inauguration of new control programs during the year.

1955 marked the fifth consecutive season that the Department has controlled seals in the Stikine River area. The same expert rifleman, Clifford Kilkenny, who conducted the work in previous years was again employed. A tabulation of the animals killed is presented below:

STIKINE RIVER

Year	Hunters	Seals killed	Sea lions killed
1951	2	946	0
1952	2	768	18
1953	1	552	11
1954	1	491	35
1955	1	362	18
	Total	3,119	82

The above figures denote a steady decrease in seals since the outset of this program, and field observations verify this trend. Substantial benefits due to a reduction of depredations, a thing both enjoyed and acknowledged by gillnet fishermen, testify to the success of this control work. Measurements, sex, breeding condition, and stomach contents were recorded from fifty-seven of the seals killed. The remaining animals sank and could not be recovered. Because the cost of this program is small in relation to the benefits returned, it will be continued in 1956.

The fishery inspector for the Taku River area, Oscar Oberg, in addition to enforcement duties, exercised local seal control during the salmon fishing season. This arrangement has proven effective since its inception in 1952, and will be continued during 1956. An enumeration of animals killed is given below, but the annual kill figures are not necessarily comparable because hunting intensity has not always been uniform. Nevertheless, it is obvious on the fishing grounds that seal numbers are being reduced.

TAKU RIVER

Year	Seals killed	Sea lions killed
1952	123	-
1953	355	-
1954	186	-
1955	81	7
Total	745	7

Seal depredations on the Copper River gillnet fishery are more severe than elsewhere due to the greater number of seals and to the wide dispersion of the fishing effort. Prior to 1951, individuals or groups attempted to relieve the problem, but their resources were not equal to the task. In 1951, the Department of Fisheries assumed and has continued to bear much of the responsibility for controlling the seals. The Cordova Seal Committee,

COPPER RIVER

a group of fishermen and packers, provides $1.00 for each $5.00 allotted by the Department for this work.

The following men conducted the control activities described below:

George Chambers
John Goeres
Harold Z. Hansen
Lewis Hasbrouck
Jim Nichols

During the summer of 1955, the depth bombing method for killing seals was used for the fifth successive season. (The reader is referred to the Department of Fisheries 1954 Annual Report for a description of this technique). The intensity of control was similar to that in the preceding three years; in 1951 the duration of control was much shorter. A tabulation of seals killed to date is given below:

Date	Seals killed
1951	500
1952	6,789
1953	6,799
1954	4,909
1955	3,356
Total	22,353

That substantial inroads have been made in the seal population cannot now be doubted, but still their depredations are occasionally so excessive that a continuation of control is necessary. It is anticipated that during the 1956 season, bombing activity will be halved, though a rifleman will be employed for the first time to hunt areas where seals are not otherwise vulnerable to control.

SEAL INVESTIGATIONS

An extra benefit deriving from seal control activities is the accumulation of information concerning many aspects of the animal's existence. The hunters record the abundance of seals in their areas and the extent of depredation. From animals collected, they record the size, sex, and stomach contents and they save sex organs (for reproductive studies). When adequate information of the above nature is at hand, a more confident and perhaps wiser approach to seal control will be possible. Acquisition of new knowledge relating to seals will continue to be an important function of control activities.

BELUGA INVESTIGATION

In Bristol Bay, where salmon runs in recent years have been alarmingly small, the beluga is a common predator. To determine how many salmon are eaten by these animals and what effect this loss has on the fishery, the Alaska Department of Fisheries launched an investigation in 1954, which was continued in 1955. James W. Brooks carried out this investigation. The results of the first season's work and other information concerning the beluga were presented in the 1954 Annual Report. The present account deals mainly with the findings that bear immediately on the question of how this predation influences the salmon fishery. Other information concerning age, growth, reproduction and behavior of belugas will be presented in a subsequent report.

To provide background for better understanding of the work that has been done, a brief description of the beluga may be helpful. The beluga is a toothed whale, more closely related to the killer whale and porpoises than to the baleen whales such as the humpback and finback. It is small in size, ranging from about five and a half feet at birth to twelve and a half feet for an adult female and fifteen and a half feet for an adult male. Its color at birth is dark grey on the back, usually shading to ivory on the belly. Within a few days its entire body becomes grey. With increasing age, the grey coloration lightens until a milky white color is attained at about five years of age (See Figure 1).

DESCRIPTION

Figure 1. An adult male beluga (No. 68, Kvichak Bay).

Belugas are found throughout the arctic and are usually migratory. Many that spend the summer in the waters of arctic Canada and Siberia migrate to the Bering Sea for the winter. The migrations of other belugas are more limited, for we find them in Cook Inlet and Bristol Bay in all but the winter months, and even then small groups are sometimes seen in these places. It is possible, even probable, that some of the belugas which we encountered in Bristol Bay had, in other years, migrated farther north because abundance in the Bay seems to vary from year to year.

RANGE AND MOVEMENTS

During the spring and summer months, when field studies were conducted, all of the belugas known to be in Bristol Bay were confined to Kvichak and Nushagak Bays. Our estimates of beluga numbers in these places, based on surface observations, aerial observations, and fishermen and pilot reports during 1954 and 1955 are given below:

NUMBERS

1954	May	June	July	August
Kvichak	250	250-400	?	600
Nushagak	?	250-400	400	400

Total - both Bays combined 1,000

1955	May	June	July	August
Kvichak	100	150-250	?	50-100
Nushagak	?	250	250-450	450

Total - both Bays combined 525

There was some movement of belugas between Kvichak and Nushagak Bays, perhaps in response to differing abundance of salmon in these places. The decrease in the number of belugas present in 1955 as compared to 1954 was obvious to nearly all who had occasion to observe the animals both seasons. Our collecting activities eliminated sixty-eight belugas in 1954, but this would not account for so large a difference between years.

To determine the kind and quantity of food consumed by belugas in Bristol Bay, 116 of the animals were collected for stomach examination during the months of May through August in 1954 and 1955. Food taken in May and June differed considerably from that taken in July and August each year, so it will simplify presentation and later evaluation if these two periods are considered separately here. During the first period, May and June of 1954 and 1955, thirty-seven belugas were caught in the lower Kvichak River; their stomach contents are tabulated in Table 1.

MATERIALS COLLECTED

Table 1 illustrates a dietary shift from smelt to fingerling salmon in late May which deserves some explanation. While the belugas were

Table 1. Stomach Contents of Belugas From Kvichak River and its Estuary, May and June of 1954 and 1955.

Field No.	Date	Red Salmon fingerlings	Smelt	Flounder	Lamprey	Blenny	Stickle-back	Dolly-Varden	Shrimp
1	5/26/54		503						
2	5/27/54		400†						
3	5/28/54	1	600						
4	5/31/54	1,040	75						2
5	6/1/54	1,342	5						
6	6/4/54	1,387	2						
7	6/6/54	931	3						
8	6/6/54	216							
9	6/11/54	218	6						
10	6/11/54	156							1
11	6/11/54	751	4						
13	6/17/54	472		1	2	24			
72	5/22/55	7	386						
73	5/24/55	140	710						
74	5/27/55	958	35						12
75	5/28/55	1,702	32						35
77	5/28/55	367	8						
78	5/30/55	437	66						
79	5/31/55	531	21						
80	5/31/55	399	44						
81	5/31/55	402	20	1					
82	5/31/55	58	2						
83	6/2/55	775	48				2	1	
84	6/3/55	358	21						
86	6/4/55	2,798	14				1		
87	6/6/55	778	29						
89	6/6/55	651	41						
90	6/6/55	367	9						
91	6/6/55	341	11						
92	6/7/55	1,622	6						
93	6/7/55	164	1						
94	6/8/55	846	34						
95	6/9/55		28						
96	6/11/55	343	40	1			2		1
98	6/11/55		4						
100	6/14/55	15	422						
101	6/14/55		14						20
	Totals	20,573	3,644	3	2	24	5	1	71

being collected, the downstream migration of young red salmon began and ended. Characteristically, this migration is composed of dense schools of salmon moving along within a foot or two of the surface. This behavior of the salmon appears to make them more readily available to belugas than are smelt which, though perhaps equally abundant, favor the bottom of the river and may be less densely schooled. The presence of smelt, rather than relieving predation pressure on the salmon, probably intensifies it by holding belugas in this area prior to the onset of the salmon migration (see Figure 2).

About mid-June, the downstream red salmon migrants have nearly all passed to the sea where they seem to be no longer troubled by belugas. Shortly thereafter, mature salmon appear in the estuaries of the Kvichak and Nushagak Rivers heading for their upriver spawning grounds. These mature fish then make up the bulk of the beluga's food. (see Figure 3).

From the first part of July to the middle of August in the 1954 and 1955 seasons, seventy-eight belugas were collected. Stomach contents from these animals are tabulated in Table 2.

It may be seen in Table 2 that 73%, or nearly three fourths, of the belugas had eaten adult salmon. Calf belugas existed on milk, small

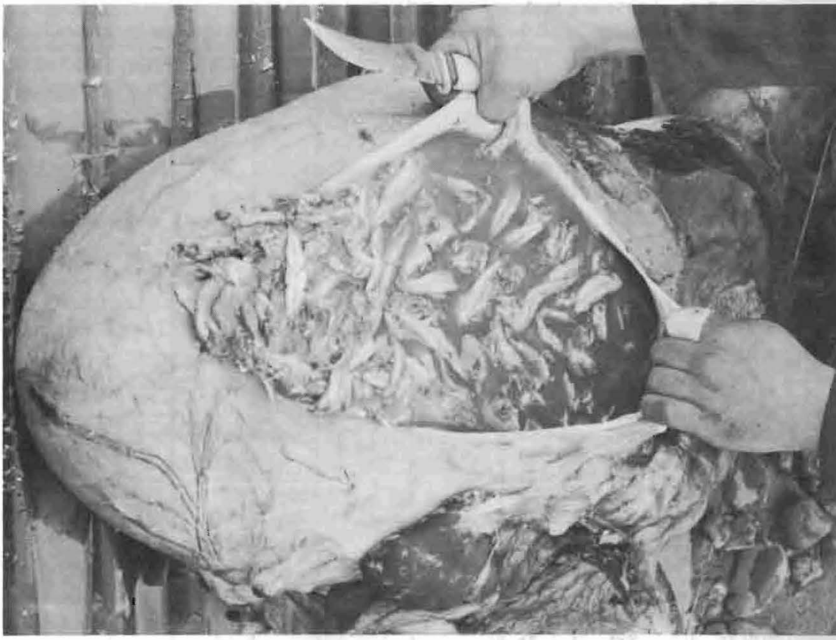

Figure 2. Beluga stomach (No. 86, Kvichak River) nearly filled with young red salmon.

Figure 3. Beluga (No. 103, Nushagak River) showing remains of several adult salmon taken from its stomach.

Table 2. Stomach contents of 78 belugas from Kvichak and Nushagak Bays, Period July 1 to August 18, 1954 and 1955.

Food	Number of stomachs in which food items occurred	% of stomachs in which food items occurred	Number of individual specimens			
			Max.	Min.	Avg.	Total
Salmon (red)	38	49	11	1	4	137
Salmon (chum)	28	36	5	1	2	51
Salmon (pink)	18	23	14	1	4	73
Salmon (silver)	14	18	4	1	2	26
Salmon (king)	5	6	4	1	2	8
Salmon (unid.)	5	6	10	1	4	20
Salmon (all species combined)[a]	57	73	16	1	6	315
Blenny	13	17	65	1	15	201
Sculpin	7	9	5	1	3	18
Smelt	3	4	10	2	7	20
Flounder	3	4	7	1	4	11
Fish, small (unidentified)	3	4	7	1	3	9
Shrimp	12	15	27	1	10	114
Milk	3	4				
Empty	12	15				

[a] All salmon listed were adults.

bottom fish and shrimp. One year old animals took few adult salmon, depending mainly on smaller fish species. No evidence was found of adult belugas intentionally sharing their food with younger animals. All food items, including king salmon, were swallowed whole and frequently failed to show even tooth marks.

As pointed out earlier, separate consideration of predation on seaward red salmon migrants (fingerlings) and predation on adult salmon will make for ease in treatment and understanding of the information that has been gathered.

Concentrating first on the young salmon, Table 1 suggests that their passage through the lower Kvichak River lasted approximately nineteen days during both 1954 and 1955, and observation of the migration itself showed this to be true. Attention is here restricted to the belugas caught during the two 19-day periods of May 30 to June 17, 1954, and May 24 to June 11, 1955. Thus, the stomachs of thirty belugas taken in the above time intervals contained 20,550 red salmon fingerlings, or an average of 685 fish per stomach.

EVALUATION OF FINGERLING LOSSES

In calculating the probable loss of salmon fingerlings through beluga predation, the average number of these fish per beluga stomach (685) is considered a complete meal. Obviously, this assumption errs on the conservative side because the belugas were in most cases still feeding in the river when interrupted by pursuit and capture. If undisturbed, the belugas usually had two active feeding periods daily, coinciding with each flood tide. Because this was not an invariable rule, greater accuracy of computations results by crediting the belugas with only one and a half complete meals per day. While the extremes were wide, 150 seems a reasonable figure for the number of belugas usually entering the river. From the above information the magnitude of the annual downstream migrant loss may be calculated as follows:

685 salmon X 1.5 meals X 19 days X 150 belugas = 2,928,375 salmon.

The importance of such predation in the Kvichak River is magnified by the present depleted state of the Kvichak salmon runs. If no predation had occurred and five per cent of these fingerlings returned as adult fish, they would at that time number about 150,000 or more than half of the 1955 Kvichak escapement to the spawning grounds (approximately 250,000).

The Kvichak River was selected for this initial investigation of predation on downstream migrants because belugas appeared more numerous than in other nearby rivers. A further consideration was that if such predation was anywhere harmful, it would be there because of the incomparable depletion of the Kvichak red salmon runs. It is possible that similar predation problems occur elsewhere, but as yet little information is available beyond the knowledge of beluga occurrence, particularly in the Naknek, Wood, and Nushagak Rivers.

In calculating and evaluating the loss of adult salmon through beluga predation, it is necessary to employ a different method for treating the data than was used in the case of downstream migrants. Predation intensity varied with changing abundance of salmon, and because more belugas were collected in time of low predation intensity a simple average of salmon ingested per beluga during the whole time that predation occurred would not be sufficiently accurate for our purposes. Therefore, the average number of salmon per beluga stomach examined during seven weekly periods in 1954 and the same periods in 1955 was calculated and the mean taken of these averages. These data are shown below:

EVALUATION OF ADULT SALMON LOSSES

Table 3. Record of Adult Salmon Occurrence in Beluga Stomachs on a Weekly Basis with Computation of Weekly and Seasonal Means.

Weekly Periods (both 1954 and 1955)	No. of Belugas (No calves included)	No. of Salmon		Average per Beluga	
		Reds	All Species	Reds	All Species
July 1 to 7	6	32	34	5.3	5.7
July 8 to 14	10	33	45	3.3	4.5
July 15 to 21	14	41	74	3.0	5.3
July 22 to 28	5	5	50	1.0	10.0
July 29 to Aug. 4	10	8	31	.8	3.1
Aug. 5 to 11	15	10	59	.7	4.0
Aug. 12 to 18	10	8	21	.8	2.1
		Mean of Weekly Averages		2.1	5.0

From Table 3, the mean values of 2.1 for red salmon and 5.0 for all species of salmon combined are taken to represent the number of these fish ingested by each beluga per day during the entire seven week period. Without doubt, belugas consumed more fish each day than were found in the stomachs which we examined, and it is even more certain that they were eating adult salmon prior to July 1. But, until we have actual evidence in hand of what these additional losses might be, a confident estimate of minimum salmon losses seems preferable to a questionable estimate of what the extreme losses might be.

While it was advantageous to combine the data from Nushagak and Kvichak Bays and also for the years 1954 and 1955 in trying to establish the probable daily rate that belugas eat salmon, the smaller number of belugas present in 1955 makes it necessary to figure total salmon losses separately for each season. Our estimates of beluga numbers have been scaled down 20 per cent in these calculations because calves do not eat adult salmon.

1954

Red salmon
2.1 salmon X 49 days X 800 belugas = 82,320

All species of salmon
5.0 salmon X 49 days X 800 belugas = 196,000

1955

Red salmon
2.1 salmon X 49 days X 405 belugas = 41,674

All species of salmon combined
5.0 salmon X 49 days X 405 belugas = 99,225

With regard to red salmon, the 80,000 fish in 1954 were drawn from a run of about 3,000,000 fish which amounts to a 2.7 per cent loss. In 1955, 40,000 fish from a run of about 4,000,000 fish gives a loss of 1.0 per cent. We do not have sufficient information to express the loss of other species of salmon as a percentage of all that were present.

In considering these losses, several facts must be kept in mind. One, the salmon taken by belugas were destined to all rivers of Nushagak and Kvichak Bays. Two, a good fraction (over 20%) of the total loss was humpback salmon which are not important to the fishery even in years when they are plentiful because of net mesh size limitations. Three, many of the salmon taken were late run fish that would not enter the commercial catch and would have questionable value on the spawning grounds. Four, the tendency of belugas to seek out areas of greatest salmon abundance would tend to reduce their pressure on depleted fish runs. And five, only the red salmon have shown marked depletion that could be attributed to, or seriously aggravated by, beluga predation or over-fishing.

Beluga predation on young red salmon migrating seaward in the Kvichak River is believed to be a serious mortality factor that is costly to the fishery while appreciably retarding the restoration of these depleted salmon stocks. For this reason and because the belugas have no commercial value, and but slight subsistence value to the local natives, it is anticipated that action will be taken to keep the animals out of this river during May and June, 1956.

CONCLUSIONS

The number of adult red salmon taken by belugas, as compared to the number which escape, appears so small (2.7% in 1954 and 1.0% in 1955) as to be of little practical importance. Other species of salmon are even less affected. There would probably be no detectable increase in salmon entering the commercial catch or reaching the spawning grounds if predation by belugas on adult fish were eliminated completely. An unfavorable change in this situation could develop, however, if the salmon runs suffer further depletion or if beluga numbers increase significantly. The Department of Fisheries will continue to gather information on this problem and will be alert to changes which could be detrimental to human interest.

OTHER PREDATOR INVESTIGATIONS

Under contract with the U. S. Fish and Wildlife Service, using funds made available by the Saltonstall-Kennedy Act, the Alaska Department of Fisheries instituted an additional investigational program in 1955. The program is composed of four study projects listed below.

Study Plan I	A study of the sea lion in Alaska with particular reference to the commercial fisheries.
Study Plan II	An ecological life history study of the beluga with special emphasis on its relationship to salmon. This study was started in 1954 and carried through 1955 with Territorial funds. The results of this work that relate to predation on salmon are presented elsewhere in this report.
Study Plan III	A study of predation on salmon by gulls, terns, mergansers and other predaceous birds.
Study Plan IV	Basic predator-prey research employing controlled experiments in natural lakes.

By contractual agreement, reports on the above investigations must be made to the U. S. Fish and Wildlife Service, which has prior rights to publication of all findings. The contract is for a single year, but it is hoped that it will be renewed so that at least two years of continuous study of the above problems will be possible.

SPORT FISH

This report covers the activities and progress of the Sport Fish Division and represents the combined efforts of the following staff:

E. S. Marvich, Senior Biologist
A. H. McRea, Senior Biologist
R. J. Simon, Junior Biologist

BIOGRAPHICAL SKETCH

Robert J. Simon was born on September 17, 1925, at Valentine, Nebraska. He attended grade and high schools in that state. From 1943 to 1946, Simon served in the U. S. Navy at San Diego, receiving an honorable discharge from the Service. He entered the University of Washington in 1949 and received his Bachelor of Science in Fisheries Degree in 1953. During university summer vacation periods and the school year he was employed by the Fish and Wildlife Service counting and identifying plankton samples, by the Fisheries Research Institute as an Alaskan stream surveyor and by the University of Washington Fisheries School as a fish hatchery assistant. Mr. Simon joined the staff of the Alaska Department of Fisheries in June 1953 and is currently stationed at Fairbanks.

PROBLEM

Alaska's remote regions are truly an angler's paradise. One can stand at a single spot in the Nushagak River watershed in the Bristol Bay area and easily catch large northern pike, grayling, and rainbow trout, each weighing several pounds apiece. With angling like this, what's the problem in sport fish management?

Unfortunately, for the most part, very few anglers can take advantage of the virgin fishing conditions found in outlying areas. Transportation costs, plus valuable time-consuming travel during Alaska's busy season, prevent the majority of anglers from traveling far afield. They must confine their efforts to the lakes and streams near their homes or available by automobile. Here, the game fish stocks have suffered an alarming depletion during the past decade. Game fish rehabilitation and management efforts, therefore, have been confined to the readily accessible waters by the sport fish staff of the Department.

WATER DISCUSSION

One cannot discuss fish without becoming involved with a discussion of the properties of water. It may seem superfluous to discuss water, one of the most taken-for-granted commodities on earth; however, it is a rather unique and wonderful substance which deserves more serious study by both the scientist and the layman. It might be wise to digress for a moment and discuss the properties of water, coupling these with sport fish management.

Water is unrivalled in its ability to store and release heat. It can give off a lot of heat or absorb a lot of heat with very little change in its own temperature. Anyone who has waited for soup to cool or water to boil is familiar with this property. For this reason, water is a favorite for transferring heat; it is commonly used for this purpose in home and building heating installations. Water exhibits a peculiar property during the absorption or loss of heat. Any solid or liquid generally contracts as it cools; conversely, it expands as heat is absorbed. Water, too, contracts as it cools but only to a point, that point being about 39° Fahrenheit. Below this temperature water expands, becomes lighter, until at the freezing point water undergoes tremendous expansion to form ice. This expansion adds about 1/11 to its liquid volume so the ice readily floats.

The ability of water to retain a large amount of heat and water's peculiar change in density during the cooling process has enabled it to support fish during the long rigorous winters in Alaska. If water contracted as it cooled, thus becoming increasingly heavier to the freezing point, 32° Fahrenheit, the lakes in Alaska would be solid packed ice. Fortunately, this does not occur. The lakes cool during the fall of the year and the heavier surface water sinks to the bottom of the lake, displacing the warm bottom layer by sending it upward. When the lake reaches 39° Fahrenheit, the water does not sink but stratifies with the colder lighter water remaining on the surface. Ice finally forms at the surface and stays there, acting as an insulating blanket, thus preventing the extreme cold, down as low as 60° below zero Fahrenheit, from penetrating down deep into the lake. The heaviest layer of ice observed during the past five years occurred in the spring of 1953 when interior Alaska lakes were covered with ice up to fifty-eight inches thick.

Obviously, the ice layer forming at the surface of the lakes cuts off oxygen replenishment during the winter. The ice and snow layer precludes water aeration and plant photosynthesis. Inlet streams can become frozen solid and eliminate this source of oxygen. As a result, some lakes must store enough dissolved oxygen during the fall to provide for the respiration of fish, other animal life, and plants during the winter. In addition, oxygen in excess of that required for animal and plant respiration must be available for the decomposition of organic material that occurs in the lake.

Fortunately, mother nature here again has taken care of this circumstance. Water has the ability to hold increased amounts of oxygen as it cools. For instance, water at 39° Fahrenheit holds over $1\frac{1}{2}$ times as much oxygen as water at 77° Fahrenheit. Since lakes cool during the fall of the year and are undergoing a "turn over", the water at all levels is subject to considerable aeration. In Alaska, this fall turn over results in the entire lake receiving a charge of oxygen at 39° Fahrenheit. Immediately after this, the lakes freeze over so that the water underneath the ice layer is saturated with oxygen.

The quantity of dissolved oxygen stored in the water beneath the ice layer in the lakes was of immediate concern to the biologists. Obviously, if insufficient oxygen were available it would be wasteful to stock trout fry in a lake. As a result, the men undertook the investigation of shallow lakes in which it was suspected that marginal quantities of oxygen may be available over the winter months. Dissolved oxygen concentrations and other chemical data were recorded in thirty lakes during the winter months.

Certain lakes, supposedly virgin and able to support fish, were investigated by the biologists and found to be deficient in oxygen during the winter and spring months of the year. This, of course, precluded successful stocking of the lakes. Among these can be listed large lakes such as Willow Lake near Copper Center, Crescent or Moon Lake near Tok Junction and numerous pothole lakes in the Anchorage area and throughout interior Alaska.

FAIRBANKS HATCHERY

Past Annual Reports have discussed the procedures used in egg procurement, incubation and hatching at the Department's hatcheries. Holding and feeding of the trout fry was also discussed in detail. The same general procedures were used in 1955; however, certain refinements were incorporated during the year, thus insuring more efficient operations at the Department's sport fish hatcheries at Fairbanks and Anchorage.

The Fairbanks Hatchery is located alongside the Richardson Highway fifty-six miles south of the City of Fairbanks (Figure 1). The hatchery is a fourteen-trough station and uses the outlet of Birch Lake for its water supply. This station, built during the spring of 1952 as a four-trough hatchery, was increased in size to accommodate fourteen troughs in 1953. During 1954 and 1955, several modifications were incorporated at this station which resulted in a higher efficiency.

Figure 1. Fairbanks Trout Hatchery.

During 1955, a 1500 watt gasoline powered generator was obtained from surplus property of the U. S. Army. This 110 volt AC generator provided sufficient power so that electric lights could be installed in the hatchery building to assist in tending incubating eggs and newly hatched fry. In addition, an electric power grinder was purchased; this saved many man hours in the tedious feed grinding during diet preparation for the fry.

Heavy rains in the spring of 1955 preceded and accompanied the spring breakup on Birch Lake where the control dam for the hatchery water supply is located. Since the ground was still frozen and some snow remained in the hills, the surface runoff was great. This raised the lake level so that water ran over the top of the retaining dam and the increased head in the lake caused the undercutting of the dam. The undercutting resulted in an unhindered flow of water down the outlet channel and nullified the control of the water level in Birch Lake and its use as a reservoir as discussed in the Annual Report for 1954.

During the summer of 1955, however, there was an adequate flow of water in the outlet stream from Birch Lake, thus supplying the hatchery with an abundance of water. When the stream flow started to subside in the fall of the year, the control dam was repaired. Six tons of rock and moss were used in anchoring the dam to prevent a reoccurrence of the undercutting experienced that spring. From all indications, the control dam will operate efficiently and can be used to impound excess water in Birch Lake during the 1956 season. The impounded water can be used during the summer to insure a sufficient flow of water to the hatchery intake in the event of inadequate rainfall in this period.

TROUT EGG PROCUREMENT

Eyed rainbow trout eggs were procured from a supplier in the State of Washington and eyed steelhead trout eggs were obtained from Kodiak for the Fairbanks Hatchery. As in previous years, the early rainbow trout eggs had incubated, hatched and been planted prior to the arrival of the steelhead trout eggs. By staggering the arrival of the eggs at the hatchery in this manner, the station could double its output of desirable trout for stocking purposes.

As discussed in past Annual Reports of the Department, the hatchery program is designed to provide trout fry (fish less than two inches in total length) for the stocking of virgin lakes and ponds, rehabilitated lakes and waters where little or no spawning facilities are available for trout. No attempt is made to rear the fish to the larger sizes. The trout fry are stocked as seed fish. Rearing is accomplished in the natural habitat - in the lakes and ponds.

Waters stocked from the Fairbanks Hatchery are listed at the end of this report. A total of 277,000 rainbow and steelhead trout were stocked from this station during 1955.

FIRE LAKE HATCHERY

The Fire Lake Hatchery is located seventeen miles northeast of Anchorage on the Glenn Highway. This building was built by the Anchorage Sportsmen's Association during 1953 and donated to the Department on completion. The hatchery commenced operations in the spring of

1954 when twelve hatchery troughs were installed in the building. The station was constructed to accommodate forty troughs, but budgetary limitations prevented the purchase of more than twelve troughs at that time.

An additional twelve troughs were installed at the station during 1955, thereby doubling the fish hatching facilities. Twenty-four troughs were in operation during the entire hatchery season.

The trout eggs were obtained from the same sources as those discussed for the Fairbanks Hatchery. The Fire Lake Hatchery produced a total of 475,000 rainbow and steelhead trout fry. A list of the waters planted from this station can be found at the end of this report. The list includes twenty-seven lakes that were stocked with trout from the Fire Lake Hatchery.

TROUT HAULING

Trout hauling from the hatcheries to the planting locations was accomplished, in most instances, by loading the fish in an aluminum tank which was mounted on a 3/4 ton pick-up truck (Figure 2). The tank has a capacity of 250 gallons of water and fish. Air was supplied to the water by means of a positive

TRUCK TANKS

Figure 2. Sportsmen helping unload trout from the fish hauling tank.

displacement piston type air pump run by a six-volt electric motor. Power was supplied to the air motor from the truck battery. Proper aeration of the water containing the fish was assured by ceramic diffusers attached to the rubber air hoses beneath the surface of the water. The diffusers broke the air, coming from the air pump, into thousands of small bubbles which guaranteed a better exchange of gases between the introduced air and the water containing the fish. The tanks, mounted on trucks, were used in all fish stocking accomplished via the highways. As many as 25,000 trout could be hauled per trip using this equipment.

Portable fish planting units were used in cases where aircraft provided the transportation to the stocking site. Each unit included four five-gallon cans for carrying fish and water, an air pump and a six volt battery to provide the power for the pump. These units operated in a similar manner to the truck type planting tanks, but were much smaller and lighter. The entire unit loaded with fish weighed 206 pounds and had a capacity of about 8,000 trout, being able to carry this load of fish for slightly over two and one-half hours.

PORTABLE UNITS

Back pack planting cans were used when hauling fish from the roads to hike-in planting waters. The five gallon cans are specially constructed so they fit and balance nicely on a packboard (Figure 3). Ordinarily, about 2,000 trout fry are loaded per can.

Figure 3. Anchorage Isaac Walton League members packing trout from the Fire Lake Hatchery in to Beach Lake near Chugiak.

LAKE REHABILITATION

The lake rehabilitation program of the Department has been reviewed in detail in past Annual Reports. Briefly, this program includes the elimination of all fish from a lake in order to remove all fish competitors or predators of trout, and the subsequent stocking of the lake with desirable game fish. The predators or competitors include such fish as suckers, stickleback, pike, cottoids and shiners. It is readily apparent that the presence of predators hampers the introduction of trout; all too frequently food competition from those fishes that appear to be innocuous is just as great a barrier to successful trout introductions. The lake rehabilitation program, using rotenone as a fish toxicant, provides the biologists with the tools to eliminate detrimental fishes from a body of water (Figure 4). The program can be compared to the farmer's clearing a field and sowing a crop.

The lake rehabilitation program during 1955 included the clearing of all fish from the following waters:

Lake	Surface Acreage	Location	Scrap Fish Killed
Lucille	370	Matanuska Valley	Suckers, stickleback
Mirror (Bear)	60	Mile 24, Palmer Highway	Stickleback
Pits (Alaska Railroad Yard)	14	Fairbanks	Suckers, chubs
	444		

Figure 4. Spraying fish toxicant in the shallow area of a lake during lake rehabilitation.

Lake Lucille, located near Wasilla in the Matanuska Valley, had been studied for several years prior to rehabilitation. That rehabilitation was essential for the proper management of this lake appeared obvious, since the lake was saturated with a sucker and stickleback population. Problems in connection with this project had to be worked out prior to attempting the rehabilitation of this 370 acre lake - the largest lake so far attempted in Alaska.

LAKE LUCILLE

Literally hundreds of small underwater springs were found at the bottom of Lake Lucille; any one of these, if it were missed or incompletely treated with rotenone, could prevent the complete eradication of the scrap fish in the lake. The outlet, meandering through ten miles of swampy area into meadow Creek of the Big Lake system could, if improperly treated, permit the suckers and stickleback to re-infest Lake Lucille after the rotenone's toxicity had dissipated. Meadow Creek provided spawning grounds for trout and salmon; the possibility of toxic water reaching this creek through the Lake Lucille outlet also had to be considered. The above problems were subject to an intensive investigation for several years prior to the actual rehabilitation.

In order to prevent the toxic waters in Lake Lucille from flowing into Meadow Creek and to prevent the upstream migration of scrap fish into the lake, a wooden barrier consisting of a low dam eighty feet across the outlet was constructed with the help of the Matanuska Valley Sportsmen's Association and a number of independent sportsmen (Figure 5). These men provided the extra man power and equipment necessary for the job; their services were donated, demonstrating again the interest shown by sportsmen in the fish management program of the

Figure 5. Barrier at the outlet of Lake Lucille during construction.

Territory. The dam kept the toxic waters in Lake Lucille from flowing down the outlet and contaminating Meadow Creek and will serve as an effective barrier, preventing the reinfestation of the lake through the outlet.

Provisions were included in the Lake Lucille outlet barrier for screening the water leaving the lake. This screen will prevent the migration of the trout out of the lake and down the outlet.

The underwater springs in Lake Lucille were located during the survey of the lake and were marked with buoys (Figure 6). Each spring was treated by lowering rotenone bearing balls into it at the time of toxicant application for the rest of the lake and periodically for another two weeks. The rotenone bearing balls slowly dispersed in the springs and prevented the trash fish from finding a source of non-toxic water which would have permitted some of them to survive the toxicant application.

Lake Lucille was treated with fish toxicant from September 13 to September 26, 1955. Local sportsmen assisted with the main toxicant application and Department biologists continued the spring treatment and general cleanup after the main body of the lake had been treated. An estimated 25,000,000 stickleback and 80,000 suckers were killed in the lake (Figure 7). In addition, 450 rainbow trout and 235 landlocked silver salmon were eradicated. It was of particular interest to note that less than two game fish per surface acre were eliminated, yet during the summer of 1955 prior to the rehabilitation, a few anglers still caught an occasional game fish. Lake Lucille will be stocked with trout in the early summer of 1956.

Figure 6. Biologist surveying a lake using an alidade and stadia rod.

Figure 7. Suckers and stickleback eradicated during the rehabilitation of Lake Lucille.

MIRROR LAKE

Mirror (Bear) Lake was treated with fish toxicant on October 4, 1955. This sixty-five acre lake, with a maximum depth of nine feet, was saturated with stickleback. Dissolved oxygen determinations had been conducted for the past three winters, the lowest recorded being 1.9 parts per million on May 17, 1953. This quantity of dissolved oxygen may be marginal and a partial winter kill may result in this lake. The economical cost for the rehabilitation of Mirror Lake, due to its shallow depth, however, should amortize off quickly once it starts producing trout.

ALASKA RAILROAD YARD GRAVEL PITS

During construction of the Alaska Railroad Yard at Fairbanks, large quantities of gravel were hauled out of pits which were dug on the railroad property. These pits quickly filled with water from subsurface seepage from the Chena River and from surface water collection. Several years ago a well-intentioned sportsman planted the pits with fry seined from Piledriver Slough, thinking the fry were grayling. Unfortunately, the fry proved to be suckers and chubs. Since the pits were all on Alaska Railroad property, permission was requested from Mr. R. N. Whitman, Manager of the Alaska Railroad, to rehabilitate the pits and introduce rainbow trout. This permission was granted and Mr. Whitman stated that the pits would be open to public fishing.

The railroad pits were treated with fish toxicant on September 1, 1955. Nine pits received treatment; suckers and chubs were killed in large numbers. It is planned to stock the pits with rainbow trout fry in the early summer of 1956.

RAINBOW TROUT PLANTING RESULTS - INTERIOR ALASKA

Experimental rainbow trout plantings have been made throughout the lakes in the Territory; these have been coupled with extensive biological surveys. This has proven to be, financially, the most efficient means for determining whether or not a body of water will support trout. Since the hatchery-planted fish are small, somewhere in the neighborhood of 2,000 per pound, the cost of the fish is nominal. These stocked trout in numerous instances, by their survival and growth, provide proof positive that the waters are capable of supporting game fish. Some of the significant trout planting results deserve special discussion and are reviewed at this time.

BOLEO LAKE

Boleo Lake, twelve miles south of Big Delta via the Richardson Highway, was stocked with rainbow trout in 1953 when the Commanding Officer at Fort Greeley agreed to allow civilian anglers access to the lake. The lake is located on U. S. Army property. During 1953, 10,000 rainbow trout were stocked in the lake, and in 1954, 90,000 were planted. Boleo Lake was fished hard by anglers during 1955. Fish up to eighteen inches in length, weighing three and one-quarter pounds were taken (Figure 8).

Figure 8. Sportsman with two year old rainbow trout caught at Boleo Lake.

The success of the anglers in Boleo Lake was sporadic. It was noted that midweek fishermen usually had better luck than weekend fishermen. Possibly the weekend activity, such as motor boat joy-riding on the lake, was enough to disturb the fish to the extent where they "went off their feed". At any rate, gillnetting as late as October 6, 1955, indicated that there was still a good number of two year old fish in the lake, which suggested that the fishermen's catch could have been heavier.

Deadman Lake, a 341 acre body of water with a maximum depth of thirty-two feet, was rehabilitated the latter part of June in 1954. The lake was stocked with rainbow and steelhead trout fry during August 1954 and closed to angling during 1955. The lake was stocked again in 1955, as it will be with each succeeding year, in order that a new age class will continually enter the fishery. Gillnet samplings of trout were made in Deadman Lake during 1955 as follows:

DEADMAN LAKE

Date of Trout Recovered	Number of Specimens	Age of Trout in Months	Average Length in Inches
August 11	30	13	9
October 6	18	3	6

As discussed in the 1954 Annual Report, Deadman Lake was rehabilitated as an experiment. Whether this shallow lake, with an average depth of twelve feet and dissolved oxygen concentrations as low as 2.0 parts per million, could support trout or not was problematical at the time of rehabilitation. The results obtained during the winter of 1954-1955 demonstrated that the lake will support trout. Subsequent investigation may show that trout will survive in even lower oxygen concentrations in Interior Alaska. It is planned to open Deadman Lake to angling sometime during 1956.

Jan Lake, approximately one mile off the Alcan Highway at Milepost 1354, was investigated during March and April, 1955. This lake was formed by a huge block of ice being imbedded in the ground by an advancing glacier; when the glacier receded the block of ice melted, leaving a "kettle" lake. This type of lake origin is quite common where glaciation has occurred, probably explaining the origin of most small deep lakes in regions that have experienced glacial activity. Jan Lake was found to be forty-six feet deep and dissolved oxygen determinations revealed sufficient concentrations to support trout. The lake showed no sign of fish life from repeated gillnetting and observation. As a result, it was stocked with 13,000 rainbow trout on July 17; by the end of September 1955, these fish had grown several inches and were observed in the shallows of the lake.

JAN LAKE

The gravel pits stocked with rainbow trout during 1952, 1953, 1954 and 1955 produced excellent fishing for children under sixteen years of age. These pits are alongside the Richardson Highway and are located the following distances from Fairbanks: Mile 20, Mile 31, Mile 80 and Mile 81. The pits are closed to fishing except by children; the

GRAVEL PITS
FAIRBANKS HIGHWAY

youngsters caught rainbow trout from seven to fifteen inches in length in the pits. The pits, because of their relatively small size of one to three acres, have a limited production, yet for the past several years they have continued to produce an annual crop for harvesting by the juvenile anglers.

OTTO'S LAKE

Otto's Lake at Healy was stocked with rainbow trout fry as an experiment in 1954. Investigations conducted during 1955 showed that this experimental plant failed to survive the winter; therefore, further stocking was abandoned.

WESTERN ALASKA

BEACH LAKE

Beach Lake is located one and one-half miles by trail from the Birchwood Airstrip below Mile 21 on the Anchorage-Palmer Highway. This lake was stocked with rainbow trout fry in 1955. By fall, the fry were several inches in length and visible in the shallows around the shoreline of the lake.

HIDDEN LAKE

Hidden Lake, planted each year from 1952 to 1955, lies at the end of the O'Malley Road near Anchorage. This seven acre lake continues to produce an annual crop of rainbows for juvenile only fishing. The rate of growth in the lake is good with the rainbows averaging about eight inches in length in their first year, and fourteen inches in their second year.

DE LANEY LAKE

De Laney Lake, a twenty-seven acre lake located on the Sand Lake Road near Spenard, was rehabilitated in 1954 and stocked in the early summer of 1955. By the end of September 1955, the three month old rainbow trout were averaging six inches in length. The survival of the stocked fish appeared to be good.

JEWEL LAKE

Jewel Lake, also located on the Sand Lake Road near Spenard, was rehabilitated in 1953 and opened to fishing in June 1955. The lake was stocked with 5,000 rainbows the end of July 1953, 500 silver and red salmon in late October, and 12,000 rainbows and steelhead in the middle of July 1954. On opening day, the Anchorage Sportsmen's Association and the Anchorage Junior Chamber of Commerce sponsored a juvenile only fishing derby at the lake. Approximately 300 children participated in this event and caught silver salmon from 10 to 12½ inches in length and rainbow trout up to 14½ inches in length.

ROCKY LAKE

Rocky Lake, a fifty-seven acre lake located in the Matanuska Valley, was rehabilitated in 1953 and stocked with 12,000 rainbow trout in August 1953, after the toxicity had dissipated from the lake. Seventeen thousand cutthroat trout and steelhead trout were later stocked in the lake during July and August 1955, the lake being closed to fishing during this rehabilitation period. The lake was opened to fishing on May 28, 1955; good catches of trout were made in the lake during the 1955 season with several weight limits (ten pounds and one fish daily or in possession) checked by the biologists (Figure 9).

Figure 9. Sportsman with rainbow trout taken from Rocky Lake.

In addition to the lakes discussed above, the following stocked lakes produced trout to the anglers during 1955: Green Lake, Anchorage area; Gregory Lake, Anchorage area; Upper Fire Lake, Anchorage area; Lower Fire Lake, Anchorage area; Falk Lake, Matanuska Valley area; Echo Lake (rehabilitated), Matanuska Valley area; Tex Smith Lake (rehabilitated), Glenn Highway; and Frank and Jerry's Lake, Glenn Highway.

PUBLIC RELATIONS

Fisheries information is eagerly sought by the public. The biologists have attempted to enlighten the people by presenting the facts and concepts underlying the fisheries program in the Territory. All media have been used in the educational program; radio, television, sportsmen's shows, newspapers and meetings of all kinds have provided their facilities for fisheries education and information. Guided tours were conducted through the Department's hatcheries and talks were given to show not only how the hatcheries operated, but also how these valuable ''tools'' fitted into overall fisheries management.

PUBLIC ACCESS

As has been mentioned in previous Annual Reports, the acquisition of public fishing areas on lakes suitable for game fish production continued to be a matter of concern for the biologists. With Alaska's tremendous land area containing thousands and thousands of lakes, it hardly seems possible that private land holdings could seriously interfere with recreational fishing. However, private ownership of land surrounding lakes, with the lack of suitable access for the public, already is a pressing problem.

As an example, using lakes immediately adjacent to Anchorage, we find there are fourteen lakes that can be expected to provide sport fishing. Two of these have suitable access areas available, four more are adjacent to public roads thus providing some public access. On one of these, however, the recent relocation of the road and the release of the right-of-way lost the access site. Three of the lakes are on military reservations and are, therefore, available to only a part of the anglers. One lake is on Alaska Railroad holdings and open to public angling through their cooperation. The four remaining lakes have no public access of any kind.

A similar condition exists along the Glenn, Sterling and Seward Highways and in the Matanuska Valley. This comprises the area available to the majority of anglers, since well over eighty percent of the sport fishing out of the Anchorage-Palmer population centers is done on waters accessible by road.

During the 1953 session of the Territorial Legislature, Chapter 65, SLA 1953, was passed. This Act authorized the Department to acquire public rights of way to sport fishing areas by purchase or gift. Budgetary limitations precluded the purchase of any public access sites; however, public access sites to the following lakes were donated to the Department:

Donated by Mr. Jesse T. Keppler, Palmer, Alaska

Echo Lake, Matanuska Valley
Bradley Lake, Matanuska Valley
Keppler Lake, Matanuska Valley

Donated by Mr. Tex Smith, Mile 161, Glenn Highway

Tex Smith Lake, Glenn Highway

Mr. Jesse T. Keppler and Mr. Tex Smith, through their generous contributions, have insured for all anglers the right of access to these lakes.

During 1955, a change in Federal Land Laws permitted that suitable access sites could be withheld for the Territory or future State of Alaska. Under this authority the Department, in cooperation with the U. S. Bureau of Land Management, the Alaska Rural Rehabilitation Corporation and the Territorial Department of Lands, has selected and set aside eleven public access sites on the following lakes: Three Mile, Blodgett, Wolf, Rocky, Long, Horseshoe and two unnamed lakes in the Matanuska Valley; Upper and Lower Bonnie on the Glenn Highway; and Birch in the Fairbanks area.

It is not the intent of the Department, or of the other agencies concerned with public access sites to angling waters, to withhold large tracts of land. In some instances less than five acres sufficed as a public access site; in others, where necessary, larger parcels of land were requested. The largest tract of land requested was less than fifty acres; this site was ideally suited to give access to two lakes and also to provide for adequate picnic and camping facilities.

1955 FAIRBANKS HATCHERY TROUT PLANTS

Date	Lake	Number Planted	Number of Trout Per Pound	Species	Area
July 27	Beaver Pond	1,000	4,000	Rainbow	Summit Lake
July 20	Boleo	101,000	3,000	Rainbow	Big Delta
June 29	Deadman	135,000	3,000	Rainbow	Northway
July 26	Gravel Pit	500	1,000	Rainbow	30 Mile
August 13	Gravel Pit	500	1,500	Rainbow	20 Mile
August 13	Gravel Pit	1,000	4,000	Rainbow	81 Mile
July 17	Jan	13,000	3,000	Rainbow	Dot Lake
August 10	Lost	10,000	1,500	Rainbow, Steelhead	Fairbanks
July 7	Meier	23,000	3,000	Rainbow	Meier
	Total	285,000			

1955 Fire Lake Hatchery Trout Plants

Date	Lake	Number Planted	Number of Trout Per Pound	Species	Area
July 10	Beach	10,000	3,000	Rainbow	Birchwood Area, Chugiak
Sept. 4	Cordova	13,000	1,500	Rainbow	Cordova
July 1, Aug. 22	De Laney	14,000	2,000	Rainbow, Steelhead	Anchorage
July 12, Aug. 22	Echo	24,000	2,000	Rainbow, Steelhead	Matanuska Valley
July 12, Aug. 22	Falk	12,000	2,000	Rainbow, Steelhead	Matanuska Valley
July 13, Aug. 24	Green	8,000	2,000	Rainbow, Steelhead	Elmendorf Air Force Base
July 16	Gregory	65,000	2,500	Rainbow	Elmendorf Air Force Base
July 7	Hidden	2,000	3,000	Rainbow	Anchorage
July 12, Aug. 22	Jewel	20,000	3,000	Rainbow, Steelhead	Anchorage
June 30, Aug. 25	Keppler No. 1	40,000	2,500	Rainbow, Steelhead	Matanuska Valley
July 2, Aug. 25	Keppler No. 2	8,000	2,500	Rainbow, Steelhead	Matanuska Valley
July 22	Lower Bonnie	38,000	2,000	Rainbow	Mile 83, Glenn Highway
July 12, Aug. 22	Lower Fire	27,000	2,500	Rainbow, Steelhead	Chugiak

1955 Fire Lake Hatchery Trout Plants (continued)

Date	Lake	Number Planted	Number of Trout Per Pound	Species	Area
July 24, Aug. 26	Long	19,000	2,500	Rainbow, Steelhead	Mile 90, Glenn Highway
July 11, Aug. 25	Matanuska	29,000	2,500	Rainbow, Steelhead	Matanuska Valley
August 28	Pippin	4,000	1,500	Steelhead	Tonsina
July 14, Aug. 23	Rocky	31,000	2,000	Rainbow, Steelhead	Matanuska Valley
July 22	Ravine	4,000	3,000	Rainbow	Mile 83, Glenn Highway
July 12, Aug. 22	Sand	45,000	2,500	Rainbow, Steelhead	Anchorage
July 14	Sharron	2,000	2,000	Rainbow	Matanuska Valley
July 15, Aug. 28	Tex Smith	12,000	2,500	Rainbow, Steelhead	Mile 160, Glenn Highway
July 1	Upper Bonnie	32,000	3,000	Rainbow	Mile 83, Glenn Highway
July 11	Upper Fire	4,000	3,000	Rainbow	Chugiak
July 15, Aug. 26	Wiener	13,000	2,500	Rainbow, Steelhead	Chickaloon
August 28	Willow	4,000	1,500	Steelhead	Copper Center
	Total	480,000			

Screen at the outlet of Gregory Lake.

WATERSHED MANAGEMENT

During 1955, the Watershed Management Division continued its main function of investigating watersheds blocked to salmon by falls and other obstructions, and testing the rearing potentials or capabilities of a number of these areas by water analysis and planting red or silver salmon eggs and fry. Some of these watershed areas will be made available for migratory fish production by means of ladders, in the future, as was done at Pauls Basin, Afognak Island, in 1952. Others will be used as rearing areas for future egg or fry plants.

A considerable amount of time was also spent by the District Biologists in the assessment of the escapements of the various species of salmon into the streams and lakes of their districts. Spawning ground surveys were made by both foot and air. This information is necessary to assess the workability or value of the regulations in effect. In general, if the escapement is poor, more stringent regulations are needed to afford a greater breeding stock of that group of fish; on the other hand, if there is an excessive number upon the spawning beds, some change of regulations can be made so that part of those fish can be utilized by the fishermen.

There were several outstanding developments in Watershed Management during 1955. Of considerable significance was the first return of adult red salmon to Laura Lake in Pauls Basin, which had been opened to anadromous species by construction of fishways in 1952 and planted annually with eyed red salmon eggs since 1951. The potential egg deposition of the returning females will, from all indications, exceed the original number of eggs transplanted into this system. This, of course, is a favorable situation.

Another development was the Ketchikan hatchery, which went into production during the winter of 1954 and put out its first fish during 1955. A fish culturist was hired to run this station. Red and silver salmon fry were planted into a number of blocked watersheds in that region during the summer. The Bakewell watershed will probably be opened to salmon by installing a fishway at the falls during 1956 or 1957.

A District Biologist was stationed at Wrangell in August 1955. His preliminary efforts have been directed mainly at the Stikine River to assess available spawning and rearing areas, time of appearance and approximate numbers of the various species of salmon on the spawning grounds, water areas blocked to salmon, and the nature of the barriers.

The following reports on the progress of the Watershed Management Division represents the combined efforts of the staff:

Walter Kirkness, Senior Biologist
Kenneth N. Thorson, District Biologist, Wrangell
Stanley D. Swanson, District Biologist, Ketchikan
Roy A. Rickey, District Biologist, Kodiak
Robert W. Neel, Fish Culturist, Ketchikan

BIOGRAPHICAL SKETCH

Robert W. Neel was born August 15, 1921, in Ocoee, Florida, and attended elementary and secondary schools at Winter Garden, Florida.

He attended the University of Florida for two years and then spent three years in the United States Air Force during World War II. Following his discharge in 1945, he enrolled at the University of Idaho and received his Bachelor of Science degree in Wildlife and Range Management (School of Forestry) in 1948.

Mr. Neel worked briefly in Arizona for the United States Forest Service and then secured work in the United States Fish and Wildlife Service salmon hatcheries on the Grand Coulee project in eastern Washington. This service included three months of counting salmon and other fish ascending the fish ladders at Rock Island Dam; then, as a fish culturist - three months at the Leavenworth, Washington, salmon hatchery; three and one-half years at the Winthrop, Washington, salmon and trout hatchery; and ten months at the Entiat, Washington, salmon hatchery. While at Entiat, he attended an in-training fish cultural school conducted by Roger Burrows, one of the foremost biologists engaged in experimental salmon rearing techniques.

Mr. Neel resigned from the Fish and Wildlife Service in June 1955 and joined the Alaska Department of Fisheries as Fish Culturist at the Ketchikan Hatchery.

KODIAK DISTRICT

PAULS BASIN

RETURNING RED ADULTS

The first adult red salmon to utilize the upper Pauls Basin as a spawning area appeared this year in Gretchen Creek, tributary to Laura Lake. This system (Figure 1), which has been reported upon in detail in previous Annual Reports, formerly contained a series of falls which prevented the ascent of anadromous fish to the two upper lakes - Laura Lake, 555 acres and Gretchen Lake, 83 acres. Fishways were constructed in 1952 and red salmon eggs (Table 1) have been introduced yearly since 1951 into the gravel of Gretchen Creek, tributary to Laura Lake. The smolts derived from these egg plants achieved exceptional growth in Laura Lake prior to their migration to the sea. They were from 4.5 to 6.0 inches in fork length after one year in the lake, whereas normal growth in this area during the first year is usually between 2.5 to 3.5 inches. This unusual growth is desirable in that it seems to increase the survival of these fish in the ocean.

As the adult red salmon entered Laura Lake during June and July 1955, they were trapped and measured and a scale sample for age determination was taken. They were also inspected for missing fins, since some of them when migrating as smolts during 1953 had been marked by removal of the left pectoral fin. A total of 66 adults had been taken in the trap by July 10 when it was removed. Of these fish, 21 had left pectoral fins missing. The fish sampled were composed of three age classifications which is discussed below.

A number of fish came in after the trap was removed. During August, a peak count of 77 red salmon was made on the spawning grounds of Gretchen Creek near its outlet into Laura Lake. Previous experience in spawning ground surveys indicates that such counts are a minimum number, because the fish present are not all visible nor are all

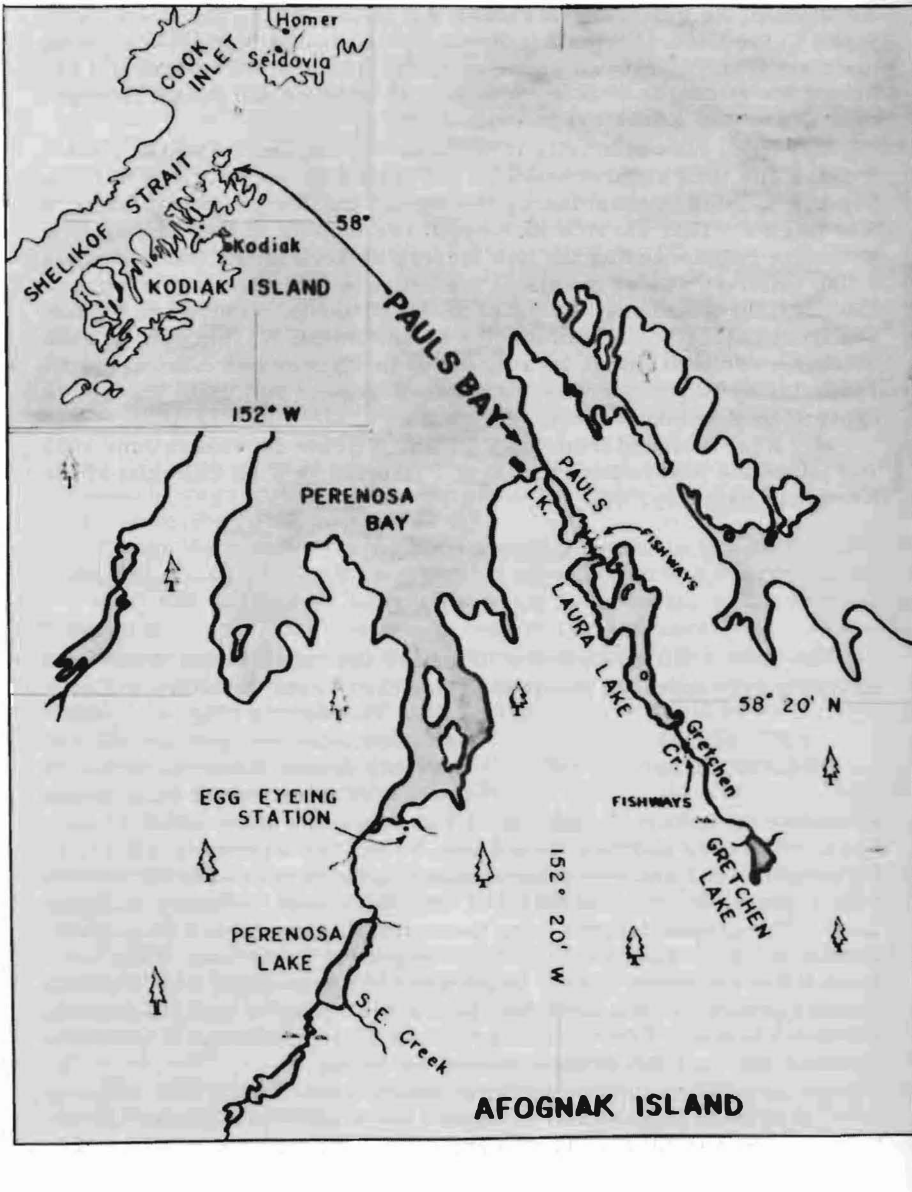

Figure 1. A map of a portion of Afognak Island showing the Pauls Basin and Perenosa watersheds.

of the fish in the run present at the same time. The actual number of fish spawning in Gretchen Creek probably exceeded 100. As the bulk of the brood stock of these fish return to spawn in their fifth and sixth year of life, the 1955 spawning return of approximately 100 fish holds good promise for the future of the 1951 brood. The sex ratio was one female to one male and the estimated deposition in the spawning gravel was between 125,000 and 160,000 eggs.

AGE STUDIES

Scale samples were taken from 58 adults at the weir. A study of the scales showed that 42 fish were in their fourth year with one annulus formed in fresh water, 7 were jacks in their third year with one year in fresh water, 8 were in their fourth year with two year's of lake residence and one fish was in its fifth year with one year's lake residence. The five year old fish was obviously a stray, as it was of the 1950 brood and the first plant of red salmon eggs was made in Gretchen Creek in 1951. This was easily discernible from the scale formation, as the Laura Lake fish, due to their tremendous growth in the lake, had a large fresh water or nuclear area with the growth rings being many in number and widely spaced, while the five year old fish had a smaller number of growth rings, which were closely spaced, similar to the natural run of reds in Pauls or Perenosa Lake. This sample indicates the returning adult red run to Laura Lake in 1955 was composed of 88 per cent four year old fish and 12 per cent three year olds or jacks. Of the four year olds, 74 per cent of the total sample had spent one year in the lake and 14 per cent two years before going to sea.

RED SALMON EGG PLANTS

Table 1 shows the number of eggs planted in the Pauls Basin system each year since 1951. In 1952, 1953, 1954 and 1955, all eggs planted in Gretchen Creek were taken from red salmon in Southeast Creek, Perenosa Lake (Figure 1), and all were incubated to the eyed stage prior to planting. The return of approximately 88 (using as a basis 100 adults) four year old red salmon to Gretchen Creek came from a transplant of three lots of eggs in 1951:

84,000 green eggs (freshly spawned) from Perenosa Lake
22,000 eyed eggs from Perenosa Lake
106,000 eyed eggs from Karluk Lake

Table 1. Number of red salmon eggs introduced into Gretchen Creek, Pauls Basin system.

Year	Number of Eggs	Source
1951	212,000	Perenosa and Karluk Lakes
1952	350,000	Perenosa Lake
1953	500,000	Perenosa Lake
1954	450,000	Perenosa Lake
1955	320,000	Perenosa Lake

Previous to 1955, the eyed red salmon eggs had been introduced into the gravel of the stream bed by means of a tube, as reported in the Annual Report for 1951. In 1955, a new method similar to that used by the International Pacific Salmon Commission was tried. Two cylinders approximately twenty-four inches in diameter and thirty-six inches

Figure 2. Introducing eyed red salmon eggs into a tributary stream of Frazer Lake with the use of two cylinders.

high were employed. Trenches were dug parallel to the current in the stream gravel in suitable locations. The two cylinders were then placed at the upstream end of the trench, one downstream from the other. A few large rocks, about six inches in diameter, were placed in the upstream cylinder and from 1,000 to 8,000 eggs were poured in. When the eggs had settled into the interspaces of the rocks, gravel from the stream bed was shoveled into the cylinder until it was slightly higher than the surrounding stream bed. Then the first cylinder was removed and placed in the trench downstream from the second cylinder. This action left a slight mound of gravel over the eggs. The above process was repeated in the second cylinder, thus moving downstream until the trench was filled. This system seems superior to the tube method because it is quicker and a better distribution of the eggs throughout the gravel is obtained. Figure 2 illustrates the method used.

SMOLT MIGRATION

Since 1953, the seaward migration of fingerlings or smolts has been sampled by a trap at the outlet of Laura Lake (Figure 3). Table 2 presents the trap catch each year by brood years. The entire population is not trapped. During 1955, when progeny of the 1951, 1952 and 1953 egg plants were sampled, many migrants were seen going downstream in Laura Creek (outlet of Laura Lake) before the trap was installed. Sampling was delayed due to extreme high water conditions at the trap site. In some years smolts have been observed after the trap was removed. Another indication that only a part of the smolts have been trapped each year is shown

Figure 3. Counting red salmon smolt migrants at the Laura Lake trap.

by the 1955 adult returns. Forty-two red salmon in their fourth year, with one year residence in the lake, were sampled and of these only fifteen, or 36 per cent were marked. This indicates the true number of smolt migrants during 1953 was approximately 3,500 fish rather than the 1,238 actually trapped and marked. The trapping of smolts was not designed to sample the total population, but to furnish a minimum figure of the relative success of the egg plants before the adult return.

Table 2. Catch of red salmon smolts by brood year since 1953 at Laura Lake.

Brood Year	Number of Years Lake Residence			
	1	2	3	Total
1951	1238	1842	184	3,264
1952	8702	1853		10,555
1953	936			936

Table 2 would indicate a much greater percentage survival for the 1952 brood than for the other years. This, however, must wait for confirmation from the returning adults, as it is not known whether or not a constant or nearly constant percentage of the smolts is taken each year in the downstream trap.

Silver salmon have been ascending the fishways each year since the completion of construction in 1952. The area above Pauls Lake was previously unavailable to them (Figure 1). Estimates of the silver salmon spawning escapement to Laura Lake and its tributary streams have been between 400 and 1,000 each year since 1952. In 1955 there were 1,566 silver salmon downstream migrants taken in the trap on the Laura Lake outlet.

SILVER SALMON

FRAZER LAKE

The Department has been investigating since 1951 the possibilities of opening Frazer Lake to anadramous fish. Frazer Lake, of 5,000 surface acres, lies on the southern end of Kodiak Island and is adjacent to the famous red salmon producer, Karluk Lake. Its outlet, which drains into Olga Bay, has a thirty-one foot falls one half mile below the lake.

To continue the policy of having a brood stock available, even before the watershed is accessible to adult red salmon, 320,000 eyed eggs were stocked in the west shore streams of Frazer Lake using the cylinder method as described earlier. The planting this year was modified from that of prior years in that eyed eggs were utilized instead of green or freshly fertilized eggs. As in other years, the source of red salmon spawn was a tributary stream and beach of Karluk Lake (Figure 4).

Figure 4. Beach seining at Karluk Lake for red salmon to be used for spawn taking.

Once again the egg take was curtailed because of the lack of available fish in the lake. From Karluk the fertilized eggs were taken to an incubation station that had been set up in the inoperative cannery at Olga Bay. This site was selected for an eyeing station, rather than erect a structure on either lake, because of the existing facilities that lent themselves quite readily to this sort of an operation. The water available was more than adequate for the four 16-foot troughs that were used. The water temperatures were not quite as high as might be desired, but the eggs eyed out in approximately thirty days.

Frazer Lake has been planted with red salmon eggs each year since 1951. The majority of the Karluk fish that provide the spawn for the Frazer stocking return in their fifth or sixth year to spawn; therefore, 1956 should be the first appearance of returnees in the Frazer system. A trap and weir will be operated in 1956 just below the barrier falls to intercept returning adult red salmon resulting from the previous egg plants. If it is feasible, the adults will be put over the falls into the stream above after scale samples and other data are taken.

CATCH STATISTICS

The catch of salmon in the Kodiak area during 1955 was one of the bright spots in a rather bleak fishing season for the Territory as a whole. The following table shows the catch in numbers of fish, by species and gear. Figure 5 shows a typical beach seine operating off the Karluk River mouth.

Figure 5. A commercial beach seine near the Karluk River mouth.

Table 3. 1955 salmon catch statistics in numbers of fish for the Kodiak district.*

No.	Gear	Reds	Kings	Pinks	Chums	Silvers	Total
22	Traps	55,350	378	2,672,912	76,814	14,632	2,820,086
440	Seines	37,781	1,818	7,803,108	384,094	18,698	8,245,499
59	Gillnets	71,351	272	318,144	21,517	1,252	412,536
	Totals	164,482	2,468	10,794,164	482,425	34,582	11,478,121

*Data courtesy United States Fish and Wildlife Service.

KETCHIKAN DISTRICT

In 1952 a program was initiated in the Ketchikan District to utilize lake and stream systems that were blocked from salmon production.

BARREN AREA PRODUCTION

Surveys and studies of these systems have resulted in the selection of one for improvement by fishway construction and five others for use as experimental fish rearing areas. Bakewell Lake, in Smeaton Bay, will be made accessible by installing a fishway over a barrier falls in its outlet. It has a lake surface area of 740 acres. The half-mile long outlet stream has a twenty-five foot barrier falls 200 yards below the lake. Initial survey work for the fishway at this falls has been completed and final surveys are planned for the 1956 season.

Smugglers Cove Lake, Whipple Creek, Princess Bay Lake, Ella Lake, and Manzanita Lake, all presently blocked to anadramous fish by falls, were stocked on an experimental basis with silver salmon fry in 1955. Table 4 gives a complete record of the silver and red salmon plants made in 1955. If subsequent production warrants, annual plants may be made furnishing adult salmon for the commercial and sport fishery as they return.

The salmon rearing program was greatly implemented in 1955 with the Deer Mountain Hatchery being put into production. The hatchery was built by the Ketchikan King Salmon Derby Committee, sponsored by the Ketchikan Chamber of Commerce, and was outfitted and manned by the Alaska Department of Fisheries. Dedication ceremonies for the new hatchery took place on April 22 with Governor B. Frank Heintzleman delivering the dedication speech before local people and fifty visitors from other cities of Alaska. Director C. L. Anderson also addressed the assembly citing the spirit of cooperation which prevailed throughout the building of the hatchery, from the inception of the hatchery project by the Ketchikan Salmon Derby Committee to its completion through the combined efforts of the Chamber of Commerce, the Derby Committee and the Alaska Department of Fisheries.

The hatchery facilities made possible the planting of salmon fry several months of age for the first time in the Ketchikan area. Planting of fry is superior to stocking by means of egg plants as over-all mortality is lessened when planting is done at more advanced stages of development. It also gives a much greater flexibility to the program, as a wide range of time to plant is available to the biologist from the freshly fertilized egg to migratory stage. Fry plants can be timed so as to conform to the maximum production of plankton in the watersheds. Green or eyed egg plants may be made in the fall and the hatchery operated at full fry capacity for plants the following summer, thus increasing the possible production of the station.

Table 4. Plantings of fry from Ketchikan Hatchery during 1955 and areas planted.

Date	Species	Area	Number	Number per pound
7-5-55	Silver salmon	Whipple Creek	20,000	900
7-8-55	" "	Ella Lake	63,000	900
7-8-55	" "	Princess Bay Lake	4,500	900
7-9-55	" "	Bakewell Lake	71,100	900
7-9-55	" "	Bakewell Lake	15,000	700
7-12-55	" "	Smugglers Cove Lake	63,000	900
7-21-55	" "	Manzanita Lake	19,500	500
8-2-55	" "	Whipple Creek	10,000	430
9-2-55	" "	Ketchikan Park Pool*	53,300	237
9-4-55	Red salmon	Bakewell Lake	49,700	710
		Totals	319,400 silver salmon	

*To be reared in pool to migratory size and released in Ketchikan Creek.

On the 20th of January, 315,000 eyed silver salmon eggs were received from the Washington State Green River Salmon Hatchery at Auburn, Washington, and were placed in the Ketchikan Hatchery. Salmon eggs from local stock; 51,500 red and 18,000 silver salmon eggs, were also placed in the hatchery on the above date. These eggs were taken at Buschmann Creek, inlet stream to Hugh Smith Lake, and were eyed out in troughs set up in the local Fish and Wildlife Service hangar. The Buschmann Creek silver salmon eggs hatched out during the first two weeks of March and the red eggs hatched one month later. The Green River eggs hatched out in March, reaching a peak in hatching on the 18th. The silver salmon fry had completed yolk sac absorption by June 1 and feeding was begun on that date. All of the salmon fry were fed for at least one month prior to planting.

Components of the hatchery diet included condemned (worm infested) beef and hog liver which was obtained at nominal prices. Salmon viscera was also included in the diet, with much of it contributed by local trollers and the Ketchikan Cold Storage. Free cold storage space for the liver and salmon viscera is provided by the New England Fish Company. Cost-free viscera, plus free cold storage facilities, has greatly reduced the cost of feeding.

The fry were transported by air to the planting sites, with one exception, Whipple Creek, where a pickup truck was used to carry the cans containing the fry (Figure 6). The containers used were square five gallon cans aeriated by a six volt pump driving air through plastic tubing to air stones placed in the

FRY PLANTING

Figure 6. Planting silver salmon fry in Whipple Creek near Ketchikan.

bottom of each can. The air stones diffuse the air into fine particles so that a greater portion may be taken up by the water. One pump supplied air to eight cans. Five pounds of fish were shipped in each can. Lids of the cans were perforated to permit escape of the released air. Sodium amytal, one half grain to the gallon of water, was used to reduce metabolism of the fish, thereby increasing by approximately 100 per cent the amount of fish possible to carry per can. Three to four pounds of ice per can was used to reduce the water temperature. While in transit, the temperature of the water in the containers was 33 to 35 degrees F. Prior to releasing the fish, the water in the containers was "tempered" by slowly adding small amounts of the water in which the fish were to be planted. While this was being done, the cans were about three-quarters immersed in the lake or stream. Observations on the released fry indicated that the effects of the sodium amytal wore off within a few seconds after release. The length of time the fish were in transit was in no case more than one hour. On September 1, the 53,000 silver salmon fry remaining in the hatchery were placed in a pond adjacent to the hatchery (Figure 7). These fish will be released into Ketchikan Creek at approximately ten months of age. The adult fish are expected to return to the hatchery ponds and will be taken for spawn.

Figure 7. Feeding silver salmon fry in a rearing pond at the Ketchikan Hatchery.

SPAWN TAKING

In September, 330,000 red salmon eggs were taken at Buschmann Creek. The female salmon were seined near the beach and retained in a holding pen from 24 to 48 hours to insure complete ripeness of the ova. The eggs were water hardened for an hour or more after taking and then transported by plane to the Deer Mountain Hatchery. One gallon thermos jugs and four gallon cylindrical cans were used for shipping the eggs. Thermos jugs proved to be particularly well suited to this use, as the water temperature within remains constant and they can be filled completely, thus eliminating movement of the contents and damage to the eggs. The eggs will be hatched at the Deer Mountain Hatchery and the fry fed for at least one month prior to planting. These fish will be released in the Bakewell system to establish a returning brood stock. This lake was first stocked by planting 100,000 fertilized and 200,000 eyed red salmon eggs in 1954. In 1955 this system received 49,700 sockeye and 86,100 silver salmon fry. The construction of fishways to bypass the twenty-five foot falls in the outlet stream of Bakewell Lake will open to the returning adult salmon the 740 acre lake as rearing area and three large lake inlet streams in which to spawn.

Only 13,700 silver salmon eggs were taken at the Reflection Lake inlet stream. A scarcity of spawners, combined with flooding conditions in the stream, caused this low egg take. The fingerling silver salmon resulting from these eggs will be planted at ten months of age in Ketchikan Creek.

An experimental electric weir for collecting the adult fish was operated in the Reflection Lake inlet creek (Figure 8). Conventional picket type weirs have proven unsatisfactory in the past in this area, especially during the fall of the year when excessive rainfalls cause flooding stream conditions. The usual result is a washed-out weir. The electric weir, patterned from one used by the United States Fish and Wildlife Service at Entiat, Washington, consists merely of a ground line and electrodes immersed in the water and sets up little resistance to the current. The alternating current is supplied by a 2500 watt A.C. portable gasoline generator. An electrical shock is received by the adult fish when they enter the area between the ground line and the electrodes, preventing their ascent up the main stream. The fish are let into a trap or holding pen in a side channel. The weir worked successfully during its trial; however, modifications are needed at the site to ensure complete success in future years.

SPAWNING ESCAPEMENT SURVEYS

Numerous surveys of pink salmon spawning streams were made in the Ketchikan district. In general, the escapement of the early segment of the run, primarily to the mainland streams, was very poor - being less than that of the parent year. The middle and late pink escapement, however, was good, exceeding in most cases the parent year. One contributing factor to this situation was, of course, the early fishing season which exposed predominately the early fish to the fishery.

Figure 8. View of the electric weir used at Reflection Lake showing the electrodes, ground line, and in the background the holding pen.

Some preliminary surveys were made into the Unuk and Chickamin systems to locate and estimate numbers of kings on the various spawning areas. These surveys were conducted both by airplane and river boat. During the period June 24 to 30, no kings were seen in either the Unuk, Chickamin, or their tributaries. A later survey from July 22 to 28 disclosed a few kings in most areas. The largest concentration was a group of thirty-six in one mile on Indian Creek, tributary of the Chickamin River. The fish had evidently just entered, as only one female was observed on a riffle digging a nest. It is planned to expend further effort in 1956 to locate all of the king salmon spawning areas and make index escapement counts.

KING SALMON PROPAGATION

The Deer Mountain Hatchery received 118,000 fall-run king salmon eggs on November 14. These eggs were shipped from the Washington State Green River Salmon Hatchery. The fry will be fed for ninety days, the usual age at migration, prior to release in Ketchikan Creek. This stocking has as its ultimate objective the establishing of fall run kings in short streams of Alaska similar to the small coastal streams of Washington and Oregon, which are frequented by fall run king salmon. The returning adults from the Ketchikan Creek plants, it is hoped, will supply a brood stock from which eggs for stocking other streams can be obtained.

WRANGELL DISTRICT

The work in the Wrangell district has been largely exploratory in nature and started late in the summer. Several lake and stream systems were surveyed on foot, noting topography and the possibilities for laddering barriers. On other systems the surveys were made to determine the ease of securing future donor brood stock. Among the lake and stream systems surveyed were Skoges Creek, streams entering Blind Slough, Ka Sheets Creek and Lake, Big Creek and Red Bay Lake, and the outlet of Neck Lake. Several smaller watersheds with barriers were also surveyed for short distances, but were discontinued because of poor spawning and rearing potential. As the major producer in the district, the Stikine River received the most attention, with the major effort being directed towards the king and red salmon spawning areas. Figure 9 shows the Stikine and its principal tributaries.

STIKINE RIVER SURVEY

The work on the Stikine River was initiated the first of August with an aerial survey of the known king salmon producing areas. This survey served to acquaint the Department with the watershed and to demonstrate the areas that deserved closer inspection. The flights covered the main river as far as the block in the Canyon of the Stikine thirty-two miles above Telegraph Creek, B C (Figure 10). It also covered the Chutine (or Clearwater), including the Barrington River and the lower portions of the Tuya and Tanzilla Rivers, both of which are presently blocked. The entire Tahltan was flown as far as Tahltan Lake at its head. There the outlet was surveyed on foot, as a number of beaver dams were reportedly barring the passage of red salmon to the lake. A number of old beaver dams were observed in the first 3/4 mile, but all were

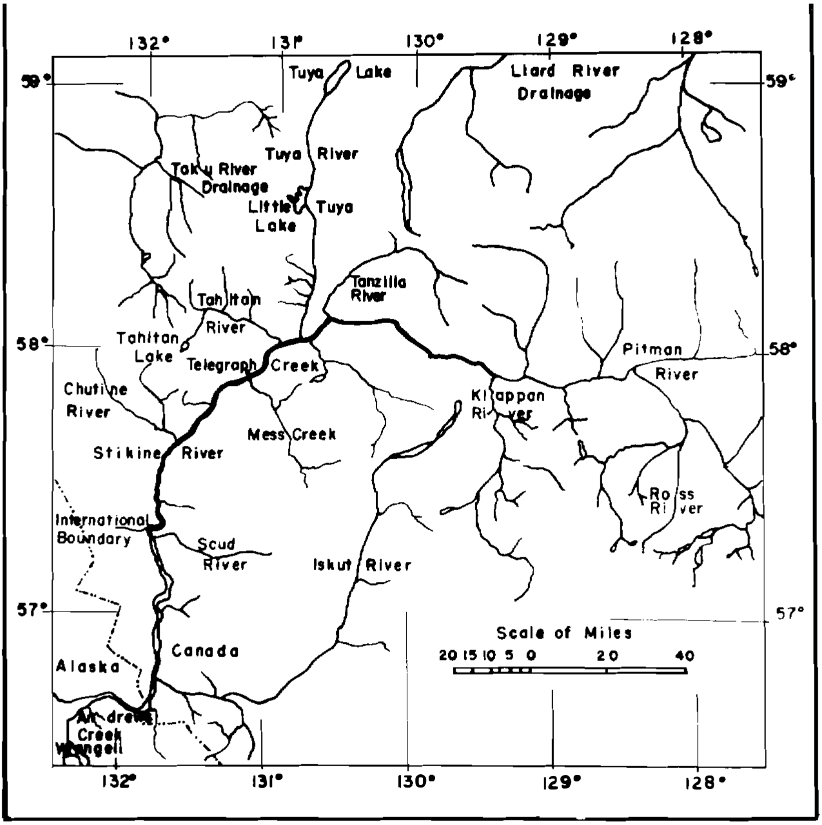

Figure 9. A map of the Stikine River watershed.

well cut through and would not in their present condition hinder the migrant salmon (Figures 11 and 12).

In mid-August a field survey was begun. First, Andrews and North Arm Creeks were visited, then two weeks were spent on the up-river spawning grounds. An entire week was spent on the Tahltan, which appeared to be the main spawning area of the Stikine for both king and red salmon. Although the survey was a little late to catch the peak of spawning, some kings were seen on all the good spawning areas, but no large concentrations were found. Several rough stretches of water were encountered, which undoubtedly hinder the passage of fish, but in all cases numbers of fish were observed above these stretches.

Kings were observed in the main Tahltan, in Beatty Creek (a North Fork), in the Little Tahltan and in the South Fork of the Tahltan. They were also seen in both the Four Mile and Eight Mile Creeks below Telegraph Creek, B. C., and in Andrews and North Arm Creeks near the mouth of the Stikine. In addition, reliable reports were received that Shakes Creek, the Chutine and Barrington Rivers, Kahtate Creek and King Salmon Creek all contain some kings. The farthest known up-river spawning grounds of king salmon in this system is King Salmon

Figure 10. View of the Stikine River at Telegraph Creek, B. C.

Figure 11. A beaver house at the outlet of Tahltan Lake.

Figure 12. Cluttered outlet stream one quarter of a mile from Tahltan Lake.

Figure 13. A view of the Tuya River near its junction with the Stikine showing the discussed barrier to anadromous fish.

Creek, which enters the Stikine from the South, up-river from the mouth of the Tuya.

Perhaps the brightest spot of the entire Stikine survey was the Tuya River (Figure 13). The Tuya is presently blocked at the mouth by a series of small falls, which do not appear too difficult to modify enough to permit the passage of salmon. It is approximately 100 miles long and has two large lakes of 3,500 and 10,000 surface acres. Flowing out of a high tableland, it has a moderate gradient and is fairly clear. On a basis of spawning and rearing area, it may be capable of doubling the production of reds in the Stikine, as well as measurably increasing the production of kings, pinks and silvers.

A much more extensive survey is planned for the Stikine River in 1956. A thorough check of the Tuya will be made from its mouth to the headwaters. If this survey reveals no further blocks in the system, a preliminary engineering survey will be made of the falls near the mouth. More emphasis will be placed on the spawning areas and the timing of the various species to these areas.

Fish buyers at Taku Inlet.

STATISTICS (1)

The commercial catch of fishery products in Alaska during 1955 totaled 315 million pounds, valued at nearly 27 million dollars to the fishermen. This represented a decrease of 22 million pounds or seven per cent in volume, and 4.5 million dollars or fourteen per cent in value from 1954. The number of persons engaged in the fishing industry increased from 23,079 in 1954 to 24,619 in 1955. The number of wholesale and manufacturing establishments decreased from 186 in 1954 to 179 in 1955, while the value of products prepared for market decreased over 8 million dollars in the same period.

In the following tables, the statistical presentation is grouped by fishing districts. The Southeastern district includes the area from the southern boundary of Alaska north to Yakutat. The Central district includes the entire area south of the Alaska Peninsula and north of Yakutat. The Western district includes that area north of the Peninsula including the Kuskokwim and Yukon Rivers.

Unloading the salmon catch, Bristol Bay.

(1) Fisheries statistics in Alaska are compiled by the U. S. Fish and Wildlife Service. The gross details are included in this Annual Report in order to acquaint the readers with the magnitude and the trend of this important industry. We have drawn our material from Alaska Fisheries, 1955, Annual Summary, published and obtainable from the U. S. Fish and Wildlife Service, and from unpublished data obtained from the U. S. Fish and Wildlife Service, Juneau, Alaska. The use of these data is hereby gratefully acknowledged.

Table 1. Comparative values of canned salmon giving initial price per case, approximate total value per species, and total for all species.

Year	Silver	Chum	Pink	King	Red	Total Value
	$ 17.30	$ 10.53	$ 10.67	$ 21.25	$ 19.55	
1946	3,250,249	6,421,647	21,895,235	805,199	20,784,864	$ 53,157,194
	18.24	17.95	18.72	21.08	24.19	
1947	2,689,888	8,229,464	32,210,755	1,112,539	35,739,285	79,981,931
	25.96	21.10	24.24	26.70	27.51	
1948	5,732,253	15,082,926	31,445,485	1,435,578	44,964,049	98,660,291
	22.00	15.00	16.00	24.00	26.05	
1949	3,781,482	7,498,382	44,147,496	1,402,934	25,581,995	82,412,289
	22,00	21.10	24.00	23.00	29.00	
1950	5,556,430	15,539,056	26,753,868	1,590,996	34,811,975	84,252,325
	25.28	15.18	20.84	28.41	31.85	
1951	8,726,587	10,925,359	32,505,086	2,489,046	24,603,107	79,249,185
	21.34	15.66	18.52	26.76	28.60	
1952	4,206,757	15,140,209	21,705,200	1,526,532	33,783,606	76,362,304
	19.67	13.43	17.59	27.64	28.50	
1953	2,511,209	10,622,248	16,613,896	1,553,585	26,877,507	58,178,445
	22.87	14.66	19.55	26.76	28.89	
1954	3,826,839	14,766,146	22,230,115	1,374,656	21,158,968	63,356,724
	26.67	17.39	21.29	28.65	31.81	
1955	3,056,498	6,322,462	26,345,976	1,369,984	19,774,011	56,868,931
			Total value for all species 1946-1955			$732,479,619

Table 2. Total salmon pack in cases (48 one pound cans) and number of operating salmon canneries by district.

Year	Southeastern Pack	Southeastern Canneries	Central Pack	Central Canneries	Western Pack	Western Canneries	Total Pack	Total Canneries
1946	1,476,326	45	1,772,318	51	711,966	20	3,960,610	116
1947	1,056,878	32	1,786,629	43	1,414,895	15	4,260,394	90
1948	1,277,773	34	1,316,494	53	1,374,254	17	3,968,521	104
1949	2,493,709	37	1,281,212	51	588,550	19	4,363,471	107
1950	1,190,174	39	1,439,029	54	643,889	15	3,273,092	108
1951	2,028,262	39	1,067,687	59	388,519	24	3,484,468	122
1952	1,320,925	40	1,456,417	46	796,786	24	3,574,128	110
1953	977,682	37	1,350,589	43	533,996	20	2,862,267	100
1954	1,302,939	29	1,394,981	43	396,833	17	3,094,753	89
1955	839,694	30	1,162,541	39	382,910	15	2,385,145	83*

*Adjusted to eliminate duplication.

Table 3. Number of salmon taken in 1955 compiled by gear, species and district.

Gear and Species	Southeastern Alaska	Central Alaska	Western Alaska	All Districts
SEINES:				
Number of units - - - - -	636	494	32	1,133(1)
Percentage of total catch	48	65	9	
Silver - - - - - - - - - - -	92,491	30,696	2	123,189
Chum - - - - - - - - - - -	1,005,291	1,125,783	109,395	2,240,469
Pink - - - - - - - - - - - -	5,098,995	10,910,612	31,572	16,041,179
King - - - - - - - - - - - -	9,874	4,841	266	14,981
Red - - - - - - - - - - - -	228,581	660,669	364,109	1,253,359
Total	6,435,232	12,732,601	505,344	19,673,177
GILLNETS:				
Number of units - - - - -	1,616	5,954	1,416	8,976(1)
Percentage of total catch	7	14	91	
Silver - - - - - - - - - - -	329,561	348,285	27,280	705,126
Chum - - - - - - - - - - -	175,901	258,560	232,741	667,202
Pink - - - - - - - - - - - -	97,660	381,269	378	479,307
King - - - - - - - - - - - -	35,095	57,723	135,207	228,025
Red - - - - - - - - - - - -	253,181	1,627,971	4,784,141	6,665,293
Total	891,398	2,673,808	5,179,747	8,744,953
TRAPS:				
Number of units - - - - -	113	90	0	203
Percentage of total catch	36	21	-	
Silver - - - - - - - - - - -	166,991	89,185	-	256,176
Chum - - - - - - - - - - -	343,344	246,549	-	589,893
Pink - - - - - - - - - - - -	4,080,050	3,466,261	-	7,546,311
King - - - - - - - - - - - -	1,344	11,762	-	13,106
Red - - - - - - - - - - - -	198,725	386,532	-	585,257
Total	4,790,454	4,200,289		8,990,743
TROLL:				
Number of units (2) - - -	1,730	-	-	
Percentage of total catch	9	-	-	
Silver - - - - - - - - - - -	749,434	-	-	749,434
Chum - - - - - - - - - - -	2,931	-	-	2,931
Pink - - - - - - - - - - - -	57,267	-	-	57,267
King - - - - - - - - - - - -	325,960	-	-	325,960
Red - - - - - - - - - - - -	758	-	-	758
Total	1,136,350	-	-	1,136,350
TOTAL				
Silver - - - - - - - - - - -	1,338,477	468,166	27,282	1,833,925
Chum - - - - - - - - - - -	1,527,467	1,468,892	342,136	3,500,495
Pink - - - - - - - - - - - -	9,333,972	14,758,142	31,950	24,124,064
King - - - - - - - - - - - -	372,273	74,326	135,473	582,072
Red - - - - - - - - - - - -	681,245	2,675,172	5,148,250	8,504,667
Grand Total	13,253,434	19,606,698	5,685,091	38,545,223

(1) Exclusive of duplication
(2) Approximate

Table 4. Comparative annual catches of fish and shellfish in pounds round and value.

SPECIES	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
Salmon - - - - - - - - -	391,689,076	381,807,676	338,369,670	388,345,160	264,918,844	276,588,312	282,966,799	220,276,191	247,032,557	203,674,983
	$17,088,935	$19,570,408	$23,143,760	$32,662,497	$22,637,117	$32,368,160	$31,020,258	$21,497,532	$24,597,049	$21,614,924
Herring - - - - - - - -	198,231,250	187.889,562	174,449,254	33,061,172	165,366,843	81,624,700	45,802,151	34,812,369	35,321,918	64,216,435
	$1,982,312	$2,077,314	$1,852,972	$414,072	$2,067,085	$1,003,292	$444,461	$452,811	$472,721	$793,752
Halibut - - - - - - - - -	35,010,441	34,016,781	34,960,888	35,196,343	38,636,402	32,045,000	33,390,807	26,749,543	36,075,542	26,504,787
	$4,082,000	$5,676,630	$5,095,063	$5,157,902	$5,776,224	$4,117,608	$4,533,808	$2,959,704	$4,352,759	$2,371,623
Sablefish - - - - - - - -	9,019,257	1,228,431	6,512,346	5,753,724	954,901	5,815,405	1,804,417	3,547,271	4,721,750	4,171,759
	$739,600	$110,559	$707,734	$427,374	$35,791	$529,368	$141,364	$250,792	$336,200	$282,089
Cod - - - - - - - - - - -	2,531,630	2,347.514	2,337,770	2,185,547	858,318	--	--	--	--	119,001
	$126,820	$81,405	$73,860	$54,639	$22,676	--	--	--	--	$2,082
Sharks and Skates - - -	6,445,025	1,975,664	2,250,474	1,507,325	18,883	11,008	3,550	2,450	2,783	--
	$60,180	$23,264	$36,358	$24,333	$105	$110	$53	$131	$141	--
Miscellaneous - - - - - bottom fish[1]	1,500,545	82,900	408,989	192,157	20,604	25,264	377,414	14,146	46,914	98,075
	$136,849	$12,462	$17,387	$12,281	$528	$1,620	$22,325	$586	$2,217	$7,414
Clams:										
Butter - - - - - - - -	412,458	11,176	15,644	5,652	--	80	23,116	80,394	9,459	158,558
	$36,965	$838	$939	$339	--	$8	$1,828	$6,432	$643	$13,509
Razor - - - - - - - -	1,804,679	606,540	1,222,649	1,699,695	2,201,717	2,355,681	1,272,454	1,486,222	1,229,135	1,969,228
	$162,421	$57,621	$128,378	$203,693	$264,206	$347,574	$165,419	$193,209	$159,788	$255,999
Crabs:										
Dungeness - - - - - -	2,438,600	1,392,611	1,222,326	1,428,401	4,119,425	5,482,416	3,749,412	3,471,806	2,739,383	4,384,043
	$131,436	$69,630	$63,217	$80,716	$277,382	$478,387	$331,433	$312,463	$246,146	$374.587
King - - - - - - - - -	22,600	752,668	2,133,354	1,206,945	1,519,249	1,993,912	2,772,833	4,613,209	8,871.070	8,162,920
	$960	$31,988	$96,001	$72,417	$91,155	$227,622	$388,197	$547,431	$880,465	$808,654
Shrimp - - - - - - - - -	2,248,900	1,657,299	2,834,803	2,267,934	2,158,260	1,707,816	1,952,777	1,733,882	1,451,929	1,828,127
	$56,222	$215,449	$226,784	$181,434	$172,661	$179,301	$181,609	$225,405	$188,751	$237,657
Miscellaneous - - - - - shellfish[2]	27,425	23,917	7,329	19,630	73,200	44,193	23,021	91,956	67,778	672
	$2,447	$2,078	$733	$1,348	$4,392	$3,596	$2,081	$8,074	$5,422	$61
Miscellaneous - - - - - fish[3]	64,128	16,855	174,467	19,596	1,445,976	32,909	45,424	87,023	58,502	34,312
	$9,932	$1,953	$38,116	$1,564	$22,304	$3,594	$5,548	$12,265	$8,739	$5,241
Miscellaneous - - - - - livers, oil & viscera	$5,377	$50,589	$13,503	$4,396	--	--	--	--	--	--
TOTALS	651,446,014	613,809,594	566,899,963	472,889,281	482,292,622	407,726,696	374,184,175	296,966,462	337,628,720	315,322,898
	$24,622,456	$27,982,188	$31,494,805	$39,299,005	$31,371,626	$39,260,240	$37,238,384	$26,466,835	$31,251,041	$26,767,572

[1] Includes rockfishes, flounders, lingcod.
[2] Includes cockles, oysters, tanner crabs.
[3] Includes trout, smelt. albacore, sheefish.

Table 5. Comparative annual production of fishery products as prepared for market by poundage and value.

SPECIES	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
Salmon - - - - - - - - -	218,653.709 $59,090,973	224,862,543 $93,145,456	210,608,877 $101,193,919	232,616,358 $86,112,666	174,765,212 $87,091,066	189,100,990 $85,887,641	194,611,255 $80,054,432	158,657,320 $62,067,161	174,484,984 $68,206,971	131,280,885 $60,617,136
Herring - - - - - - - -	63,883,821 $6,573,416	63,249,923 $6,533,778	58,388,893 $5,694,889	15,081,412 $944,106	52,106,111 $3,819,994	28,213,195 $2,069,608	15,995,582 $944,667	14,365,884 $805,260	12,464,513 $793,790	23,025,111 $1,531,354
Halibut - - - - - - - - -	27,944,512 $5,460,111	26,795,227 $5,989,188	27,566,134 $6,615,876	27,513,244 $5,425,754	27,401,794 $6,081,896	23,807,098 $4,198,542	25,591,753 $4,730,643	20,534,801 $3,261,482	27,345,901 $4,477,799	23,247,276 $3,220,205
Sablefish - - - - - - - -	6,841,983 $1,153,025	934,435 $143,250	4,943,507 $968,100	4,281,771 $529,935	680,301 $51,579	4,170,292 $548,426	1,297,365 $161,812	2,455,115 $271,366	3,277,673 $394,791	3,042,343 $369,866
Cod - - - - - - - - - -	921,114 $152,660	819,822 $163,498	786,931 $85,389	660,664 $74,680	519,035 $65,347	-- --	-- --	-- --	-- --	107,327 $2,655
Sharks and Skates - - -	277,038 $153,241	164,276 $59,572	177,847 $82,016	153,777 $42,019	2,104 $125	1,321 $155	426 $170	294 $131	334 $141	-- --
Miscellaneous - - - - - bottom fish[1]	1,097,973 $91,342	63,261 $19,404	240,463 $24,115	140,167 $14,938	14,804 $689	20,298 $2,170	372,809 $22,591	6,938 $832	24,777 $2,983	88,308 $10,231
Clams:										
Butter - - - - - - - -	261,681 $171,947	2,700 $1,985	13,452 $3,584	5,916 $1,219	3,192 $3,073	80 $40	11,483 $3,303	36,108 $12,745	423,262[2] $502,771	82,068 $41,358
Razor - - - - - - - -	680,555 $752,783	259,690 $247,801	428,551 $498,489	613,140 $680,171	754,684 $857,871	670,398 $812,791	390,956 $501,354	471,222 $607,326	-- --	551,333 $732,478
Crabs:										
Dungeness - - - - - -	585,280 $640,908	345,583 $326,958	302,972 $293,550	375,908 $349,693	1,130,828 $972,812	1,715,967 $1,125,419	1,037,741 $876,432	723,158 $921,893	2,857,599[3] $2,994,518	1,110,859 $881,686
King - - - - - - - - -	5,421 $8,172	195,433 $168.507	572,107 $684,260	499,121 $272,905	626,871 $630,876	812,690 $754,208	618,408 $683,882	1,272,524 $1,171,554	-- --	2,086,565 $1,767,923
Shrimp - - - - - - - - -	346,811 $323,372	350,375 $326,467	493,271 $523,750	521,703 $473,790	500,566 $443,410	427,096 $434,201	507,857 $485,153	503,168 $476,469	481,225 $442.159	567,919 $495,557
Miscellaneous - - - - - shellfish[4]	6,780 $5,800	4,899 $2,949	1,026 $684	4,356 $3,504	47,400 $8,875	2,174 $1,609	3,561 $3,069	8,398 $7,734	-- --	150 $80
Miscellaneous - - - - - fish[5]	41,504 $8,556	12.587 $2,435	181,390 $50,827	14,249 $3,481	55,441 $16,508	20,658 $4,391	30,963 $9,941	71,888 $16,311	50,978 $10,482	23,092 $6,325
Miscellaneous - - - - - livers, oil & viscera	74,275 $433,575	199,967 $66.701	417,704 $149,906	23,337 $4,396	529,963 $39,149	-- --	-- --	-- --	-- --	-- --
TOTALS	321,622,457 $75,019,883	318,265,721 $107,197,949	305,123,125 $116,869,334	282,505,123 $94,933,257	259,138,306 $100,083,272	248,762,257 $95,839,201	240,470,159 $88,477,449	197,106,818 $69,620,264	221,411,226 $77,826,405	185,213,236 $69,676,854

[1] Includes rockfishes, flounders, lingcod.

[2] Includes both butter and razor clams.

[3] Includes both Dungeness and king crabs.

[4] Includes cockles, oysters, tanner crabs.

[5] Includes trout, smelt, albacore, sheefish.

FINANCIAL REPORT

ALASKA DEPARTMENT OF FISHERIES

Expenditures April 1, 1955 - March 31, 1956

FUNDS ALLOTTED, BIENNIUM APRIL 1, 1955 - MARCH 31, 1957:

ADMINISTRATION	$ 61,500.00
BIOLOGY	167,910.00
CONSTRUCTION - FISHWAYS	60,000.00
EXPENSES OF FISHERIES BOARD	9,000.00
ENGINEERING	27,500.00
EDUCATION and INFORMATION	8,000.00
INSPECTION	25,000.00
MARINE PREDATOR CONTROL and INVESTIGATIONS	60,000.00
SILVER SALMON RESEARCH, S. E. ALASKA	19,830.00
SPORT FISH PROPAGATION	95,000.00
WATERSHED MANAGEMENT	139,050.00
TOTAL	$672,790.00

ADMINISTRATION	Allotted biennium April 1, 1955 - March 31, 1957	March 31, 1956 Balance
Salary of Director, Administration	$22,000.00	$11,000.08
Salaries of Personnel, Administration	23,000.00	11,605.00
General Expenses, Administrative & Travel	16,500.00	10,102.06
	$61,500.00	$32,707.14

	Expenditures	
Salaries & wages	$22,394.92	
Transportation	2,575.75	
Subsistence & lodging	1,011.00	
Office Expense	707.40	
Telephone & telegraph	279.73	
Postage, freight & express	178.33	
Printing	272.50	
Industrial Insurance	55.68	
Other General Expense	175.20	
Operating Expense	848.90	
Office Equipment	293.45	$28,792.86
		$32,707.14 Balance

BIOLOGY	Allotted biennium April 1, 1955 - March 31, 1957	March 31, 1956 Balance
Salaries, Biology	$100,000.00	$54,532.84
General Expenses, Biology	67,910.00	22,762.88
	$167,910.00	$77,295.72

	Expenditures	
Salaries & wages	$45,467.16	
Transportation	4,813.39	
Subsistence & lodging	12,186.00	
Office Expense	150.82	
Telephone & telegraph	309.84	
Postage, freight & express	714.31	
Printing	155.60	
Rent	358.95	
Industrial Insurance	298.35	
Other General Expense	1,212.66	
Operating Expense	19,277.68	
Office Equipment	409.20	
Floating Equipment	990.53	
Utility Equipment	152.95	
Structures	4,116.84	$90,614.28
		$77,295.72 Balance

CONSTRUCTION - FISHWAYS	$60,000.00	$60,000.00
EXPENSES OF FISHERIES BOARD	$ 9,000.00	$ 4,982.25

	Expenditures	
Transportation	$ 1,370.10	
Subsistence & lodging	2,441.00	
Telephone & telegraph	60.95	
Office Expense	41.25	
Printing	54.45	
Other General Expense	50.00	$ 4,017.75
		$ 4,982.25 Balance

		Allotted biennium	March 31, 1956
ENGINEERING . . . . April 1,		1955 - March 31, 1957	Balance
		$27, 500. 00	$18, 791. 51
	Expenditures		
Salaries & wages	$ 5, 762. 25		
Transportation	743. 00		
Subsistence & lodging	1, 797. 00		
Office Expense	11. 94		
Industri al Insurance	15. 00		
Operating Expense	219. 56		
Utility Equipment	98. 50		
Postage, freight & express	9. 14		
Other General Expense	52. 10	$ 8, 708. 49	
		$18, 791. 51 Balance	

EDUCATION and INFORMATION		$ 8, 000. 00	$ 797. 17
	Expenditures		
Salaries & wages	$ 3, 766. 66		
Transportation	648. 15		
Telephone & telegraph	6. 16		
Postage, freight & express	99. 52		
Printing	210. 00		
Industrial Insurance	15. 00		
Other General Expense	1, 456. 79		
Operating Expense	165. 45		
Utility Equipment	835. 10	$ 7, 202. 83	
		$ 797. 17 Balance	

INSPECTION			
Salaries, Inspection		$20, 000. 00	$ 9, 660. 84
General Expenses, Inspection		5, 000. 00	2, 383. 58
		$25, 000. 00	$12, 044. 42
	Expenditures		
Salaries & wages	$10, 339. 16		
Transportation	70. 00		
Industrial Insurance	283. 65		
Other General Expense	142. 18		
Operating Expense	2, 120. 59	$12, 955. 58	
		$12, 044. 42 Balance	

		Allotted biennium	March 31, 1956
MARINE PREDATOR CONTROL and INVESTIGATIONS . . . April 1,		1955 - March 31, 1957	Balance
		$60, 000. 00	$20, 612. 14
	Expenditures		
Salaries & wages	$19, 953. 33		
Transportation	1, 075. 52		
Subsistence & lodging	2, 082. 00		
Postage, freight & express	73. 80		
Office Expense	33. 70		
Telephone & telegraph	3. 53		
Industrial Insurance	939. 73		
Other General Expense	152. 55		
Operating Expense	14, 721. 70		
Utility Equipment	110. 00		
Floating Equipment	242. 00	$39, 387. 86	
		$20, 612. 14 Balance	

SILVER SALMON RESEARCH, S. E. ALASKA		$19, 830. 00	$16, 987. 75
	Expenditures		
Salaries & wages	$ 2, 725. 00		
Postage, freight & express	2. 05		
Other General Expense	9. 00		
Operating Expense	106. 20	$ 2, 842. 25	
		$16, 987. 75 Balance	

SPORT FISH PROPAGATION		$95, 000. 00	$51, 794. 14
	Expenditures		
Salaries & wages	$25, 123. 50		
Transportation	562. 40		
Subsistence & lodging	3, 030. 00		
Office Expense	30. 65		
Telephone & telegraph	186. 62		
Postage, freight & express	397. 78		
Rent	290. 00		
Industrial Insurance	143. 75		
Other General Expense	297. 26		
Operating Expense & Dept. car expense	13, 029. 86		
Utility Equipment	114. 04	$43, 205. 86	
		$51, 794. 14 Balance	

WATERSHED MANAGEMENT	Expenditures	Allotted biennium April 1, 1955 - March 31, 1957	March 31, 1956 Balance
Salaries, Watershed Management		$ 85,000.00	$45,897.51
General Expenses, Watershed Management		54,050.00	27,890.72
		$139,050.00	$73,788.23
Salaries & wages	$39,102.49		
Transportation	2,270.68		
Subsistence & lodging	5,724.00		
Office Expense	177.23		
Telephone & telegraph	352.70		
Postage, freight & express	450.35		
Rent	378.10		
Industrial Insurance	102.58		
Other General Expense	427.74		
Operating Expense	13,686.35		
Floating Equipment	1,320.82		
Utility Equipment	1,256.73		
Office Equipment	12.00	$65,261.77	
		$73,788.23 Balance	

FISHERIES CONTINGENT RECEIPTS FUND (Chapter 64, S. L. A. 1953)

	Expenditures		
Monies received from Wakefield's Deep Sea Trawlers, Inc., Seattle, Washington, from October 13, 1953 - August 15, 1955		$ 5,000.00	$ 2,700.50
Salaries & wages	$ 2,299.50	$ 2,299.50	
		$ 2,700.50 Balance	
Monies received from Fishermen and Cannery Workers Union No. 24365, Juneau, for use on destruction of Taku River seal, according to Chap. 64, S. L. A. 1953		$ 300.00	$ 300.00
		$ 3,000.50 Balance	$ 3,000.50

ALASKA FISHERIES RESEARCH, SALTONSTALL-KENNEDY FUND (Not to exceed) $25,000.00

March 31, 1956 Balance $15,774.14

Money to be used for investigation of predatory animals and their influences on prey species of fish with commercial importance.

	Expenditures	
Salaries & wages	$ 5,535.00	
Subsistence and lodging	1,539.00	
Transportation	707.80	
Office Expense	30.20	
Postage, freight & express	48.04	
Printing	32.00	
Other General Expense	62.40	
Operating Expense	1,271.42	$ 9,225.86
		$15,774.14 Balance

LOOKING FORWARD

In general, the operations of the several divisions for the coming year will continue along the lines outlined in this report. It is planned, however, to start some new projects and to expand certain others that were inaugurated during 1955.

ALASKA FISHERIES BOARD

The fishermen of Alaska, both commercial and sport, will continue to be urged and welcomed to attend and participate in the semi-annual meetings of the Alaska Fisheries Board. It is reiterated that all meetings are open to the public. Comments and suggestions, either written or oral, are requested at the fall meetings for consideration of the Board in preparing its annual brief to the Fish and Wildlife Service pertaining to the fishing regulations for the ensuing year.

ADMINISTRATION

The Director will continue to attend fishery meetings and hearings, when it is felt his attendance would be of advantage to the Territory. The annual meeting of the International North Pacific Fisheries Commission should always have a good representation from Alaska, since many questions of vital interest to the Territory continually crop up. Some of the major problems in the world's fisheries are occurring and will occur, virtually, in Alaska's front yard.

BIOLOGICAL RESEARCH

TAKU RIVER SALMON INVESTIGATIONS

The Taku River salmon investigation will be continued during 1956; this is a long term research project aimed at ascertaining the magnitude of the salmon resources of the watershed and in evaluating the effect of the existing fisheries on the spawning escapement. Refinements in techniques for sampling by means of the fish wheel at Canyon Island, and refinements in other experimental tools should provide better estimates of the total runs and escapements in the future.

KITOI BAY RESEARCH

The Kitoi Bay Research Station provides the biologists with extremely valuable experimental tools to use in the prosecution of their studies on the fresh water life of the red salmon. The geographical location of this station, with its many nearby lakes and streams, is ideally situated for basic research. Several experimental projects will be inaugurated during 1956.

KING CRAB STUDIES

The king crab investigation will be continued with headquarters at Kodiak, in which vicinity the most important fisheries take place within Territorial waters. To facilitate these studies, a salt water aquarium will be built for use of the biologist in charge. Tagging operations will again be carried out to determine the migratory patterns of this species.

Although the troll salmon and blackcod fisheries are of considerable importance and value, only a minimum of effort can be devoted to them for the next year.

MINOR STUDIES

ENGINEERING

A preliminary survey for a fishway on the outlet stream of Bakewell Lake near Ketchikan was made in 1955. From this survey it appeared that it would be possible to undertake this project with the allotted funds. Accordingly, plans and specifications will be prepared and bids called for during 1956. Construction should get underway shortly thereafter.

INSPECTION

It is expected that operations in this division will continue on approximately the same scale as in the 1955 season. Two roving inspectors using cars will again cover the Kenai Peninsula and the Upper Copper River districts. An additional one or two men, as funds permit, will be assigned to other locations.

MARINE PREDATOR CONTROL AND INVESTIGATION

HAIR SEALS

The present type of hair seal program will be carried forward in the Stikine, Taku and Copper River districts, where these animals carry on their greatest depredations. The population of hair seals on the Copper River flats has now been reduced so that the ''bombing' operations can be considerably curtailed.

BELUGAS

The investigational phases of the beluga studies in Bristol Bay have now reached the point where actual control measures can be instituted. Two men will be employed during 1956 to harass and drive the belugas away from the river mouths during the period the young red salmon smolts are migrating to the sea. One man will be stationed on the Kvichak River and the other on the Nushagak.

SALTONSTALL-KENNEDY FUNDS

In June 1955 an allotment of $25,000 was given to the Department from the Saltonstall-Kennedy funds for ''An Investigation of Predatory Animals and their Influence on Prey Species of Fish of Commercial Importance.'' Although a start was made on this program late in 1955, much of the actual investigation will be carried out in 1956.

SPORT FISH

The sport fish program in the Fairbanks and Anchorage-Palmer areas will be continued along the same lines as during the past year.

KODIAK AREA

With funds to be provided by the Kodiak Conservation Club, a sport fish biologist will be assigned to the Kodiak area during 1956 to supervise the sport fish program in the lakes on the Naval Base and in the immediate vicinity of the town of Kodiak. The hatchery built by the club will be made available to the Department for its work.

WATERSHED MANAGEMENT

KODIAK AREA

The year 1955 saw the completion of a full cycle (five years) of planting of eyed red salmon eggs in Gretchen Creek (Pauls Basin) on Afognak Island. If encouraging returns of adult salmon are obtained in 1956, it may not be necessary to plant this stream in the future. However, the plants of red salmon eggs at Frazer Lake on Kodiak Island will be repeated in 1956.

KETCHIKAN DISTRICT

The program for development of brood stock runs of silver and fall king salmon are progressing. Fry of both species hatched and reared at the Deer Mountain Hatchery will be ready for stocking in 1956. Red salmon fry, also from the Deer Mountain Hatchery, will be released in Bakewell Lake during 1956. Previous plants in this system have been composed of green or eyed eggs.

BRISTOL BAY

It is expected that a permanent district man can be assigned to the Bristol Bay area in 1956, with his probable location being at Dillingham.

Picking salmon from the gill net and unloading the catch, Bristol Bay