

UNITED STATES
DEPARTMENT OF THE INTERIOR
Julius A. Krug, Secretary

FISH AND WILDLIFE SERVICE
Albert M. Day, Director

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QUARTERLY REPORT
DIVISION OF FISHERY BIOLOGY
Elmer Higgins, Chief
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DIVISION HEADQUARTERS, Washington, D. C.

During the winter quarter when active field work is normally at a minimum, the field staff of the Division, as shown by the following sectional reports, was concerned chiefly with the analysis of data collected during the more active field season of the previous quarter and the preparation of technical reports on various research programs delayed by the war. A number of manuscripts have been completed and submitted, either in preliminary or final draft.

The outstanding event of the quarter, however, was the Divisional Conference of section chiefs and project leaders in Washington from January 27 to 30, inclusive, when 35 members of the staff and 15 other Service employees met for a thorough review of plans, methods and procedures for developing and revitalizing the program of fishery research. Administrative and organizational matters were given rather full consideration and a number of constructive proposals were made to facilitate the research program. A mimeographed report of the conference was distributed to all members of the Division.

Owing to limitation of funds many of the excellent suggestions for an improved organization have been held in obedience, but steps for carrying out some of the principal recommendations have been taken.

At the end of the quarter the Assistant Chief of the Division, Mr. Paul Thompson moved his office from Chicago to Washington, and now occupies quarters in the Interior Department Building, thus removing one of the sources of delay, confusion and inconvenience in the administration of Divisional affairs. Mrs. Catherine Criscione has been appointed as principal administrative clerk, vice Mr. Joe Abeln, who transferred to another office in Chicago, and Miss Frances Roti transferred from the Administrative Office in Chicago to Washington to serve as Mr. Thompson's secretary, vice Miss Litwin.

The Committee on Technical Planning and Coordination, consisting of Drs. Rounsefell, Galtsoff and Mottley, has been strengthened by the addition of Dr. Lionel A. Walford, during the period in which he is winding up his affairs as Assistant Chief of the Division of Information and assuming his new duties as Chief of the Atlantic Coast Fishery Investigations, the section which has been established by combining the functions of the North Atlantic and the Middle Atlantic Fishery Investigations.

Prospects for increased appropriations for the next fiscal year are so discouraging that action to establish additional positions for improved administration and coordination in Washington have not been taken.

During the quarter, members of the Washington staff visited a number of field sections and participated in various conferences concerned with programs of research. Mr. Higgins and Dr. Mottley attended the Regional Directors' meeting in Chicago on January 17 and 18. Dr. Mottley made several trips during the quarter to various field points in the southern and southwestern States.

Mr. Higgins and Dr. Walford spent two days in Cambridge and participated in staff meetings of the Section for review of the North Atlantic Fishery Investigations, particularly the future program of the Albatross III. Mr. Higgins made an additional trip to Cambridge and Boston for review of the architect's plans for reconstruction of the Albatross III for which contracts will be let and reconversion started before the end of the fiscal year.

Dr. Rounsefell attended a conference in Boston with State officials on the program of development of the Connecticut River.

Mr. Higgins and Dr. Rounsefell attended the meeting of the Chesapeake panel of the Atlantic States Marine Fishery Commission in Baltimore, and as a result of this meeting a conference was called in Washington by the Chief of the Division for a review of crab investigations in Chesapeake Bay, and for planning cooperative studies in the future. Biologists of the States of Maryland and Virginia and several members of the staff of the Division participated.

Publications and Fishery Leaflets which were issued during the quarter are as follows:

Special Scientific Report

- No. 38--Water Quality Studies of the Delaware River with Reference to Shad Migration, by M. M. Ellis, B. A. Westfall, D. K. Meyer and W. S. Platner.
- No. 39--Effects of Aquatic Weed Infestations on the Fish and Wildlife of the Gulf States, by J. J. Lynch, J. E. King, T. K. Chamberlain and Arthur L. Smith, Jr.
- No. 40--Evaluation of Fisheries in Determining Benefits and Losses from Engineering Projects, by Richard A. Kahn and George A. Rounsefell.

Fishery Leaflet

- No. 123--(Rev.) Sharks, and Skates or Rays, by Samuel F. Hildebrand
- 55--(Rev.) Breathing in Fishes, by James S. Gutsell
- 216--Diamond-back Terrapin Culture, by Samuel F. Hildebrand and Herbert F. Prytherch
- 58--Some publications on Diseases and Parasites of Fishes, Revision by the Division of Fishery Biology.
- 222--Disease Control in Hatchery Fish, by Frederic F. Fish.

ALASKA FISHERY INVESTIGATIONS, George B. Kelez, Chief of Section.

GENERAL

Director Albert M. Day visited the laboratory on February 27 and delivered an inspiring talk at a get-acquainted assembly of staff members of the North Pacific, Alaska and Technology Sections. Mr. Day later discussed Pacific Coast and Alaska fishery problems with individual investigators.

The laboratory was visited by three foreign fishery research men during January and February: one from Argentina, one from Russia and one from India. Dr. Pedro H. Bruno-Videla from Argentina visited January 2, 3 and 4, and was interested in meeting fisheries people in this region to discuss fishery problems. Mr. Barnaby and Mr. Kelez discussed with him the various phases of research carried on in their respective sections.

Dr. Alexander S. Bogdanov, Director of the Institute of Fishery and Oceanography, spent February 12 and 13 at the laboratory reviewing local fisheries research problems. His position in Russia is comparable to that of the Director of the Fish and Wildlife Service in this country. Dr. Bogdanov addressed a group meeting, through his interpreter Mr. Visey. His discussion concerned various phases of fishery research in the USSR.

Mr. G. D. Bhawnani, of India, called at the laboratory February 21 to discuss economic fishery problems. He was interested in the processing and handling of fishery products. Some of the subjects discussed were Alaskan fishery methods; and handling, and preparation and distribution systems used to get the fish to distant markets.

Mr. Kelez and Mr. Hutchinson reviewed the chum salmon fishery in Excursion and Tenakee Inlets in southeastern Alaska with respect to the new 1947 regulations which will curtail the catch of this species in these areas. A brief discussion was held with Mr. John Tension of the Superior Packing Company, at which time he presented salmon catch statistics for Tenakee Inlet.

Members of the staff prepared and submitted data covering distribution of salmon herring, and groundfishes in Alaskan waters.

The planning of an experiment to determine the effect on the Vitamin A content of dog-fish livers during storage was discussed with Mr. Bruce Sanford of the Technological Section. Since the livers are very expensive and the analysis of the livers for Vitamin A involves a great deal of labor, it was desirable to determine how small a sample could be used and yet obtain reliable results. The experiment as planned was carried through and the results analyzed by members of the Technological staff with Miss Vaugh acting as consultant on all statistical procedures. A report on this experiment is being written for publication.

A conference was held with Dr. Victor Scheffer and Mr. Ashbrooke of the Division of Wildlife Research on the use of data obtained from tagging seal pups in determining an estimate of the seal populations of the Pribilof Islands. This estimate of the population would be used as a check upon present methods of obtaining the number in the seal herds. Use of the data for other purposes and the general methods of handling it were discussed, as well as the number of pups to be tagged in order to obtain reliable data.

PROJECT 1. SALMON RESOURCES IN BRISTOL BAY.

Transcription and tabulation of the data obtained from adult red salmon during the 1946 field season has been completed relative to the age composition of the Kvichak and Naknek River commercial fishery samples. These data were tabulated by daily samples and the results summarized for the season, are given in the following table.:

| | <u>Age Composition</u> | | | | | <u>2 Yr.</u> | <u>3 Yr.</u> | <u>Males</u> | <u>Females</u> |
|---------|------------------------|----------------------|----------------------|----------------------|----------------------|--------------|--------------|--------------|----------------|
| | <u>4₂</u> | <u>5₂</u> | <u>5₃</u> | <u>6₂</u> | <u>6₃</u> | <u>FW</u> | <u>FW</u> | | |
| KVICHAK | 25.1 | 40.2 | 21.1 | 1.8 | 11.8 | 67.0 | 33.0 | 42.3 | 57.7 |
| NAKNEK | 40.8 | 51.6 | 2.6 | 1.6 | 3.4 | 93.3 | 6.1 | 51.0 | 49.0 |

Lengths in Centimeters by Age Groups

| <u>KVICHAK</u> | | | | <u>NAKNEK</u> | | | |
|----------------|------------|----------------|--|---------------|---------------|----------------|--|
| <u>Males</u> | | <u>Females</u> | | <u>Males</u> | | <u>Females</u> | |
| 4 ₂ | 57.7 ± 2.6 | 57.7 ± 1.7 | | 58.0 ± 2.6 | | 56.3 ± 2.4 | |
| 5 ₂ | 63.1 ± 4.1 | 61.0 ± 2.3 | | 63.8 ± 3.5 | | 61.5 ± 3.4 | |
| 5 ₃ | 59.1 ± 2.7 | 57.2 ± 2.3 | | | Insignificant | | |
| 6 ₃ | 64.5 ± 3.7 | 61.3 ± 2.5 | | | Insignificant | | |

During the 1946 season the fresh-water age of the Kvichak red salmon differed materially from that of the Naknek red salmon. This difference is probably greater than indicated because the samples are taken from a mixed group affected by the intermingling of these two populations in the fishery. A preliminary analysis of the migrant age of either Kvichak or Naknek fish shows a marked difference in the age at migration. From a sample of known Kvichak fingerlings the age composition has been determined to be composed of 94 percent 3 year migrants and the remaining 6 per cent, 2 year migrants. From a sample of known Naknek fingerlings, the age composition was found to result in practically the opposite in that the 3 year migrants contributed only 15 percent of the total, while the 2 year migrants contributed 85 percent.

An analysis of the length, weight, sex, and girth data for five Bristol Bay districts is being continued and some interesting correlations are being made relative to racial differences or similarities. These analyses are not complete at this time but when all existing data have been employed some indication of the existence of definite racial differences should be obtained.

Much of the preliminary data necessary to the age interpretation of adult fish is being completed and an analysis of these data is now being undertaken. Because the variance in growth rate and time of seaward migration affects the general appearance of the scales, it is necessary to first establish the range of types of migrant scales and determine the peculiarities that exist in each particular district before the validity of interpretations of the age at maturity from adult scales may be established.

PROJECT 2: Investigations of the Salmon Populations of the Karluk River, Kodiak Island.

In 1946 the Karluk sockeye run was the lowest on record, being approximately one-half that of the lowest previous run (1922). The escapement was 442 thousand; catch 228 thousand; total run 670 thousand. This is another reminder that the runs are in a serious state of depletion, and that immediate steps must be taken to prevent complete exhaustion of these populations.

The escapement of 1922 was 400 thousand, and this resulted in one of the best returns obtained. However, the productivity level of the lake is obviously quite different from what it was in 1922, and what return can presently be expected from such a low escapement is problematical. It should be self-evident that the decrease in spawning populations cannot continue indefinitely without, somewhere reaching a disastrous end-point. With the perpetuation of the stock in mind it became necessary to know if the run of 1947 will be large enough to yield to normal fishing efforts and still provide a minimum spawning requirement. The indications are that it cannot.

A study of the return-from-escapement data makes it evident that the poor run in 1946 was caused by poor survival of the brood years 1940 and 1941. On reading the age of the 1946 fish it was found that 1940 produced relatively few 6-year fish, and that 1941 produced few 5-year fish. As the ratio of 5-year fish in the run of one year to the 6-year fish in the next is somewhat constant, it is evident that the 1947 run will receive few 6-year fish. On the average, 5-year plus 6-year fish make up about 93% of the run of any year. Therefore, unless the brood year of 1942 was unusually successful (in producing 5-year fish for 1947) the total run for the coming season can be expected to be very poor. There is nothing to indicate that the 1942 brood year will have been any more productive than the previous two. With such prospects it will be necessary to regulate the fishery with great care to insure even a moderate spawning escapement.

In the last quarterly report it was stated that "observations support the belief that an escapement of 400,000 will result in 100 percent seeding of available stream gravels." This does not mean that such an escapement is sufficient to seed the lake gravels, too, and certainly does not mean that such an escapement is adequate or optimum. A large share of the sockeyes at Karluk (especially of the fall run) spawn in the littoral zone of the lake. Neither the numbers spawning in these areas, nor the extent of usable gravels have been measured, but that these areas have been productive cannot be denied.

Data at hand indicate that, at present productivity levels, we may expect the best yield from an escapement of approximately 700 thousand fish. The indications are that the total run of 1947 will not greatly exceed this figure, and that it may not be so great.

PROJECT 3: PINK SALMON RESOURCES OF SOUTHEASTERN ALASKA

Regular observations on the incubation and rate of development of the pink salmon eggs in the stream at Little Port Walter were continued during the quarter, as was weekly sampling of the pink salmon nests. The rate of development of the embryos has been greatly retarded this past winter due to severe climatological conditions which set in early in December and have continued throughout January, February, and the first two weeks in March. Subnormal temperatures have caused considerable loss to the developing pink salmon in Sashin Creek, and it is assumed a similar situation exists in other streams in the Eastern District. The potential number of pink salmon fry in Sashin Creek was already far below average due to the low escapement of adult spawners (363 females) into the stream last fall.

A comparison of the number of thermal units affecting the developing eggs and fry in the gravel each week are presented in the following table. The thermal units reaching the egg during the first 14 weeks of incubation (prior to January 1) have been totaled for that period. The number of thermal units reaching the eggs each week thereafter are compared with the seven-year average at Little Port Walter.

Thermal Units Reaching Developing Eggs and Fry
Sashin Creek - Little Port Walter

| Week of Incubation | 7-Year Weekly Average | 1947 Weekly Average | 1947 Above or Below Average |
|--------------------|-----------------------|---------------------|-----------------------------|
| 1 - 14 (Oct.-Jan.) | 920.6 | 566.7 | - 353.9 |
| 15 | 27.0 | 17.4 | - 9.6 |
| 16 | 29.3 | 11.4 | - 17.9 |
| 17 | 31.1 | 12.8 | - 18.3 |
| 18 | 28.2 | 3.0 | - 25.2 |
| 19 (February) | 27.1 | 1.9 | - 25.2 |
| 20 | 24.0 | 2.5 | - 21.5 |
| 21 | 21.1 | 3.7 | - 17.4 |
| 22 | 16.2 | 12.1 | - 4.1 |
| 23 (March) | 17.2 | 15.5 | - 1.7 |
| 24 | 19.9 | 16.2 | - 3.7 |
| 25 | 20.0 | 25.7 | - 5.7 |
| Total | 1,181.7 | 688.9 | - 492.8 |

From the table it is evident that the number of thermal units reaching the eggs and fry have been far below average, and it is evident that the rate of development of the fry has been retarded. Thus it is anticipated that the downstream migration of fry this spring will be from 4 to 6 weeks late.

Mr. Olson, station foreman, reported that on January 10 Sashin Creek was quite low, exposing some of the higher bars, and there being no snow on these bars, some eggs were subjected to freezing temperatures. On January 30 he reported there had been a week of high winds reaching a velocity of 70 miles per hour and accompanied by freezing temperatures. These severe conditions are considered as being deleterious to the developing pink salmon fry.

The scientific staff of the Alaska Salmon Industries, Inc., under the direction of Dr. W. F. Thompson, are planning salmon tagging programs in the Southern District of southeastern Alaska this summer. As yet they have not undertaken any direct observations of the salmon fry during their incubation or downstream migration periods.

PROJECT 4: ALASKA HERRING INVESTIGATION

Statistics collected from the herring fishery of Southeastern Alaska during the years of 1944, 1945, and 1946 have furnished substantial evidence that the abundance in this area has been restored. Since the reopening of this district in 1943, the abundance index has steadily increased from 96 in that year to a new high of 161 in 1946. Studies of age composition data reveal that the primary factor in this increase has been the entry of the successful year classes of 1944 and 1942 assisted by the moderately successful year class of 1943.

The recovery of the fishery has unquestionably been accelerated by the low fishing intensity during recent years. There was only one plant in the district in 1943, two plants in 1944, and three plants in 1945 and 1946. The fishing success of the past two seasons, coupled with favorable marketing prospects for meal and oil, has aroused the interest of other operators so that an increase in intensity in the coming season appears certain. From present information there will be at least two and possibly three additional operators next season which will materially increase the reduction capacity and the size of the fishing fleet.

With the abundance restored and with the prospects of expansion of the fishery imminent, the need for positive policies of management to sustain the fishery at a high level becomes particularly acute. The method of forecasting abundance through the establishment of ratios of increment and decrement has proven so useful in the management of the Kodiak fishery that it now appears opportune to apply this method to the management of the Southeastern fishery. Since the application of this procedure requires an uninterrupted series of data on abundance and age composition of the catch it has not been possible to apply this method until the present time. The suspension of fishing in the years 1940 through 1942 prevented the accumulation of the necessary data.

Preliminary work toward establishing ratios of increment and decrement is now in progress. In order to make the procedure identical with those used in the Kodiak analysis the data is being regrouped into ten-day fishing periods. A new standard curve of availability embracing the period from 1932 to 1946 is being prepared. The catch of each year is being tabulated according to locality of capture (statistical area number) by ten-day periods.

In order to obtain knowledge of the numerical strength of each of the year classes that have contributed to the fishery the number of individuals removed each year by the fishery is being calculated. This is accomplished by using the percentage age composition of the catch, the mean weight at each age, and the total catch for each period. Because weight data is not available prior to 1943, the mean weight at each age by ten-day periods has been calculated from the combined data of the years 1943 through 1946. Age composition is being carefully checked since it is from these data, weighted by the abundance index of each year, that the ratios of increment and decrement are obtained.

Through the establishment of indices of abundance and ratios of increment and decrement it will become possible to evaluate the total potential yield of each year class in advance and to ascertain the number of individuals that each can safely contribute to the fishery. Under the system of quota limitations fishing intensity can be regulated so as to comply with the ability of the stocks to produce on the basis of a sustained yield. It is anticipated that this method can be used in establishing the quota for the southeastern fishery in the season of 1948.

PROJECT 5: INVESTIGATION OF FLUCTUATIONS IN TIME OF APPEARANCE AND ABUNDANCE OF ALASKA SALMON RUNS.

Since the pink salmon migrations have become late in the season throughout southeastern Alaska and since the pink salmon comprises approximately seventy-five percent of the catch in this area, the opening and closing dates for the fishing seasons have been set from two weeks to a month later in 1947 than in previous years. The effect of this later season upon the catches of other species should be studied. Chum salmon are second in importance in this region, comprising 15 percent of the catch. Therefore an analysis of the daily catch of chum salmon by traps has been undertaken.

In order to answer specific questions raised by operators in the Western District of Southeastern Alaska, the chum salmon catch by traps operated on the east coast of Chichagof Island is being analyzed first. Records of traps operated in this area in 1923 and from 1927 through and including 1946 have been summarized. While the analysis has not been completed, it can be seen that the curve of the average daily trap catch is positively skewed, the catch rising rapidly during the last of June, reaching a peak the second week of July and tapering off gradually as the fishing season progresses. The opening date for the 1947 fishing season in this area is July 28. From inspection it appears that approximately 70 percent of the chum salmon run will be over by this opening date. As soon as the analysis of this area is completed, the other areas of southeastern Alaska will be studied in turn.

PROJECT 6: ALASKA FISHERY STATISTICS

A memorandum was prepared for Mr. Kelez on the Bristol Bay pack of red salmon for the years 1936 to 1946 inclusive. Weekly pack data only were available for each river. These weekly packs were divided equally among the fishing days of the preceding weeks to obtain average daily packs. These packs were converted to numbers of fish where needed. From these data and the estimated total packs for each of the four river systems for the 1947 season, the estimated daily average catches for varying numbers of boats for each of the rivers were calculated for the coming season. These calculations were made originally for the season from June 25 to July 25. When the regulations were issued setting the season from June 23 to July 23, many of the calculations and graphs had to be remade.

A comparison was made between the runs of red salmon at False Pass and Bristol Bay. Rich and Ball found the abundance of the runs in these two areas to fluctuate together for several years preceding 1928. Their methods of comparison were used for the years 1936 to 1946 inclusive, and for these years the runs were found to vary independently of one another. In the years before the war, adverse weather conditions curtailed production at False Pass, while during the war operating conditions were so abnormal as to affect the size of the packs at both False Pass and Bristol Bay. The thought had been entertained that if a high degree of correlation still existed the time of appearance and the magnitude of the runs at False Pass might afford an early indication of the magnitude of the Bristol Bay runs. This does not seem possible at the present time.

All of the daily trap reports for the 1946 season were checked in during the middle of March. As usual, there were a number of stragglers from whom it was difficult to obtain reports. These reports cover all trap catches for all of Alaska from Southeastern to and including the Peninsula area.

Mrs. McNamée has continued to summarize the trap catches of red salmon in Southeastern Alaska.

PROJECT 7: IMPROVEMENT AND EXPANSION OF SALMON SPAWNING AREAS.

Analysis of the data collected in southeastern Alaska last October was continued. Of the 27 streams surveyed, approximately 12 warrant improvement in that the increase in the number of salmon produced in each stream would justify the cost of necessary structures. A pictorial report was prepared covering improvements on 11 streams in southeastern Alaska. Navy Creek, located in Burnett Inlet, is given first priority because it contains a large expanse of excellent spawning grounds that cannot be reached by the salmon due to the presence of an 8-foot falls approximately 150 feet upstream. It is considered that a fish ladder would permit passage of this falls and provide a potential increase of 60,000 salmon annually. A fish ladder in Navy Creek would cost approximately \$40,000.

Following Navy Creek in order of importance for improvements are Sunny Creek, Beauty Creek, Mill Creek, Maybeso Creek, Cabin Creek, Shipley Bay, Pavloff Creek, Eva Creek, and Ketchikan Creek. A cost estimate of improvement for all these streams would range somewhere in the neighborhood of \$400,000. From the information and survey data taken last fall, it is believed that these improvements would soon repay their costs in the form of increased salmon production in southeastern Alaska.

Stream survey maps were completed for the following seven streams: Cabin Creek, Fall Creek, Chomly Creek, Gambier Bay Creek, Navy Creek, Shipley Bay Creek, and Thayer Creek. These are large scale maps (1:600) which show type of bottom, location of falls and log jams, widths, depths, and extent of suitable spawning area. Photographs of falls, log jams, and stream sections accompany these maps. General location maps have been made for each of the 27 streams that were surveyed in the previous quarter. These maps are designed to give a general picture of the watershed drained and the point of discharge into the bay.

Reports in rough draft have been completed for 15 streams, evaluating the potentialities of each for the production of salmon. The following table lists the streams for which the extent of spawning area above the barrier has been computed. Many of these figures represent the minimum area that would be available to the salmon after improvements were completed; for some streams additional areas above these must be covered before the survey will be complete.

| <u>Stream</u> | <u>Square yards of suitable spawning area above falls.</u> | |
|-------------------|--|-------------------|
| Beauty Creek | 1,560 | - Paul Lake |
| Cabin Creek | 3,900 | |
| Fall Creek | 13,500 | First three miles |
| Gambier Bay Creek | 1,200 | |
| Mill Creek | 1,100 | - Virginia Lake |
| Navy Creek | 26,000 | |
| Sunny Creek | 9,400 | Right branch |

GENERAL

During the period February 10 to 14 Mr. Barnaby attended the meeting of the River Basin staff at Fox Lake, Illinois.

Dr. Alexander Bogdanov, Director of Research of the Institute of Fishing and Oceanography of the U.S.S.R., visited the Laboratory during the period February 6 to 13, and during that time various problems relating to the maintenance of the fishery resources on the Pacific Coast and in Russia were discussed. On February 12 Dr. Bogdanov gave a very interesting lecture in the library of the Seattle Laboratory to members of the Fish and Wildlife Service, the International Fisheries Commission and faculty of the School of Fisheries, University of Washington.

Mr. Barnaby, with members of the Regional Office, conferred with members of the Indian Service on March 19 in regard to the salmon fisheries on the Quinault River in Washington. This river is within an Indian reservation and the Indian Service is deeply concerned over the fact that our Service plans on discontinuing the operation of the salmon hatchery in that area. Mr. Barnaby provided information as to the results of his field survey in that area several years ago.

As has been mentioned previously the responsibility for preparing reports on proposed water use projects was transferred during the latter part of last year to the Regional Office. Members of this Section temporarily assisting, in whole or in part, in the preparation of project reports until such time as a River Basin staff can be assembled are as follows: Barnaby, Holmes, Brown, Doudoroff, Jewett, Zimmer, Gangmark, Maltzeff and Fulton.

PROJECT I. FLUCTUATIONS IN ANNUAL AND SEASONAL ABUNDANCE OF SALMON AND TROUT POPULATIONS.

The various subprojects described in previous reports were continued during the quarter by Mr. Silliman. He made a trip to Palo Alto, California, February 18-26 to confer with Dr. Willis H. Rich, with whom he is collaborating on a continuation of the type of analysis described in Dr. Rich's paper "The Salmon Runs of the Columbia River in 1938" (Fishery Bulletin 37). Reports on individual subprojects follow.

Estimation of Troll Catch of Columbia River Chinooks

Although this subproject was stated in the October-December report to have been terminated, its reopening was necessitated for three reasons: (1) additional data were received from British Columbia which changed the estimate for that region materially; (2) as a result of discussion with Dr. Rich and with Dr. Holbrook Working of Stanford University it was decided to revise the regression analysis which furnished the basis of the estimate for the California area; (3) it now appears that because of financial limitations it will not be possible to carry out a tagging program to obtain further direct evidence on the troll catch--it will be necessary for the

time being to rely on the estimated catches, which therefore should be made as accurate as possible and published.

The new British Columbia data have been incorporated into the estimates, adding 300,000 pounds to the average annual catch for that region. Revision of the California regression analysis has been begun, and when completed will be reviewed by Drs. Rich and Working.

Study of Average Weight of Columbia River Chinook Salmon

A rough draft report on this study was completed during the quarter, and was reviewed and discussed together by Dr. Rich and Mr. Silliman. As a result of this review and discussion, the section on setting up a sampling system has been substantially revised, and the entire report is now being retyped for final review.

Study of Catch-per-unit of Columbia River Chinook Salmon

The computations of catch-per-unit of effort for the lower river gill net fishery, carried out as described in previous reports, have to date yielded data for three fishing seasons. Results are given below, in terms of pounds caught per 1940 standard fisherman-week.

| <u>Year</u> | <u>May</u> | <u>June-July</u> | <u>Aug-Sept.</u> | <u>Season</u> |
|-------------|------------|------------------|------------------|---------------|
| 1938 | 443 | 351 | 1,418 | 701 |
| 1939 | 352 | 443 | 1,725 | 823 |
| 1940 | 67 | 199 | 1,812 | 673 |

A comparison of these results with total catch data reveals considerable differences. For instance the May total catch declined only 60 percent from 1939 to 1940, while the measure of catch per unit declined 81 percent. For the season as a whole the total catch indicates an insignificant 1 percent decrease, while the catch-per-unit fell 19 percent.

The catch-per-unit of effort does not, of course, directly measure either absolute or relative abundance (although it gives a rough indication of the latter). Measures of abundance can be derived from catch-per-unit and a few other data, however, by using mathematical analyses developed by Baranov, Ricker and others. Such measures will be calculated for Columbia River chinook salmon as soon as enough catch-per-unit and other data are available.

PROJECT III. FISH PROTECTION AT DAMS AND DIVERSIONS

Plans were prepared under the supervision of Mr. Bair for electrification of the Echo Feed Canal fish-screen project on the Umatilla River near Echo, Oregon. The plans call for the installation of an electric gear-head motor to replace the existing paddle-wheel drive mechanism and an electric gear-head motor on the gantry crane to facilitate removal of the screen drums from the canal. The provision of electric power as a means of screen propulsion was considered necessary as fluctuation of water levels in the canal did not permit for successful operation of the screen drums with paddle-wheel method of propulsion.

Electric power on the gantry crane was deemed advisable, as this fish screen will operate principally during the winter and spring months when ice conditions might require removal of the screens within a matter of minutes to prevent damage to the screens or to the canal banks.

As a means of checking the downstream migration of salmon in the Wenatchee River, consideration has been given to the installation of a fingerling trap in the fish-screen bypass at the Tumwater Dam near Leavenworth, Washington. Mr. Lambert, under the supervision of Mr. Bair, has prepared plans, including necessary lifting facilities, for an inclined-plane type of fingerling trap to be installed at one of the weirs in the bypass.

At the request of the State of Washington Department of Fisheries, Mr. Bair designed and plans were prepared for two small timber fish ladders for Zosel Dam on the Okanogan River at Oroville, Washington. One ladder will replace an existing ladder which is in a somewhat dilapidated condition. The second ladder was considered advisable by the State as a means of providing better fishway facilities at this dam. The situation at the Zosel Dam is one of international significance, as the dam, at certain river flows, has some effect on the water levels in Osoyoos Lake which is located partly in the United States and partly in Canada.

In connection with a proposed electric fish screen for the Big Flat Canal on the Bitter Root River near Missoula, Montana, Bair and Lambert have been studying the feasibility of the installation of other types of screens. Such action was deemed advisable, as not enough is known about the effectiveness of electric screens to endorse their use. Bair made a visit to the project and with Mr. Whipple, Resident Engineer, selected a site for a rotary-drum screen.

At the present time consideration is being given to the installation of an experimental ring-sprocket drive for one of the screen drums at the Prosser Power Canal fish-screen structure. The ring sprocket will be secured to the outer flange of the rim angle at one end of the drum and will operate with an overdrive type of chain from a sprocket on the paddle wheel shaft. This type of drive will replace a ring-gear which, due to excessive wear from lubrication difficulties, has not proven very satisfactory.

A preliminary plan was prepared for an aerator for the pumped well water at the Leavenworth hatchery. The purpose of this aerator was explained under Project 3, Fish Protection at Dams and Diversions, in the quarterly report of October 1 to December 31, 1946.

Passage of Fish at Bonneville Dam

The winter lull in movement of migratory fish at Bonneville Dam continues through the greater part of the first quarter of the calendar year. Only scattered individuals of blueback, silver, chinook, and chum salmon ever are found. The run of steelhead trout always gets under way in March and there occasionally are significant counts during January and February.

Figures furnished by the U. S. Engineers for the counts of fish during the first quarter of this and preceding years of record are presented in the following table.

| <u>Year</u> | <u>Number of Fish Counted Through Fishways at Bonneville Dam</u> | | | | |
|-------------|--|----------------------------------|--------------------------------|------------------------------|----------------------------------|
| | <u>Chinook</u> <u>Salmon</u> | <u>Blueback</u> <u>Salmon</u> | <u>Silver</u> <u>Salmon</u> | <u>Chum</u> <u>Salmon</u> | <u>Steelhead</u> <u>Trout</u> |
| 1939 | 139 | - | 3 | 2 | 602 |
| 1940 | 504 | - | 3 | - | 1,789 |
| 1941 | 1,364 | - | 2 | - | 1,754 |
| 1942 | 50 | - | - | - | 297 |
| 1943 | 60 | - | - | - | 686 |
| 1944 | 68 | 1 | - | 1 | 1,226 |
| 1945 | 91 | 10 | - | 2 | 5,147 |
| 1946 | 28 | - | 14 | - | 3,654 |
| 1947 | 143 | - | 15 | - | 2,486 |

Little significance is to be attached to the comparison of these counts of chinooks and steelheads because they represent merely the variable beginning of runs that reach their peaks during April and May.

Fingerling and Adult Studies at Bonneville Dam

Fyke nets were operated under the direction of Messrs. Burner and Weber throughout the quarter in the power house channel of the forebay at Bonneville Dam. A preliminary analysis of the results of the data indicates that the seaward migrating salmon fingerlings utilize the full width and full depth of the channel during their seaward migration. The greatest depth of the bottom channel immediately above the power house is 72 feet below normal pool level. The largest catches of the fyke nets were made at depth of from 25 to 50 feet. However, it appears that the fingerlings are fairly evenly distributed from the surface to virtually the bottom. The finding of migrating fingerlings at all depths of water indicates that the proposed use of moving lights to divert the fingerlings into safe channels of migration is virtually doomed to failure since, due to the turbidity of the Columbia River in this area, most of the migrating fingerlings would not be able to see the lights even if they should be attracted by them and follow them.

Work on the construction of a large trapping device to be installed below the outlet of one of the turbines has been delayed due to construction difficulties. However, the work is progressing fairly satisfactorily and it is anticipated that the trap will be in operation during the coming quarter.

A rough draft of a manuscript on the results of the observations made last season on the extent and causes of the mortality of adult salmon both below and above Bonneville Dam has been completed and is being given a final revision by the authors, Messrs. Hanson and Zimmer.

Fish Screens

Mr. Holcomb, assisted by Mr. Argetsinger and temporary laborers, has continued with maintenance and repair work on fish screens in the Yakima Valley. The task of complete reconstruction of the fish-screen drums on the Tieton project and of paddle wheels on the Wapato project has been completed. A new drive mechanism was installed on one of the eight drums of the Prosser screen. During March all of the Service's eight large fish screens in the Yakima valley started operation for the season.

PROJECT VI. SALMON AND TROUT IN THE UPPER COLUMBIA RIVER

Mr. Hanavan continued the preparation of material and the analysis of returns from marking experiments conducted on the Grand Coulee Project during the past six years. Returns from several of these experiments are now complete and ready for detailed study. As no further marking studies of upper Columbia River races are proposed, returns from the present series will be complete in 1950.

In the course of these studies 1,220,000 fish have been marked in 40 lots. They include chinooks, blueback, and silver salmon, and steelhead trout. Thus far 5,296 adults have been recovered.

The experiments are providing information concerning the life histories of the upper river races, time of migration, contribution to the fishery, and homing. Some experiments were designed to demonstrate the success or failure of exotic stocks introduced into the upper Columbia. Several lots were paired to test hatchery techniques such as the proper time of, or place for, the liberation of fingerlings.

Mr. Gentry, Fisheries Technician, has cooperated with Mr. Hanavan in obtaining information concerning the early history of the 1946 brood. Spring and summer chinook and blueback redds were selected for periodic inspection during the past winter and samples of eggs, alevins, and fry were obtained at various stages of development. Ice jams, with subsequent silting or washing away of redds apparently are a major cause of mortality while fish are in the egg or alevin stage. It is believed that such losses were more severe this winter than normally.

The emergence of spring chinook fry, from mid-August spawning, occurred in February. By the latter part of March blueback fry were emerging from the redds in White River and migrating downstream into Lake Wenatchee in large numbers. Sampling will continue to determine the period of seaward migration of yearling blueback from Lake Wenatchee.

COLLECTION OF MARKED FISH

An office memorandum on the marked fish recovery in 1946 was completed by Mr. Bryant in January, covering collection activities at the various canneries and a discussion of the procedures used. Summaries of the marks collected by species and experiments included 1624 chinook from 32 experiments (of all age groups), 1,162 blueback from 10 experiments, 395 silver salmon from 8 experiments, and 8 steelhead from 4 experiments. The total collection of 3,188 valid marks is the largest of 5 successive years of collecting. Twenty-nine additional marks from the 1945 season were also received. These recoveries of marked fish were, as indicated, from a number of experiments started in previous years by members of this Section and the Section West Coast Fish Cultural Investigations. The recoveries from the respective experiments have been turned over to the various investigators for detailed analysis.

The tabulation of the 1946 average weight samples of Columbia River fish was completed and included in an office memorandum made on the sampling methods and application of the data secured. The tables prepared include totals for the day, week, month, season and year, with sub-totals for data on fish from the lower third and the upper two-thirds of the commercial fishery section.

Averages for the year are shown in the table on the following page.

| | <u>No. Sampled</u> | <u>Total Weight</u> | <u>Average Weight</u> |
|------------------------------------|--------------------|---------------------|-----------------------|
| River caught Chinook | 53,218 | 958,669 | 18.0 |
| River caught Steelhead | 25,843 | 193,682 | 7.5 |
| River caught Blueback | 9,589 | 29,460 | 3.1 |
| River caught Silvers | 882 | 7,710 | 8.7 |
| Troll caught Chinook ^{1/} | 440 | 2,612 | 5.9 |
| Troll caught Silvers ^{1/} | 1,652 | 8,463 | 5.1 |

^{1/} Troll samples were taken mainly between June 10 and July 12 and included fish caught within 20 miles of the Columbia River mouth. Sixty-three marked silver salmon and 97 marked chinook salmon from the Columbia River experiments, most of which were just starting their third year of life were recovered from this troll fishing this year.

The chinook salmon average weight was 1.8 pounds less than that of the 1945 sampling; the blueback average was 0.3 pounds less, the silver 0.2 pounds less, and the steelhead was 0.4 pounds more. The chinook peak weight of 23.8 was not reached until the week ending August 13, it being both smaller and later than in the previous two years.

No conclusions have been arrived at as yet as to the causes for these variations in the average weight of the various species.

SOUTH PACIFIC INVESTIGATIONS, Oscar E. Sette, Chief of Section

GENERAL

In conformance with previous instructions, Dr. A. S. Bogdanov, of the USSR Institute of Fisheries and Oceanography, was taken on a tour of various San Francisco fisheries establishments by Mr. Mosher on Feb. 17. On February 20 he visited this laboratory and spent some time conferring with members of the staff and with Drs. Meyers, Rich and Moffett.

Dr. L. A. Walford spent the period from February 8 to February 26 at this laboratory conferring with staff members in regard to the completion of manuscripts for publication.

Mr. Ralph Silliman also spent a week here during the latter part of February conferring with Dr. Walford and members of our staff on revision of his manuscripts for publication.

Mr. Wm. C. Herrington visited the laboratory on February 25 en route to Japan.

Dr. Ahlstrom attended the Conference of the Division at Washington, D.C. on Jan. 27 to 31, and the meeting of the American Wildlife Conference at San Antonio on February 3 to 5.

Following the sharp drop in landings last year, the very great decrease during the current season has brought the California sardine catch to the lowest point since the depression year of 1931. The dearth of fish was not, however, evenly distributed. As may be seen from the tabulation given below, the fisheries at San Francisco and at Monterey were complete failures, while the landings at San Pedro were extraordinarily high, particularly during the early part of the season.

| Fishing | SAN FRANCISCO | | | MONTEREY | | | SAN PEDRO | | |
|---------|---------------|--------|--------|----------|--------|--------|-----------|--------|--------|
| Dark | 1944-5 | 1945-6 | 1946-7 | 1944-5 | 1945-6 | 1946-7 | 1944-5 | 1945-6 | 1946-7 |
| "Aug." | 21458 | 12381 | 404 | 23766 | 28901 | 8643 | -- | -- | -- |
| "Sept." | 28327 | 29690 | 35 | 53680 | 32395 | 8585 | -- | -- | 15827 |
| "Oct." | 35803 | 33481 | 64 | 82764 | 57937 | 6061 | 73959 | 39270 | 81117 |
| "Nov." | 21135 | 6983 | 0 | 43405 | 11538 | 703 | 27702 | 39498 | 47638 |
| "Dec." | 20428 | 694 | 2042 | 11734 | 3964 | 2121 | 42663 | 55550 | 28627 |
| "Jan." | 7232 | 0 | 301 | 15921 | 0 | 337 | 21563 | 14129 | 7646 |
| "Feb." | 1735 | 554 | 0 | 3081 | 7014 | 129 | 10933 | 18773 | 9886 |
| "Mar." | | | | | | | | 4130 | |
| TOTAL | 136118 | 83783 | 2846 | 234351 | 141749 | 26579 | 176820 | 171350 | 190741 |

The increase in San Pedro catches over the previous year is, of course attributable to the greatly augmented fleet operating from that port. The opening of the season at San Pedro on October 1 saw fish in good abundance in the waters off that port as contrasted with the virtual absence of schools off Monterey and San Francisco. The majority of boats from the northern ports, therefore, deserted their home areas for San Pedro.

Our studies on the dynamics of the fishery have indicated that the decreased catches of the last two seasons have been partly due to decreased availability of the pilchards to the fishermen at the northern ports and partly to a decrease in the stock of fish in the sea as a result of lowered recruitment of year classes since that of 1939. Fluctuations in both the availability and the recruitment rate are presumably connected to some extent at least with changes in oceanic conditions about which our knowledge is woefully incomplete. In addition there is the possibility that the sharp decline in recruitment could be the result of overfishing. Whether this is true or not must remain a question since our present knowledge of oceanic conditions is insufficient to distinguish between fluctuations caused by environmental factors and those caused by the fishery.

This disastrous fishing season has led the industry to become greatly concerned over the future of the resource, and to consult scientists for their opinions regarding the reasons for the virtual disappearance of fish from the northern part of the state this year. Upon becoming aware that the conditions in the sea are a vital and yet almost unknown factor and that, therefore, predictions of the future state of the fishery are impossible, members of the industry have taken active measures towards filling this hiatus. After consulting with our staff and with the California State Fisheries Laboratory, the Scripps Institution of Oceanography and California Academy of Sciences, they have introduced a bill in the State Legislature to provide funds for converting and outfitting several research vessels to be operated by Scripps and another bill to increase the tonnage tax on sardines to provide a fund to be administered by the industry for operating these vessels and for analysis of the data obtained on a cooperative basis by Scripps and by other agencies. Representatives of the institutions involved have recommended the establishment of a technical committee to coordinate the research program and recommend allocation of funds to the various agencies involved. This technical committee has been temporarily established, pending formal organization to consist of one member each from the California Bureau of Marine Fisheries, California Academy of Sciences, U. S. Fish and Wildlife Service, and Scripps Institution of Oceanography.

The awakening of the industry to the need for a greatly expanded research program promises to become a major factor in the planning of the future research of this section.

PROJECT I. FISHERY DYNAMICS

Sub-project 1: -Size and age composition of the stock.

With the end of the fishing season, scientists of the staff of the California State Fisheries Laboratory are visiting our laboratory for a final check of the joint age determination. The cooperative sampling program has terminated for the season at San Francisco and San Pedro, but some inter-season sampling is being carried on by the State's representative at Monterey, of the continuing fishery for sardines for specialty packs.

During the "December" dark two samples were obtained at San Francisco and five were taken during the "January" dark. These consisted mainly of large fish with younger ages only sparsely represented. At Monterey the "December" samples consisted predominantly of younger fish and the "January" catches were unusual in including a group of very small fish of the 1946 year class ranging in size from 100 to 130 mm. These O-ring fish continued to be present in the "February" samples. The season frequency curve for Monterey shows three modes, that of the fish of the year, that of an intermediate group centering around 180-190 mm., and that of older fish at around 230 mm. The total range of sizes, 100 to 270 mm. is unusually great.

At San Pedro larger fish have been more strongly represented since the "December" dark, with the younger age groups still contributing most of the catch.

Dr. Felin, in addition to the routine age and size work, has continued preparation for publication of age data gathered since 1941.

Mr. Mosher is continuing his studies to evaluate the relative accuracy of otolith and scale reading for pilchard age determination.

PROJECT II. AVAILABILITY OF PILCHARDS

Sub-project 1--Experimental fish scouting.

The field work on this sub-project has been terminated and a report is in process of preparation.

Sub-project 2--Pilchard populations.

Dr. Felin's preliminary examination of specimens taken at San Pedro in 1945-46 for study of morphometric characters in connection with scale growth - types has so far yielded negative results but will be further pursued.

PROJECT III. RECRUITMENT OF PILCHARDS

Sub-project 1--Spawning surveys of 1939, 1940 and 1941.

Dr. Ahlstrom's revision of his manuscript on the haul-data of the spawning surveys is nearing completion and should be finished during the coming quarter. He has also completed revision of his paper dealing with effect of temperature on rate of development of pilchard eggs in nature.

Sub-project 2--Correlation of size of year-class with meteorological and oceanic conditions.

Dr. Smith and Miss Calderwood have extracted from the records of Navy Weather Central in San Francisco pressure data for all of the war years. From these data are being calculated pressure gradients to obtain an expression of influences underlying fluctuations in oceanic conditions which may be related to variations in recruitment and availability in the pilchard stock.

PROJECT IV. EFFECTS ON FISHES OF THE ATOMIC EXPLOSIONS.

Mr. Marr has written a draft report on the pelagic fisheries survey at Bikini and it is now in the hands of Mr. Brock for comment and revision.

SPECIAL ACTIVITIES

Early in June Mr. Schaefer proceeded aboard the Pacific Explorer to the tuna grounds off Costa Rica where he was able to gather much valuable data on the tuna and tuna-bait fisheries. Preliminary data have been obtained on various aspects of the biology of the yellowfin tuna including size composition of the stock, feeding habits, aggregation habits, morphometric characters, and maturation of gonads. Primary emphasis has been placed on obtaining information which will be useful in planning future tuna investigations and on gathering data not obtainable ashore. Mr. Marr relieved Mr. Schaefer on March 7. It is planned to terminate these field studies about May 15 regardless of whether the Pacific Explorer returns then because of the urgency of other work and lack of funds to continue beyond that date.

GULF OF MEXICO FISHERY INVESTIGATIONS, William W. Anderson, Chief of Section.

GENERAL

On February 6, Mr. Anderson, in company with Dr. A. E. Hopkins, attended a meeting in Apalachicola, Florida, to advise with members of the shrimp and oyster industries of that section relative to these fisheries.

At the request of Dr. H.J. Deason, Mr. Anderson participated in meetings held by the State Department in New Orleans on March 4 and 5.

Mr. King attended the 12th North American Wildlife Conference in San Antonio, Texas, from February 3 to 5, and the National Fisheries Institute meeting held in New Orleans, Louisiana, on February 7.

During the quarter a considerable portion of the time was necessary for planning, preparation and conduct of a tagging study on shrimp in the Gulf of Mexico off the northern coast of Mexico. As much time as possible was devoted to preparation of material for the shrimp report.

South Atlantic and Gulf Shrimp Fishery

It has long been suspected that there occurs a migration of shrimp between Mexico and Texas somewhat comparable to that found along the South Atlantic Coast. Since there is no established fishery on the upper Mexican Coast plans were made to tag shrimp in Mexican waters during the early spring of 1947, so that if a northward migration was occurring the tagged individuals would be recovered in the Texas fishery. Approval of the program was secured from the Mexican Government through our State Department after considerable delay. The 50 ft. vessel Vieux Carre was chartered for the period March 8 to April 1 for conduct of the work. With a two-man crew, Mr. Anderson and Mr. King left aboard the Vieux Carre on March 8 from Patterson, Louisiana, for Brownsville Texas, where Mr. Milton J. Lindner, Chief, Fisheries Mission to Mexico, and Don Antonio Garcia, official observer for the Mexican Fisheries Department, joined the vessel. Between March 13 and March 23 tagging operations were carried out from a short distance south of the Rio Grande River to Soto La Marina, approximately 150 miles south of the border. While plagued continuously by bad weather and a scattered shrimp population, 1,000 tagged individuals were released along the coast between the points mentioned above. While the number of shrimp released was less than the number planned, it is believed that a sufficient number were tagged to yield very valuable information on the migrations in the area. Prior to the actual tagging Mr. King was detailed to cover the Texas Coast from Galveston to Brownsville for the purpose of informing the Texas industry of the work and to distribute posters, tag return books and jars of preservative to all shrimp houses along the coast where shrimp trawlers land.

More detailed information regarding this tagging study will be given in the next quarterly report, at which time sufficient returns should be at hand to furnish some indication of the results.

MIDDLE ATLANTIC FISHERY INVESTIGATIONS, William C. Neville, Chief of Section.

GENERAL

During the quarter the efforts of the staff were concerned principally with the analysis of data and with preparation of reports on shad, blue crab, summer flounder, and sea bass.

PROJECT 1. RESTORATION OF SHAD, Louella E. Cable, Project Leader.

Subproject 1--Trends of Abundance of Shad.

Miss Cable continued the reading of spawning scars and during this period read approximately 1450 scales. On the basis of these readings she discussed informally with officials of the Maryland Department of Tidewater Fisheries the extent of recovery of Maryland's shad population. Shad stocks in Maryland's streams where fishing intensity has been reduced are showing improvement, while those in streams where effort has been merely maintained at a previously established level appear to be holding their own.

Arrangements have been made for the collection of length frequency data and scales for selected areas in New York, New Jersey, Maryland and Virginia. In all of these states, collections will be made by state employees as a part of their official duties.

Miss Cable, assisted by Mr. Davies, worked on the problem of reorganizing races of shad. For this purpose they are using the discriminant function.

Subproject 2--Migration and Mortality of Shad

Data on the migration of adult shad in the Hudson River for earlier years has been further analyzed. A new grouping of data gives recaptures in various parts of the river: on the spawning grounds in an intermediate area where the character of the fishery is diverse and subject to changes in intensity, in the lower area of the river where the fishing rate is more stabilized, and in the Sandy Hook Bay area where the catch fluctuates with climatic conditions and with movements of the fish. Returns have also been plotted according to the time between tagging and recapture. The time required to reach the spawning ground appears uniform from year to year.

For a study on tagging methods, trout tagged on the preopercle at the Leetown, W. Va., hatchery are still being held for observation as to the retention of the tags. To date, there has been no mortality reported and no tags lost. It is hoped that this tag will be retained and can be used for tagging adult shad off the coast of Maine in late summer (1947) to determine the area of their origin.

Plans have been made for the rearing of shad for tagging at Maryland's Fairlee Pond in the upper area of Chesapeake Bay and at the Service's Harrison Lake Station, Westover, Va. Both areas have shown a fluctuating survival of juvenile shad which has been attributed to the inclusion of eggs of predator fishes when the ponds are filled. To some extent, predators have been introduced by being trapped in the McDonald jars with the hatching shad. Even very careful screening of the water has not proved effective in excluding these predators. Because of the low water temperatures at these locations in the spring months, the use of derris in eradicating predators would make the ponds unfit for shad culture for an excessively long period. For more rapid eradication, it is proposed that the ponds be chlorinated with calcium hypochlorite. Chlorine will dissipate within a few days and then after fertilizing the ponds, the shad will be hatched in floats staked in the ponds. By this procedure it is hoped to exclude all predatory fish.

PROJECT II. LIFE HISTORY AND ABUNDANCE OF SHORE FISHES, Wm.C.Neville,
Project Leader.

Subproject 2---Life history and abundance of summer flounder (fluke)

During the quarter, attention was directed to the completion of summaries and tabulation of miscellaneous data in preparation of a report on the fluke. This report will feature recommendations towards the solution of such problems of the fishery as:

- (1) Whether a significant decrease in abundance has occurred over the past years with expansion of fishing effort.
- (2) What minimum size limits are appropriate to effect greater utilization of the supply?
- (3) What is the significance of the southern winter trawl fishery off the Virginia Capes in the overall problem of conservation of the species?

Progress was made in completion of illustrations for the report and a start on writing text was made towards the latter part of the quarter.

Subproject 4---Abundance of the sea bass, Nathan Lavenda, Project Leader.

A report on the sexual differences found in the Sea Bass, its relationship to sex reversal, and the effects on any intended management program is being prepared with completion expected by April 30. This study inquires into the remarkably disproportionate ratios of female to male in the various year-classes.

Evidence from both histological and field studies is strong that sex reversal occurs, fish starting out as females, changing later to males. In old females evidences of male tissue can be seen developing in the undifferentiated epithelium associated with the oviduct. This tissue is identical in character with the tissue of juvenile males. Evidences of regressive female tissue could be found in functional males in regions farther anterior.

PROJECT III. FLUCTUATIONS IN THE ABUNDANCE OF THE BLUE CRAB, John C. Pearson, Project Leader.

A manuscript report on the "Blue Crab and its fishery in North Carolina" was completed during the quarter. This report was prepared at the request of the North Carolina Marine Fisheries Survey under the auspices of the University of North Carolina, Dr. Harden F. Taylor, Director. The survey on the blue crab resource indicates that economic rather than biological limitations now restrict the future development of the crab industry in the state. The stock of crabs appears capable of offering greater commercial exploitation, but high production costs and limited markets discourage expansion.

NORTH ATLANTIC FISHERY INVESTIGATIONS, William Royce, Acting Chief of Section.

Interest of the public in the status of the fishery resources of New England continued, and several conferences were granted by Mr. Herrington to local newspapers. Papers were presented by Mr. Herrington Dr. Royce, and Mr. Schuck, at fishery sessions of the A.A.A.S. meetings in Boston on December 26-31. Mr. Herrington and Dr. Royce attended the Washington conference of the Division of Fishery Biology on January 27-31.

On February 21, Mr. Herrington left the North Atlantic Fishery Investigations to assume charge of the Fisheries Division, Natural Resources Section, Allied Military Command, in Japan. Dr. Walford, who has been appointed to succeed Mr. Herrington as Chief of Section, North Atlantic Fishery Investigations, visited the Cambridge office in company with Mr. Higgins on January 8 and 9. A seminar was held at which time the objectives, accomplishments, and present studies of each project were reviewed by project leaders. Dr. Royce will be Acting in Charge until Dr. Walford arrives later in the spring.

Additional staff seminars during the quarter included a review of Joseph Craig's paper on striped bass by Mr. Clarke, a review of the Pacific Halibut studies of Thompson and Bell by Mr. Taylor, a review of the recent findings in the haddock and lobster investigations by Messrs. Herrington and Taylor, and presentation by Dr. Royce of a preliminary program for research to be pursued with ALBATROSS III. The ALBATROSS III seminar also was attended by Mr. Higgins.

Mr. Schuck conducted members of the clerical staffs on a tour of the Boston Fish Pier where types of fishing gear, unloading of trips, processing and freezing methods were seen. Although some clerical personnel had been working in the section for as many as 11 and 12 years this was their initial acquaintance with such fishery operations.

Mr. Frederick T. Baird, Jr., assumed duties as Aquatic Biologist, Lobster Investigation, at Boothbay Harbor, Me., on March 3, and Mr. Arthur R. Murray, Biological Aid with the Flounder Investigation at New Bedford was separated from the service on March 22.

Acquisition of the QUEEN OF PEACE to replace the SKIMMER was delayed due to a Navy ruling that vessels taken from commercial activities must be offered back to that activity before being offered to Government agencies. The QUEEN OF PEACE had been a dragger.

The architects completed plans and specifications for ALBATROSS III and they were forwarded to Washington. Dr. Royce prepared a preliminary draft of a research program and schedule of operation for ALBATROSS III for the next fiscal year.

PROJECT I. THE HADDOCK AND HADDOCK FISHERY, Howard Schuck, Project Leader

Mr. Herrington spent considerable time on the completion of a manuscript entitled "Limiting factors for fish populations. Some theories and an example" and submitted it for publication. Among the conclusions reached in this paper were: (1) that the recent scarcity of haddock resulted from reduced food supplies for haddock and from underfishing during the war; (2) the increases in the population of other species have not been sufficient to explain the decrease in haddock food; (3) recruitment should increase during 1947-48; and (4) to maintain a high yield in the future, the adult population must be held within the limits required for good spawning and minimum intraspecific competition.

A paper entitled "The role of intra-species competition and other factors in determining the population level of a major marine species" was presented by Wm. C. Herrington at a joint meeting of the Limnological and Ecological Societies, and later submitted for publication. Mr. Herrington discussed some of the results at a Symposium on Fish Populations at Toronto, January 23, and general conclusions regarding the factors controlling recruitment were presented to a group representing Boston boat owners on February 6.

A paper "An application of regression methods to growth studies in fish populations" was presented by Mr. Schuck at a joint meeting of the Atlantic Fisheries Biologists and Biometrics Section of the American Statistical Association.

An exhibit "The preparation and use of fish scales for biological studies" was prepared by Herrington, Royce, and Schuck, and shown in connection with the A.A.A.S. meetings in Boston, December 26-31.

In view of the present crisis in the haddock fishery, a more complete understanding of the factors affecting the abundance of haddock on Georges Bank should be obtained as rapidly as possible. This necessitates evaluating recruitment, and an accurate index of recruitment is impossible without the age composition of the population throughout the years considered. This work had been started rather recently for the winter and spring seasons of recent years. At present, efforts are being made to expand the analysis to the summer and fall seasons and to the complete span of years over which these data have been collected, i. e., 1931-46.

Summarization of approximately 600,000 length measurements spread over 16 years, 4 seasons of each year, 6 subareas of Georges Bank, was continued and a large number of scrod scales for the years 1931-46 was read by Mr. Schuck. More efficient methods for handling the large amounts of data in these analyses were developed. The entire personnel of the haddock investigation at present is being concentrated on completing studies of the size and age composition of haddock of Georges Bank. The part-time assistance of Mr. Arnold of the Salmon staff was obtained to assist in this work. In view of the magnitude of this work, it is not considered feasible to attempt a comparable analysis of the Nova Scotian populations at present.

PROJECT II. THE ABUNDANCE AND YIELD OF GROUNDFISH, Beatrice Stone,
Project Leader.

Miss Stone, who is now in charge of the Groundfish Abundance project has spent her time chiefly on a review of the methods used in statistical compilation in the past. In the reviewing process it became evident that there were certain inaccuracies in the computations which seriously affected the final results. A method of recomputing the data is being organized with adequate checks on the computations.

During the quarter, summary statistical tables were prepared for the Washington office. These included comparative catch-per-day indices for haddock and cod for the New England and Nova Scotian Banks from 1930-45, based on data published in Current Fishery Statistics and data on the rosefish catch for the New England and Nova Scotian Banks from 1935-46.

PROJECT III. FLOUNDERS AND THE FLOUNDER FISHERY, William Royce, Project
Leader.

The preparation of the manuscript "The stocks and migrations of the yellowtail flounder" continued to occupy the investigators during the quarter. It was found that data on the total production for 1946 could be worked up and added without causing too much delay. This manuscript has been delayed because of transfer of Dr. Royce to other duties, but will be completed in the near future.

Routine collections of market news data, statistics on landings, port interviews, scale samples, and length measurements at New Bedford were interrupted for a month during the quarter due to a dispute between fishermen and local buyers. The fishermen would not sell or unload their catches unless the buyers consented to weigh out the trips in wire baskets. After several unsuccessful attempts were made to bring the fishermen and buyers together, a compromise was effected, the buyers consenting to weigh out the trips in wire baskets for a trial period of thirty days.

PROJECT IV. THE LOBSTER AND LOBSTER FISHERY, Leslie W. Scattergood,
Project Leader

The tremendous increase in the productivity of the Maine lobster fishery since 1939 has been the object of investigation during the past quarter in an effort to identify and evaluate the factors causing it. Theoretical reconstructions of stocks for the period 1934-39 have been completed from catch data and one set of length-frequency measurements collected during that period. Analysis of data from 1939-45 is practically completed and the manuscript setting forth methods and conclusions is in the process of revision.

Interest expressed by the Maine Department of Sea and Shore Fisheries in the efficiency and efficacy of the lobster rearing program carried on in cooperation with the Fish and Wildlife Service has necessitated a reexamination of various data to answer various practical and theoretical questions which have arisen. Sea and Shore Fisheries has inquired as to whether or not it might be possible to extend the rearing season by hastening the development of eggs by heating water. Examination of available data indicates that a definite number of temperature units is required to hatch eggs, and thus it is possible to predict temperature requirements to bring about hatching at various dates.

Available data indicate that the relationship between temperature and the period of time required to bring larvae to the fourth stage is not linear but is expressed by an equation of the type: $Y = kx^{-n}$; where y equals temperature in degrees Fahrenheit and x equals times in days. This relationship is of practical as well as theoretical importance since it is evident that in this type of relationship there is a point on its curve where maximum efficiency for heat applied will be obtained. It is seen that this point is where the slope of the curve equals -1 and this point is found easily by differentiating the equation and equating to -1 . In the equation, k equals 118.3 and n equals .2087. For these constants, the temperature of maximum efficiency is found to be about 68° F, at which temperature the lobsters will reach fourth stage in about 14 days. While it is not practical to obtain this temperature during the early part of the rearing season, it is evident that nothing would be gained by trying to exceed it later in the season. It is interesting to note that this temperature is in very good agreement with that considered optimum from hatchery experience in rearing lobsters.

PROJECT V. NEW ENGLAND SALMON RESTORATION, Louis D. Stringer, Project
Leader

During the first half of the quarter, Mr. Stringer spent considerable time making drawings of the fish fence developed by Herrington and Stringer last year. A report on this fence was prepared describing the construction and use of the weir. A report was also prepared summarizing the data collected to date on the dams of the Connecticut River. This information has been requested by several of the bordering states.

The latter part of the quarter has been spent in organizing material for the construction of 90 feet of fish fence. Several blue-prints were made and a list of necessary materials, with their suppliers, was prepared.

Mr. Stringer was present at a conference with New England Power Service representatives at which time fishways and dams, particularly those at Vernon, Bellows Falls, and Wilder, were discussed.

Mr. Arnold spent the early part of the quarter reviewing literature and programs on salmon to familiarize himself with the available data. Later he assisted in compiling data for the haddock investigation and the ALBATROSS III program.

PROJECT VI. THE ROSEFISH AND ROSEFISH FISHERY, Alfred Perlmutter,
Project Leader

The major portion of Dr. Perlmutter's time was spent in preparing reports and manuscripts. A paper titled "The future of the redfish fishery" was prepared for inclusion in the Gloucester Master Mariners' Year Book for 1947. In response to a rush request from Washington a preliminary report was prepared on "Fluctuations in the catch and abundance of rosefish, Sebastes marinus, in the Gulf of Maine, April 1942, through June 1946. Work continued on a revision of a paper titled "Preliminary study of the age and growth of immature rosefish in the Gulf of Maine and Western Nova Scotia." All figures and tables were completed and about two thirds of the manuscript revised.

Mr. Bocken started tabulating the number of days spent fishing for rosefish in the various unit areas by a random sample of the rosefish fleet in order to determine fishing concentrations. These data, in conjunction with information on percentage of copepod (Sphyrion lumpi) infection of rosefish on various fishing grounds, and on differences in size composition of fish on various fishing grounds (compilation now being carried on by Mr. Clarke and Miss Dee), will be used to determine the degree of independence of rosefish stocks on different grounds.

Collection of length-frequency samples by sex was continued by Messrs. Clarke and Bocken. Data collected from April 1942 through June 1946 were summarized by Mr. Clarke and further analyzed by Miss Dee. The data were used in preparation of the report on "Fluctuations in the catch and abundance of rosefish, Sebastes marinus, in the Gulf of Maine, April 1942, through June 1946.

GENERAL

Meetings and conferences. Dr. John Van Oosten attended a symposium on "Fish Populations" at the University of Toronto, January 10-11 (he was Chairman; and the Tri-state Fishery Conference at St. Paul, February 25-26 (he was Chairman of the afternoon session of February 26 dealing with Great Lakes fishery problems).

In Ann Arbor, Dr. Hile served as Chairman of the Zoology Section at the annual meeting of the Michigan Academy of Science, Arts, and Letters, March 21-22. At this meeting Dr. Frank W. Jobes presented the paper, "The age, growth, and bathymetric distribution of the bloater, Leucichthys hoyi (Gill) in Lake Michigan."

Dr. Van Oosten conferred with Service officials on administrative and other matters at Regional Headquarters in Minneapolis on February 27 and in Chicago on March 4 and March 27-29. On March 1-3 he held discussions with Wisconsin officials at Madison on administrative and research problems of the Great Lakes fisheries.

Among those who visited the Ann Arbor offices for consultations with staff members were: Mr. Harris Miller, Michigan Planning Commission--with Dr. Van Oosten, February 6, on a program for the increased utilization of burbot; Mr. H. G. McKinley, Ontario Department of Lands and Forests--with Drs. Van Oosten and Hile, March 10-13, on methods of collection and analysis of commercial fishery statistics; Mr. Frank Hereford, U. S. Food and Drug Administration, Detroit--with Dr. Van Oosten, March 12, on problems of identification of fish inspected by the Administration; Mr. W. R. Martin, Fisheries Research Board of Canada--with Dr. Hile, March 18-20, on research in relative growth of fish; Prof. L. W. Halverson, Head of the Department of Geology and Geography, Northern Michigan College of Education, Marquette--with Dr. Van Oosten, March 22, on a survey of Lake Superior fisheries.

Manuscripts and reports. Dr. Van Oosten has continued the revision and expansion of his manuscript on the relationship between turbidity and the abundance of Lake Erie fishes.

Dr. Jobes' paper on the bloater (mentioned above) has been submitted for publication in the Papers of the Michigan Academy of Science, Arts, and Letters. In this study Dr. Jobes presented information on the following aspects of the natural history; geographical and bathymetric distribution; regional abundance; age; growth; length-weight relationship and condition; length-frequency distribution; sex ratio; maturity. The bloater, the smallest of the seven species of chubs, was formerly used only as bait in the sethook fishery for lake trout. With the decline in the abundance of the larger chubs, however, the bloater has become an important component of the commercial catch.

Progress in current activities. In his capacity as Chairman of both the Great Lakes Lake Trout Committee and the Great Lakes Sea Lamprey Committee, Dr. Van Oosten has devoted considerable time to the planning and coordination of the proposed cooperative research for 1947.

Dr. Hile is resuming work (largely suspended during the war years) on the yellow pike (walleye) of Saginaw Bay. Analyses of extensive data have yielded rather conclusive evidence that during the spring the stock is heterogeneous with respect to the length-weight relationship. The changes that occurred within a few days in the average weights of fish of corresponding length (and captured in the same nets) were far greater than could be explained reasonably as the result of loss or gain of weight by individual fish. These sharp fluctuations were lacking in the fall collections. Walleyes averaged heavier in the fall than in the spring; the advantage of the fall specimens was about 12.5 percent up to a length of 15 inches and approximately 18.5 percent at greater lengths.

Dr. Jobes has compiled length-frequencies of the short-jawed chub (Leucichthys zenithicus) of Lake Michigan and has made the preliminary tabulations for a study of the bathymetric distribution. He has also completed the tabulation of the commercial production of fish in the Great Lakes in 1945, and has computed the value of the catch for six of the eight states.

Changes in personnel. Mr. Wagner Terrazas Urquidí, fishery fellow from Bolivia assigned to this office for training, arrived in Ann Arbor on January 16.

Mr. Howard Buettner, CAF-4, entered on duty March 17.

EASTERN INLAND FISHERY INVESTIGATIONS, Charles M. Mottley, Chief of
Section.

GENERAL

The Section Chief attended the Regional Directors' meetings in Chicago in January and addressed the staff of the Office of River Basin Studies at their Fox Lake meeting in February. The Atlanta Regional Office and the pond experiment unit under the direction of Mr. H. S. Swingle at the Alabama Polytechnic Institute were visited and discussions were held regarding fishery research problems in the Southeastern Region. The Section Chief also visited the Virginia Polytechnic Institute at Blacksburg, Virginia, where discussions were held with Dr. D. B. DeLury regarding the development of methods for estimating fish populations.

Mr. T. K. Chamberlain spent several weeks at the Leetown Station and visited Pisgah Forest, North Carolina, to obtain the basic information for a follow-up report on the Pisgah system of trout stream management.

The Cortland Laboratory's Annual Report was completed during the quarter and submitted to the three cooperating agencies. It included a summary of the past season's work on the vitamin B requirements of trout, anemia studies, the effect of oxygen upon the red cell content of trout blood, and various other phases of the experimental work.

The in-service training school for fish-culturists was continued at Cortland during the quarter. The material covered in the course was organized and submitted to the Section headquarters for mimeographing.

PROJECT I. (PHYSIOLOGY) NUTRITIONAL REQUIREMENTS OF SALMONOID FISHES,
Arthur M. Phillips, Project Leader

Subproject 1--Vitamin Requirements of Salmonoid Fishes.

The analysis of the data obtained from the experiments that were run during the past summer was completed and a paper entitled "The Vitamin B Requirement of Trout" was submitted for publication. Preliminary work was started on the investigation of the nicotinic acid requirement of trout. The analysis of the ingredients to be used in the diets was started; the lay-out of the experiments was studied and experimental techniques were developed.

PROJECT II. (PHYSIOLOGY) ANEMIA IN TROUT - Arthur M. Phillips, Project
Leader.

Two papers were prepared and submitted on this subject: "The Effect of Asphyxia Upon the Red Cell Content of Trout Blood," and "This Question of Anemia." The latter was submitted for publication in the Progressive Fish-Culturist.

PROJECT III. (TOXICOLOGY) EFFECTS OF INSECTICIDES AND CHEMICALS ON FISH, Eugene W. Surber, Project Leader.

Subproject 1--Effects of DDT on Fish.

A series of laboratory experiments was performed to compare the sensitivity of several species of fish to DDT. The results are included in a summary report being prepared by the Service.

Subproject 2--Effects of Newly Developed Chemicals on Aquatic Organisms.

A Fishery Leaflet (No. 217) was prepared with the collaboration of the Chemical Corps of Camp Detrick on "Aquatic Plant Control with 2, 4-D."

A very effective method of controlling cattails, bur reeds, willows, spikerush, and softstem bulrush, employing a 5.0 percent solution of 2, 4-D in tributylphosphate and kerosene, was described in this article.

PROJECT IV. (DISEASES) THERAPEUTIC TREATMENT FOR FURUNCULOSIS.

James S. Gutsell, Project Leader.

A conference was held at the Lamar, Pa., hatchery with Messrs. Tunison, Markus and Tanner and Drs. Mottley and Snieszko, and a disease control program was agreed upon. An attempt is to be made to free Lamar of furunculosis, without deliberately killing the fish, by treating yearlings and older fish with sulfamerazine, disinfecting emptied ponds, and careful quarantine methods.

Dr. Gutsell visited Lamar late in March, found many trout dying from other causes, but found only one fish which showed signs of furunculosis. (Of nine inoculations from dying trout, this was the only one in which B. salmonicida developed.)

"Dosage of sulfamerazine in the treatment of furunculosis in brook trout (Salvelinus fontinalis)," prepared in collaboration with Dr. Snieszko, was sent to the editor of the Transactions of the American Fisheries Society for publication.

A considerable amount of time was devoted to the preparation of the final typescripts of the following papers:

1. Dosage of sulfamerazine in the treatment of furunculosis in brook trout Salvelinus fontinalis. (Accepted for publication in the Transactions of the American Fisheries Society.)
2. These two papers deal with the effect of sulfamerazine on the growth of brook and rainbow trout and on the combined treatment with sulfamerazine and calomel, or carbarsone.

PROJECT V. (DISEASES, DEVELOPMENT OF CULTURE MEDIA AND METHODS,
S. F. Snieszko, Project Leader

A microfilm was prepared from the book on fish diseases by Schäperclaus (in German) and his method of differential diagnosis was used as a basis for the preparation of the first rough draft of a key for the quick diagnosis of the most important diseases of trout.

A detailed plan was prepared for an experiment on the development of preventive treatments for furunculosis, gill disease and octonitiasis. This plan was discussed with Dr. Mottley and the staff of the Leetown Station. This experiment is expected to begin on April 15.

The following papers were accepted for publication or for presentation:

1. Dr. Snieszko and Mr. Taylor. A bacterial disease of the Lobster (*Homarus americanus*), in Science.
2. Dr. Snieszko and Mr. Taylor. An outbreak of a bacterial disease of lobsters.
3. E. R. Hitchner and S. F. Snieszko. A study of a micro-organism causing a bacterial disease of lobsters. Papers Nos. 2 and 3 will be presented at the meeting of the Society of American Bacteriologists, Philadelphia, May 1947

PROJECT VII. (FISH CULTURE) PROPAGATION OF POND FISHES

Subproject 1--Fertilization of Hatchery Ponds.

Plans were made for the forthcoming summer's experimental work. It was decided to determine the quantities of fertilizer required to produce a water bloom. Owing to the demand for bluegill sunfish for stocking farm ponds it was decided to use them as a measure of the production resulting from different quantities of fertilizer.

Subproject 2--Farm Ponds

During the period 1943 to 1946, several combinations of bass and bluegill sunfish, listed below, have been experimented with in farm ponds on the station grounds at Leetown. These ponds were fertilized with a 12-5-5 inorganic combination, and when water bloom failed to keep the vegetation under control, chemicals were occasionally resorted to for this purpose.

Production of "edible-sized" fish in fertilized farm ponds with different stocking combinations

| Combination | Number per acre | | Ponds (pounds per acre) | | | Means |
|-------------|-----------------|----------|-------------------------|-----|-----|-------|
| | Bass | Bluegill | I | II | III | |
| A | 80 | 640 | 258 | 190 | 149 | 199 |
| B | 100 | 800 | 186 | 199 | 192 | 192 |
| C | 100 | 1,000 | 175 | 222 | 165 | 187 |
| D | 100 | 1,500 | 97 | 234 | 204 | 178 |

These results show that approximately 189 pounds of "edible-sized" fish could be produced per year in the Leetown ponds.

Analyses of the data during the current quarter revealed no significant difference in production of "edible-sized" fish in the different combinations employed.

The average size of blue gills varied inversely with the stocking combination used. The smallest bluegills occurred in the 1:15 ratio; these fish averaged about 5.5 inches (fork length) in length as compared to about 6.5 inches in the 1:8 combinations. Bass failed to make good growth at the 1:15 ratio.

PROJECT IX. (FISHERY MANAGEMENT) FISH PRODUCTION IN SOUTHERN WATERS
T. K. Chamberlain, Project Leader.

Mr. Chamberlain and Dr. Mottley made a trip to the TVA Headquarters at Norris, Tennessee, and reviewed their fishery work as a basis for the study of the Conchas Lake impoundment. Plans were developed for the Conchas Lake fishery investigation to begin early in April.

PROJECT X. (FISHERY MANAGEMENT) EFFECTS OF WATER-HYACINTH CONTROL MEASURES ON FISH, J. J. Lynch, Project Leader.

The work of this investigation was completed and the results were incorporated in Special Scientific Report No. 39 entitled "The Effects of Aquatic Weed Infestations on the Fish and Wildlife of the Gulf States" by J. J. Lynch, J. E. King, T. K. Chamberlain, and A. L. Smith, Jr. This document was submitted to the Corps of Engineers to be included in their report to Congress on the subject.

SOUTHWESTERN INLAND FISHERY INVESTIGATIONS, James W. Moffett, Chief of
Section.

GENERAL

Southwest Inland Fisheries Investigations has been almost entirely concerned with River Basin Studies and the seaward migration of chinook salmon from the rivers in Central Valley. The migration studies are continuing and a more complete digest of findings will be made in the next quarterly report. Seven River Basin Reports were prepared and studies continued on several more, and many conferences regarding these activities were attended. A conference of staff members was held to discuss and coordinate future programs and to discuss other administrative and operational problems. The Section Chief attended a conference with other section heads and Division officials in Washington, D. C. Meetings of the American Wildlife Federation in San Antonio, Texas, were attended on the return trip.

Reports completed:

A preliminary report on the Fish and Wildlife Aspects of the Prosser Creek Project (Truckee River) U. S. Engineer Office

A report on the Fish and Wildlife aspects of the North Fork project, Mokelumne River as proposed for construction by Pacific Gas and Electric Company (Federal Power Commission Major Power Project No. 137)

A comprehensive report on the fish and wildlife resources of Lahontan Basin as they relate to general water development plans of the Bureau of Reclamation.

Revision of "A Preliminary Report on the Fish and Wildlife Aspects of the Upper Sacramento River Tributary Plan (Alternate to Iron Canyon Dam)," Bureau of Reclamation.

A report on the fish and wildlife aspects of Pine Flat Project, Kings River, California. U. S. Engineer Office and Bureau of Reclamation.

Recommendations for fish protection on Minor Power Project No. 1959 (Farley Creek). Federal Power Commission.

Comments on recommendations for fish protection connected with Major Power Project No. 120. (Southern California Edison Company) Federal Power Commission.

Reports near Completion:

Trinity River Comprehensive Plan - Fisheries Section
Evaluation of Fish Protection Plans for Iron Canyon Dam
Russian River Basin Report - Coyote Valley and Dry Creek Reservoirs
Kaweah River Basin Report - Terminus Reservoir
Kern River Basin Report - Isabella Reservoir
Tule River Basin Report - Success Reservoir
Eel River Basin Report - Branscomb and Dry Creek Reservoirs
The fish and wildlife aspects of the Yolo-Solano Project
Fishery problems arising from power development projects of the
Pacific Gas and Electric Company on Feather River (Federal
Power Commission).

Hearings and Conferences attended:

San Pablo Mosquito Abatement hearings, January 7 and February 4.
Conference of Pacific Entomological Society on methods and materials
for mosquito abatement, January 4.
Conferences with U. S. Engineers San Francisco District Office
January 14, February 7, 20, and March 4.
Wildlife Administration and Pest Control Relations Committee,
California State Chamber of Commerce, January 14.
Conferences with State Division of Fish and Game and Bureau of
Reclamation on Delta Fisheries problems, February 18.
Conferences with Bureau of Reclamation on Grasslands wildfowl main-
tenance problem, March 13 and 24.
Division of Fishery Biology conference January 27-31.
Twelfth North American Wildlife Conference February 3-5.
Conference of District heads, Southwest Inland Fishery Investiga-
tions, February 24-28.

Visitors:

Dr. Alexander S. Bogdanov of the U. S. S. R. visited the Stanford
Office on February 20.
Mr. Herbert E. Warfel and Mr. Fenton Carbine of the Philippine
Fisheries rehabilitation program visited the Stanford Office
during the quarter.

Operations:

Stanford Office

Preparation of River Basin and research reports occupied much of the
time of the Stanford Office staff. Basic data have been collected for all
of the project reports listed as near completion. Supporting data on the
Iron Canyon Project have been analyzed and the report is being written.

Budget estimates for fiscal years 1948 and 1949 covering all projects under this office were prepared and forwarded to the Central Office. Work programs and budgets were requested of each district head this year. Such procedure made the preparation of the section's budget much easier and yielded a more accurate estimate of fiscal needs.

On February 24, men in charge of the district offices came to Stanford for a week of conferences. Proceedings of the Division Conference in Washington, D. C. were discussed and major features of the 12th North American Wildlife Conference were presented. Administrative, operational and organizational phases of the Section program were reviewed. Lively discussions concerning standards and technical procedures ensued in all instances. Participants expressed themselves as pleased with the course of the discussions and it is believed that much good was accomplished. Since the conference, operations and administrative phases of our program have been notably smoother. As a result of the conference, an administrative guide was prepared for field use by Mr. Sanborn. This guide sets forth in clear and concise terms the administrative regulations affecting field offices. Field personnel report that it is of great value in keeping them informed regarding administrative procedures.

RED BLUFF - DISTRICT NO. 1

Observations on and sampling of the downstream migration of young salmon from spawning beds in Sacramento River and Deer Creek have occupied the Red Bluff District personnel almost exclusively. Fyke nets were fished in the main Sacramento River at Balls Ferry and at Squaw Hill Bridge. The latter station is located about 60 miles below Balls Ferry and about 40 miles below the proposed Iron Canyon Dam site. Catches at these stations yielded some rather striking results. The pattern of seaward migration at the Balls Ferry site bears very little resemblance to patterns obtained in previous years. Records from previous seasons' operations describe a rather uniform distribution curve over time. Catches were low in early January, increasing gradually through the month to peak either in late January or early February. This year a peak in abundance was reached in the last two weeks in December. With the exception of the 1945-46 season, records of catches are quite fragmentary. However, 1945-46 data are sufficiently complete to be directly comparable with the 1946-47 catches, because all sampling factors are almost identical. If records for both seasons are adequate quantitative samples of the downstream migration, the number of migrants moving seaward this past season is greater than anything ever experienced since records were made. The catch per hour for the season 1946-47 is 20.4, while that for the 1945-46 season is only 4.5 fish. When it is considered that the bulk of the 1946-47 catch was made at a time when only spring-run migrants were moving, the size of the spring-run adult crop which entered the river in April, May and June of 1946 must have been very large or the reproductive process and subsequent hatching must have been remarkably efficient. The peak in abundance of seaward migrants at Squaw Hill Bridge occurred six weeks later than the peak at Balls Ferry, indicating a downstream rate of travel of about 10 miles per week.

Because of drought conditions and the desires of the Bureau of Reclamation to conserve water, flow conditions in Sacramento River below Shasta Dam were especially critical during the incubation and hatching periods of the young salmon. Spawning took place when the river flow was about 5700 c.f.s. Beginning January 24, flows were cut to 2500 c.f.s. for 6 hours, and this flow extended to 19 hours February 1. On February 8, flows were reduced to 2000 c.f.s for 16 hours per day. For the other periods of time involved, the flow was held to 5200 c.f.s. Examination of spawning areas during this regime of flow indicated that 10 to 15 percent of the areas were exposed sufficiently to endanger alevins and advanced fry as they attempted to reach the main stream. However, timely rains during the period increased flows sufficiently to protect all salmon nests and insure successful incubation and emergence. This experience suggests that in anticipated drought years, flows should be reduced during the spawning period in order to confine spawning to areas over which flows can be maintained.

Fyke-net catches from Deer Creek were not as great in relative numbers as in the 1945-46 season, but the pattern of downstream migration was similar. This similarity was especially noteworthy because of the dissimilarity between patterns for the same seasons in Sacramento River at Balls Ferry. Apparently the change in the Sacramento River downstream migration is closely associated with the operation of the Shasta Project, and not entirely the result of natural causes. Because flow conditions in Deer Creek prevented entry of fall-run salmon, results of this season's netting will represent a true picture of the downstream movements of spring-run progeny only. One of the main problems in Deer Creek is excessive water temperature which occurs in early June, and earlier in drought years, and halts all seaward migration. If it could be determined that the downstream movement of spring-run progeny was completed, or nearly so, before water temperatures became dangerous, some of the apprehensions now felt, concerning the success of transferring Sacramento River spring-run salmon to Deer Creek might be eliminated.

Summary of Coleman Hatchery Salmon Releases

1946-47 Season

| Salmon- run | Dates | Adult salmon handled | N u m b e r o f | | | | Losses to Apr.1 | Totals |
|----------------|--------|----------------------------|-----------------|-------------------------|------------------------------|--|--------------------|------------|
| | | | Eggs taken | Fingerlings released | Fingerlings on hand Apr.1 | | | |
| Spring | 4/1/47 | 4,661 | 2,763,000 | 1,809,119 | 606,648 | | 347,233 | 2,763,000 |
| Fall | 4/1/47 | 14,840 | 25,178,100 | 22,791,139 | 644,770 | | 1,742,191 | 25,178,100 |
| Total | 4/1/47 | 19,501 | 27,941,100 | 24,600,258 | 1,251,418 | | 2,089,424 | 27,941,100 |

As reported last quarter, salmon redds in Antelope Creek were marked for a study of natural reproduction and incubation. One nest was opened each week beginning December 11 and ending January 31, and a random sample of eggs was recovered from each nest and examined to determine stage of incubation and percentage of mortality.

Results of Salmon Nest Examinations
in Antelope Creek, California
Season 1946-47

| Nest No. | Approximate age of eggs(days) | Pre-eyed | Eyed | No. of eggs in sample | No. of live eggs | No. of dead eggs | Percent of live eggs |
|----------|-------------------------------|----------|------|-----------------------|------------------|------------------|----------------------|
| 1 | 12/11/46 | 14 | X | 292 | 241 | 51 | 82.5 |
| 2 | 12/18/46 | 20 | X | 39 | 36 | 3 | 92.3 |
| 3 | 12/27/46 | 29 | X | 223 | 207 | 16 | 92.8 |
| 4 | 1/ 3/47 | 36 | X | 488 | 449 | 39 | 92.0 |
| 5 | 1/10/47 | 42 | X | 520 | 496 | 24 | 95.4 |
| 6 | 1/17/47 | 49 | X | 376 | 336* | 40 | 89.4 |
| 7 | 1/24/47 | 56 | X | 329 | 299** | 30 | 90.9 |
| 8 | 1/31/47 | 63 | X | 744 | 714 | 30 | 95.8 |
| Totals | | | | 3,011 | 2,778 | 233 | 92.3 |

* One alevin

** Two alevins

Irrigation diversions from Deer Creek have been shown to remove many seaward migrant salmon and steelhead trout despite the presence of rotary screens. The State of California Fish and Game officials have condemned present screens and will replace them with adequate screens soon to be installed. Efficient screens on the diversions should go far to improve the contribution of Deer Creek to the fishery resources of California.

The water system at Deer Creek Station was replaced by high-pressure system connected to a deep well which was recently drilled. The new system will provide satisfactory supply for domestic use, and will permit improvement and landscaping of station grounds.

Temperature records were maintained throughout the entire quarter at various places in this district, serving for comparison with those of recent past years. Continuous water temperatures were recorded at Balls Ferry and at Squaw Hill on the Sacramento River, at Coleman Hatchery on Battle Creek, and at our station on Deer Creek. In addition, weekly readings of temperatures of the discharge from Shasta Dam are in our files through the cooperation of the U. S. Bureau of Reclamation. Another feature of the temperature program in District No. 1 for this

quarter was the installation of three platforms for thermographs at critical points on the Anderson-Cottonwood Irrigation District Canal, the object being to initiate a special study of temperature changes in canals. We await only the return from the factory of three instruments under repair; upon their arrival the full-scale temperature records program of this district will be under way.

OROVILLE - DISTRICT NO. 2

The seaward migration of young salmon in Feather and Yuba Rivers was studied closely by the Oroville District staff during this quarter. Fyke-netting stations were established on the main Feather River at Oroville and Yuba-Sutter Boat Club, and on the Middle Fork at Bidwell Bar. One station was established on the Yuba River at Marysville. Fyke-netting is continuing at these stations at the present time.

The station at Bidwell Bar is near a site proposed for the construction of a dam as planned by the Bureau of Reclamation. Seaward migrants were first taken at this station late in January, but by February 11 a peak in abundance was reached, and catches have been diminishing since that date.

Only a few seaward migrants were taken in the Oroville net between December 17, when the net was first placed in operation, and January 25. Catches increased gradually with minor fluctuations after that date, and reached a peak of abundance during the five-day period March 27-31, 1947.

The first seaward migrants were taken in the Yuba-Sutter Boat Club net during the period January 16-20. Catches increased thereafter until an initial peak was reached February 15-19. There followed a diminishing catch rate during the next ten days after which catches increased until a much greater peak in abundance was indicated in the results for March 27-31. It is believed that the second peak in abundance might be accounted for by the appearance of progeny of fall-run salmon that spawned in the 35-mile section of river immediately above the net site. The peak of downstream migration in the 1945-46 season occurred during the period March 29 to April 2.

Catches of seaward migrant salmon in Yuba River at Marysville portray a remarkable success of reproduction. The magnitude of the seaward movement of young indicates that rather large numbers of adults utilized the spawning areas in the river below Daguerre-Point Dam which is a partial, if not a complete, barrier. The first migrants were caught during the period January 26-30, with the rate of capture increasing through February until a broad peak in abundance was reached March 2, and continued until March 21. Catches diminished after that date, but were still rather high at the end of the quarter.

An intensive survey of the lower Feather River indicated the presence of many steelhead trout and a few adult salmon. In consideration of this fact, and with prevailing low water, a counting station was established at the Sutter-Butte Dam fishway to make a count of the spring-run salmon at that point.

During counting operations at Sutter-Butte Dam last fall, ovaries were taken from eleven female salmon and subsequently counted. The average number of eggs per female is 6,525, which is quite similar to the average of 7,000 derived from a larger series of ovaries from Sacramento River fish. Additional counts will be necessary before a reliable average can be derived.

A survey of the North Fork of Feather River was made in order to establish a schedule of minimum flows necessary for the maintenance of fish life which will be required below power diversions proposed by the Pacific Gas and Electric Company. The company contemplates construction of two units in the very near future, and it is imperative that adequate minimum flows be provided.

The temperature records program in District No. 2 was carried on at full scale throughout the entire quarter. This represents the first time that a full three months of water temperature readings has ever been recorded on a large scale in this area, and as the spring and summer periods are completed it is anticipated that an extremely valuable set of records will be in our files. During this quarter water temperatures were continuously recorded on Sacramento River at Knights Landing, on West Branch of Feather River near the mouth, on Feather River at Yuba City, and at Nicolaus, on Yuba River at Laguerre Point, and on Stony Creek west of Orland. In addition, continuous air temperatures were recorded at the Knights Landing, West Branch of Feather River, and Stony Creek sites.

Delta Area - Districts Nos. 3 and 4

Fyke-netting in Delta waters for migrant and resident fishes continued. Striped bass, chinook salmon, catfish (Ictalurus catus) and two species of smelt: Hypomesus olidus and Spirinchus thaleichthys, continue to be the major species caught at three netting stations in the area. The gradual decrease in numbers of young striped bass, as mentioned in last quarter's report, has continued through the quarter with a few being taken at Antioch, and practically none at Tolands Landing. The presence of these small fish in the catches indicates that some adult spawning occurs either late in the fall or very early spring in contrast to the usual spawning period in April and May.

Smelt continue to be taken in nets, although in reduced numbers. It is believed that these fish spawn in January and February. Sexually mature individuals were taken in late December through January and some larval forms were caught in early April.

A steady downstream migration of salmon in San Joaquin River began shortly before February 18, and has continued. On February 19, the first large catch of chinook fingerlings was made by the Sacramento River nets. Studies made by the State of California in 1940-41 showed migrants in the Delta Area as early as December 10, with fairly large migrations in progress during January. Their fishing sites were located somewhat upstream from the positions at which our nets are fishing. Apparently drought conditions influenced the time of arrival of the young salmon in the Delta Area this year. The migration was late, but when it started it was rather heavy.

Many fork-tailed catfish were caught in the Sacramento River nets during the winter and early spring months. These fish are generally considered to be bottom-dwellers, and it is peculiar that they should be taken in nets fished at or near the surface. Analysis of stomach contents of specimens provide a probable clue for the change in habit. Stomachs were found to be gorged with a species of Mysidacea which swarmed in Delta surface waters in February and March. It is reported that with the disappearance of the Mysid swarms the catfish returned to the bottom areas. Catfish had practically disappeared from catches by the end of March.

Fyke nets installed in Old River near the site for the Delta-Mendota canal intake pumps proposed by the Bureau of Reclamation have taken practically no fish, except a few catfish and smelt, during the quarter even though the nets were rigged to fish both ebb and flood tides. Seaward migrant species either cannot be caught by such means or they have not been in great abundance in Old River during the quarter.

Water temperature studies in the District were continued on their previous scale. For the first time, a full quarter's readings were recorded at the two stations, with both water and air temperatures being recorded continuously. Stations were maintained at Walnut Grove on Sacramento River and at Stockton on San Joaquin River. It is planned to install one additional thermograph in this District during the next quarter.

The purchase of a 26-foot, Higgins-built launch from U. S. Army surplus was completed and the craft is being refitted for service in the Delta Area.

MODESTO - DISTRICT NO. 5

Fyke-net sampling of seaward migrant chinook salmon in San Joaquin, Tuolumne, Merced, and Stanislaus Rivers and field work incident to the preparation of River Basin reports on Kings, Kern, Tule, and Kaweah Rivers have been the chief activities of the district staff during the quarter.

Fyke nets are being fished at two sites on San Joaquin River and at one site each on Tuolumne, Merced, and Stanislaus Rivers. Catches on the Tuolumne were low but steady from the middle of January to the middle of February, increased abruptly during the next four weeks, and have been increasing sharply since.

The first seaward migrant chinooks were taken in the Merced River net on January 20 and 21. None were taken after that period until February 18-19 when 46 were captured. Catches increased sharply the following week, dropped the next week, reached a peak of abundance March 10-11, and have been declining since that period.

Five albino chinook fry were taken in the net, three on February 24 and two on March 3. These fish conformed to the growth pattern of normal fry taken in the same net, but were distinctive because of their bright coloration, pink eyes, and absence of parr marks. An earlier record of an albino salmon fry was made on the Tuolumne River in March 1942 when one was taken in a California Bureau of Marine Fisheries fyke net.

Catches on the Stanislaus River indicate that the seaward migration is bimodal, however, extreme fluctuations in stream flow that occurred during the period of emergence was, no doubt, responsible for this condition. Peaks of abundance of almost identical magnitude were reached during the periods February 17 through March 1 and March 10-29.

Catches in the San Joaquin River net fishing near Herndon increased gradually in early January, reached a peak of abundance during the last week of the month, and have declined steadily since then. The net fishing the river near San Joaquin City had taken only five fry to the close of the quarter. These fish were taken the last two weeks in March.

The abandoned Trinity River Station was inspected the last week of December. Service facilities were in good order and there was no evidence of vandalism. Local residents were interviewed concerning the fall run of salmon in the river and all evidence gathered indicated that the run was conservatively about 50 percent greater than in 1945 which would make an estimated run of about 15,000 salmon passing Lewiston. The steelhead run was estimated to be about the same as in 1944 and 1945 although there was an increase in the sport catch undoubtedly resulting from increased effort.

Work was continued on a revision of the Trinity River study report.

Water temperature studies in the Modesto District were confined to the operation of one thermograph recording water temperatures continuously in Tuolumne River at Modesto. An ambitious temperature program has not been planned for the waters of this district inasmuch as the California State Division of Fish and Game maintains several instruments in the San Joaquin Valley streams.

GENERAL

Dr. Fish completed the report with Mr. M. G. Hanavan, summarizing the work of the Grand Coulee Fish-Maintenance Project, 1939 through 1946. The final draft of the report was sent to the Washington Office at the close of the quarter.

A staff conference of Project Leaders was held at Seattle on March 6 and 7 to discuss the Sectional research program for fiscal year 1948. A critical examination of the estimated benefits to be derived from each subproject was balanced against probable funds and a considerable modification of the work program resulted.

During the quarter Dr. Fish completed the first draft of a manuscript interpreting the results obtained during the past 20 years in artificially propagating fall-chinook salmon at the Service's Spring Creek Station. Considerable time likewise was devoted to assembling and analyzing data acquired during a preliminary survey for potential hatchery sites in the lower Columbia Basin. This survey was undertaken early in 1945 and terminated on September 1, 1946, for lack of funds. A report summarizing the accumulated data will be prepared for no additional work on this subproject is contemplated.

Mr. Harvey L. Moore student at Oregon State College, joined the Corvallis staff March 31 as Biological Aid, on a w.a.e. basis.

SEATTLE PATHOLOGY LABORATORY
Dr. Robert R. Rucker, In Charge

Dr. Rucker, assisted by Mr. Johnson, continued studies on the bactericidal properties and toxicities of new or untested disinfectants. Pyridylmercuric acetate was found non-toxic to No. 1 blueback salmon fingerlings at concentrations of 1:50,000 (1-hour) and 1:500,000 (1-week). In vitro studies with this compound, using C. columnaris as test organism, indicated that a 1:2,000,000 concentration was bactericidal in a 1-hour either in buffered water or in 0.1 percent tryptone broth. Field tests with this compound will be undertaken in the immediate future.

An homologous series of two quarternary ammonium compounds also were tested. The alkyl-trimethyl-ammonium bromide series appears to possess little value as germicides for controlling fish diseases. The alkyl-dimethyl-benzyl-ammonium chloride series (Rocoal is a mixture of this series) proved very interesting as both the toxicity to fish and the bactericidal properties (in 1-hour exposures at 50° F using C. columnaris as test organism) increased more or less proportional to the length of the carbon chain contained by the compound.

A general summary of the results obtained with the latter series:

| Length of Carbon Chain | Concentration tolerated by fish | Bactericidal concentration 0.1% tryptone | Buffered water |
|---------------------------|------------------------------------|---|----------------|
| 6 | 1:25,000 | 1:10,000 | 1:10,000 |
| 8 | 1:25,000 | 1:10,000 | 1:10,000 |
| 10 | 1:25,000 | 1:25,000 | 1:10,000 |
| 12 | 1:50,000 | 1:200,000 | 1:100,000 |
| 14 | 1:400,000 | 1:2,000,000 | 1:500,000 |
| 16 | 1:1,500,000 | 1:2,000,000 | 1:2,000,000 |
| 18 | 1:800,000 | 1:1,000,000 | 1:1,000,000 |
| Roccal | 1:75,000 | 1:300,000 | 1:300,000 |

Field tests with the myristyl (14) and cetyl (16) carbon chain compounds are planned in the immediate future.

Steri-Chlor (trade name of a commercial preparation containing 16 percent chloramine-T) was included at the request of the Division of Game Fish and Hatcheries, as well as a toxic grade of Roccal.

Attempts were made to induce "gas" disease among blueback salmon fingerlings under laboratory conditions for a controlled study of the problem associated with use of the wells at the Leavenworth Station. Various methods designed to produce a supersaturated concentration of nitrogen proved unsuccessful. Finally, a pressure chamber was developed for adding both oxygen and nitrogen to the water in the approximate proportions found at Leavenworth. Use of the pressure chamber appears promising but the device has not yet been fully tested.

Requests for advice in solving fish-cultural problems were received from three commercial and four Federal fish hatcheries.

LEAVENWORTH LABORATORY
Mr. Roger E. Burrows, In Charge

An experiment designed to determine the optimum poundage for stocking the standard deep troughs with blueback salmon fingerlings of various sizes was undertaken during the quarter. The initial phase of the experiment--involving trough capacities for fish just starting to feed--was complicated by the appearance of an unidentified internal bacterial infection. Treatments with sulfamerazine at the 6-gram level are being administered to check the disease.

Two reports are in process of preparation: one summarizing the various fish-cultural techniques recommended on the Grand Coulee Project; the other describing a new device for obtaining unbiased samples from a fish population. Several other reports remain in the preliminary draft stage.

Observations made during the routine biological control over production at the three Grand Coulee hatcheries indicate that 1-hour treatments with Roccal 1:50,000 given on three consecutive days will effectively control "fin rot" among chinook-salmon fingerlings. Weekly prophylactic treatments at the same concentration proved ineffective. Observations also indicate the advisability of using Roccal at a 1:40,000 concentration in the weekly prophylactic treatments against bacterial gill disease when water temperatures are below 50°F.

COLEMAN LABORATORY

Mr. Daniel W. Slater, In Charge

Correlation analysis of the percent loss to the eyed state (blanks shocked out) of 32 lots of chinook-salmon eggs averaging 36,500 per lot on elapsed time (1 to 130 minutes) between washing up and the start of a 4-mile haul gave an insignificant coefficient, r , of -0.08. This is in agreement with Burrow's findings at Leavenworth in the sense that water-hardening prior to transit is unessential.

Evaluation of the cost data resulting from testing six different fungus control schedules on 24 lots of chinook-salmon eggs averaging 33,000 per lot showed routine semi-weekly treatment with malachite green by Burrows' method to be most economical. Weekly removal of blank eggs (the usual procedure) cost \$0.039 per 1,000 eggs to the eyed stage including shocking out and removal of blanks. Semi-weekly treatments with final removal of blanks at the same stage cost but \$0.013 per 1,000.

In the first trial of an experiment on deep trough carrying capacity for fingerling chinook-salmon just starting to feed, a significant reduction in growth rate was noted at fish weights in excess of 16 pounds under water flows of 5 g.p.m., and at weights in excess of 22 pounds under 12 g.p.m. when compared to 8-10 pound constant-weight controls. Significant reductions in growth rates were also noted under 5 g.p.m. flows as compared to 12 g.p.m. flows. The latter observation is in agreement with that of Schuck and Kingsbury (P.F.C. 9 (2), April '47, p.110) who found growth of brown trout to be greater in fast stream sections as compared to slow-water sections.

The 12 troughs under test here were originally stocked with 8 pounds of feeding chinook fingerlings averaging around 1,150 per pound. All fish were fed the Coleman production diet. A second trial using part of the same group of fish is now under way.

Toxicity trials with pyridylmercuric acetate and chloride indicate that 10 p.p.m. of the acetate can be used safely for routine prophylactics of one-hour duration with chinook fry and fingerling at Coleman. The efficacy of the compound for such use in fish culture has yet to be shown. The chloride is of little practical use in this regard due to its low solubility (2:10,000 in water).

SHELLFISH INVESTIGATIONS, Paul S. Galtsoff, Chief of Section

GENERAL

Yellow Water Considerable time was spent by Dr. Galtsoff at College Park headquarters in answering inquiries and preparing memoranda regarding the cause of extremely high mortality of fish and shellfish along the west coast of Florida. It has been estimated by the fishermen and residents of Fort Myers, Florida, that in December 1946-January 1947, from 50 to 100 million pounds of dead fish were washed ashore or were floating in the water in the area extending about 130 miles along the coast and 10 miles wide. Concurrently with the mortality of fish the water was of deep yellow color. Examination of plankton samples sent to College Park showed the predominance of a naked Dinoflagellate of the genus *Gymnodinium*, resembling but not identical to *G. flavum*. The latter species was found by Kofoid to be the cause of yellow water observed at La Jolla, California, in the summer of 1914.

Residents along the shore suffered great discomfort not only from the decomposing fish but also from an odorless and acrid gas evolving from sea water. The gas produced severe irritation of respiratory organs, causing coughing, sneezing, and similar reactions. Unfortunately, when the arrangements were completed with the Woods Hole Oceanographic Institution for the analysis of sea water and samples comprising 15 gallons of water were collected at Fort Myers and delivered to Woods Hole, the gas was no longer present. The results of chemical analysis showed no abnormal condition in the composition of water. From a critical study of all the facts available at present, it is apparent that the mortality of fish and shellfish was caused by *Gymnodinium*. The nature of the poison and the origin of acrid gas remain, however, a mystery.

Management of Public Reefs

At the request of the Director of the Maryland Department of Tidewater Fisheries, the Service issued through the Director's office a statement regarding the necessity of management of public oyster grounds and the value of private planting. Mr. Engle continued to give technical advice to the Maryland Department of Tidewater Fisheries and attended several meetings of the General Assembly where bills relative to oyster management were under discussion.

Dr. Hopkins attended several meetings at Appalachicola, Florida, assisting the members of the industry in formulating recommendations regarding the management of oyster bottoms in Appalachicola Bay. This program is being developed with full cooperation of Mr. J. T. Hurst, State Supervisor of Conservation.

After spending 10 days at Pensacola, Florida, Dr. Galtsoff visited the Texas coast to confer with the State authorities at Corpus Christi and Rockport regarding the plans for rehabilitation of oyster bottoms. At the request of the Lee County Chamber of Commerce he stopped at Fort Myers, Florida, to evaluate the extent of damages caused by fish mortality in January-February, 1947, and proceeded to Coral Gables for a conference of the Advisory Board of the Marine Laboratory of the University of Miami. Recommendations regarding fishery research and conservation were discussed and submitted by the Board to the Florida Supervisor of Conservation. The members of the Board were asked also to express their view regarding the site of the proposed new marine laboratory at Virginia Key, near Miami.

RESEARCH LABORATORIES

Milford Research Laboratory, Victor L. Loosanoff, In Charge

Early in March this laboratory was requested to assemble all available data on the nature and abundance of the various marine forms of life, except vertebrates, for Long Island Sound and the Atlantic Ocean off Long Island. The survey began within a few days after receipt of the order and is now nearing completion. Almost the entire personnel of the laboratory is engaged in various phases of this survey. The survey will result in summarizing data on the important aquatic invertebrates in the inshore and offshore waters, indication of their economic values, and a description of the industries dependent upon them.

Pensacola Research Laboratory, A. E. Hopkins, In Charge

Dr. Galtsoff paid a short visit to the Pensacola station to carry on some special experiments on conchs and on the activity of oyster gills. Dr. Gabrielson also visited the station. Mr. Albert Collier, formerly a member of the biological staff of the Fish and Wildlife Service, is now carrying on experimental study of the effects of oil well waste materials on oysters at the Pensacola laboratory. Although the staff of the station is not directly concerned in this work, it is giving every possible cooperation, assistance, and advice.

Dr. Hopkins continued the survey of oyster mortality in Louisiana waters. The first survey was made in conjunction with officials of the Louisiana Department of Wild Life and Fisheries, and with the biologists of the Gulf Refining Company, and in the Grand Bay area of Louisiana. This bay is on the east side of the delta of the Mississippi River and is not far removed from new oil well operations. Oyster growers have recognized for the past year that mortality of oysters on privately leased grounds has become rather large. The second survey had for its purpose to determine from representative samples of planted oysters the approximate extent of the mortality in the Barataria Bay region, which includes Cyprien Bay, Bay Scofield, and other adjacent small bodies of water where oyster cultivation has for years been the standard practice. It is to be emphasized that this study was made for the purpose of finding out whether there is any significant mortality and, if so, to recommend a complete study of the cause of mortality. It is definitely recommended that an intensive biological and chemical study be made in the waters bordering the Mississippi Delta to determine

what is the cause of the observed mortality, which, in some cases, is apparently as high as 75 percent.

FIELD INVESTIGATIONS

Rehobeth Bay, Delaware

During the winter oysters in the Rehobeth Bay failed to fatten and their yield was lower than that which is normally attained at this time of the year. Furthermore, some of the shucked oysters and clams were pink. At the request of the State Sanitary Engineer, Mr. Engle and Dr. Chipman, examined the bottoms. Salinity, pH and oxygen content of water were adequate and there was no indication of pollution of water. No obvious reason for the failure of oysters to fatten could be determined. It is quite possible, however, that the oysters were planted too densely for the type of bottom in the bay. Pink discoloration was found to be due to pink yeast and the oyster dealers were advised to sterilize all their benches and utensils.

Mobile Bay Region

At the request of oyster dealers in the Mobile Bay region, Dr. Hopkins made a survey of the salinity in the inside waterway between Perdido Bay and Mobile Bay with respect to the proposed construction of a canal from this inside waterway to the Gulf. The question which arose was whether such a canal would change the salinity of the water in Bon Secour Bay so as to interfere with oyster culture. Records were taken for a period of one week of the salinity on the bottom throughout the area concerned, and the results were presented to the oyster producers and to Mr. Bert Thomas, State Director of Conservation, without recommendation. The seafood industry had hoped that we could recommend to the United States Engineer Corps that the canal be built because it might help the oyster industry. It was considered expedient, however, simply to submit the results and let interested parties draw their own conclusion.

PROJECT I. PHYSIOLOGY, PROPAGATION, GROWTH AND FATTENING OF OYSTERS

Subproject 1--Metabolism of Oyster

Dr. Galtsoff continued the analysis of experimental data and has recomputed some of the results on the rate of oxygen consumption of the adult oyster on the basis of wet and dry weight of meat.

A new method of microdetermination of dissolved oxygen in 1 ml. of sample was studied. Models and technical drawings of micropipette and manipulator necessary for sampling were made and, after long search a machinist was found who undertook to make the necessary apparatus at a reasonable price. The new method permits the taking of samples of water directly from the cloaca of the oysters and eliminates the necessity of using complex metabolism chamber employed in previous experiments.

Subproject 3--Feeding and Fattening of Oyster

Studies on feeding of oysters in relation to different environmental factors were continued. Several experiments were conducted by Dr. Loosanoff and the Biological Aides, Frances Tommers and James Shimer, to determine the effect of rapid changes in water temperature on the rate of pumping of oysters and also to determine the effect of changes in pH of the surrounding water upon the feeding of oysters. Temperature studies are now completed and the material is being prepared for publication.

A final check on whether or not oysters grow during the hibernation period was made by Loosanoff and Nomejko in March. Examination of 70 oysters, which were measured, weighed and the volume of which was determined early in December 1946, showed on March 14, 1947, that their dimensions, weight and volume remained the same, thus indicating that no increase in size occurred during the period of observation, which covered almost the entire hibernation period. Data on previously collected aspects of growing of oysters are still being analyzed.

Subproject 9--Effect of Salinity Changes on Oysters

Dr. Hopkins continued preparation of material for reports on the effects of changes in salinity on oysters. Progress has been constant but relatively slow. It is hoped that the first manuscript will be ready to submit to the Editorial Committee before June 30.

Subproject 10--Seasonal Variation in Chemical Composition of Oysters

Samples of oysters from South Carolina were tested by Dr. Chipman as to quality of their meats. These oysters were reported as being in very poor condition and were examined on the beds by R. O. Smith. Laboratory examination verified this report of their condition, the meats being watery and low in glycogen. These meats averaged 88 percent water and contained an average glycogen content of 3.2 percent. James River oysters, collected somewhat earlier, had been found to have glycogen contents ranging from 5 to 9 percent and their condition was good.

Subproject 11--Biology of Oyster Larvae

Considerable time was devoted by Dr. Loosanoff and the newly appointed Aquatic Biologist, Harry C. Davis, to designing and constructing a hatchery for oyster and other pelecypod larvae that would constitute part of a standard method for rearing these organisms. A device has been constructed which automatically supplies filtered and aerated sea water at a controlled temperature to the oyster rearing vessels. Difficulties are being encountered, however, in finding suitable filters that will permit drawing of water from the vessels without losing or injuring the eggs or larvae in the early stages. Work is being continued to improve the method which was developed last winter for obtaining fertilizable oyster eggs in the winter months. Although fertilizable eggs may be obtained under a wide range of temperature, it appears that the rate and degree of development are not the same in all cases. Experiments are now underway to determine the optimum temperature and the duration of exposure necessary to obtain eggs fully viable and capable of complete development.

PROJECT II. ECOLOGY OF OYSTERS IN CHESAPEAKE BAY

Gonad Development During the summer of 1946, 500 oyster gonads were preserved by Dr. Butler for the purpose of studying the effect of environment on gonad development.

The sources of the samples were two areas, one at Tolchester in the head of the Bay where low salinities usually occur during the spring and early summer, and the other in Eastern Bay where the salinities remain fairly constant and at a reasonably high level throughout the whole year. Processing of the gonad samples by serially sectioning and staining has been in progress through most of this quarter. The examination of the material will be reported in the next quarter.

Relationship of environment to the growth of seed oysters. The seed oyster measured 7 months after the start of the observations doubled in length. At the beginning of the experiment, conducted by Messrs. Engle and Dr. Butler, the mean length of the oyster was 28 mm. with the range from 12 to 47 mm., and at the February measurement the mean was 54 mm. and the range from 23 to 85 mm. The increment of the means was 26 mm. or, for the above period, indicating an increase in length of very nearly 100 percent. The seed was composed of 1945 set transplanted and measured in the late spring of 1946 and again measured at the beginning of this quarter. No oysters were 3 inches in length at the start of the experiment but, at the time of recent measurement 1.5 percent has reached the legal marketable length. These figures are based on a partial analysis of the experiment. Ice in the upper Chesapeake Bay and tributaries interfered with the examination of all the samples.

The seasonal condition of oysters from several parts of Chesapeake Bay and Tributaries. Observations by Mr. Engle on seasonal conditions of oysters from several parts of Chesapeake Bay and tributaries were continued. In the Bay proper all oysters whose condition was poor during 1945-46 have improved and are now in marketable condition. The most conspicuous change in the Bay waters is the salinity which has risen from fresh water during last year to an average of 12 parts per thousand. It seems reasonable to assume that the improvement in the condition of the oysters is related to the increase of salinity. Where the salinity remained comparatively constant, the fluctuations in condition were less pronounced than in the areas where drastic salinity changes occurred.

PROJECT IV. PROTECTION AGAINST NATURAL ENEMIES

Subproject 1--Control of Starfish and Drills

Work is being continued by Dr. Loosanoff and Mr. Shipley on developing a method to attract or repel oyster enemies, especially starfish and drills. Numerous experiments with various lures have been conducted under laboratory conditions and will later on be tried in the field. At present the data obtained are being evaluated. Organic amines, animal lures, and various oils have been tried thus far, and some appear to be rather promising. Statistical analysis of the data on starfish setting in Long Island Sound for the last ten years is continued when time permits.

At College Park, Maryland, Dr. Galtsoff, with the assistance of Mr. A. DeMettriff, developed a method for recording and measuring the rate of movements of drills (*Urosalpinx*) and conchs (*Thais*). The apparatus consists of a well-balanced wheel made of plastic; the mollusk is placed inside the wheel, in the part of it submerged in water. As the snail creeps along the periphery, the movement of the wheel is recorded on kymograph. So far, the maximum rate of movement recorded at 20-22° C. and salinity - 26 ‰ was 23 feet per hour for *Thais*, and 2 feet per hour for *Urosalpinx*. Some of the snails continued to move without stopping for 14 hours. These experiments are carried out with the idea of obtaining better understanding of the behavior of snails on oyster grounds and improving the technique of trapping them.

Subproject 3--Distribution of *Nematopsis*

The paper on the distribution of *Nematopsis* in Chesapeake Bay is being prepared by Helen Landau.

Xanthid crabs, collected during this fall-winter season from the Patuxent River by Dr. E. Cronin of the Chesapeake Biological Laboratory, are being examined for gregarine infection for comparison with those collected in the summer from other parts of the bay. Those examined so far were found free from parasite. This is expected, since the crabs have probably ceased feeding and are no longer being infected.

PROJECT V. EFFECT OF POLLUTION ON OYSTERS

Subproject 3--Pollution of Oyster Beds in Hampton Roads Area.

Dr. Hansen continued to work on a manuscript describing the trend of pollution in the lower Chesapeake Bay. The work consisted in rearrangement and new tabulation of data and drawing of diagrams. Some additional observations made by the outside agencies have been assembled and incorporated in the report. The information collected by the Service during 1945-46 indicates that the pollution has materially decreased since the State Board of Health made a Survey in 1942-44. However, the improvement has not yet been sufficient to reestablish the conditions which existed before 1934.

By February 1947 the work on the improvement of the sanitary condition in the Hampton Roads area has been brought to the following state: all sewers up to the western outskirts of Hampton have been connected with the Small Boat Harbour outfall at Newport News. The underground system of sewers in the area between Hampton, Buckroe, and Phoebus has been completed, including the installation of seven pump stations. The latter have not yet been accepted, however, by the Hampton Roads Sewage Disposal Commission.

For the south side of Hampton Roads a large amount of sewage is collected and discharged at the Army base outfall; the corresponding collection of sewage at the two remaining disposal locations at Lambert Point and at Pinner Point has not taken place.

Laboratory work consisted in developing accurate technique for determination of numbers of bacteria in oyster tissue. Critical experiments conducted at Hampton show that maceration of tissues by shaking with glass beads and by employing other commonly used procedures are inadequate. A considerable number of bacteria may be killed by this technique, especially if shaking is extended for some time.

PROJECT VI. BIOLOGY AND CONSERVATION OF EDIBLE MOLLUSCS OTHER THAN OYSTERS.

Subproject 2--Soft Clam Fishery of Plum Island Flats, Parker River National Wildlife Refuge.

Samples of the clam flats, collected during November and December of 1946 from Parker River National Wildlife Refuge, Newburyport, Massachusetts, are still being examined by Dr. Engle. A report will be submitted during the next quarter.

PROJECT VII. EFFECT OF DDT ON OYSTERS

The data collected by Dr. Loosanoff on the effect of DDT upon oysters have been analyzed and tabulated. The final report, ready for publication, will be submitted to the Section Chief some time in April.

ICHTHYOLOGICAL LABORATORY, Samuel F. Hildebrand, In Charge.

GENERAL

Studies pertaining to the herrings (Clupeidae) of the Western North Atlantic and the preparation of a descriptive catalogue of the fishes of the Gulf Coast of the United States were continued. Routine identifications of specimens submitted by institutions and individuals received prompt attention. Information as to the proper common and scientific names of some fishes appearing in the trade was given to the American Cannery Association, the U. S. Tariff Commission, the U.S. Customs Service, and the Pure Food and Drug Administration.

Dr. Hildebrand continued the study and revision of the menhaden, genus Brevortia. Accounts of the five species to be included in the "Fishes of the Western North Atlantic" are about finished. Simultaneously, a preliminary paper, embodying the revision, is being prepared. Seven species will be recognized from North and South America. Extensive data in the form of tables will be included in the revision.

Mrs. Green took care of routine office matters, completed four drawings of menhaden and assisted in the preparation of the tables.

Mr. Ginsburg continued the study of the family Sciaenidae of the Gulf Coast. The following interesting findings may be mentioned: What appears to be a new species of king whiting, Meristicirrhus, is included in the material collected on the coast of Florida. Frequency distribution tables of the counts of meristic characters of the new species were compared with similar tables for the three species of the genus known from the east coast of the United States, two of which range to the Gulf Coast.

A specimen of the genus Umbrina from the Gulf Coast was compared with U. ceroides from the West Indies. The evidence indicates that the Gulf Coast specimen might represent a new species; but on account of the paucity of material, the evidence is not altogether convincing.

As a result of these studies, the descriptive part of most genera and species from the Gulf Coast, of this important family, was prepared, in a form nearly suitable to be included in the final manuscript.

BEAUFORT LABORATORY. Herbert F. Prytherch, In Charge

PROJECT I. EXPERIMENTAL OYSTER FARM

An additional marsh pond has been constructed for use of a new series of experiments on the growth of oysters of different types under controlled conditions. On March 17 the operation of this field unit was inspected by the Assistant Director, Dr. Clarence Cottam.

PROJECT II. TERRAPIN CULTURE

The concrete inner walls dividing the breeding pens, Nos. 2, 3 and 4, were undermined by tidal action and have been rebuilt so that Pen. No. 3 can again be utilized for terrapin propagation during the coming season. During bad weather the station employees have repainted and repaired the inside of the terrapin rearing house and adjoining small aquarium containing 17 exhibit tanks.

Special Activities.

Dr. Prytherch's services were loaned to River Basin Studies to determine how the fishery resources of the Albemarle Sound region may be affected by the regulated flow of the Roanoke River. The commercial fisheries in the 12 counties around Albemarle Sound, which yielded a crop of 15,135,300 pounds, in 1940 with a value of \$465,223.00, have been subjected to extreme variations in precipitation and river discharge in the past 7 years which may indicate how they may be affected by changing the time of flow of approximately 724,000 acre feet of fresh water into this coastal region. Two field surveys were made during periods of bad weather in February and March when it was possible to observe the effects of heavy winds on movement of the sound water, pollution and low salinity after an extended period of low river discharge.

WATER QUALITY INVESTIGATIONS, M. M. Ellis, In Charge, Columbia, Missouri.

As has been pointed out previously in these reports, the physiological condition of the fish is subject to very definite changes as the soluble compounds in the water are varied both as to absolute quantity and as to ratios. Potentiation of some forms of pollution is also a correlative of certain changes in these components. Consequently several physiological characteristics and responses, particularly those of the respiratory, cardiovascular and muscle-tissue systems can be used as a measure of the suitability of water for fish life. These physiological tests, therefore, when made in the field give important indices concerning the water quality not obtainable by direct chemical analyses.

Through the cooperation of the University of Missouri, facilities for this phase of the Unit's work have been materially augmented during the present winter season by special apparatus for some of the tests and through special plumbing and wiring of the quarters assigned to this Unit.

At present irrigation water and water carrying large amounts of soil salts are being given major attention. Messrs. Jones and Hale at the Spearfish station are participating in this program and are making the necessary tests in trout.

The Unit has almost completed a series of bioassays tests on some new chemicals submitted by the paper industry. This assay work, although of a very specific sort, was considered to be of sufficient importance to the industry as a whole to warrant inclusion in the program of the Water Quality Unit. A report will be filed within a few weeks on these studies.

An administrative report covering the general plan, program, and work completed to date on irrigation waters by this Unit was prepared for use by the Geological Survey and other governmental agencies interested in irrigation waters. A meeting with several of the officials of these agencies is planned at Columbia, Missouri early in April.

A fishery leaflet on the general effects of the temperature on fishes has been submitted.

Mr. Henry Baetkey, Administrative Assistant, from the Regional Office at Minneapolis spent two days with the Unit during the last week of February. Mr. Baetkey was making routine checks of paper work and property. His visit was very helpful.