

---

---

**REPORT OF THE  
UNITED STATES COMMISSIONER OF FISHERIES  
FOR THE FISCAL YEAR ENDED  
JUNE 30, 1921**

---

---

1

BUREAU OF FISHERIES.

---

HEADQUARTERS STAFF, 1920-21.

---

*Commissioner,*

HUGH M. SMITH.

*Deputy Commissioner.*—H. F. MOORE.

*Assistants in Charge of Divisions:*

*Office.*—IRVING H. DUNLAP.

*Fish Culture.*—GLEN C. LEACH.

*Inquiry Respecting Food Fishes.*—ROBERT E. COKER.

*Fishery Industries.*—LEWIS RADCLIFFE.

*Alaska Service.*—WARD T. BOWER.

*Architect and Engineer.*—GEORGE A. SCHNEIDER.

*Accountant.*—CHARLES W. SCUDDER.

*Superintendent Central Station and Aquaria.*—L. G. HARRON.

*Bureau of Fisheries Document No. 900.*

# CONTENTS.

---

	Page.
Inquiry respecting food fishes and fishing grounds.....	5
Importance of the service.....	5
Studies of fishes.....	6
Mosquito control by the use of fish.....	7
Fish-cultural experiment work.....	7
Surveys of particular waters.....	9
Aid to the shellfish industries.....	9
New sources of seaweed gelatin.....	10
Activities of the biological laboratories.....	10
Propagation and distribution of food fishes.....	11
Outline of the work.....	11
Distribution of fish.....	12
Relations with the States in fish culture.....	13
Cooperation with fish-protective associations.....	15
Hatching of river fishes of the Atlantic seaboard.....	15
Propagation of commercial fishes of the Great Lakes.....	16
Propagation of the Pacific salmon.....	17
Cultivation of fishes of interior lakes and streams.....	18
Hatching of marine fishes.....	20
Rescue operations in Mississippi Valley.....	21
Distribution of mosquito-eating fishes.....	22
Artificial propagation of fresh-water mussels.....	22
Relations with the fishery industries.....	23
Summary of conditions and activities.....	23
Fishery intelligence service.....	25
Studies of fishery methods.....	25
Improvement in handling fresh fish.....	26
Fish-marketing survey.....	26
Increasing the consumption of fish.....	27
Technological investigation.....	27
Increasing the use of by-products of the fisheries.....	28
Fishery conferences.....	29
New England vessel fisheries.....	30
Vessel fisheries at Seattle, Wash.....	32
Shad fishery of the Hudson River.....	33
Shad and alewife fisheries of the Potomac River.....	33
The frozen-fish trade.....	34
Fisheries of the South Atlantic States.....	34
Fisheries of the New England States.....	35
Sardine industry of Maine.....	35
Florida sponge fishery.....	36
Increased usefulness to the fisheries.....	36
Alaska fisheries service.....	37
Extent of the Alaska fisheries.....	37
Enforcement of fishery laws and regulations.....	38
Private salmon hatcheries.....	39
New salmon fishery regulations.....	39
Protection of walrus and sea lion.....	41
New legislation needed.....	41
Future development of Alaska fisheries.....	42
Control over the Alaska fisheries.....	42

	<b>Page.</b>
Alaska fur-seal service.....	43
General activities at the Pribilof Islands.....	43
The seal herd.....	44
The take of sealskins.....	45
Sale of sealskins.....	45
Foxes and reindeer.....	46
Miscellaneous.....	46
Semicentennial of the Bureau.....	46
New buildings and improvements.....	47
Vessel service.....	48
Appropriations.....	50

# REPORT

OF THE

## COMMISSIONER OF FISHERIES.

DEPARTMENT OF COMMERCE,  
BUREAU OF FISHERIES,  
*Washington, September 15, 1921.*

SIR: I have the honor to present herewith a report giving a résumé of the operations of the Bureau of Fisheries during the fiscal year ending June 30, 1921. The major captions under which the activities are considered are inquiry respecting food fishes and fishing grounds, propagation and distribution of food fishes, artificial propagation of fresh-water mussels, relations with the fishery industries, Alaska fisheries service, Alaska fur-seal service, and miscellaneous administrative functions.

### INQUIRY RESPECTING FOOD FISHES AND FISHING GROUNDS.

#### IMPORTANCE OF THE SERVICE.

The resources of the fresh and salt waters of the United States constitute great national assets as the means of livelihood of large numbers of people, as the basis of important industries, and as a conspicuous source of food. It is toward the manifold problems relating to the perpetuation of the supply of raw materials that the activities of the Bureau in biological investigation and experimentation are chiefly directed. It would be a shortsighted National or State policy that allowed the fishery resources to decline indefinitely or that failed to lay the basis of definite and exact knowledge necessary for their maintenance and increase.

Notwithstanding the importance of this matter, the Bureau's activities in this field have been seriously restricted, and at times altogether suspended in certain lines, by the low and inflexible salary scale which prevents the maintenance of a full staff of trained investigators. Under existing conditions some positions can not be filled, while in others assistants are retained for only brief periods. A further handicap is that promotions necessary to retain the services of a competent employee can often be made only by a transfer and change of duty from a field in which the employee has acquired skill to another in which he must have further experience before he can be expected to render service in proportion to his general ability. These and other disadvantageous conditions can readily be remedied by congressional action allowing the Secretary of Com-

merce to arrange salaries, within reasonable limits, with reference to the efficiency of employees rather than to the titles of positions. The entire subject of salary readjustment has been thoroughly studied in connection with the reclassification of Government employees, and a comprehensive and adequate salary schedule has been worked out by various competent agencies. It is hoped that all the time and thought devoted to the rectification of a chronic defect in the civil service may not terminate in mere discussion.

#### STUDIES OF FISHES.

General investigation of the life-history of the chinook salmon, special studies of the salmon of Alaska, and an inquiry into the injurious practice of taking immature salmon by trolling and seining off the mouths of Pacific rivers have been continued. It has been determined in the last-named investigation that in the early part of the season nearly three-fourths of the salmon taken are immature, although later these fish constitute only a small proportion of the total catch. Relatively few immature salmon are taken at the mouth of the Columbia River, but a very considerable percentage of the chinook salmon obtained by trolling in Monterey Bay are not prospective spawners of the year. The facts ascertained obviously call for appropriate regulatory measures, for the killing of immature salmon is both economically and biologically wasteful. In the evident belief that the matter can not be fully handled by the several States, the United States Senate has passed a resolution requesting the President to negotiate such treaty or treaties as may be needed to secure to the salmon of the Pacific Ocean off the coasts of the United States and Canada protection from unnecessary destruction through wasteful practices, devices, and methods of capture. During the 1920 season there were taken on their return to the Columbia River a number of salmon that had been marked at the time of their planting several years previously. Although the number of marked fish recovered was limited, their study has afforded a basis for inferences on both the natural history of the salmon and the value of fish-cultural practices.

The study of the whitefishes and their relatives of the Great Lakes, which had previously been conducted on Lake Huron, was extended to Lakes Michigan and Ontario, and substantial progress was made. As soon as the necessary field work in other lakes can be completed a report of the results will be given out. The investigation takes account of species, distribution, places and seasons of propagation, life histories, and food. The results are expected to afford a proper basis for regulatory measures and guidance in artificial propagation and may therefore be a means of bringing about a restoration of the former abundance of these important fishes.

Considerable attention has been devoted to the food and distribution of fishes in interior lakes, the inquiries being intended not only to afford guidance in regard to the stocking of waters, but also to reveal the character of shores and border waters which should be preserved or maintained in order to promote the productiveness of lakes in food supply. It has not been possible to give the river systems the study which is evidently required if the continual decline

of important commercial and game fishes is to be checked, but the Bureau has, nevertheless, availed itself of the opportunities occurring to study extensively the conditions prevailing in certain portions of the Mississippi River and to direct a special inquiry into the natural history and propagation of the paddlefish.

Coincidentally with the prosecution and development of the marine fisheries there is required a full understanding of the life histories and migrations of the fishes involved and of the conditions of their reproduction and growth. The Bureau has been attempting to supply the necessary data, and to this end has been conducting special surveys of waters and special studies of individual fishes and groups of fishes and has accumulated much valuable material. During the year there was completed a report bringing together what was previously known and what has recently been learned of the natural history of the fishes of one of the most important commercial families, and there has been begun a compilation of the results of many years of collection and study of material bearing on the life histories and habits of the food fishes of the North Atlantic.

Announcement is made of the completion of the study of the fishes of Panama as the Bureau's cooperative part in the Smithsonian Biological Survey of the Panama Canal Zone. The survey was undertaken several years ago to lay a basis for comparison of conditions prevailing before and after the completion of the canal connecting the two oceans. The necessity of keeping the staff of the Bureau occupied upon problems of immediate importance has delayed the completion of the study of the fishes until during the past fiscal year.

#### MOSQUITO CONTROL BY THE USE OF FISH.

The cooperation of the Bureau of Fisheries having again been sought by the United States Public Health Service in the anti-malaria campaign in southern States, an assistant was detailed, as last year, to give counsel and assistance to Federal, State, and local health officials concerning the use of fish for the control of mosquitoes. The value of this service is attested both by the statements of health officers as to the results gained and economies effected and by the report of the Surgeon General of the Public Health Service. Investigations have been continued to gain additional information as to the conditions of the most effective use of fish for destruction of mosquitoes both in southern waters, where the prevention of malaria is a primary object, and in northern waters, where mosquitoes have a recognized deleterious effect upon the efficiency of labor and upon property values. As a result of the inquiries conducted in the north the Bureau has been able to give helpful advice to various municipalities and individuals.

#### FISH-CULTURAL EXPERIMENT WORK.

While national attention is directed to the important object of promoting the productivity of lands, we generally take what the waters produce as a gift of nature, something to be exploited and perhaps protected, but not to be cultivated. As the culture of plants and ani-

mals of the land can be made responsive to the application of scientific principles and experimentation, so the culture of the products of the ponds, lakes, and rivers may be increased by discovering the favorable and the limiting factors of production. The necessary investigative work involves careful studies of conditions characteristic of rich and poor waters, observations of the relations existing between fish and the other animals and plants with which they are associated, and experimental work to test the effect of particular factors upon the growth and multiplication of fish.

While scant special provision has been made for strictly fish-cultural experiment work, the Bureau endeavors to take advantage of such opportunities as are offered for work of this character, and these are found principally at the fisheries biological station at Fairport, Iowa. Experiments are conducted at that station to appraise the capacity of small ponds to support fish life, to determine the best plans of pond management, to discover what species of aquatic plants or animals should be introduced or fostered in fish ponds, and to make fish-cultural methods applicable to species of fish not hitherto propagated by artificial methods. Some experiments have also been conducted in connection with fish-cultural stations to discover means of reducing losses of eggs, fry, and brood stock, and of preventing deterioration of fertility of brood stock. If adequate and permanent provision could be made for the facilities and personnel of experimental work of this nature, the interests of economy would be served in the long run by increasing efficiency in all fish-cultural operations affected. One of the results incidentally obtained at the Fairport station—the devising of a new form of pond outlet which has stood the test of several years' trial—has shown the possibility of effecting substantial economies in the construction and maintenance of ponds at all stations where earth ponds are used.

Another means of effecting permanent economies in fish-cultural operations can be found in the reduction of disease or other causes of mortality in hatcheries. To serve this purpose, the primary necessity is a competent and permanent employee for the study of fish diseases. The need was recognized by Congress when in 1915 it established the position of fish pathologist as a part of the regular scientific personnel of the Bureau. During the six years which have elapsed since the position was created it has been vacant for one-third of the time and during the remainder has been held by three incumbents, none remaining in the service long enough to make more than an encouraging beginning. The difficulty has been that the salary was inflexible and fixed at too low a rate to attract and hold the proper man. The remedy is easily found in a readjustment of salary conditions such as has been referred to in a preceding paragraph. The position of fish pathologist was occupied during half of the past fiscal year, and investigations were directed at the ovarian diseases of fishes and the high mortality rate prevalent in all pike-perch hatcheries. Utilizing the services of temporary investigators, the Bureau has also made investigations of the losses of fish rescued in warm weather, finding a practicable remedy, and studies of injurious parasites of fishes.



## SURVEYS OF PARTICULAR WATERS.

For the proper conservation of fishery resources and for gauging the necessity for and results of fish-cultural work it is important to have the most complete knowledge of the natural conditions in waters where fish propagate, grow, appear, and disappear under the control of factors now but little understood. During the past year such general investigations and surveys have been conducted both in the North Atlantic Ocean and in Chesapeake Bay—two of the most important sources of fish food and the locations of some of our principal fisheries. A comprehensive report embodying the results of observations gathered during a number of preceding years in the Gulf of Maine is now in preparation, special consideration being given to the life histories of the useful fishes and the conditions governing their distribution. In Chesapeake Bay the field work of the general survey has been completed, and it remains to compile and report upon the large mass of data accumulated. The special field studies of the occurrence and distribution of fish in the bay and tributary waters is being actively prosecuted. Other studies of a general nature have been conducted at relatively small expense in certain interior lakes, in cooperation with the Wisconsin Geological and Natural History Survey, and in the Mississippi River as a part of the work of the biological station at Fairport.

An event of interest and promise was the formation during the year of an international committee on marine fishery investigations composed of three representatives from Canada, one from Newfoundland, and three from the United States. The function of this committee is not to engage in joint work, but to serve as a ready means of effecting interchange of counsel, coordination of plans, and harmony in methods of marine investigations.

## AID TO THE SHELLFISH INDUSTRIES.

The Bureau is rendering every practicable service to the oyster growers in the difficult circumstances which confront them in certain regions because of the failure of natural seeding. The conditions during the season of 1920 were very unfavorable to experimentation, and the work was further hampered by the loss in course of the season of the assistant charged with major responsibility for the investigations. The natural conditions in the beginning of the season of 1921 seemed favorable for experimental work, and the Bureau was able, as the results of the methods of study worked out and followed during preceding years, to render direct service to planters in the waters where investigations were being conducted. Progress has been made in the investigations to determine the effect of pollutions upon oyster propagation, both through direct action on the larvæ and through impairment of the vitality of oyster larvæ or of the fertility of breeding oysters by exhaustion of oxygen supply in the water.

Investigations of previous years had opened the way for artificial propagation on a commercial scale of fresh-water mussels, on which a very important button industry depends. The nature and extent

of this work in the past fiscal year are elsewhere shown. Further and practically continuous efforts will be necessary in order to supply deficiencies in existing knowledge and to determine the effects of fishing operations and regulatory measures on the mussel resources of particular water areas. During the year there were distinct advances in experimentation, artificial propagation, and protection. An experiment in recovering young mussels dropped from infected fish retained in an inclosure gave a proportionate yield much greater than had been assumed to be necessary to justify the expenditures for artificial propagation. Protection is, of course, a function of the several States, but the Bureau has done much to stimulate interest in the matter, and almost invariably the counsel of representatives of the Bureau is sought by the States in determining the portions of rivers to be closed against shelling operations for the protection of mussels.

#### NEW SOURCES OF SEAWEED GELATIN.

The investigation of gelatin derivable from seaweed was extended during the year to certain species of red algæ of the Pacific coast, with the result that a new source of agar-agar of superior quality was disclosed.

Agar-agar is the commercial name applied to a gelatinous product of certain red algæ which is imported from Japan, China, and other places. The importations in 1919 amounted to nearly a half million dollars. Agar is used in making foods and confections, but its principal importance arises from the fact that it is a necessary medium for bacteriological work and is, therefore, essential to medical laboratories and hospitals. Four species of algæ from the Pacific coast were the subject of experimentation, and agar prepared from one of these tested at the Army Medical School in Washington was pronounced equal or superior to the imported agar, while another species yielded a product apparently of like quality.

The discovery of domestic raw materials from which this important peculiar product may be made is a noteworthy event. In order that both Government and private interests may hereafter be independent of foreign sources of supply, further investigations should be conducted to determine the availability and locations of the proper algæ on our coasts as well as the suitability of other species than those used in the experiments already made.

#### ACTIVITIES OF THE BIOLOGICAL LABORATORIES.

The situation with regard to the marine biological laboratories remains distinctly unsatisfactory. The anomalous salary conditions make it hopeless to secure and retain a competent scientific staff, and the positions are generally vacant. While the stations at Beaufort, N. C., and Key West, Fla., have been virtually nonproductive during the past year, it has nevertheless been necessary to incur expenditures for maintaining the property. It has not, however, been practicable to prevent deterioration of the properties without more drastic curtailment of activities in other directions than seemed consistent with the accomplishment of a reasonable measure of public

service. The Woods Hole (Mass.) laboratory was in operation with a small scientific staff in the summer of 1920, but it was impracticable to reopen it in the summer of 1921.

In the last annual report (pp. 22 and 62) reference was made to the new building nearing completion at the Fairport (Iowa) station. The building was occupied in August, 1920, and has been found excellently suited for the purposes of fishery investigations. On two occasions during the year it was the scene of conferences of national scope for consideration of questions affecting the conservation of resources of interior waters and the application of scientific studies to that end. Both conferences, but particularly the one held June 8-10, 1921, brought together persons of varied interests from many States and were most helpful in affecting interchange of ideas and promoting harmonious action to the end that more care may be taken to insure the permanency of fishery resources.

### PROPAGATION AND DISTRIBUTION OF FOOD FISHES.

#### OUTLINE OF THE WORK.

The fish-cultural activities of the Bureau are directed to the maintenance of the existing aquatic resources of the country and the development of new sources of supply by the stocking of barren waters and the introduction of useful species into waters to which they were not indigenous. In this work the Federal Government operates along the same lines and with the same object as do many of the States. Five distinct functions are involved in this service, namely, the collection and fertilization of the eggs of food fishes, the incubation of the eggs in hatcheries, the feeding and rearing of the young of certain species, the distribution of fishes (and, in some cases, eggs) for planting in suitable waters, and the rescue of fishes from landlocked flood waters of the Mississippi Valley.

The principal source of the fish eggs handled by the Bureau continues to be the commercial fisheries, in which vast numbers of eggs that would otherwise be sent to market in the fish and be a total loss are obtained for hatching purposes by experienced spawn takers. In the case of some important fishes, notably, but not exclusively, the salmons of the Pacific coast, where commercial fishing does not extend to or is not permitted in the spawning areas, the ripe fish are caught in seines or traps and their eggs are removed, the object being to bring about a higher percentage of fertilization than is possible under natural conditions and to afford to eggs and resulting young protection from enemies and physical fatalities during and immediately after the hatching period. Eggs in noteworthy numbers are obtained also from domesticated fish held from year to year in ponds at the stations.

No material increase in the scope and magnitude of the fish-cultural work was possible during the year. With the available operating funds remaining the same, the most careful scrutiny of expenditures and the closest application of employees to their duties have been required to maintain the service at its existing standard of efficiency.

The fish-cultural operations in 1921 were conducted in 33 States, Alaska, and the District of Columbia, and the output reached every

State and Territory. The number of fingerlings handled was 226,589,545, fry aggregated 3,626,262,730, and the fertilized eggs assigned to State hatcheries or planted on the natural spawning grounds of the respective species numbered 1,109,637,130. The following table gives a summary of the output of each species:

SUMMARY, BY SPECIES, OF THE OUTPUT OF FISH AND FISH EGGS DURING THE FISCAL YEAR 1921.

Species.	Eggs.	Fry.	Fingerlings.	Total.
Catfish.....			35,257,070	35,257,070
Carp.....		106,043,000	3,918,580	109,961,580
Buffalofish.....		108,307,000	1,645,835	109,952,835
Shad.....		32,792,275		32,792,275
Alewife.....		43,815,000		43,815,000
Whitefish.....	181,650,000	238,800,000		420,450,000
Cisco.....	186,510,000	89,800,000		276,310,000
Silver salmon.....		600,000	6,486,150	7,086,150
Chinook salmon.....	6,780,000		32,780,765	39,560,765
Sockeye salmon.....	360,000	38,778,500	30,434,500	69,563,000
Chum salmon.....		7,000,000	19,436,400	26,436,400
Steelhead salmon.....	493,000	38,810	2,928,915	3,460,725
Atlantic salmon.....		1,387,000	280	1,387,280
Landlocked salmon.....	575,000	208,115	124,280	907,385
Rainbow trout.....	2,553,240	414,100	3,872,225	6,839,565
Blackspotted trout.....	820,000	3,899,100	1,000,300	5,719,400
Loch Leven trout.....			64,000	64,000
Lake trout.....	2,824,000	16,563,300	208,500	19,595,800
Brook trout.....	856,890	8,642,330	7,559,625	12,058,845
Grayling.....		1,400,000		1,400,000
Smelt.....	600,000	7,000,000		7,600,000
Pike and pickerel.....			540,510	540,510
Fresh-water drum.....			34,080	34,080
Crapple.....			37,303,900	37,303,900
Large mouth black bass.....		585,050	1,221,905	1,806,955
Small mouth black bass.....		303,700	54,590	358,290
Rock bass.....			108,305	108,305
Warmouth bass.....			100	100
Sunfish.....			30,371,475	30,371,475
Pike perch.....	296,475,000	57,385,000	108,515	353,968,515
Yellow perch.....	12,000,000	176,369,450	6,166,435	194,635,885
White bass.....			27,170	27,170
Striped bass.....		70,184,000		20,184,000
Cod.....	208,800,000	175,341,000		384,141,000
Pollock.....		455,066,000		455,066,000
Haddock.....	188,940,000	271,880,000		460,820,000
Winter flounder.....		1,768,660,000		1,768,660,000
Pole flounder.....	19,410,000			19,410,000
Miscellaneous fishes.....			4,935,185	4,935,185
Total.....	1,109,637,130	3,626,262,730	226,589,545	4,962,489,405

As compared with 1920, there was a general increase in production of nearly 200,000,000. Species handled in larger numbers were whitefish, cisco, alewife, chum salmon, blackspotted trout, brook trout, carp, pike perch, yellow perch, striped bass, and haddock, while the output of catfish, buffalofish, shad, various Pacific salmon, lake trout, cod, and pollock was less.

#### DISTRIBUTION OF FISH.

The increased cost of railroad transportation has been accompanied by no increase in the funds available for the distribution of fishes and has necessitated curtailments. The five special railroad cars that were in commission during the year traveled 85,060 miles and detached messengers in charge of minor shipments of live fish traveled 385,988 miles in planting fish in public waters and in filling upward of 9,000 special applications. The cars were employed principally in

distributing fishes of the interior waters, which are assigned on requests of individuals, fish associations, State fishery officials, and officers of the National Park Service and Forest Service. Fishes representing the commercial species are usually planted on the Bureau's initiative on the spawning grounds from which eggs are derived and, in some instances, in barren waters where the conditions favor the development of new and promising fisheries.

In the Bureau's estimates of appropriations for the fiscal year 1923, under the item for the propagation of food fishes, there has been inserted a clause which is intended to bring to the attention of Congress the desirability of instituting a new policy in the distribution of fish produced at the Government hatcheries or obtained in the course of the regular operations. This clause provides that the Secretary of Commerce may make a reasonable charge for fish supplied for planting in any waters in which the public is not allowed to take fish.

RELATIONS WITH THE STATES IN FISH CULTURE.

The numerous States engaged in fish culture are laboring for the same purposes that actuate the Bureau in its operations within the respective States. The field is large, the need for very extensive work is nearly everywhere apparent, and there is no conflict of authority or duplication of effort between the States and the Federal Government. Under the cooperative arrangements that have been made the practical efforts of one agency supplement and augment those of the other, with maximum benefit to the public.

The Bureau acknowledges invaluable assistance afforded by the States during the past year, resulting in reduced expense, augmented output, and increased efficiency in stocking waters. Joint occupation of productive collecting fields and the use of State hatcheries for the incubation of eggs provided by the Bureau, the young fish being planted by the State in local waters in accordance with previous plans, have continued to be features of the interrelations with the States. In the fiscal year 1921 the fish commissions of 28 States were assigned fish and eggs, as set forth in detail in the following table:

ASSIGNMENTS OF FISH AND FISH EGGS TO STATE FISH COMMISSIONS DURING THE FISCAL YEAR 1921.

[All figures are for eggs unless otherwise indicated. Fingerlings are designated a and fry b.]

State and species.	Number.	State and species.	Number
California: Chinook salmon	3,000,000	Iowa:	
Colorado: Rainbow trout	50,000	Lake trout	50,000
Connecticut: Brook trout	a 52,000	Rainbow trout	62,000
Idaho:		Maine:	
Blackspotted trout	50,000	Lake trout	50,000
Landlocked salmon	16,000	Landlocked salmon	475,000
Rainbow trout	50,000	Maryland:	
Whitefish	a 7,000	Cisco	300,000
Illinois:	500,000	Lake trout	4,000
Black bass	a 200	Pike perch	1,000,000
Catfish	a 25,300	Rainbow trout	150,000
Crappie	a 5,800	Whitefish	100,000
Drum	a 175	Massachusetts: Rainbow trout	50,000
Pickereel	a 410	Michigan:	
Pike perch	a 250	Landlocked salmon	10,000
Rock bass	a 500	Lake trout	1,000,000
Sundish	a 26,325	Pike perch	223,200,000
White bass	a 175	Smelt	200,000
Whitefish	500,000	Whitefish	20,000,000

## ASSIGNMENTS OF FISH AND FISH EGGS TO STATE FISH COMMISSIONS, ETC.—Con.

State and species.	Number.	State and species.	Number.
Minnesota:		Oregon:	
Black bass.....	a 9,340	Chinook salmon.....	3,650,000
Catfish.....	a 6,800	Rainbow trout.....	604,940
Crapple.....	a 5,200	Pennsylvania:	
Sunfish.....	a 5,200	Chinook salmon.....	a 10,000
Steelhead salmon.....	70,000	Cisco.....	65,000,000
Yellow perch.....	a 2,250	Lake trout.....	80,000
Missouri:		Steelhead salmon.....	30,000
Rainbow trout.....	a 100	Whitefish.....	10,000,000
Sunfish.....	a 100	South Dakota:	
Montana:		Brook trout.....	a 2,100
Blackspotted trout.....	350,000	Rainbow trout.....	a 3,000
Rainbow trout.....	150,000	Tennessee: Rainbow trout.....	55,000
Steelhead salmon.....	75,000	Utah: Lake trout.....	50,000
Nebraska:		Vermont:	
Brook trout.....	a 32,900	Lake trout.....	25,000
Rainbow trout.....	a 30,000	Landlocked salmon.....	20,000
Nevada: Rainbow trout.....	50,000	Pike perch.....	14,700,000
New Hampshire:		Steelhead salmon.....	25,000
Landlocked salmon.....	20,000	Yellow perch.....	12,000,000
Lake trout.....	25,000	Washington:	
Pike perch.....	2,000,000	Blackspotted trout.....	75,000
Whitefish.....	250,000	Rainbow trout.....	75,000
New Jersey: Pike perch.....	1,000,000	Steelhead salmon.....	49,000
New York:		Wyoming:	
Cisco.....	104,410,000	Black bass.....	a 2,150
Lake trout.....	1,500,000	Blackspotted trout.....	100,000
Landlocked salmon.....	100,000	Brook trout.....	100,000
Steelhead salmon.....	199,000	Catfish.....	a 1,200
Whitefish.....	29,200,000	Rainbow trout.....	309,800
Ohio: Whitefish.....	23,640,000	Smelt.....	200,000
Oklahoma:			
Rainbow trout.....	100,000	Total.....	484,114,740
Rock bass.....	b 41,000		a 230,575
	a 8,000		b 41,000
	a 100		

In realization of the great and growing need for more adequate laws for the protection of food and game fishes in various parts of the country, the Bureau has been in communication with the fishery authorities of a number of States. Attention has been directed in certain cases to the lack of suitable laws or to the lack of stringent enforcement of the laws, and the States have been reminded of the stipulation made by Congress in connection with the annual appropriation for the propagation of food fishes, which prohibits the expenditure of funds for hatching or planting fish in any State where, in the judgment of the Secretary of Commerce, inadequate protection is afforded the particular species handled. In every instance the response to the Bureau's communication has shown a desire on the part of the States to bring about any needed reforms in fishery legislation, and there is reason to believe that some States that have been derelict in this matter will enact new and better laws in the near future. It has been the Bureau's policy not to summarily recommend the discontinuance of fish-cultural work in any State, but to use every proper influence to bring the States in line for the maintenance of their fish and other aquatic animals.

The shad hatchery at the head of the Chesapeake Bay, near Havre de Grace, Md., closed by the Secretary of Commerce in 1917 for reasons fully set forth in published reports, has been definitely abandoned, as the State gives no indication or intimation of an intention to meet the conditions imposed by law. The equipment and machinery have been transferred to other stations, the major build-

ings have been razed, and the lumber therein has been used in construction work elsewhere.

Mutually profitable cooperative relations have continued between the Bureau and the Dominion and provincial fishery authorities of Canada. The collecting of spawn of the whitefish and the cisco in the Great Lakes has thus been facilitated, and an exchange of trout eggs for Atlantic salmon eggs has been effected.

#### COOPERATION WITH FISH-PROTECTIVE ASSOCIATIONS.

A matter of great interest in connection with the fish-cultural work in interior waters is the rapid increase within recent years in the number of fish-protective associations throughout the country. Generally speaking, these organizations are composed of the leading citizens of the community, and the influence they exert in maintaining the fishery resources of the minor waters and in securing a proper utilization of those resources is most beneficial to the public at large. They make a practice of securing the services of men of experience in the stocking of local waters with fish life, and in some cases they maintain, at their own expense, ponds in which to rear to a larger size consignments of young fish obtained from State and Federal hatcheries for planting in public streams, ponds, and lakes. Another important service rendered by such organizations is the respect they inspire for the State fish laws, as most of them advocate adequate protective laws and their rigid observance by their members and the public. The Bureau has been pleased to cooperate with such organizations in the stocking of local waters with the most suitable kinds of fish. The cooperation has had the effect of reducing the expense of distribution and of increasing the chances of survival of the fishes planted.

#### HATCHLING OF RIVER FISHES OF THE ATLANTIC SEABOARD.

Hatcheries for the commercial fishes of the Atlantic coast rivers are located on the Penobscot River in Maine, the Potomac River in Maryland and Virginia, and Albemarle Sound and Roanoke River in North Carolina.

A full discussion of the circumstances attending the artificial propagation of Atlantic salmon on the Penobscot River was contained in the last annual report. The disinclination of the Bureau to continue paying to Penobscot fishermen a bonus for the careful handling of adult salmon purchased from them resulted in the refusal of many of them to sell their fish to the Bureau. The local collection of Atlantic salmon eggs was therefore considerably smaller than usual, but it was augmented by the receipt of 600,000 eggs from Canadian hatcheries, in return for which the Canadian Government was furnished an equal number of eggs of the black-spotted trout and rainbow trout. While it is probably true that the careful handling of salmon taken in the weirs involves a small amount of extra work to the fishermen, this is believed to be more than offset by the benefits accruing to them from the hatchery. Hence, the Bureau feels justified in discontinuing the payment of this so-called bonus. Under the existing arrangement each fisherman receives the market price for his

fish at the time of delivery, and to avoid constant weighing an average weight of  $11\frac{1}{2}$  pounds per fish has been established as a basis for computing the cost, this being conceded by the fishermen as a very fair average. The fish thus purchased are released immediately after their eggs are secured, and they undoubtedly return to the river in appreciable numbers in subsequent years. The point of greatest importance, however, is the salvage of a very large percentage of the immature spawn contained in the fish at the time of capture for market.

The shad hatcheries on both the Potomac River and Albemarle Sound were adversely affected by peculiar climatic conditions that prevailed during the spring of 1921. In the former field the first eggs were taken on March 22, the earliest recorded date for spawning shad on the river. This premature spawning was undoubtedly brought about by the warm weather and consequent high water-temperatures prevailing in the latter part of February and in March, the minimum water temperature recorded at the Potomac River station during March being  $40^{\circ}$  F. An unfavorable reaction was occasioned by the abnormally cold weather in April and early May, when the season was brought to a close. Equally unsettled weather prevailed in the Albemarle Sound region, and to this fact, together with the very extensive fishing operations permitted in the sound, the reduced output of the station is due.

It should not be necessary to emphasize the great need for immediate restrictive measures if the shad is to be saved in the few remaining rivers where the run still persists in sufficient volume to be commercially attractive. The subject has been a prolific source of discussion, but the various States most intimately concerned and responsible for the conditions have apparently made no progress toward ameliorating the situation. It is pertinent to note that the weather which was so unpropitious for the hatcheries actually favored a large catch of fish in the pound nets in the lower reaches of Chesapeake Bay and Albemarle Sound.

Very good results attended the initial attempt to propagate the glut herring or alewife on Albemarle Sound, and over 55,000,000 eggs were collected for the Edenton hatchery and nearly 44,000,000 fry were produced. The hatching of striped bass on the Roanoke River was conducted as usual in the spring of 1921, and, notwithstanding unfavorable weather, the collection of eggs, amounting to 24,620,000, was larger than in any previous season.

#### PROPAGATION OF COMMERCIAL FISHES OF THE GREAT LAKES.

The most important commercial species of the Great Lakes—whitefish, cisco, lake trout, and pike perch—were handled along the customary lines, and, with the exception of the lake trout, all showed a satisfactory increase in output as compared with the previous year. This increase was made possible largely by favorable weather conditions, although in the case of the cisco the egg collections were greatly augmented by the receipts from new fields in the Canadian waters of Lake Ontario.

The need of a hatchery at some point on Saginaw Bay to take care of the immense numbers of pike perch and yellow perch eggs avail-



able in that field and now going to waste was again demonstrated by the collection of upward of 277,000,000 eggs of the former species. Owing to the lack of hatching facilities most of these eggs had to be sent to the State hatchery at Detroit for development.

In response to the continued demand for Government aid in maintaining the supply of carp in the western end of Lake Erie, large numbers of eggs of that important fish were obtained for hatching in cooperation with the Ohio fishermen.

#### PROPAGATION OF THE PACIFIC SALMONS.

Hatching and rearing of the Pacific salmon are conducted in California, Oregon, Washington, Idaho, and Alaska, and all of the five species, together with the steelhead, are usually handled, although in the past fiscal year no eggs of the pink salmon were secured.

There was a good run of chinook salmon in the Oregon and California fields, and the only reason for not obtaining record-breaking collections of eggs was that very heavy floods occurred at the height of the spawning season, permitting the escape of the fish that were being held below the racks. The floods were especially severe in California, interrupting all railroad and highway travel for a number of days. The work was therefore a practical failure at all points in those States.

At the new location on Snake River, Idaho, a collection of 6,000,000 chinook eggs from the spring run of salmon was made. The floods in this region during the fall of 1920 were in sharp contrast to the conditions encountered during the preceding fall, when the prevailing drouth and low-water stages in the spawning streams were such as to seriously handicap the work.

Owing to the limited funds available for salmon work in the Washington field, the two substations closed last season were not reopened. The run of chum salmon in Hood Canal was considerably larger than last year, thus permitting increased egg collections at all the Federal stations in that region. This outcome is attributed to less extensive commercial fishing as a result of the decided drop in price. The operations at Baker Lake were even more favorable than last year; and the collection of sockeye salmon eggs, amounting to nearly 12,000,000, was the largest since the establishment of the station more than 20 years ago; these eggs were taken from 3,645 fish.

The experiment recently undertaken at the substation at Quinault Lake for the purpose of demonstrating the relative efficiency of artificial propagation and natural reproduction has been temporarily postponed, as it was found that many of the fish passing through the counting weir were being gilled in the 4-inch mesh webbing used in its construction. Approximately 12,000 fish had been counted before the necessity for discontinuing the work became apparent.

At the Yes Bay (Alaska) hatchery no egg collections whatever were attempted during the fiscal year, and fish-cultural work was restricted to the incubation of a limited number of eggs transferred from other points. This course was necessitated by the condition of buildings, water-supply system, and equipment. In order to prevent complete deterioration of valuable property, extensive repairs and improvements were required. No special appropriation for this

purpose was allowed by Congress, and the allotment ordinarily made for the regular operations of the station had to be devoted to upkeep of the plant.

There was again a large run of sockeye salmon into Litnik Lake, on which the Afognak station is located, and while the egg collections were not equal to the previous year's, when the hatchery was filled and additional eggs were taken for incubation in gravel boxes, the shortage was caused by the occurrence of floods during the spawning period rather than to any diminution in the run of fish.

As evidence of the trend and progress of salmon culture on the Pacific coast, it may be noted that of the 124,484,000 salmon planted by the Bureau in the last fiscal year 92,066,000, or over 71 per cent, were of the fingerling size.

#### CULTIVATION OF FISHES OF INTERIOR LAKES AND STREAMS.

The diversified and widespread fish-cultural work addressed to the food and game fishes of the streams and minor lakes of the interior has been conducted along the usual lines. The principal species involved are various trouts, landlocked salmon, black basses, crappies, sunfishes, and buffalofish. One of the fishes in this class most in demand and most desirable for planting over a wide range of country is the eastern brook trout. The production at all the trout stations is not sufficient to meet the demand, and recourse has been had to private hatcheries for supplies of eggs. The high prices now asked for such eggs, however, have necessitated a curtailment of purchases, and the shortage has been augmented by a poor take of eggs in Colorado, usually one of the most productive fields. The situation emphasizes the desirability of developing as rapidly as possible the proposed brook-trout station in the White Mountain National Forest at a site that has been made available to the Bureau through the courtesy of the Forest Service and the State of New Hampshire. A large part of the preliminary work connected with this project has been completed, surveys have been made, a road constructed, telephone line installed, a portion of the pond extension site cleared, and a temporary dam constructed. The officers of the Forest Service have rendered valuable assistance in the accomplishment of this work, but the station can not be fully developed and put in operation until additional funds are provided. The special appropriation requested for the purpose seems very small when compared with the results that may reasonably be expected from such an undertaking.

Successful results attended the fish-cultural activities of the stations in the Rocky Mountain region, with the single exception of the Colorado field, where the work was adversely affected by the inclement weather and the serious difficulty in transporting the eggs from the isolated field stations. Good collections of rainbow trout eggs were made in Madison Valley, Mont., notwithstanding the continuous cold and stormy weather prevailing throughout the spawning season. Aside from other valuable assistance rendered by the Montana Game and Fish Commission, the Bureau is indebted to it for its entire output of grayling. The work in the Yellowstone National Park was of a satisfactory nature, and upward of 2,000,000

young blackspotted trout were returned to its waters during the season. The Glacier National Park hatchery was well stocked with eggs shipped from other hatcheries and produced therefrom an output of over 2,000,000 fry and fingerlings of the brook trout, rainbow trout, blackspotted trout, and grayling, in addition to approximately 450,000 fingerlings which were on hand at the close of the year.

Under the handicap of exceedingly difficult natural conditions successful rainbow trout collecting operations were conducted in Wyoming on Sage Creek, Lost Creek, and Canon Creek, the two last named being in fields which have never heretofore been exploited. The results obtained, despite the very limited means available, appear to demonstrate beyond question the wisdom of establishing a permanent collecting station on Sage Creek in order that the work may be handled in a manner in some degree commensurate with the potential value of the field. This stream is a tributary of the North Platte River, and as the other streams mentioned are within a few miles of it the eggs obtained from them and from other collecting points in the Pathfinder reclamation project could be assembled and incubated in a properly equipped hatchery on Sage Creek.

The efficiency of the Spearfish (S. Dak.) station has recently been increased as the result of an arrangement with the city authorities of Spearfish. Under the provisions of a long-term lease the Bureau has secured without cost all surplus water from a reservoir lately constructed by the city. While this arrangement is satisfactory and gives the station an ample amount of water during the greater part of the year, with a surplus most of the time, the supply falls to a minimum during summer, when unusually large amounts of water are used for domestic purposes. In order, therefore, to provide against a shortage of water for the work at any season, it will be advisable to provide a storage reservoir for emergency use. A suitable reservoir can be constructed at small cost by placing a dam in a canyon on property adjacent to the Bureau's reservation, and with this additional outlay the station would be assured of an adequate water supply for an indefinite period of time.

In the propagation of the domesticated rainbow trout the results show continued improvement as to both quality and quantity of eggs and fry. Small consignments of eggs taken from wild rainbow trout at the western stations have been transferred to the eastern hatcheries from time to time to maintain the virility of the brood stock, and by this means no difficulty whatever is experienced in producing this species in sufficient numbers to meet all requirements. Recent anatomical studies of the rainbow trout conducted by the division of scientific inquiry have disclosed a number of facts relating to the reproductive organs of the female fish that have heretofore been overlooked or were not understood at the hatcheries and may have an important bearing on fish culture, especially with regard to the manipulation of spawning fish. The experiments were conducted at the Wytheville (Va.) station, and preparations have been made to continue them indefinitely at the Erwin (Tenn.) station, or until the problems involved can be fully worked out. The scientific division has also rendered assistance in overcoming the mortality which usually occurs among adult trout at spawning time. A careful examination of specimens of trout dying during that time

has revealed the cause of death in many cases, and remedial measures have been suggested to the superintendents of trout stations.

Efforts to find a satisfactory food for young salmonoid fishes at a lower price than the expensive meat products in general use have been continued. Canned herring milt has been found to have some value when used in combination with meat, but used alone it has not yielded good results, as it appears to lack some important requirement of a full meat diet.

Climatic conditions during the 1921 nesting season of the basses were very unfavorable for a large output of fish. A period of unseasonable warmth in March unduly advanced the spawning season. This was followed by a cold spell in April and variable weather in May, such conditions appearing to prevail all over the country. A sudden fall in water temperature invariably causes spawning bass to desert their nests, with a subsequent loss of the eggs deposited. The bass output was therefore curtailed at practically all stations, and at some of them it was a complete failure.

In cooperation with the fishery authorities of Minnesota, investigations were made with the view of determining the feasibility of making collections of pike-perch eggs in the Rainy Lake region of that State. Operations were conducted at two sites, and eggs to the number of 13,680,000 were obtained as the Bureau's share of the returns.

On the Atchafalaya River, in Louisiana, 96,440,000 eggs of the buffalofish were taken between February 27 and March 25, 1921, the collections being materially reduced below those of the preceding year by the short spawning season and the small numbers of fish available. These unfavorable conditions are attributed to the late rise in the river, which, occurring in January, acted as an incentive to the fish to pass by their usual spawning grounds and seek more inaccessible spots in the denser portion of the flooded swamps. The catch of fish along the river was reported by local fishermen to be the smallest since 1913.

Taking advantage of an opportunity to save eggs of buffalofish and carp on the Mississippi River at Bellevue, Iowa, and Lynxville, Wis., during the spring of 1921, the Bureau collected 68,267,000 eggs of the former and 42,712,000 of the latter species, all of them being secured from fish caught for the market by commercial fishermen. The eggs were fertilized and immediately planted on the spawning grounds in the river.

#### HATCHING OF MARINE FISHES.

Operations in this branch were conducted at the usual points in Maine and Massachusetts and were addressed to the cod, pollock, haddock, winter flounder, and pole flounder. The weather throughout the spawning season of the various species was favorable, resulting in the taking of eggs of better than average quality at a lowered cost of production. There was a reduction in the number of cod and pollock eggs taken as compared with the previous year. A rather sharp decline in the price of pollock deprived the local fishermen of an incentive to pursue the fishery, and the catch at Gloucester fell off about 70 per cent. The collection of eggs for hatching purposes

was necessarily affected, as the only source of supply is the fish caught for market. As against more than 954,000,000 taken in 1920, the past season's collections reached only 650,000,000.

The shortage in cod eggs may be ascribed to somewhat similar, though not identical, conditions. The body of cod on the shore grounds appeared to be smaller than usual, and as the market price of haddock offered more lucrative employment for the fishermen comparatively few boats engaged in the cod fishery. Egg collections of this species in the Gloucester field amounted to 210,040,000, while 214,702,000 were secured from brood fish held at the Woods Hole hatchery. Haddock eggs to the number of 629,120,000 were obtained for the Gloucester station between January 22 and April 29, 1921, this number exceeding the previous records for that species.

Weather conditions were generally favorable for flatfish propagation, and the egg collections at all stations aggregated 1,980,291,000, an increase of 175,000,000 over the previous year. High water-temperatures occurring toward the latter part of the season in the Woods Hole region and an unusually early ending of the spawning in Maine waters were factors in curtailing the take of eggs.

The artificial propagation of the pole flounder (*Glyptocephalus cynoglossus*) was undertaken by the Bureau for the first time during the past year. The presence of this fish in New England waters has long been known; but, because of its peculiarly small, soft mouth it was not taken by fishermen on the hand lines and trawl lines commonly used. With the coming into general use of the otter trawl in the shore fisheries of the section the pole flounder has made its appearance in the markets in constantly increasing numbers, and because of its food value and excellent flavor it commands a ready market at a high price. With the view of encouraging and assisting a new and growing industry an experienced spawn taker was detailed to investigate the spawning habits of this species. A close watch was kept on the fish landed at the markets during April and May, but no fully matured eggs were found until May 22. From that date to the end of June 19,410,000 eggs were collected, fertilized, and planted on the spawning grounds, and several small lots were taken to the Gloucester hatchery for observation. The eggs are semibuoyant, nonadhesive, and about 0.05 of an inch in diameter, measuring approximately 462,000 to the fluid quart. Those placed in a Chester jar for incubation did not survive, but the freer circulation of the McDonald tidal box appeared to meet their requirements. It is believed that the hatching of this fish can be profitably extended during the coming season.

#### RESCUE OPERATIONS IN MISSISSIPPI VALLEY.

The salvaging of food fishes in the overflowed waters of the Mississippi and Illinois Rivers has continued to be a prominent adjunct of the fish-cultural service. In the 1920 season, as early as the water stages would permit, this work was begun and continued without intermission as late as weather conditions were favorable. Owing to the persistence of high water much beyond the usual time, many millions of young fish, which under ordinary circumstances would have been left to perish in isolated pools and sloughs, were able to

return to the main river channels. The permanent employees of the Bureau, supplemented by a force of temporary men, were organized into units equipped with boats, seines, and vessels for holding the fish, and the most productive river sections were systematically covered in the manner fully described in previous reports. When the operations were brought to a close on November 10, the number of fishes rescued and replanted had reached 120,656,420, consisting of catfish, buffalofish, carp, black bass, sunfish, crappie, and other food fishes of the region.

The striking results, undoubted benefits, and low cost of this work commend it to everyone familiar with it and warrant its extension over all parts of the Mississippi Valley where flood waters become cut off from the main streams. There are both opportunity and need for the annual salvaging of untold millions of food fishes in this region, and the Bureau has noted with great satisfaction the passage by the House of Representatives of a bill giving formal recognition of this intensely practical work and making financial provision for enlarged facilities and personnel for its prosecution.

#### DISTRIBUTION OF MOSQUITO-EATING FISHES.

The fish-cultural service has been called on to supply lots of the mosquito-eating fish *Gambusia* for consignment to foreign countries. The fish were collected at several southern stations and were desired because of the success that has attended their employment in this country in eradicating malarial mosquitoes.

In response to requests from the League of Red Cross Societies, with headquarters in Geneva, Switzerland, shipments of these little minnows were made to Italy and Spain, and pursuant to a request coming through the usual diplomatic channels, a consignment was furnished for the Government of Argentina. A lot supplied to the international health board was destined for Porto Rico. All these fish were intended to be used in antimalarial work.

Inasmuch as the top minnows can be grown in the reserve ponds of various southern stations or collected in near-by waters at little or no expense, it seems proper for the Bureau to be in position to meet reasonable demands for this fish, especially in view of the active participation of the Bureau in recent campaigns for the eradication of mosquitoes by the use of this species.

#### ARTIFICIAL PROPAGATION OF FRESH-WATER MUSSELS.

Under the general direction of the fisheries biological station at Fairport, Iowa, extensive work has been done, as heretofore, in the propagation of pearly mussels native to the Mississippi River and tributaries. During the fiscal year 1921, 169,740,050 glochidia, or larval mussels, in a condition of parasitism on fishes, were liberated in public waters, as compared with 183,021,720 in the previous year. The fish hosts used for inoculation with glochidia were salvaged from overflowed waters, chiefly in the vicinity of Fairport, Iowa, and New Boston, Ill. The number of fishes rescued was 976,550, of which 40,020 were adults, and the number infected with the glochidia of appropriate mussels before being liberated was 50,268.

Two species of commercial mussels were handled in this work, the Lake Pepin mucket (*Lampsilis luteola*) and the river mucket (*Lampsilis ligamentina*), the last being propagated in only limited numbers. The infected fish were liberated in Lake Pokegama, Minn., and in the Mississippi River at the following places: Lake Pepin, Minn. and Wis.; Minneiska, Minn.; Lynxville, Wis.; Fairport, Iowa; New Boston, Ill.; and Lake Keokuk, Iowa and Ill. Operations were not conducted in Arkansas as in previous years, owing to the impracticability of obtaining the necessary labor and equipment. The cost of mussel distribution, including overhead station expense, was \$0.0581 per thousand, as compared with \$0.0562 in 1920 and \$0.0689 in 1919.

Following is a detailed tabular statement of the number of larval mussels of each species deposited in the stated places:

Locality.	Mucket.	Lake Pepin mucket.	Total.
Lake Pokegama, Minn.....		77,781,750	77,781,750
Mississippi River at Lake Pepin.....		44,128,800	44,128,800
Mississippi River at Minneiska, Minn.....	2,153,000		2,153,000
Mississippi River at Lynxville, Wis.....	250,000	4,196,300	4,446,300
Mississippi River at Fairport, Iowa.....		14,300	14,300
Mississippi River at New Boston, Ill.....		28,158,850	28,158,850
Mississippi River at Lake Keokuk, Iowa and Ill.....		13,057,050	13,057,050
Total.....	2,403,000	167,337,050	169,740,050

In order to supplement the efforts of the Bureau in increasing the supply of pearly mussels on which the pearl-button industry depends and to demonstrate the possibilities of mussel propagation in connection with the extensive operations in rescuing food fishes, the National Association of Button Manufacturers offered to cooperate with the Bureau by providing men to accompany each rescue crew on the upper river and to inoculate all fishes with the glochidia of the Lake Pepin mucket, the most important of the local mussels. Seven agents of the button manufacturers cooperated with seven crews working under the direction of the superintendent of the Homer (Minn.) station, and during October and November inoculated nearly 6,000,000 fish with glochidia, estimated to number upward of 478,705,000. Material cooperation of this nature by an association of business men is a source of gratification to the Bureau as evidence of a cordial spirit and of faith in the practical value of the service rendered in the propagation of river mussels.

#### RELATIONS WITH THE FISHERY INDUSTRIES.

##### SUMMARY OF CONDITIONS AND ACTIVITIES.

For several years the American fishing industry has been experiencing a critical condition to which various factors have contributed. During the Great War there was a universal demand for increased food production, to which the fisheries responded by providing augmented facilities for capturing and handling fishery products. Immediately following the war the demand for and the consumption of fish declined sharply at home and abroad, and an

immediate curtailment in production became necessary before the program of expansion had been completed and while the costs of labor and materials were still advancing. Prices of fishery products for domestic use and for export fell and operations in many fields became unprofitable. Thus the fishing industry was one of the first to feel the necessity for postwar readjustments and to respond to that necessity.

As instances of recent marked changes in the fishery industries it may be noted that the decreased production of the New England vessel fisheries between 1918 and 1920 exceeded 25,000,000 pounds, the pack of sardines in Maine and California fell off 800,000 cases, and the output of canned salmon dropped 3,000,000 cases. The curtailment of operations in 1921 promises to be even greater in certain branches, as the trawler fleet of New England has been idle much of the time and a reduction of 50 per cent in the number of operating canneries is reported, and because of unsettled conditions in the oil and fertilizer trades a number of whaling and menhaden plants have been idle. As indicative of the trend of the great foodfish fisheries out of New England ports the landings during the first six months of 1921 compared with the same period of 1920 showed a decline of nearly 15 per cent in quantity and over 31 per cent in value, and the average price of all fish dropped from 4.6 cents to 3.68 cents per pound. The unfavorable situation has been further complicated by high transportation rates on fresh fish, which have discouraged shipments and shortened the distances over which it is practicable to send many of the low-priced fishes. It is to be said to the credit of the industry that it is striving wholeheartedly to meet the untoward conditions, to make sacrifices, and to practice such economies and to adopt such new policies as may be necessary to cope with the situation.

Under these circumstances it is not surprising that there should have been a widespread public appeal to the Bureau for some kind of assistance. Without enlarged provision of authority and funds for work in this field the Bureau's ability to serve the industry has of necessity been limited. Nevertheless, it has been able to render practical aid in numberless cases by suggesting ways and means for effecting improvements or economies in the methods of handling, manufacturing, and merchandizing water products and by widely disseminating timely statistical and other information for the use of fishermen, dealers, manufacturers, and consumers.

The following may be mentioned among the activities during the past year: The initiation of a fishery intelligence service on the northeast coast for supplying information relative to the presence of schooling fish; the effecting of arrangements for an extended trial of seaplanes as an adjunct of the fisheries; the collection of information regarding the construction and operation of little-known types of fishing gear that are adapted for more general use in our fisheries; recommendations for improvements in the methods of handling and shipping fish as an aid to increased consumption and better prices; assistance to producers in securing and transporting materials, such as salt and barrels, required for immediate use at a time when fish were available; the practical application of methods developed in fish-salting investigations; the dissemination of information on the preservation of fish nets; the stimulation of the saving and use of



by-products of the fisheries, including the manufacture of fish meal, leather, and pearl essence; the initiation of a series of surveys of certain primary inland markets; and studies of the methods of conducting certain fisheries and their effects on the supply.

The statistical inventories completed during the year included the vessels fisheries centering at Boston and Gloucester, Mass.; Portland, Me.; and Seattle, Wash.; the shad fishery of the Hudson River and the shad and alewife fisheries of the Potomac River; the sardine industry of Maine; and the fisheries of the New England States. There has been an increased demand for and use of the general statistical information gathered and published by the Bureau, and there is evidence of growing appreciation of the need of support for worthy conservation measures, the necessity for which is disclosed by the statistical data. A full account of the activities of this branch of the service, with detailed tables and discussions of the results of various canvasses, is embodied in a report of the division of fishery industries for 1920 (issued as Document No. 908).

#### FISHERY INTELLIGENCE SERVICE.

The daily patrols by seaplanes of the Naval Aviation Service of the menhaden fishing areas in Chesapeake Bay and along the coast between Assateague and Bodie Island Lights begun in June, 1920, were continued until October, when the Navy Department abandoned them on the ground that the experiment had fully demonstrated the commercial value of planes in this fishery. This service was very beneficial to the menhaden industry and was the first thorough test of the value of seaplanes in spotting schools of fish. Under the present unsettled conditions in the fish oil and fertilizer industries it is not to be expected that a service of this kind will be established by the fishery interests.

The Bureau has obtained the cooperation of the Director of Naval Communications and the Commissioner of Lighthouses whereby reports of the presence of schooling fish are transmitted daily by radio by the keepers of certain New England lightships to shore stations from which they are forwarded to the Bureau's local agent in Boston. This service was begun about November 1, 1920. Reports of schooling fish are forwarded to the Bureau's local agents in Gloucester, Mass., and Portland, Me., by the Boston agent. Lightkeepers have reported the presence of such fish as mackerel, menhaden, and pollock. The subject has not received a sufficient trial to determine its practical value to the industry or the desirability of extending it to include a number of advantageously located lighthouses.

#### STUDIES OF FISHERY METHODS.

Descriptions and diagrams of little-known fishing gear, such as paranzella and lampara nets used in the fisheries of California, have been published for the information of the trade. The paranzella net has been used in the Mediterranean for a long period and was introduced into California in 1876. It is a heavy, strongly constructed net, intended for dragging the bottom chiefly in deep water. It is operated with steam and power boats in a manner similar to the otter

trawl, except that two vessels are required. The nets vary in length from 25 to 35 fathoms, and the catch of food fish consists principally of flounders. The lampara net, used chiefly in the capture of sardines, anchovies, and other small surface fish, was introduced from the Mediterranean about 1900. It is fished at or near the surface, usually on dark nights, as these fish can more easily see the net in daylight or moonlight and avoid it, and may be operated by one or two boats, the net being laid around the school of fish after the manner of the purse seine. Studies of the methods of conducting the fisheries and of the effects of various methods of fishing on the supply are in progress.

#### IMPROVEMENT IN HANDLING FRESH FISH.

Fresh fish being a highly perishable commodity, whose delicate flavor and attractive qualities may be quickly impaired by improper handling, the first requisite to an increased appreciation of the value of such fish for food and to increased consumption is to improve the quality of the product offered to the consumer by the adoption of improvements in handling and distribution. The more important of these recommended by the Bureau are: The elimination of the pew or fork, and where its use is unavoidable or can not be immediately suppressed the employment of only a one-tined fork to be inserted into the head or tail but not in the body of the fish; the avoidance of needless bruising and rough handling; the prompt removal of the body heat by precooling, either on the vessel or at the landing wharf; the use of shallow boxes rather than barrels for shipping purposes, as fish in such receptacles keep longer and have better appearance; the use of an abundance of crushed ice to properly preserve the fish without unnecessary bruising; the observance of every precaution which will tend to retard deterioration; and to offer for sale only sound fish displayed in an attractive manner amid sanitary surroundings. The fish trade should exercise as much care in handling fresh fish as is now used in the handling of choice fruits.

#### FISH-MARKETING SURVEY.

Appreciating the lack of detailed information on marketing conditions existing in the larger inland distributing and consuming centers, and believing that a survey of certain of these markets may yield information of intrinsic value to the fresh and frozen fish trade and aid in increasing the consumption of fish, the Bureau initiated such a survey in June, 1921, beginning with Louisville, Ky., a city of nearly 235,000 inhabitants.

Among the items concerning which it is planned to secure information are the following: Lists of wholesale and retail dealers, indicating the kinds of fish each handles; geographical sources of supply; available transportation facilities and rates; character of containers in which fish are received and reshipped; population and preference by nationalities for particular classes of fish; months of abundance of the leading species; opinions of the trade regarding trade prospects, etc.

In the Louisville market less than 40 species of fresh and frozen fish and other aquatic forms are marketed. There are but 2 whole-

sale firms who also retail and 12 firms engaged solely in the retail business, half of whom are located on the same street. The disadvantages of this centralization are counterbalanced in part by the fact that a large number of grocers and butchers handle fish on Fridays. This market has a decided preference for fresh-water species and a prejudice against salt-water forms, which must be overcome by educational means if the demand for salt-water forms is to be largely increased. The estimated consumption of fish is about 6 pounds per annum per person.

#### INCREASING THE CONSUMPTION OF FISH.

Owing to the lack of funds for continuing the demonstrations in fish cookery and in popularizing the less-used fishes, the operations in this field have been largely limited to the issuance of printed matter and its judicious distribution. Economic circulars and placards emphasizing the food values, good qualities, and low prices of haddock and of pink and chum salmons were prepared for the use of the trade, as were also a poster and a leaflet recommending frozen fish.

With the introduction of steam trawlers there has been a heavy increase in the production of haddock, the vessel landings at Boston and Gloucester in the 1918-1920 period being about double the landings for 1908-1910. The haddock catch in New England in 1919 amounted to 89,405,600 pounds, and the average price received for the fish was 2.84 cents per pound. The haddock is taken in quantity throughout the year, can be distributed well if properly handled, and is an excellent white-meated fish similar to the cod. The demand for this fish in some of the inland markets is increasing, but the prejudice against marine fishes is a retarding factor. The economic circular contains 31 recipes for cooking this fish.

The consuming public has been educated to the high quality of red-meated salmon, but does not appreciate the excellence of pale-fleshed fish. While pink and chum salmons usually have less fat than the more highly colored forms, they contain as much tissue-building material. More than 3,250,000 cases of these fish were packed in 1920, and at recent prices they represent one of the lowest priced protein foods on the market. The Bureau has lent its assistance in educating the public to an appreciation of these fishes, which may be kept indefinitely when canned, are ready for immediate use, and may be prepared in many ways.

The Bureau has encouraged the wider use of frozen fish, as freezing conserves fish in times of abundance and cheapness for use in times of scarcity, and as a rule fish are now frozen under excellent conditions. The printed matter distributed through the trade stresses the importance of keeping frozen fish at a low temperature, of never thawing and refreezing, of avoiding bruises and rises in temperature, and of buying the fish while frozen and placing them in an ice box or cool place for thawing before cooking.

#### TECHNOLOGICAL INVESTIGATION.

Owing to lack of funds for operation, the fishery products laboratory in Washington City was practically idle during the year, and the temporary laboratory at San Pedro, Calif., was loaned to the California State Fish and Game Commission.

The practical application of methods evolved in the investigation of the principles of preserving fish with salt has been embodied in a report entitled "Improvements in Process of Salting River Herring, Especially Adapted to Warm Climates" (issued as Document No. 908). The report is based on the results of actual field tests in Florida designed to overcome the failures heretofore experienced by fishermen, and the fundamentals of the method, which should be followed wherever fish are to be preserved by salting in a warm temperature, are: Careful handling of the fish before salting, thorough cleaning and removal of all blood, use of salt of a high degree of purity, and application of the salt in a dry state.

A report on the preservation of fish nets has been prepared and published (as Document No. 898). This important means of economizing in the expense of nets has been largely neglected in this country. In view of the fact that our fishermen employ gear to a value exceeding \$15,000,000, a large part of which is in twine, and in view of the increasing cost of such netting such information is greatly needed and has been appreciated. The document sets forth the fundamental principles governing net preservation and gives for use those recipes which seem best calculated to serve the purpose of the fishermen. The Bureau has initiated some additional studies in net preservation which it plans to continue as opportunity affords in order that the industry may benefit to the fullest possible extent through the application of desirable methods.

For investigations in the refrigeration of fish the Bureau has a modern air-freezing plant with a sharp freezer capable of producing a temperature of  $-40^{\circ}$  and automatic carbon-dioxide compressor and controls; a plant for freezing fish in brine; a precision temperature-measuring apparatus consisting of precision thermometer, Wheatstone's bridge, precision double potentiometer, conductivity apparatus, etc.; and a commercial apparatus for the experimental utilization of frozen fish. This equipment has been assembled and prepared for use in the conduct of investigations for which the trade lacks information as well as facilities. In view of the widespread interest in the industry in the freezing of fish in brine, this subject is to be investigated in detail, and considerable preliminary work has been completed.

#### INCREASING THE USE OF BY-PRODUCTS OF THE FISHERIES.

The Bureau has continued to aid in increasing the saving and use of the by-products of the fisheries with most gratifying results. It is inevitable that the year 1921 will show a heavy curtailment in production owing to unsettled market conditions. Fish oils now command about a fourth and fish scrap less than half war-time prices, while costs of operation and transportation have declined but little.

It is estimated that in 1920 the production of scrap and meal from all fishery products in the United States including Alaska was in excess of 125,000 tons. Of this amount the Pacific coast is to be credited with nearly 17,000 tons. As a result of the Bureau's work on the Atlantic seaboard there was a large increase in the production of fish meal for stock-feeding purposes, and menhaden and

other interests are well pleased with the advantages accruing from the development of an additional outlet. The trade is energetically building up markets to care for the increased production. The Bureau of Animal Industry has continued its cooperation in the conduct of feeding tests and in educating farmers to the value of this commodity and is issuing a publication giving the results of the feeding tests. There are numerous problems that have arisen in connection with the utilization of waste fish which should receive attention from the Bureau of Fisheries, and it is hoped that means for studying these may soon be provided.

On the basis of reports published by the Bureau of the Census the production of fish and marine mammal oils in 1920 amounted to 8,803,574 gallons, distributed as follows: Menhaden oil, 3,676,453 gallons; whale oil, 3,073,574 gallons; sperm oil, 416,737 gallons; herring oil, 380,379 gallons; cod and cod-liver oil, 196,108 gallons; and all other, 1,060,322 gallons.

The fishery for sharks is developing satisfactorily despite unsettled conditions in the fishery industry, and the number of persons and companies attempting to place the fishery on a permanent basis is increasing. Shark hides are being tanned into leathers which are excellent for shoes, bags, brief cases, collar boxes, bill folds, and similar articles. Wearing tests of shoes with uppers of shark leather indicate that such leather is fully comparable to the best grades of calfskin, and shark leather has been produced whose tensile strength exceeded 6,500 pounds per square inch.

As the Bureau's small special appropriation for work in this field has lapsed, the future aid that can be given this industry will of necessity be limited. With the establishment of the facts that high-grade leathers can be made from the hides and that the remainder of the fish can be converted into marketable commodities, the chief purposes of the Bureau's assistance have been served. There is still need for information relative to the possible extent of the fisheries and areas and seasons of greatest abundance of sharks, but with a certainty of markets for the products it is believed that private enterprise will be able to cope with the situation.

It is worthy of report that a number of American manufacturers are now engaged in the manufacture of "pearl essence" or "fish-scale essence" from the scales of native fishes, such as the river herring, sea herring, and shad, and that considerable quantities of the scales are now being utilized for the purpose. In 1919, 5.2 tons of alewife or river herring scales, valued at \$5,200, or 50 cents per pound, were so used in Massachusetts, and at present silvery scales are being saved by the fishermen of Maine, Massachusetts, and Virginia.

#### FISHERY CONFERENCES.

The Secretary of Commerce has adopted the practice of calling from time to time conferences of men interested in the upbuilding of the fishing industry. These conferences have been well attended and promise to mark an epoch in the history of the industry by establishing closer relations between the industry and the Federal agencies concerned and by affording a better understanding of the problems which the industry is attempting to meet, of the means

whereby Federal agencies can cooperate, and of the limitations beyond which these agencies can not go.

The first of these conferences, attended by about 30 men prominently identified with the industry from the Atlantic and Gulf coasts, the Great Lakes, and the Mississippi Valley, representing the fresh, frozen, salt, and canned fish trades, and the oyster, crab, shrimp, and menhaden industries, was held at the Department of Commerce on May 9 and 10, 1921. The conference in a formal expression of views emphasized the seriousness of polluted coastal waters as affecting the fisheries and the need for remedial legislation; the effects of high transportation rates on the marketing of fish, especially of the lower-priced grades; the desirability of educational work among all classes to improve the quality of fish marketed and increase the consumption of fish; and the need of closer cooperation for the protection of important migratory fish.

The second conference, held on June 16, 1921, was called to consider measures for the prevention and control of water pollution and the protection of anadromous and shore fishes and other aquatic forms. It was attended by about 70 conferees, State fish commissioners, fish producers, and anglers from the Atlantic and Gulf coasts, as well as by Members of Congress and interested Federal departmental officials. The conference revealed a very great increase in the quantity of undesirable material dumped into our coastal waters in recent years, with impairment of their use for bathing and other recreation purposes and resultant damage to aquatic life, to which may be added the menace to our cities from fire due to oil on the water. There was indicated a general failure or inability of the States to cope with the many important and complex problems involved, and the demand for assistance from the Federal Government was practically unanimous.

On the question of the control of migratory fishes there was a greater diversity of opinion, but it was the sentiment of the meeting that our anadromous fishes and certain shore forms require greater protection that may be attained through uniform State action, the Department of Commerce to use its best offices to the accomplishment of this end in an advisory capacity.

#### NEW ENGLAND VESSEL FISHERIES.

The Bureau, through its local agents, has collected detailed statistics of the extensive vessel fisheries centering at Boston, Gloucester, and Portland, which have been published in monthly and annual bulletins. Two annual bulletins have been issued, one showing the catch by months, the other by fishing grounds. The number of trips and the catch at these ports were not so large as in the previous year, but there was a considerable increase in the total value of the products. There was a large increase in the fishery products landed at Boston during the year, but a decrease in the receipts at Gloucester and Portland.

The fishing fleet at these ports during the calendar year 1920 numbered 471 sail, steam, and gasoline-screw vessels, including 41 American and 3 Canadian steam trawlers. These vessels landed at Boston 3,342 trips, aggregating 118,558,902 pounds of fish, valued at \$6,136,569; at Gloucester 2,381 trips, aggregating 46,740,296 pounds, valued

at \$1,460,336; and at Portland 1,883 trips, aggregating 12,981,503 pounds, valued at \$630,108. The totals for the three ports were 7,606 trips and 178,280,701 pounds of fresh and salted fish, having a value to the fishermen of \$8,227,013.

The foregoing totals include 54 trips—43 at Boston, 1 at Gloucester, and 10 at Portland—landed by 18 Canadian fishing vessels, amounting to 2,588,218 pounds of fish, valued at \$119,028. Of this quantity, 1,308,774 pounds, valued at \$62,147, were landed at Boston; 271,580 pounds, valued at \$13,606, at Gloucester; and 1,007,864 pounds, valued at \$43,275, at Portland. As compared with the previous year, there was an increase of 9 vessels and 15 trips but a decrease of 707,929 pounds, with an increase of \$12,767. These fish were brought into American ports in accordance with an arrangement with the Canadian Government as an emergency war measure that granted reciprocal privileges to fishing vessels, by which Canadian fishing vessels were permitted to land their fares at American ports direct from the fishing grounds. Canadian vessels began to utilize this privilege in April, 1918. The arrangement was terminated by departmental order effective July 15, 1921.

Compared with the previous year, there was a decrease of 663 trips, or 8.01 per cent, in the total number landed at Boston, Gloucester, and Portland, and of 18,200,569 pounds, or 9.26 per cent, in the quantity, with an increase of \$678,630, or 8.99 per cent, in the value of the products landed. The only important species showing an increase in both quantity and value were halibut, mackerel, and swordfish. The catch of halibut increased 1,674,669 pounds, or 79.19 per cent; and \$354,630, or 91.59 per cent; the mackerel catch increased 1,580,523 pounds, or 27.66 per cent, and \$215,852, or 39.44 per cent; and the catch of swordfish increased 1,648,942 pounds, or 186.80 per cent, and \$281,834, or 132.71 per cent. The yield of cod decreased 3,108,838 pounds, or 4.75 per cent, but increased in value \$54,456, or 2.10 per cent; haddock decreased 7,436,708 pounds, or 8.99 per cent, and \$53,886, or 1.92 per cent; pollock decreased 10,191,066 pounds, or 54.34 per cent, and \$118,387, or 31.11 per cent; cusk decreased 208,459 pounds, or 10.10 per cent, and \$14,099, or 22.67 per cent; and herring decreased 3,361,901 pounds, or 32.45 per cent, and \$73,487, or 30.64 per cent. The output of hake increased 381,880 pounds, or 8.80 per cent, but decreased in value \$27,177, or 15.01 per cent. The Newfoundland herring fishery had a decline of 404,753 pounds, or 11.55 per cent, and \$79,626, or 41.95 per cent. There were no tilefish landed at Boston during the year. In the various other species combined there was an increase of 853,897 pounds, or 20.66 per cent, and of \$60,368, or 37.85 per cent.

The fishery products landed at Boston, Gloucester, and Portland by fishing vessels each year are taken principally from fishing grounds lying off the coast of the United States. In the calendar year 1920, 78.88 per cent of the quantity and 79 per cent of the value of the catch landed by American and Canadian fishing vessels were taken from these grounds; 3.35 per cent of the quantity and 4.63 per cent of the value, consisting largely of herring, from off the coast of Newfoundland; and 17.75 per cent of the quantity and 16.36 per cent of the value from fishing grounds off the Canadian Provinces. Newfoundland herring constituted 1.73 per cent of the quantity and 1.33

per cent of the value of the fishery products landed during the year. The herring were taken from the treaty coasts of Newfoundland and the cod, haddock, hake, halibut, and other species from that region were obtained from fishing banks on the high seas. All fish caught by American fishing vessels off the coast of the Canadian Provinces were from offshore fishing grounds.

Haddock ranked first in the New England vessel fisheries in 1920, with a catch of 75,279,477 pounds, valued at \$2,740,052. The yield of cod was 62,265,582 pounds, valued at \$2,637,637. There was unusual activity in the halibut fishery during the year. The catch of 3,789,330 pounds, valued at \$741,821, was the largest in five years. There was a large increase in the receipts of halibut at Portland, the catch in 1920 amounting to 1,159,973 pounds, the next largest in the past five years being 535,314 pounds in 1916. There has also been a noteworthy increase in the receipts of halibut at Boston in recent years but a decrease at Gloucester. The output of pollock was the smallest in many years, amounting to only 8,560,901 pounds, valued at \$262,128, as compared with 18,751,967 pounds, valued at \$380,515, in 1919, and 26,560,620 pounds, valued at \$962,085, in 1918. The hake product amounted to 4,721,356 pounds, valued at \$153,876, an increase of 381,880 pounds but a decrease of \$27,177, as compared with the previous year. The yield of this species has been comparatively small in recent years. The catch of other fish was as follows: Cusk, 1,854,739 pounds, valued at \$48,070; swordfish, 2,531,669 pounds, valued at \$494,202; flounders, 3,637,774 pounds, valued at \$166,895; and herring, 6,997,984 pounds, valued at \$166,301. The herring output included 3,900,960 pounds, valued at \$56,144, taken off the coast of the United States and landed fresh, and 3,097,024 pounds of salted Newfoundland herring, valued at \$110,157.

The mackerel fishery in 1920 yielded 79,799 barrels of fresh fish, compared with 53,992 barrels in 1919, and 4,897 barrels of salt fish, compared with 7,007 barrels in 1919. The value of the catch was \$671,310 for the fresh fish and \$91,784 for the salt fish, an increase of \$215,852 over the previous year. In 1921 the total yield of mackerel up to July 1 was 33,632 barrels fresh and 3,143 barrels salted, compared with 60,842 barrels of fresh and 3,357 barrels salted for the same period in 1920. In the southern mackerel fishery the purse-seine vessels had a poor season and the gill-net vessels had only fair success. The weather most of the time was unfavorable for fishing. The seiners reported seeing more fish in the South than for many years. The weather was good on the Cape Shore, and this fishery was comparatively successful, three vessels making second trips. The fish were caught mostly at night and in small schools. The fish averaged large, and the fresh sold from 6.60 to 16 cents per pound and the salted from \$12 to \$13.50 per barrel.

#### VESSEL FISHERIES AT SEATTLE, WASH.

The fishing fleet at Seattle, Wash., during the year 1920 brought in 822 fares, consisting of 14,355,450 pounds of fish, having a value to the fishermen of \$1,992,759, from the fishing grounds along the coast from Oregon to Alaska. The largest quantities were taken from Flattery Banks, off the west coast of Vancouver Island, and in



Hecate Strait. The products included 12,683,450 pounds of halibut, valued at \$1,913,849; 950,200 pounds of sablefish, valued at \$49,963; 513,035 pounds of "lingcod," valued at \$21,153; and 208,765 pounds of rockfishes, valued at \$7,794. Compared with the previous year, there was an increase of 152 trips landed and an increase of 704,480 pounds, or 5.16 per cent, in the quantity, and of \$462,475, or 30.22 per cent, in the value of the products. The yield of halibut increased 1,572,730 pounds, or 14.15 per cent, and \$491,330, or 34.53 per cent, but there was a decrease in the catch of other species. Sablefish, for which there was an augmented demand during the war period, decreased 603,400 pounds, or 38.83 per cent, and \$24,327, or 32.74 per cent; "lingcod" decreased 209,965 pounds, or 29.04 per cent, and \$3,280, or 13.42 per cent; and rockfishes decreased 54,935 pounds, or 20.83 per cent, and \$1,248, or 13.80 per cent.

The fishery products taken in Puget Sound and landed at Seattle by collecting vessels during the year aggregated 9,813,966 pounds, valued at \$881,066. This quantity included 7,911,820 pounds of salmon, valued at \$765,145, and the remainder consisted of herring, steelhead trout, smelt, rockfishes, flounders, crabs, and other species. Compared with the previous year, there was a net decrease in the products landed by collecting vessels of 1,995,484 pounds, or 16.89 per cent, and \$102,753, or 10.44 per cent, which decline was due to a large falling off in the catch of salmon. The decrease in salmon was, however, offset to some extent by a considerable increase in various less important species.

#### SHAD FISHERY OF THE HUDSON RIVER.

Figures gathered in a special canvass of the shad fishery of the Hudson River for 1920 indicated a reduction in the number of shad taken amounting to 40,986, or 45.38 per cent, and a diminished revenue to the fishermen amounting to \$27,415, or 32.74 per cent, compared with the season of 1919. The persons engaged in this fishery numbered 368, an increase of 69 over the previous year. The equipment included 185 rowboats, valued at \$10,011; 10 gasoline boats, valued at \$2,050; 200 gill nets, valued at \$23,710; 10 seines, valued at \$1,655; and shore and accessory property valued at \$2,925, the total investment being \$40,351.

The catch comprised 49,315 fish, or 199,844 pounds, valued at \$56,309, of which 39,692 fish, or 157,715 pounds, valued at \$43,882, were taken on the New York side of the river, and 9,623 shad, or 42,129 pounds, valued at \$12,427, were taken on the New Jersey side. The possibility of reestablishing a run of shad on a considerable scale in this river is still a matter of conjecture.

#### SHAD AND ALEWIFE FISHERIES OF THE POTOMAC RIVER.

The shad fishery of the Potomac River is of special interest to the Bureau owing to the long continuance of shad hatching operations thereon and the very active fishing that has been conducted in Chesapeake Bay. Statistics for the season of 1920 showed a catch of 529,358 shad, weighing 1,979,780 pounds, valued at \$334,464. The

number of fish taken was 15,111 less than in the previous year. Maryland fishermen are credited with only 80,944 shad, weighing 302,237 pounds and selling for \$55,963, as against 448,414 fish, weighing 1,677,543 pounds and valued at \$278,501, taken by Virginia fishermen.

The production of alewives or river herrings was 8,759,336 fish, or 4,352,668 pounds, valued at \$55,137, of which 7,681,561 fish, weighing 3,813,780 pounds and having a value of \$41,197, were taken by Virginia fishermen.

The combined fisheries for shad and alewives gave employment to 753 persons, who used 451 boats, valued at \$83,889; 271 pound nets, valued at \$126,455; 211 gill nets and one haul seine, valued at \$39,620; and shore and accessory property worth \$1,375.

#### THE FROZEN-FISH TRADE.

From compilations made from the monthly memoranda issued by the Bureau of Markets it appears that fish frozen between January 15, 1920, and January 15, 1921, aggregated 85,324,366 pounds. The quantity of halibut frozen was 10,625,029 pounds; herring, 10,356,305 pounds; whiting, 10,208,755 pounds; salmon, 7,836,620 pounds; ciscoes, 6,968,750 pounds; mackerel, 4,835,173 pounds; cod, haddock, hake, and pollock, 3,940,163 pounds; and squid, 3,252,720 pounds, with smaller amounts of other species. The maximum quantity in storage at one time during the year, amounting to 67,827,934 pounds, was reported on November 15; and the minimum, amounting to 20,284,470 pounds, on May 15, 1920. A study of the data over a period of several years indicates that the storage peak is reached about November 15 and the low point between April 15 and May 15 of each year.

#### FISHERIES OF THE SOUTH ATLANTIC STATES.

Tabulated returns of the statistical canvass of the fisheries of the South Atlantic States concluded by the Bureau in 1920 indicate that in 1918 the industry gave employment to 15,046 persons, of whom 8,036 were credited to North Carolina, 2,000 to South Carolina, 1,680 to Georgia, and 3,330 to eastern Florida. Compared with the returns for 1902, there was a decrease of 8,406, or 35.84 per cent. The capital invested was \$7,423,971, distributed as follows: North Carolina, \$4,222,043; South Carolina, \$221,251; Georgia, \$769,998; and eastern Florida, \$2,210,679. Compared with 1902, there was increase of \$4,432,822, or 148.19 per cent. The principal forms of apparatus employed in the fisheries were pound nets, gill nets, purse seines, haul seines, and otter trawls, the last-named device having been introduced in the shrimp fisheries about 1915.

The products of the fisheries aggregated 332,614,123 pounds, with a value to the fishermen of \$5,348,616, distributed among the several States as follows: North Carolina, 210,501,750 pounds, \$2,978,708; South Carolina, 3,746,932 pounds, \$207,690; Georgia, 37,153,953 pounds, \$416,043; and eastern Florida, 81,211,488 pounds, \$1,746,175. Some of the more abundant species arranged in order of size of catch were: Menhaden, 257,757,799 pounds, valued at \$1,605,117; shrimp, 15,656,903 pounds, valued at \$470,346; alewives, fresh and

salted, taken mostly in North Carolina, 15,185,585 pounds, valued at \$412,067; mullet, fresh and salted, 11,757,318 pounds, valued at \$508,044; oysters, 5,871,376 pounds, or 838,768 bushels, valued at \$260,863; squeteagues or sea trouts, 5,105,249 pounds, valued at \$360,527; Spanish mackerel, taken mostly in Florida, 3,211,405 pounds, valued at \$232,355; cero and kingfish, credited mostly to Florida, 2,483,647 pounds, valued at \$161,562, and spot, 1,692,775 pounds, valued at \$72,795. As compared with the Bureau's returns for 1902, there was increase in the catch aggregating 226,168,051 pounds, valued at \$2,508,983. The large advance over previous years was mostly due to the greatly increased output of menhaden, the 1902 catch amounting to only 18,862,000 pounds, as against 257,757,799 pounds in 1918. The yield of all other species in 1902 was 87,584,072 pounds and in 1918, 74,856,324 pounds. Other products which have shown a noteworthy increase are cero and kingfish, drums, Spanish mackerel, and shrimp.

#### FISHERIES OF THE NEW ENGLAND STATES.

A canvass of the fisheries of the New England States for the calendar year 1919 was completed early in 1921. The number of persons ascertained to be engaged in the fisheries was 30,767, credited to the different States as follows: Maine, 14,386; Massachusetts, 12,346; Connecticut, 2,289; Rhode Island, 1,646; and New Hampshire, 100. Compared with the returns for 1905, there has been a decrease in the number of persons employed of 6,572, or 17.60 per cent. The investment in the fisheries of the different States arranged in the order of importance was as follows: Massachusetts \$19,111,269; Maine, \$17,544,969; Rhode Island, \$2,249,536; Connecticut, \$1,645,793; New Hampshire, \$45,530; total, \$40,597,097. This represents an increase of \$18,066,377, or 80.18 per cent, as compared with 1905.

The yield for the region amounted to 467,339,870 pounds, valued at \$19,838,657, distributed as follows: Massachusetts, 246,951,241 pounds, valued at \$10,859,746; Maine, 147,956,369 pounds, valued at \$3,889,035; Rhode Island, 48,250,883 pounds, valued at \$3,296,578; Connecticut, 23,652,647 pounds, valued at \$1,700,638; and New Hampshire, 528,730 pounds, valued at \$92,660. The most important products were: Cod, 84,917,535 pounds, valued at \$3,597,891; oysters, 19,337,374 pounds, or 2,762,482 bushels, valued at \$2,617,020; lobsters, 10,666,706 pounds, valued at \$2,550,980; haddock, 89,405,609 pounds, valued at \$2,544,617; and mackerel, 15,785,012 pounds, valued at \$1,562,088. Compared with 1905, there was a net decrease amounting to 12,943,734 pounds, but a net increase of \$5,654,452 in the first value of the products.

#### SARDINE INDUSTRY OF MAINE.

A complete enumeration of the sardine industry of the State of Maine was made by the Bureau for the calendar years 1919 and 1920. In 1919 the plants engaged in canning sardines numbered 53. The herring utilized amounted to 125,309,415 pounds, valued at \$852,450, and the pack of canned fish was 2,450,268 cases, valued at \$11,933,986, of which 1,902,430 cases, valued at \$9,327,665, were quarter oils. In 1920 the plants numbered 50 and the herring consumed aggregated

104,700,010 pounds, valued at \$767,141. The total pack was 1,877,757 cases, valued at \$7,435,056, of which 1,458,670 cases, valued at \$5,669,352, were quarter oils.

#### FLORIDA SPONGE FISHERY.

The sponge-inspection service, to make effective the law regulating the size of commercial sponges taken from waters off the Florida coast and landed at American ports, has been kept up throughout the year. The Florida sponge fishery appears to be maintaining a satisfactory equilibrium between the natural supply and the catch. It is regrettable that large quantities of small sponges barely meeting legal requirements continue to be taken. In the previous report attention was called to the large profit to be obtained if the small sponges were permitted an additional year's growth. This seems to have been demonstrated during the year by the quantity of large sponges taken on certain bars that had not been fished for several years. The continued demand for the larger sizes has somewhat encouraged the spongers to work in deeper water, say, from 9 to 12 fathoms. If a period of rest and recuperation for the shallower bars can be secured for a reasonable period, the sponge fishery as a whole will be greatly benefited.

The fishery has not escaped the fluctuations in value and general depression felt in other industries. The radical changes in price throughout the year, with considerable quantities of sponges remaining unsold from time to time, have not tended to simplify the financing of operations, but with a gradually improving market and the high quality maintained in the sponges taken the future may be viewed without concern.

#### INCREASED USEFULNESS TO THE FISHERIES.

The Bureau has recently been extending to the fishing industry a larger service than ever before, but it falls short of the opportunities and has been unable to meet various obligations that naturally devolve on the sole Federal agency charged by law with the duty of aiding the fisheries.

With due regard for the utmost economy in governmental expenditures, and having in view the efforts which the industry should undertake on its own behalf, there has existed and still exists a real need for additional Federal aid to the fisheries such as the Bureau is able to render but which it can not undertake with its present facilities. In an industry yielding an annual harvest of 2,500,000,000 pounds of products it is highly important from the standpoint of national welfare that the aquatic resources be utilized to the best advantage, and the Government would be amply justified in greatly increasing the appropriations that are available for such a purpose.

Some of the technological work that the Bureau felt should be undertaken in behalf of the fisheries has been indicated in estimates of appropriations that have been submitted to Congress in recent years and in special bills on which the Department has made favorable reports. At the present time an appeal is being made for an increase in the general funds for maintaining the division charged

by law with duty toward the fisheries, to the end that the unique fishery-products laboratory in Washington and the temporary laboratory on the California coast be operated for the solution of various technological problems, that statistical canvasses showing the condition and trend of the fisheries may be prosecuted more frequently and more promptly, and that numerous field inquiries and investigations concerned with methods of taking, handling, preserving, and marketing fishery products may be carried on. A special appropriation is requested for the conduct of investigations in the development and standardization of methods of preservation of Pacific coast fishes.

When provision is made for enlarged investigations of wider scope, there will be required also such a readjustment of salaries as will enable the Bureau to secure and retain the services of persons properly qualified in the various branches and for an increased personnel that will include an assistant in fishery trade practices, three fishery technologists, a technical machinist capable of operating and caring for the highly specialized equipment of the fishery-products laboratory, and at least three additional statistical agents.

#### ALASKA FISHERIES SERVICE.

##### EXTENT OF THE ALASKA FISHERIES.

The 1920 salmon season had as its outstanding features a diminished catch in southeast Alaska and an increased catch in central and western Alaska as compared with 1919; an increase in the number of canneries operated but an output of canned fish that was less than in each of the five preceding years; a decline in the business in mild-cured, pickled, and fresh salmon; and a very dull market for canned salmon, especially the cheaper grades, many lots of which were sold for less than the cost of production.

The salmon taken in the Alaska fisheries in 1920 numbered 65,080,539 fish, of which 32,112,611 were humpback or pink salmon, 20,187,925 red or sockeye salmon, 10,113,677 chum or dog salmon, 1,890,859 coho or silver salmon, and 775,467 king or spring salmon. Apportioned by geographical districts the catch in southeast Alaska was 33,096,640 fish, central Alaska 19,574,332 fish, and western Alaska, 12,409,567 fish. Comparing these figures with the returns for 1919, it appears that there was a net increase of about 12 per cent; coho, chum, and king salmon were taken in less numbers and humpback and red salmon in greater numbers.

The canneries, which consumed the principal part of the salmon catch, numbered 146, an increase of 12 over 1919. The pack of canned fish was 4,429,463 cases, with a market value of \$35,602,800, a decrease of 154,225 cases and \$7,662,549 from the previous year. The pack both of red and king salmon was larger and that of the other species was smaller than in 1919.

Other salmon products were 1,857,800 pounds of mild-cured fish, valued at \$364,219; 964,400 pounds of pickled fish, valued at \$104,873; 1,916,595 pounds of frozen fish, valued at \$161,143; 3,248,081 pounds of fresh fish, valued at \$263,264; 244,840 pounds of dry-salted, dried, and smoked fish, valued at \$40,785; 39,052 gallons of oil, valued at \$16,370; and 1,778,000 pounds of fertilizer, valued at \$88,382; giving

\$36,641,836 as the total value of the products of the Alaska salmon industry in 1920.

The halibut fishery ranks next to the salmon fishery, and in 1920 yielded 7,506,763 pounds of fresh fish, valued at \$1,034,380; 7,788,017 pounds of frozen fish, valued at \$692,343; and 720 pounds of canned fish, valued at \$75.

Products of the herring fishery consisted of 8,223,490 pounds of Scotch-cure fish, valued at \$490,485; 344,619 pounds of Norwegian-cure fish, valued at \$22,199; 3,602 cases of 1-pound cans, valued at \$28,980; 681,067 gallons of oil, valued at \$404,090; and miscellaneous commodities, valued at \$357,860.

The cod fishery yielded a catch valued at \$1,117,464. The products of the shore whale fishery had a value of \$562,302. Minor items were: Clams, \$46,812; crabs, \$1,740; shrimps, \$49,123; trout, \$13,662; sable-fish, \$28,544; and miscellaneous fresh fish, \$229.

The entire Alaska fishing industry, exclusive of fur sealing, gave employment to 27,482 persons, represented an investment of \$70,986,221, and yielded products valued at \$41,492,124.

A detailed account of the extent and condition of the Alaska fisheries in 1920 and of the activities of the Bureau under the laws and regulations for the protection of the fisheries is embodied in the annual report of the Alaska service for that year.<sup>1</sup>

#### ENFORCEMENT OF FISHERY LAWS AND REGULATIONS.

During the fishing season of 1920 the Bureau had in service for patrol purposes 13 vessels, and the same number was available in 1921. For the 1921 season the persons engaged in connection with the enforcement of laws and regulations numbered 63, of whom 23 were regular and 40 were temporary employees.

A number of violations of the fishery laws were detected and successful prosecutions were made in the local courts. The Bureau is doing its utmost, however, to prevent violations by maintaining watchmen or guards at the mouths of salmon streams throughout the fishing season. In some instances the stream guards, being equipped with small power boats, are able to look after two or three streams so close together that their absence from any one stream will not be so protracted as to permit illegal fishing within the stream or inside the protected area at its mouth. It is the policy to discourage and prevent violations, for thereby not only are the expense and annoyance of prosecution avoided but, what is of greater importance, the salmon which would have been killed through such illegal fishing are permitted to proceed to the spawning grounds. The extension of the stream-watchmen system will be made as fast as funds are available and should soon embrace every important salmon stream.

Attention has been devoted during the year to the erection of additional markers near the mouths of salmon streams to give fishermen notice as to the limits of the areas in which salmon fishing is prohibited. Suitably inscribed cloth notices have been posted conspicuously, and thus far upwards of 200 of the more important salmon streams have been marked.

<sup>1</sup> Alaska Fisheries and Fur-Seal Industries in 1920, by Ward T. Bower, agent, Alaska service (Bureau of Fisheries Doc. No. 909).

The systematic stealing of salmon from fish traps in southeastern Alaska was renewed during the 1920 fishing season but was less extensive than in 1919. Some of the cannery owners augmented their force of watchmen and detailed fast boats to the special duty of protecting their traps from these marauders. It would seem that one of the most certain and effective methods of bringing this nefarious practice to an end would be for cannerymen or other purchasers of salmon to establish definitely the source of fish offered for sale by independent boats. The suppression of this practice does not fall within the functions of the Bureau.

Detailed instructions issued to the Bureau's employees in Alaska on May 25, 1921, prescribed methods of observance of the close season for fixed fishing apparatus and the proper labeling of all apparatus, also the procedure to be followed in inspecting such apparatus and in reporting and prosecuting violations of the laws and regulations.

#### PRIVATE SALMON HATCHERIES.

The private salmon hatcheries in Alaska have been inspected, as required by law. In 1921 two such hatcheries were operated. One of these, on Naha Stream, liberated 17,375,000 red salmon fry in the fiscal year 1921, and the other, located on Hugh Smith Lake, liberated 18,913,000 red salmon fry in the same period. The total rebate of taxes on canned salmon, at the rate of 40 cents a thousand fry released by these hatcheries, amounted to \$14,515.20.

#### NEW SALMON-FISHERY REGULATIONS.

In accordance with announcements duly issued, hearings were held at Cordova on October 5 and at Seattle on November 18, 23, and 30, and December 3, 1920, for the consideration of necessary changes in the regulations regarding salmon fishing in Alaska. The waters affected are southeastern Alaska, the region between Cape Spencer and Cape Newenham, including Bering and Copper Rivers, and the Kuskokwim and Yukon Rivers. As a result of these hearings the following order was issued on December 18, 1920:

Hearings having been given, after due notice in accordance with law, for the purpose of determining the advisability of limiting or prohibiting fishing in certain waters in Alaska, and to amend or modify certain existing regulations, and all persons having had full opportunity to be heard, it is hereby ordered, by virtue of the authority vested in me by section 6 of "An act for the protection and regulation of the fisheries of Alaska," approved June 26, 1906, that until further notice all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in all herein-after-described waters of Alaska be, and is hereby, made subject to the following limitations and prohibitions in addition to the general restrictions already applicable by virtue of existing laws and regulations.

1. Waters east of the longitude of Cape Spencer:

(a) All fishing is prohibited in all salmon streams and their tributaries and lakes.

(b) All fishing, except with purse seines and drift gill nets, is prohibited within 500 yards of the mouths of all salmon streams.

(c) All fishing with purse seines and drift gill nets is prohibited within 200 yards of the mouths of all salmon streams, and all fishing with purse seines and drift gill nets, as well as with all other apparatus, is prohibited within 500 yards of the mouths of Chilkat River, Chilkoot River, Anna Creek, Hetta Creek, Sockeye Creek, and Naha Stream.

2. All fishing is prohibited in all salmon streams, their tributaries and lakes and within 500 yards of the mouths of such streams flowing into the Pacific Ocean or Bering Sea between Cape Spencer and Cape Newenham, except as follows:

(a) Fishing is permitted in Copper River and its tributaries in accordance with the terms of the order promulgated December 20, 1918, which order is continued in full force until September 1, 1921, upon which date said order of December 20, 1918, becomes of no further force or effect, and on and after September 1, 1921, and until further notice, all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in the Copper River, its tributaries and lakes, and within 500 yards of each mouth of the Copper River is prohibited.

(b) Fishing is permitted at Karluk beyond the zone 100 yards outside the mouth of Karluk River where it breaks through Karluk Spit into Shelikof Strait.

(c) Fishing is permitted in Ugashik River below a line extending at right angles across the Ugashik 500 yards below the mouth of King Salmon River.

3. On and after September 1, 1921, all fishing is prohibited in the Kuskokwim River, its tributaries and lakes, and within 500 yards of the mouth of the Kuskokwim for other than local use in Alaska.

4. Fishing is permitted in the Yukon River and its tributaries in accordance with the terms of the order promulgated December 14, 1918, which order is continued in full force until September 1, 1921, on which date said order of December 14, 1918, becomes of no further force or effect, and on and after September 1, 1921, and until further notice, all fishing for salmon, or other fishing in the prosecution of which salmon are taken or injured, in the Yukon River, its tributaries and lakes, and within 500 yards of each mouth of the Yukon is prohibited for other than local use in Alaska.

5. The driving of salmon downstream and the causing of salmon to go outside the protected area at the mouth of any salmon stream are expressly prohibited.

6. This order does not apply to persons taking salmon with rod, hand line, or spear for their personal or family use and not for sale or barter.

7. The waters of the Afognak Reservation are covered by presidential proclamation of December 24, 1892, and the regulations promulgated by authority thereof are not modified or affected by this order, but remain in full force.

8. All previous orders of the Secretary of Commerce imposing limitations or prohibitions upon fishing in the waters covered by this order, except as hereinbefore indicated, are hereby superseded.

9. This order becomes effective January 1, 1921.

Announcement has been made of hearings to be held in the fall of 1921, as follows: Juneau, Alaska, October 19, and Seattle, November 15, to consider further restrictions on commercial fishing in waters of southeastern Alaska, and at Seattle, November 17, in regard to waters of western and northern Alaska.

In submitting to the Secretary of Commerce recommendations for the protection and maintenance of the salmon resources of Alaska, the Bureau is guided largely by the personal knowledge of conditions possessed by its staff of assistants regularly employed in Alaska or detailed thereto for special duty. The data that are considered cover both the practical aspects of the fishery and the biological situation as regards the salmon in given waters, and the established policy is to impose no greater restrictions on the fishery than are believed to be required for the perpetuation of the industry. In recent years very important and far-reaching investigations of the habits, age, growth, spawning grounds, etc., of the different species of salmon in different streams have been in progress, and the Bureau has been fortunate in retaining for this work the services of the leading authority on the Pacific salmons.



## PROTECTION OF WALRUS AND SEA LION.

Pursuant to the provisions of the act of May 31, 1920, which transferred to the Department of Commerce the jurisdiction heretofore exercised by the Department of Agriculture with respect to the walrus and the sea lion in Alaska, the Secretary of Commerce approved a new set of regulations governing the killing of these animals within the territorial limits of Alaska, and in a circular issued under date of April 21, 1921, promulgated the regulations and quoted from the Alaska game law approved May 11, 1908, extracts in regard to the walrus and the sea lion. The new regulations are as follows:

## WALRUSES.

1. The killing of walruses for their tusks or hides, or both, is prohibited as being wanton destruction within the meaning of the act of May 11, 1908.
2. The killing of walruses at their breeding places in Alaska is prohibited at all times.
3. The killing of walruses throughout the territorial limits of Alaska is prohibited from May 1, 1921, to April 30, 1923, both dates included, except by natives for food or clothing or by miners or explorers when in need of food.

## SEA LIONS.

1. The killing of sea lions on their rookeries or hauling-out grounds is prohibited at all times.
2. The killing of sea lions is prohibited from May 1, 1921, to April 30, 1923, except by natives for food or clothing, or by miners or explorers when in need of food, or by anyone in the necessary protection of property, or while such animals are actually engaged in the devastation of runs of salmon. The killing of sea lions under any other circumstances than the foregoing will be deemed wanton destruction and punishable as a violation of this order.

## NEW LEGISLATION NEEDED.

The act of June 26, 1906, which provides for the regulation and protection of the fisheries of Alaska, is obsolete in some of its features and in general is quite inadequate to meet the conditions that have existed for a number of years. The law is practically restricted to the salmon fishery, which, under its operation, has become so extensive that the salmon supply in certain waters has been seriously depleted and the future welfare of the industry and of the Territory is jeopardized. The law imposes no limit on the number of canneries and salteries that may be established and operated, the number of fixed and floating traps that may be constructed, the number of purse seines, haul seines, set and drift nets that may be used, the number of trolling boats and trolling lines that may be employed, the number and age of salmon that may be caught. Various restrictive features of the law have long since proved ineffective to prevent the capture of an undue proportion of the run of salmon in certain waters, and fishing operations in full compliance with law may be entirely incompatible with the welfare of the fishery.

One of the most serious defects of the law is its failure to give sufficient protection to salmon off the mouths of spawning streams. The maximum distance from the mouth of a stream to which the jurisdiction of the Department extends is 500 yards. It is entirely

feasible to conduct fishing operations with various kinds of gear so actively beyond the restricted zone as to offset the effects of the protection afforded the salmon in streams and immediately off their mouth, and this, in fact, is occurring in various localities. A measure designed to meet this situation and furnish this limited relief pending the enactment of a new general fish law for Alaska is the bill (H. R. 2394) which confers on the Secretary of Commerce jurisdiction over the fisheries for a distance of 3 miles off the mouth of any stream in Alaska and authorizes him to prescribe for such area the regulations deemed by him necessary or desirable to perpetuate the salmon supply. The bill, which has received the indorsement of the Department, has been favorably reported by the House Committee on the Merchant Marine and Fisheries and is now on the calendar.

The present law has no application to whales, crabs, shrimp, clams, and various other valuable products, and the taking of such animals is permitted without any restriction whatever. In the absence of any protection very extensive and valuable clam beds in central Alaska have been depleted, and other instances of the kind might be cited.

#### FUTURE DEVELOPMENT OF ALASKA FISHERIES.

While the salmon and halibut fisheries of Alaska will undoubtedly hold a dominant place for many years, the greatest development of the fishing industry is to be expected in other branches, particularly in the increased attention given to cod and herring, and ultimately to certain minor resources which are now almost untouched but which in the aggregate constitute a potential source of food and wealth that will mean much to the future welfare of Alaska. The herring supply of Alaska is possibly unsurpassed anywhere in the world, and there may be anticipated such a growth in herring fishing and herring curing that a formidable rival of the salmon industry may arise. Vast expanses of water in all parts of Alaska abound with bottom food fishes of a kind in good demand in other parts of the world, but their surface has remained practically unbroken by the boats of fishermen equipped to take such fishes. Substantial development may be expected also in the crab and shrimp fisheries. The Alaska shrimps are not surpassed elsewhere in size and quality and are undoubtedly destined to enter largely into commerce in a fresh, frozen, and canned condition.

#### CONTROL OVER THE ALASKA FISHERIES.

There has been the usual agitation for the transfer to the Territory of Alaska of the control over the aquatic and other natural resources that has heretofore been exercised by the Federal Government. The desire for this change of jurisdiction, while not entertained by a conspicuously large number of the representative people of the Territory, is a legitimate aspiration of those who hope to see Alaska soon take her place as a sovereign State. As regards the fisheries, the feeling is quite generally prevalent among those having property interests that the time is not yet ripe for the assumption of the responsibilities of statehood.

While constantly dwelling on real and imaginary defects of the fishery administration, it is a fact that interests ostensibly friendly

to Alaska have successfully opposed all efforts on the part of the Department to have Congress give to Alaska a new fishery code adapted to the needs of the industry and have prevented the passage by Congress of constructive measures that have received favorable action in committee after protracted hearings.

It is the well-known desire of the Department to give to Alaska the most direct administration of the fisheries compatible with the requirements of law, and a large measure of independent action has been vested in the responsible representatives in various parts of the Territory. As a matter of fact, the fisheries of Alaska are now administered largely without reference to the Washington office, and the criticism properly made about the attempts at long-range control does not apply. With the exception of the power of appointment to statutory positions which is vested in the Secretary of Commerce, and the interpretation of questions of law which is vested in the Department of Justice, practically full authority without recourse to Washington is reposed in the Department's agents charged with the protection of the fisheries of Alaska. Of the 63 persons employed in the enforcement of law and regulation for the protection of the Alaska fisheries in 1921, 40 were regular residents of Alaska. An even larger proportion of appointments from Alaska would be made if suitable persons could be secured at the salaries that are available.

#### ALASKA FUR-SEAL SERVICE.

##### GENERAL ACTIVITIES AT THE PRIBILOF ISLANDS.

The administration of the Pribilof Islands, with their dependent native inhabitants and with their valuable herds of fur seals and blue foxes, is one of the most important duties devolving on the Bureau. The material interests of the Government arise from international relations having to do with the utilization of the fur seals and from the fact that the annual return from the islands is more than a million dollars.

The affairs of the Government on the Pribilofs are managed by a staff of about 15 white people, augmented by more than 300 natives. These natives, the descendants of Aleuts taken to the islands by the Russians more than a century ago, are undoubtedly as well cared for as any other native people in Alaska. They are furnished food, fuel, clothing, shelter, and other necessities, and have the benefit of schools and competent medical supervision. In return they perform most of the labor involved in taking and caring for the valuable products of the islands and in maintaining the Government plants. They receive cash remuneration in proportion to the amount and grade of service rendered. In recent years the local force of able-bodied natives has been supplemented during the few weeks of the active sealing season by 30 native laborers from the Aleutian Islands.

In 1920 a dentist was engaged to spend a few months at the Pribilof Islands. An excellent start was made in this much-needed field, for which special provision had never before been made. In order to continue the work thus inaugurated a dentist was sent to the Pribilofs in the summer of 1921; he will remain through the winter or until such time as his services are no longer required.

The important problem of housing the natives has received attention, and improvements in the native dwellings on St. Paul Island will be made as funds are available. One additional dwelling on St. Paul Island was completed and occupied during the past year. School buildings and dwellings were repaired, a new shop and warehouse was built on St. George Island, extensions to the salt houses were made on St. Paul Island, additional roadwork was undertaken, and, in conjunction with the Navy Department, preliminary work in drilling an artesian well was done. The by-products plant on St. Paul Island was operated, and 8,759 pounds of seal meal and 5,271 gallons of various grades of oil were produced.

The Bureau's vessel *Eider* has given valuable service in transportation of supplies and persons between Unalaska and the Pribilof Islands, and also made trips to King Cove and Kodiak. While returning from the latter place in December, the *Eider* rendered noteworthy assistance in locating at Chignik the disabled mail boat *Pulitzer*, long overdue, whose passengers, crew, and mail were taken to Unga. Credit is due the master and crew of the *Eider* for this work, as well as for other hazardous voyages during the winter to the Pribilof Islands.

Acknowledgment is made of courtesies extended by the Navy Department in the transportation of supplies and passengers on the *Saturn* from Seattle to the Pribilof Islands and in carrying seal-skins and fox skins on the return voyage of that vessel. The operation of the radio stations on St. Paul and St. George Islands has been of great value to the Bureau. The Bureau is also pleased to acknowledge numerous courtesies by the Coast Guard in the transportation of personnel and supplies upon vessels of that service.

#### THE SEAL HERD.

The 1920 census of the seal herd, taken as of date of August 10, indicated 552,718 animals of all ages, an increase of 28,483 over 1919. The census for 1921 gave 587,820 animals on the same date, an increase of about 35,000. The number of pups born in 1921 was 176,655. The seals killed from one census date to the next are not included in these figures. The 1920 enumeration was made by Dr. G. Dallas Hanna, who had been in charge of this work for several years; the 1921 census was placed under Edward C. Johnston, who had participated in the work of the previous year.

An innovation connected with the census in 1921 was the construction of two runways 6 feet above the ground leading to observation towers on one of the large rookeries on St. Paul Island, where in former years much difficulty and danger were experienced in making accurate observations on the large number of massed seals. To further facilitate the census, a number of concrete markers were prepared and placed on the rookeries at important points.

The average number of cows per harem in 1920 was 41; in 1921 the average was 45. These figures are regarded as indicating a very satisfactory condition of the herd.

In order that the Bureau might have the views and counsel of persons familiar with the fur-seal herd, an important conference was held in Washington on January 10, 1921, at which there were dis-

cussed methods and results of the seal census, the quota of 1921 and subsequent years, the length of the seal-killing season, etc. It was the sentiment of the conference that representatives of the interested nations should visit the Alaskan, Japanese, and Russian seal islands at an early date.

In June, 1921, a representative of the Bureau authenticated at Sitka 199 fur-seal skins legally taken by natives in the spring of this year, when the seal herd was migrating northward. A patrol of the sealing grounds was maintained by the Bureau's vessels *Murre* and *Auklet* in the latter part of May, while the herd was in that vicinity.

#### THE TAKE OF SEALSKINS.

The number of seals killed under governmental supervision on the Pribilof Islands in 1920 was 26,648, of which 25,978 were taken during the regular season ending on August 10 and the remainder in fall and winter for the food purposes of the natives. Seals 3 and 4 years old yielded 25,297 of the total skins secured.

The quota of seals to be killed during the calendar year 1921 was tentatively fixed at 30,000. The first drives were made in June, and the season closed on August 5, five days earlier than usual, to avoid the risk of killing cows which about that time began to resort to the hauling grounds of the bachelor seals. The seals taken numbered 22,546, mostly 3 years of age. The usual fall killing, beginning October 20, will add some hundreds to the skins available for sale.

As a result of extensive experimental work in 1920 certain innovations and improvements in the taking and handling of fur-seal skins were developed and put into effect along practical lines in 1921. It was found that the highest grade of finished product could be secured by removing the pelt from the carcass with the least possible use of the knives, thus practically eliminating all cuts or flays on the underside of the pelt previously unavoidable at times even by the most skillful skimmers. This was accomplished by suspending the seal from a tripod, cuts being made around the flippers, head, and down the abdomen, and the skin then being simply stripped off the carcass. In continuance of the new methods, the skins are then blubbered and washed in sea water before salting, the experiments last season having shown the great advantage of washing the pelts. An improved method of spreading and stretching them at the time of salting has also been tried. By another year it is contemplated that all skins will be taken in accordance with the new and improved processes, for which special facilities have had to be provided.

#### SALE OF SEALSKINS.

In the fiscal year 1921 two public auction sales of fur-seal skins were held at St. Louis. At the sale on February 21, 1921, 10,120 skins brought \$355,689, and on May 23, 1921, 10,060 skins were sold for \$359,715, a total of \$715,404. The lower prices received reflected the general depression in the fur markets of the world.

At the sale on February 21, 1921, there were also sold 111 sealskins from the Japanese herd on Robben Island, representing the share of the United States in the skins taken in the years 1918 and 1919. The 111 skins brought \$3,434.

As a net result of the sales of fur-seal skins in the fiscal year 1921 there will have been deposited in the Treasury of the United States the sum of \$341,543.46. In addition to this amount the sum of \$123,058.42 has been set aside for payment to Great Britain and Japan as their share of skins to which they are entitled under the North Pacific Sealing Convention of 1911.

#### FOXES AND REINDEER.

A valuable natural asset on the Pribilof Islands are the herds of blue foxes. The animals have to be held in check, and the taking of a certain number of pelts each winter is desirable. Under the plan in effect on St. George Island, involving the systematic feeding of the foxes during the winter on preserved seal carcasses, the herd has increased steadily and further improvement may be expected.

The foxing operations in the winter of 1920-21 were most satisfactory. Blue foxes to the number of 1,125 were taken for their skins, together with 14 foxes in the white phase. This is the largest number of foxes taken since 1892-93, when 1,301 skins were reported by the lessees of the islands.

During the past winter 240 pairs of the best blue foxes entering the large trapping inclosure on St. George Island were released as breeders.

The fox skins taken in the season of 1919-20, numbering 901 blues and 37 whites, were sold at public auction in St. Louis on February 21, 1921. The price realized was \$80,699, an average of \$88.12 for blues and \$35 for whites.

The introduction of reindeer on the Pribilof Islands in 1911 has proved very successful. The original stock consisted of 40 animals. The most recent computation indicated 192 on St. Paul Island and 125 on St. George Island, or 34 more than the number reported for the previous year. These figures do not include 53 animals used for food purposes during the intervening period. The herds are becoming more and more valuable as a splendid source of fresh meat for both the whites and natives.

#### MISCELLANEOUS.

##### SEMICENTENNIAL OF THE BUREAU.

The Bureau of Fisheries attained the fiftieth year of its existence on February 9, 1921, having had its origin in a joint resolution passed by Congress on February 9, 1871.

At the time of its establishment, and for many years thereafter, the Bureau was an independent commission and its duties were largely investigatory. Scientific investigation, the initial function imposed on the service by law, has remained a prominent branch of the work, recognized as an essential aid to fish culture and the fisheries. From time to time in the early years Congress imposed new responsibilities and duties, and the growth was rapid. The collection of statistics of the commercial fisheries, which was undertaken at an early date to meet a pressing national need, soon expanded into a comprehensive study of all phases of the fisheries which reached a high degree of progress in the second decade of the

Bureau's existence, and in more recent years has been extended and amplified, with a view to supplying practical aid to the fishing industry.

The early investigations of the food-fish resources of the coastal and interior waters of the country, undertaken in response to acts of Congress, convinced the first Commissioner that, with the control and regulation of the fisheries vested in the various States, an important rôle for the Federal Government to play in the maintenance of those resources was in the field of artificial propagation. This soon became the most extensive branch of the service, and has continued to employ the most people and receive the largest appropriations, but in the organization and administration of the Bureau fish culture has never been more than a coordinate division of the work. In 1910 there was imposed on the Bureau for the first time responsibility for the administration of protective laws, when the fishes and fur seals of Alaska were transferred to its custody.

The early operations of the Bureau attracted to its service an able corps of men who became pioneers in various branches of fish culture, aquatic biology, and fishery technology, and who gave to the work a trend and character which have continued to serve as a guide.

As evidence of the scope and character of the Bureau's activities during the 50 years of its existence, there has been issued an analytical subject bibliography of its publications from 1871 to 1920, inclusive. This document lists many thousand separate titles covering the fisheries, fish culture, aquatic biology and physics, oceanography, fishery legislation and protection, etc., constituting the most extensive series of reports in this field ever published.

#### NEW BUILDINGS AND IMPROVEMENTS.

A very satisfactory new fireproof building has been constructed at the Woods Hole (Mass.) station, under a contract awarded January 6, 1921, for \$51,000. The new structure replaces a storehouse and machine shop destroyed by fire and an old boiler house and pump house which had become so permeated with dry rot that it had to be demolished. From the special appropriation provided for this purpose the equipment, machinery, and stores consumed by the fire have been replaced, a salt-water filter has been provided, and various other improvements have been brought about.

The balance of the special appropriation for the Bozeman (Mont.) station after the repairing of the superintendent's residence was used for the purchase and erection of a bungalow for the foreman containing five rooms, a cellar, and a spacious attic.

The new laboratory building of the fisheries biological station at Fairport, Iowa, has been completed and equipped and has been actively used for the purposes for which the station was established. Formal acceptance of the building from the architect and its dedication to the service of the fisheries occurred on October 7, 1920. The structure, which replaces a frame building destroyed by fire in 1917, is of concrete, stone, and brick, is about 100 by 50 feet, with three stories and basement, and is superior to the old building in respect to capacity, convenience, and serviceability. The normal ac-

commodations for 16 investigators may be increased as circumstances demand. Among the useful features are a library, a chemical laboratory, a photographic room, a museum, a mess hall and kitchen, and tank and aquarium rooms, in addition to offices.

At the beginning of the year reconstruction work at the Baker Lake (Wash.) station was well under way, and though hampered by difficulties in transportation and by high prices of material and labor has progressed to a point where the station is again on an efficient working basis. In addition to the hatchery described in the last report a bunk house, sawmill, and workshop have been erected, all of which are of frame construction with iron roofs. Practically all the tools and appliances, including nets, seines, hatchery equipment, and furniture of all kinds, were destroyed and have been replaced. Communication with Baker Lake station is by means of pack horses over an 18-mile trail, and the large amount of heavy material needed in the reconstruction of the plant has made it necessary to undertake considerable improvements to the trail, including the rebuilding of bridges, corduroy work over swampy portions, and grading at other points.

The construction work at the Yes Bay (Alaska) station has included the installation of a new water-supply system, the main line consisting of about 4,000 feet of 16-inch and 18-inch wood-stave pipe for conveying water to the hatchery and ponds, with 1,250 feet of 6-inch pipe to supply water for domestic use and fire protection. New foundation timbers have been laid under the hatchery, the worn-out floors of the building have been replaced with new ones, 240 hatching troughs and a 196-foot supply trough have been constructed, and important repairs have been made to other buildings and equipment.

#### VESSEL SERVICE.

Owing to the Bureau's inability to secure qualified personnel for investigation and research work, the operations of the steamers *Albatross* and *Fish Hawk* were restricted during the fiscal year. The *Albatross* (excepting one trip in connection with the Chesapeake Bay survey, when the *Fish Hawk* was in quarantine) was not actively engaged and advantage was taken of the opportunity to make needed improvements to the crew's quarters, to modernize sanitary arrangements, to repair and strengthen deck houses, to replace sounding and dredging gear with approved appliances, and to renew the equipment generally. The ship has been lying at the Coast Guard depot at South Baltimore, and the advisability of placing her out of commission and releasing her naval officers and crew is under consideration.

The physical and biological survey of Chesapeake Bay, undertaken in the previous year, was continued by means of the steamer *Fish Hawk*, and has been practically completed in so far as need for that vessel is concerned. Seven trips, extending the entire length of the bay, were made, with a total mileage of 2,275. The plan of the work embraced observations at about 35 stations, and while each one was not occupied on every trip, 190 stations were made in all and 29 stations were made by the *Albatross*.



During the fiscal year three cruises were undertaken by the steamer *Halcyon*—two for the purpose of oceanographic investigations in the Gulf of Maine and one at the request of Massachusetts fishing interests in an endeavor to locate schools of mackerel. The latter cruise occurred in August and covered some 1,000 miles of fishing grounds in the Gulf of Maine and to the southwest and west of South Shoal Lightship. The results were almost entirely negative. The vessel was accompanied by practical mackerel fishermen who represented the Gloucester Board of Trade. The oceanographic cruises were made in December, January, and March, and were under the charge of Dr. Henry B. Bigelow. None of the trips was of long duration, but 23 stations were occupied with the use of appropriate apparatus and 1,286 miles were steamed between Cape Cod and Nova Scotia. During July and August the vessel was overhauled and contemplated improvements were completed. She is now equipped with a single drum hoist for dredging purposes and a complete electric-light system.

The auxiliary schooner *Eider* performed excellent service during the year as a tender for the Pribilof Islands, 10 round trips having been made between Unalaska and the islands for the transportation of cargo and passengers and one trip to King Cove. In November, 1920, it was necessary for the vessel to go to Kodiak for repairs which could not be made at Unalaska. The vessel was at sea every month in the year and cruised about 7,800 miles.

The small fishery patrol boats *Murre* and *Auklet* were engaged the greater part of the year in their usual work in southeastern Alaska for the protection of the fisheries. Transportation was afforded to a number of employees of other Government bureaus. In May the two vessels maintained a patrol in the vicinity of Sitka for the protection of the migrating fur-seal herd. The *Auklet* made a trip to Prince Rupert during May for the purpose of procuring foodstuffs needed by merchants of Wrangell and Ketchikan to relieve the shortage resulting from the steamship strikes. In June the *Auklet* towed the *Osprey* from Wrangell to Seattle and on the return trip towed the *Petrel* from Seattle to Wrangell. Each of the two boats cruised about 4,400 miles.

The *Phalarope*, *Gannet*, and *Shearwater* were occupied as usual in fish-cultural work, the first two on the New England coast, the last on Lake Erie.

The motor boats obtained by transfer from the Navy have been renamed, and two, the *Petrel* (formerly the *Cobra*) and the *Merganser* (formerly the *Calypso*), have been transported to Puget Sound on a naval collier and prepared for fishery patrol work in Alaska. A third, the *Curlew* (formerly the *Polly*), has been taken to Cape Vincent, N. Y., and is doing good service in connection with the fish-cultural operations on Lake Ontario. The *Fulmar* (formerly the *Wachusett*) is being fitted out for similar duty on Lake Michigan.

## APPROPRIATIONS.

The regular appropriations for the support of the Bureau of Fisheries for the fiscal year 1921 aggregated \$1,216,310. The specific purposes for which the appropriations were made and the amounts thereunder were as follows:

Salaries.....	\$448,810
Pay of officers and crews of vessels for Alaska service.....	28,000
Miscellaneous expenses:	
Administration.....	11,000
Propagation of food fishes.....	400,000
Maintenance of vessels.....	120,000
Inquiry respecting food fishes.....	45,000
Fishery industries.....	7,500
Protecting sponge fisheries.....	8,000
Protecting seal and salmon fisheries.....	140,000
Special appropriations:	
Fur-seal islands, repairs and improvements.....	10,000
Fairport (Iowa) biological station, equipment.....	5,000

Deficiency appropriations as follows, amounting to \$13,775, became available during the year:

Maintenance of vessels.....	\$4,422
Protecting seal and salmon fisheries.....	9,353

In accordance with law, a detailed statement of the expenditures under the regular and deficiency appropriations will be duly submitted.

Respectfully submitted.

HUGH M. SMITH,  
*Commissioner of Fisheries.*

To Hon. HERBERT HOOVER,  
*Secretary of Commerce.*

