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THE LATENT FISHERIES OF WASHINGTON AND ALASKA [1]

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The marine fisheries of the section of the Pacific coast upon which I have been asked to report are, at the present stage of their development, some of the most productive of any similar area in the world. In the course of a year Washington and Alaska produce about one billion pounds of fish and fisheries products. This is a sizable portion of the Nation's production of animal protein, and is not being ignored in the planning of the Nation's food supply in these critical times. Therefore it may sound peculiar to hear me say that there is no section of the northern hemisphere of similar productive possibilities whose marine fisheries are less intensively prosecuted. Yet such is the case. We hear much of the tremendous fisheries of Alaska, but some 98 per cent of the product of those fisheries are salmon, herring, and halibut (Table 1). Of the 500-odd species of fish, and numerous edible shellfish, inhabiting the waters of Alaska and the Bering Sea only some 27 are fished upon commercially, and only 14 of these produce a million pounds or more annually. It is the purpose of this report to point out, within the limits of present knowledge, those fisheries which can be depended upon to produce more heavily, the general area where they can be developed, and to suggest means by which they can be exploited.

TABLE 1. THE CATCH OF FOODFISH AND SHELLFISH IN ALASKA IN 1937, 1938 AND 1939 *

Species	*1937 weight*	*1938 weight*	*1939 weight*
Salmon	593,384,000 pounds	583,706,000 pounds	452,166,000 pounds
Herring	206,446,000 pounds	179,735,000 pounds	185,462,000 pounds
Halibut	13,281,681 pounds	13,930,142 pounds	13,565,387 pounds
Cod	3,999,230 pounds	3,368,316 pounds	3,383,109 pounds
Clams	816,942 pounds	1,029,588 pounds	425,205 pounds
Crab	711,318 pounds	483,276 pounds	305,498 pounds
Shrimp	463,385 pounds	435,801 pounds	438,193 pounds
Trout	61,999 pounds	78,732 pounds	55,161 pounds
Sablefish	2,102,967 pounds	909,234 pounds	1,713,331 pounds
Rockfish	16,843 pounds	4,376 pounds	69,813 pounds
Flounders	180,000 pounds	232,145 pounds	30,323 pounds
Lingcod	3,007 pounds	2,154 pounds	1,080 pounds
Smelt	275 pounds		
Oysters			52 gallons
Totals	821,467,667 pounds	789,914,764 pounds	657,565,000 pounds

* These figures are taken from Bower (1938, 1939, and 1940). Some represent round weight, some dressed weight, some dried weight, and some the cut-out canned weight. The reader is referred to the original sources for more detailed presentation.

[1] This paper was presented at the symposium "Resources of the sea for wartime economy" at the meeting of the Oceanographic Society of the Pacific, held in Salt Lake City, Utah, June 17, 1942. and was published in California Fish and Game, Vol. 28, No. 4, Oct. 1942 (182-198) by Division of Fish and Game, Department of Natural Resources, State of California. Dr. Chapman is now Curator of Fishes at the California Academy of Sciences, on leave while engaged in Fisheries Research for the Board of Economic Warfare.

Aside from the few heavily fished species, little concrete knowledge has been available regarding the distribution in commercial quantities of Alaskan fishes. It has been the speaker's good fortune to examine an excellent manuscript, as yet unpublished, describing the results of the Alaska Crab Investigation of the U. S. Fish and Wildlife Service, and for this he is indebted to Mr. Roger Harrison, in charge of that investigation. Mr. H. A. Dunlop, Director of Investigations of the International Fisheries Commission has kindly given permission to examine unpublished data gathered by that organization. Dr. W. F. Thompson, Director of Investigations of the International Pacific Salmon Commission has given much oral information based on his years of experience in the Northeast Pacific. Such other information presented as is not available in the published literature is based on the personal experience of the speaker and oral information from numerous fishermen and fisheries biologists, who equally draw their living from the North Pacific.

Few general statements can be made regarding the present fishing intensity on any single species along the coast line extending from the Columbia River to Bering Straits. For instance the halibut is fished very intensively off British Columbia and southeastern Alaska. Yet in the southeast Bering Sea, where it is known to be in commercial abundance, it is unfished. The gray cod is fished commercially in Washington, yet the center of abundance is more than 2,000 miles to the northwest in Bering Sea, where it occurs in quantities comparable to those found on the Grand Banks. In general the intensity of the fishery for all species, except for such valuable fish as the salmon, decreases in proportion to the distance from Seattle, and only a relatively few are prosecuted at any great distance from that port. Fifty-five species of fish and shellfish are fished commercially in the State of Washington. All of these species except two are present in Alaska, and, for the most part, in much greater quantities than in Washington; yet only 24 of them are fished at all in Alaska, and only 12 are fished to any considerable extent.

Latent Fisheries of the State of Washington

The commercial fisheries of the State of Washington are rather highly developed. Many of them must be guarded carefully to see that overfishing does not reduce the supply, and the emphasis in most cases must be on restraining the fishery, not in encouraging it to further expansion. Yet there are others which can be made to produce more heavily without neglecting proper conservation principles, and there are some that have been relatively untouched up to the present time.

Skates:

Two species of skates (*Raja binoculata* and *R. rhina*) are present in commercial quantities in Puget Sound and along the open coast. At present they are being fished heavily, in common with the other elasmobranchs of the coast, for the vitamins in their livers. The carcasses are either thrown away at sea or made into fish meal. Little use is made of the excellent meat of the wings.

until this year it is probable that the landings will be in excess of 10,000,000 pounds. The maximum development of the fishery has not yet been reached by any means, because all species taken are not now landed and the potential grounds are not as yet exploited. In the early years of the fishery practically all of the landings were of the cape sole. The other species, which were also caught in abundance, were discarded, although those same species formed the backbone of the Puget Sound fishery. Most of the production is brought in from the banks near the mouth of the Strait of Juan de Fuca. The stocks of fish off Grays Harbor and the Columbia River are just beginning to be fished. Fish are still abundant enough that the fishermen need not venture to the farthest banks, nor is it necessary to bring in the lower priced species. To date the expansion of the fishery has been impeded by the lack of development of the market, and of the proper means of handling the catch, rather than as a result of the limitation in the supply of fish. It is probable that the present wartime prices will serve to stimulate the fishery to its proper proportion without other effort.

Mackerel:

The mackerel occurs in considerable quantities along the open coast of Washington in the spring and summer at least, in with the schools of pilchard. Numbers of mackerel are brought in incidental to the landings of pilchard, but they are not sorted out of the catch and, if the catch has been in the hold for more than a few hours, the mackerel are no better fitted for human consumption than are the pilchard. They pass on into the reduction plants. There is no regular fishery for the species, and few of those brought in from other fisheries are marketed.

Black Cod:

The black cod, or sablefish, occurs in large concentrations along the coast of Washington and British Columbia. From 2,500,000 to 3,000,000 pounds are landed annually in Seattle, but those catches are, in large part, made incidental to the halibut and flounder fishery. Without a doubt the species could produce a great deal more than it now does along our coast. We are faced here with the same problem that prevents the development of some of the hook and line fisheries of Alaska, and that is that under the present regulation of the halibut fishery of the North Pacific the vessel owners voluntarily restrict the trips which each boat makes to the banks. Therefore during the regular halibut season the fisherman fills his limited hold space with the most valuable species, the halibut. Recent changes in the halibut regulations to allow black cod fishermen to land a certain portion of their fare as halibut after the regular halibut season is closed has resulted in stimulating the black cod fishery.

Rock Cod:

Thirty species of rock cod (*Sebastodes* and *Sebastolobus*) occur in the waters of Washington. *Sebastodes caurinus* and *S. maliger* form the basis for a growing sport fishery and a moderate commercial

It should be mentioned also that a tremendous wastage of food results from the dogfish shark, soup-fin shark, and other elasmobranchs along our coast. A process has now been developed by the Columbia River Packers Association for the smoking of the flesh of the soup-fin shark on a commercial scale, and the product is said to be as tasty as could be desired. The successful marketing of this product would bring another large fishery into full production. The principal difficulty with the processing of all elasmobranchs is that there is such a high retention of the nitrogenous products of metabolism in the body that when the fish are held for any length of time after landing ammonia is given off in copious quantities. During the last war dogfish shark were canned as grayfish, but due to the lack of technological advancement in the trade at that time the canned product was not satisfactory because of ammonia liberation in the container. The difficulty with most elasmobranchs is not one of taste but of the technology of their processing, problems that are susceptible to scientific study and successful treatment.

Anchovy:

The northern anchovy occurs in tremendous schools off the coast of Washington and in Hood Canal. Not infrequently they are met with elsewhere in Puget Sound in commercial quantity. In the summer months, at least, they enter Grays Harbor and Willapa Bay and the mouth of the Columbia River in enormous schools. While scouting for pilchard by airplane last year during the height of that fishery off the Washington coast the schools of anchovy, which for the most part lay close inshore, seemed much more extensive and regular in appearance than did the pilchard. They were a continual source of annoyance to the pilchard fishermen because they are of just the right size to gill in their seines. I saw one boat come in last summer with about 14 tons of anchovy gilled in their net. They were two days working with a steam hose getting their net back in shape for fishing. I think that it would be no exaggeration to say that along the Washington and British Columbia coasts the annual take of anchovy would be measured in thousands of tons if the market would absorb them. They are every whit as tasty as the European species of the same genus, which, before the war, brought such high prices in our delicatessen stores. Here again the problems are of a technological and marketing nature; there would be no trouble with the supply. At the present time their only use is for bait in the albacore fishery off Oregon and Washington.

Flounder:

A number of species of flounder, called "sole" by the trade, are fished commercially in Washington. Chief among these are the Cape sole, English sole, rock sole, starry flounder, flathead sole, rex sole, C-O sole, slippery sole, bastard halibut, etc. The fishery was long ago brought to its maximum production in Puget Sound, although the fishery was, and is, unevenly distributed upon the various species. But the development of the otter trawl fishery off the open coast did not start until 1935. Since that year it has increased by leaps and bounds

fishery in Puget Sound. Other species occur in limited, but commercial, quantities in these enclosed waters. However, it is off the ocean coast that these fish are most abundant. There *Sebastodes rubrovinctus* and *S. pinniger* are met with, as well as other species collectively called by the fishermen "red snappers," or "canary birds." Scarcely a more delectable fish swims the sea, but except for certain periods, the catches are mostly made incidental to the halibut and otter trawl fisheries.

Sea Cucumber:

The sea cucumber (*Stichopus californicus*) forms the basis for a small fishery in Puget Sound, where it is canned as "rollops." The product is tasty, but the fishery has never been developed to approach maximum productivity. The species is abundant throughout Puget Sound, and, for that matter, along the British Columbia and Alaska coasts. Sea cucumbers form the basis of an extensive fishery in the South Seas where they are dried under the name of "Trepang." They are also considered something of a delicacy by Alaskan natives.

Crab:

The crab of commerce in Washington is the Dungeness crab. The species is now landed in excess of 3,000,000 pounds annually, but the maximum productivity of the fishery has not yet been reached. The fishery is developing rapidly, however, under the impetus of the high prices caused by the stoppage of Japanese imports of canned crab, and it will soon be necessary to restrict, rather than encourage, production.

A second species, the red crab (*Cancer productus*), is found in abundance in Washington waters but is not fished at all. It is smaller than the Dungeness crab and is therefore ignored, but it compares favorably in size with the highly touted blue crab (*Callinectes sapidus*) of the Atlantic coast and will undoubtedly form the basis of a fishery in the future.

Abalone:

The green abalone (*Haliotis wallalensis*) occurs in abundance along the open coast of Washington and British Columbia. In Washington it supports no fishery whatever and it is probable that because of its habitat (rocky coasts mostly below mean low water) relatively few people know of its existence. While smaller in size (5½ to 6 inches) it is no less tasty than its southern relative, the red abalone, which is so highly esteemed in California.

Octopus:

The fishery for octopus produces about 50,000 pounds a year in Washington. The production could be increased many times if the market were developed. Nearly all the catch now comes from a restricted area around Port Angeles, although the abundance of the species is no greater there than elsewhere in Puget Sound. Few people realize how delicious chopped octopus is in chowder, cocktails, or salads.

Latent Fisheries of Alaska

While the fisheries of Washington are important, they do not, and never will, compare in productiveness with those of Alaska. They produce scarcely a fifth as much poundage as do those of that territory, and, while they are well developed, those of Alaska have only been touched. Few people realize the extent of the coast line of Alaska, or that its nearly 8,000 miles of coast line is longer than that of the eastern sea coast of the United States. When one travels without a halt night and day for two weeks in a halibut schooner without getting half way along the coast, the enormous size of the territory becomes apparent. In all these waters edible fish and shellfish occur in profusion. The hordes of salmon that inhabit every creek and river in the territory are famous the world over. Less well known are those gardens of the sea, the offshore banks, such as the Yakutat Grounds, Portlock, Albatross, Sanak, Baird, Slime Banks, etc. What the rolling countryside of Iowa is to the farmer, so is the fertile plain of the eastern Bering Sea to the fisherman. Had I the choice of the land of Alaska with its rich mines, farm lands, timber, furs, etc., or its waters, I should not hesitate a moment in taking the latter. Mines once worked are done, forests once cut are slow in regrowing, but year after year into eternity the seas of Alaska can be made to give up 1,000,000,000 to 2,000,000,000 pounds of fish. Developed with any care at all there could be no exhaustion.

The salmon, herring, and halibut which yield more than 95 per cent of the present catch of fish in Alaska are being exploited to such an extent that constant care must be exercised to prevent their depletion. Little additional can be expected of them without cutting into the spawning stock, and of them I shall speak no more. Nor will I refer to the numerous "minor" fisheries which will one day bulk large in the total output of Alaskan waters. I shall speak only of those fisheries, now relatively undeveloped, which can be depended upon to be great fisheries, with annual landings counted in millions of pounds. These are the crab, trout, gray cod, pollack, rock cod, and black cod.

Crab:

Three types and four species of crab of commercial size occur in Alaskan waters: two species of king crab, the Dungeness crab, and the Tanner crab. Other species of edible crab occur, but of these four species the prospecting for occurrence is well started, thanks to the Alaska Crab Investigation of the Fish and Wildlife Service, the methods of canning are worked out, and the market is available and crying for the product.

For many years the United States has been largely dependent upon Japan for canned crab meat. Imports of canned king crab in recent years have accounted for 95 per cent of the canned, and over half of the entire crab meat consumption of the United States. In the past 30 years the United States has paid to Japan more than $100,000,000 for canned crab meat. The peculiar part of this is that a large part of the Japanese pack came from those parts of the Bering meat in that area could dare put up a large pack in the face of his high costs and the Japanese control of the American canned crab meat market. It is well known in the fish trade that the very large stocks of Dungeness crab that are exploited along the California, Oregon, and Washington coasts continue along the coasts of British Columbia and southeastern Alaska to Prince William Sound, and that the stocks in the north are practically untouched. The results of the Alaska Crab Investigation (Table 3)* confirmed this and also showed them to be abundant around Kodiak Island, and present along the south side of the Alaska Peninsula.

The Tanner crab has not yet been exploited at all in Alaska. Yet the Crab Investigation actually caught more of them than they did of the two species of king crab for which they were fishing. They were found in particular abundance in southeast Alaska, Cook Inlet, around Kodiak Island, in Canoe Bay (on the south side of the Alaska Peninsula), and in the Bering Sea north of the Pribilof Islands. How valuable a part of the Alaskan stock of crab this species will represent when the fishery is developed can only be conjectured, but it will not be small.

Trout:

Two species of trout occur in abundance in the marine waters of Alaska, the Dolly Varden and the steelhead. In 1939, 55,161 pounds of trout were recorded as having been caught in Alaska, and sold, and in 1938, 78,732 pounds. Many are the salmon traps in Alaska where that poundage of trout is discarded each season, not only as waste but as a nuisance. Dolly Varden are so abundant to westward as to be thought by some to be a serious detriment to the stocks of salmon. For years the Fish and Wildlife Service paid a bounty on this fish to encourage the lessening of its abundance. Yet no commercial fishery has been developed for it. The quality is good, but trout are more difficult to process than salmon, and cold storage facilities are not developed to an extent necessary to handle a large frozen pack.

It should be pointed out here that from the standpoint of conservation no qualms should be felt for instituting a fishery for trout in the marine waters of Alaska. Every species and stock of fish will support a fishery of some size without becoming diminished to extinction, in the same way that a herd of cattle will yield beef without being wiped out. Failure to harvest this surplus is no less poor conservation than overfishing, and about as sensible as letting a herd of beef cattle increase until they have eaten all the grass off the range and died of starvation. Because trout are hard to get in Pennsylvania, Wisconsin or Montana, is no reason why they should be allowed to go to waste in Alaska. That is not conservation.

Cod:

The gray or true cod is found in moderate to great abundance along the entire Pacific Coast from northern California to Bering Strait, but in its southern range it tends to be small, not particularly good in quality, and restricted in quantity. On the banks from Kodiak Island to westward the reverse is true, and in the vast stretches of

*See p. 9.

Sea that we consider American and were taken to Japan for subsequent shipment to this country. Furthermore the Japanese have manipulated the American market with sufficient care that American producers could not risk the hazards of packing our own crab for our own market. The onset of war has abruptly altered the situation by stopping Japanese exports. Domestic canned crab which before the war brought $9 per case, and had been at times depressed to $6, now brings $16 and the demand can not be filled.

The Alaska Crab Investigation (Tables 2 and 3)* found a large population of king crab in Bering Sea, and smaller but still commercially important, stocks in Pavlof and Canoe Bays on the south side of the Alaska Peninsula, around Kodiak Island, and in lower Cook Inlet. Two hundred and thirteen experimental hauls with an otter trawl, scattered over an area of 100,000 square miles in Bering Sea, yielded 19,164 king crab for an average of more than 80 crab per hour of fishing. When it is remembered that these crab average about 6.5 to 11.5 (males) pounds each the amount of meat in this area becomes clearer. In thinking of the results of this investigation it must be born in mind that they were prospecting hurriedly over tremendous areas, not staying to fish where they located crabs. Their results are those of more or less random sampling and thus, to a degree, representative of the entire area. Under these circumstances it would appear that the available stock of king crab in this area is surprisingly large, and it is no wonder that the Japanese were able to make money fishing so far from home. The Alaska pack of king crab amounted to 7,600 pounds (dressed weight) in 1939 and 24,312 pounds in 1938, or, for practical purposes, nothing at all.

TABLE 2. SUMMARY OF KING CRAB CATCH *

Area	Trawl catch			Tangle net catch			
	Fishing efforts	Number of crab	Catch per effort per hour	Fishing efforts	Number of crab	Catch per effort	Actual catch by both gear
Southeastern	5	1	0.2	0			1
Yakutat	6	4	0.8	0			4
Kayak Island	11	0	0.0	0			0
Prince William Sound	40	184	6.4	3	34	11.3	218
Cook Inlet	43	939	23.1	16	541	33.8	1,480
Shelikof Strait	31	175	5.1	4	26	6.5	201
Kodiak Island	133	2,685	32.9	29	61	2.1	2,746
Shumagin Island and Alaska Peninsula	59	380	7.9	11	164	14.9	544
Pavlof Bay	44	2,886	69.8	16	410	25.6	3,296
Canoe Bay	88	6,801	136.8	14	1,054	75.2	7,855
Bering Sea (Area XI) inshore	133	12,492	80.3	48	3,607	75.1	16,099
offshore	80	6,672	83.4	0			6,672
Bering Sea (Area XII)	26	150	6.2	0			150
Total	699	33,369		141	5,897		39,266

* This table is abbreviated from Table 1 of the Report of the Alaska Crab Investigation. The reader is referred to that source for a proper understanding of the figures. The fishing efforts of the first column do not include efforts when the net snagged or fouled. The fishing efforts of the fourth column each include two shackles of gear, each 100 fathoms long and each effort represents 30 to 45 minutes of vessel effort.

The Alaska fishery for Dungeness crab has simmered along for years producing from 300,000 to 500,000 pounds of meat per year, most of which was sold as fresh picked meat. No canner of crab

the eastern Bering Sea there is an amazing quantity of these fish, large in average size, and of first class quality. The Alaska Crab Investigation in 213 hauls with an otter trawl, which was hung to catch crab, and which were scattered all over the area, averaged 30 cod per haul.

As Pacific fisheries go the fishery for cod in Alaska is an old one. Records of catches are available back as far as 1863. It is not now an inconsiderable fishery, for in the neighborhood of 12,000,000 pounds (round weight) are caught annually. But these landings are not a reflection of the abundance of the fish; they represent, rather, the lack of a properly developed market. During the last war, when prices were high, the annual landings stayed above 3,800,000 fish from 1914 to 1919, or about 40,000,000 pounds per year. In this most expanded period of the fishery only from 15 to 21 vessels were engaged in it (Cobb, 1927), and certainly no considerable portion of the known cod banks were heavily fished. What can be expected from the cod fishery of Alaska in the future is anybody's guess, but it will certainly exceed by far anything that it has produced in the past. The Bering Sea has not been fished commercially for cod far north of the Slime Bank and the banks along the Aleutian Islands have never been put into production. Commercial fishing, because of the labor involved in longlining, has always followed most intensively the shallow banks, and has seldom reached into waters over 75 fathoms in depth, although it is known that the fish are abundant in considerable depths and that those fish are larger and of better quality than those from the shallower banks.

To my mind the proper development of the cod fishery has always been impeded by the manner in which the product is processed and the shape in which it reaches the market. I imagine that the Basque fishermen, who are said to have fished cod on the Grand Banks before Leif Erickson visited those parts, were putting up a product comparable in quality with some that I have seen offered for sale. Those people who like salt cod think it wonderful, but those people are decreasing in numbers all over the world and it is not practical to expand a fishery for a declining market. What is needed worse than anything else is a new approach to the packaging and processing of cod which will permit placing on the market anywhere in the world a product that can compete on even terms of attractiveness with any other fisheries product. Then the cod fishery would not have to depend upon the cheap Old World and Midwest markets, where ignorance of what good fish taste and look like is a strong selling point.

Pollack:

The Pacific pollack occurs in similar quantity as the cod, and over the same range on our side of the ocean. From the little that is known about its abundance it apparently follows the cod in being most abundant in the Bering Sea and on the banks south of the Alaska Peninsula. It is said to occur in incredible numbers in the Bering Sea, where it is reported to be a mainstay in the diet of the huge fur seal herd in its northern range (Lucas, 1899), and according to Cobb (1927), "Alaska pollack seemed to be the main food of the cod." The Alaska Crab Investigation in 239 otter trawl hauls all over the eastern Bering Sea

caught 73,300 pollack, or an average of 307 per haul. In spite of the great quantities of pollack known to exist, and its good taste, it has never been caught commercially.

Two other species of cod-like fish occur in abundance along the northern part of the Pacific, the tom cod and the hake. The tom cod, while small, is an excellent food fish. The hake, which to my taste is nothing to get excited about, nevertheless supports a large fishery in the Atlantic, and will do so one day in the Pacific. At the present time the fresh market absorbs a few tom cod, but no hake are caught commercially in the North Pacific.

Except for those fishes that come close to shore, or ascend streams to spawn, the public at large is not aware of the great abundance that fish life assumes in northern seas. This is especially true of the bottom or subsurface feeders like the cod-like fishes and the flatfish, which, while they occur in bays and inlets, are typically fishes of the high seas. It remains for the deep-sea fishermen, and the biologists who follow their efforts, to appreciate this wealth of food which is going to waste. An experience I had in May of 1940 is a case in point. Hake are not thought of as abundant in Washington waters. One morning just after daybreak I came out on the beach at Seaview to dig razor clams and found to my surprise that the beach for about 10 miles was covered with large hake that had apparently chased a school of anchovy into shallow water and had been stranded by the receding tide. In the two miles between Seaview and Long Beach I counted more than 2,200 of these fish, which average about five pounds in weight.

Flounder:

It is hard to say which of the Alaskan fisheries of which I am speaking will be the most productive when they all become fully exploited, but that for flounders will be among the greatest, and it will dwarf in size the fishery for that other flatfish, the halibut, for which the North Pacific is now famed. Twenty-seven species of flatfish other than halibut occur in Alaska and the Bering Sea. Most of these are present not only in commercial abundance but in great abundance. If I did not have figures of actual catches to give you I should not attempt to describe the quantities of flounder available in those waters, for you would simply not believe me.

Let us again refer to the results of the Alaska Crab Investigation (Table 3). In 669 hauls with an otter trawl, scattered all along the coast of Alaska from Southeastern, Yakutat, Shelikof Strait, Kodiak Island, the Shumagins, along the south side of the Alaska Peninsula, and all over the Bering Sea to as far north as St. Lawrence Island, and over all types of bottom, they caught 769,000 pounds of flounder, or an *average* of better than 1,100 pounds per haul. They not only were not fishing for flounder, but those fish were a nuisance to their work, to be avoided when possible. They say: "In Bering Sea the quantity of edible flatfish was phenomenal. Two hundred and forty tows, spread at random over more than 100,000 square miles of area, at depths ranging from 10 to 60 fathoms, averaged almost a ton to the drag. In the more productive sections of this area, average catches often ran as high as 2 tons, and single tows as high as 9,000 pounds were recorded.

seine, which is built to fish at, and shortly below, the surface, is the last type of gear one would pick to catch rock cod, but these three boats hit the jack-pot. It is probable that 8,000 fish would not be an exaggeration of their combined catches. The men on one boat were well into the afternoon clearing their net. All of the fish were, of course, thrown away, and I have pictures of the ocean as far as can be seen covered with the floating white bellies of the dead fish.

There would be no point with the present restricted data in discussing the relative abundance of the different species of rock cod. This will undoubtedly vary greatly from area to area, with the type of bottom, and with the depth. In the halibut fishery of southeast Alaska and British Columbia it is probable that *Sebastodes ruberrimus*, a large species, and *S. pinniger* predominate.

TABLE 5. FISH CAUGHT ON HALIBUT GEAR FROM THOMPSON (1916)

Date	*March, 1915*				*December, 1915*		*Total*
Halibut	37	44	31	26	35	20	193
Blackcod	22	4	22	11	11	13	83:
Arrow tooth halibut	8	16	7	12	1	0	44:
Dogfish	3	0	24	3	0	0	30:
Skate	2	2	2	3	0	0	9:246
Red cod	3	1	4	3	21	36	68:
Gray cod	2	0	5	4	0	0	11:
Chimaera	1	0	0	0	0	0	1:
Total fish	78	67	95	62	68	69	439
Species	12	12	13	15	15	15	

Little information is available on the fish actually taken by the halibut fishery besides halibut. Thompson (1916) lists a few catches (Table 5). It will be seen that other fish are taken in greater number than halibut, and that black cod and rock cod form a much more important part of the catch than is reflected in the landings. It should be kept in mind that most of these catches resulted after active effort of the halibut fishermen to avoid both rock and black cod, and for this reason no figures from the halibut fishery would accurately reflect the abundance of the other species. The landings of black cod from Alaska now run from one to two million pounds per year, and of rock cod less than 100,000 pounds. What will happen with these species is reflected in the tremendous expansion of the landings of the related rosefish of the east coast, where in a few years the fishery has developed from practically nothing to the point where about 150,000,000 pounds (round weight) are caught annually.

Such a brief review can not do justice to the latent potentialities of the fisheries of Alaska. I have not mentioned the clams, scallops, squid, shrimps, skates, "Atka" mackerel, smelt, etc., or the stock food that could result from a more complete utilization of the flesh of the herd of fur seals, that now includes more than 2,500,000 individuals. In reference to the latter herd of animals there can be made an interesting commentary on the lack of development of the fisheries of the northeast Pacific. From such data as are now available it would appear that this herd, at a minimum figure, consumes in excess of 2,500,000,000 pounds of fish and squid each year in the area from the Pribilof Islands to California. This is roughly the annual production of food fish by all the commercial fisheries in Alaska, British Columbia, Washington, Oregon, and California. Yet the complaints of fishermen

In contrast to the schooling of king crabs, which was pronounced during the mating and moulting season, the "sole" were spread quite uniformly over all the favorable bottom. They were taken in considerable quantity almost everywhere except where other organisms, such as starfish, sponges, or crabs, predominated."

Let us contrast this with the average catch per haul in the successful otter trawl fishery of Puget Sound. In 55 hauls listed by Smith (1936) (Table 4) the average catch was 250 flounders, or something less than 500 pounds per haul. This is a highly developed fishery in which the area of the fishery has been thoroughly prospected, the fishermen are experienced and specialized, and each haul is carefully laid in the area in which the experience of the captain indicates that the largest catch is to be made, not in a random manner as were those of the crab investigation. The coast of Washington is small in comparison with that of Alaska. Its rapidly expanding offshore otter trawl fishery has not yet reached its maximum development, but this year the State will yield about 10,000,000 pounds of flounder. Contrast this with the yield of the Alaska flounder fishery which in 1938 landed 232,145 pounds and in 1939 30,323 pounds, and you have an idea of the expansion that can take place in that fishery.

TABLE 4. LANDINGS OF FLOUNDER IN PUGET SOUND 1935-36 FROM SMITH (1936)

Location of hauls	*Georgia Straits*	*Bellingham Bay*	*Saratoga Passage*	*Hood Canal*	*Total fish*
Number of hauls	13	27	7	8	55
English Sole	494	887	3,457	338	5,176
Starry Flounder	1	803	621	13	1,438
Sand Sole	33	1,533	158	3	1,727
Flathead Sole	58	1,656	271	0	1,885
Bellingham Sole	34	2,083	12	1	2,130
Rock Sole	17	144	346	544	1,051
Arrowtooth Halibut	69	31	0	2	102
Sand dab	1	3	9	1	14
Slender Sole	0	0	25	0	25
Rex Sole	4	19	17	0	40
Cape Sole	0	0	1	0	1
C-O Sole	0	1	20	15	36
Halibut	1	0	0	0	1
Slippery Sole	3	2	5	0	10
Hybrid Sole	0	0	2	0	2
Total	715	7,062	4,944	917	13,638

Rock Cod and Black Cod:

The rock cod, or red snapper, and the black cod may be spoken of jointly because their habitat is more or less similar and the present method of fishing them is the same. They are both by-products of the set-line fishery for halibut.

Twenty-one species of rock cod are found in Alaska and Bering Sea. They occur literally everywhere that the water is salty, from the shore to depths far greater than it is possible to fish commercially. Next to halibut they are perhaps the most prominent feature of the hook and line fishery in the northeast Pacific. In the absence of adequate data it would be ridiculous to make statements as to their abundance, and I will merely say that it is tremendous. It is not an infrequent occurrence that the halibut men will haul in their gear and find on every hook a large rock cod, much to their disgust. One morning just after daybreak I saw three salmon purse seiners make sets within half a mile of each other on Swiftsure Bank. Now a purse regarding the depredations of seals on the food fishes along this coast are based almost entirely upon hair seals and sea lions. Seldom does one hear complaints about the fur seal, which generally stay out to sea and are not often found within 15 miles of the coast. Where do these animals get such a tremendous quantity of fish without interfering materially with our own efforts in that direction? Most of their food must be taken in Alaskan waters, and probably the greater share of it is taken in and about the Bering Sea, where our efforts are so slight. This situation does indicate, however, what an expansion can be made in the prosecution of the Alaskan fisheries.

In the present state of our National affairs the enumeration of the stores of fish which we have left yet to tap in the North Pacific has little more than academic interest unless these stores can be placed on the shelves of the grocers of the country. How is this to be accomplished? First by creating a demand which will raise the price high enough so that the fishermen will put their effort in on the fishery which it is desired to develop. The recent tremendous growth of the shark fishery along this coast is an example in point of how a fishery can grow to large size quickly under the stimulus of an increased price. The reason, of course, why the landings are not made now is that the fishermen can make more money with the same amount of effort fishing for the higher priced species, and there is not enough profit in the ventures to interest new capital and new fishermen. It is not simply a matter of cost in all instances, however. Some fish, such as rock cod and black cod do not keep under light refrigeration as easily as halibut do. Much research is needed on several species to develop methods of putting them in the hands of the consumer in as good a condition as when they left the sea. The careless handling of fish between the net and the consumer is probably the greatest single deterrent to the marketing of most fish, for a consumer who has been fooled once on a fish will not buy that kind of fish again. There is also the fact that the war has made it possible that the entire area of which I am speaking may be a theater of enemy action.

In these days no considerable new effort could be made toward the development of these new fisheries without the consent and desire of the National Government, because of the scarcity of boats, manpower, and everything from hooks to rope that a fisherman must have in his business. It will therefore be the task of the administration to decide whether these products are of sufficient value to the war effort to divert to them the materials and energy needed for their catching, and we will have fulfilled our function by pointing out that they lie there ready for the gathering. It is interesting to note, along these lines, that word has recently come from the administration that the Navy would cease requisitioning fishing boats along this coast unless the emergency became great; that the National Government has undertaken to insure the entire Alaskan salmon fishery this year against loss due to enemy action, in order to ensure the flow of this food resource; that it has been announced that the salmon canners will be permitted to obtain the tin-plate needed to put their product in; and that draft boards are deferring experienced fishermen. These items indicate that the administration is aware of the desirability of keeping up the flow of fish from the northeast Pacific. That any of the latent fisheries that I have

mentioned will be encouraged is, however, problematical at the present time because of the belligerant activities in the western Alaska and Bering Sea areas.

There is a fundamental deterrent to the development of the great fisheries of the Bering Sea either in peace or war time, and that is that the need for capital investment is far above the ability of the individual fisherman to provide. Therefore it can not be expected that these fisheries will be developed, as have most of the fisheries on both of our coasts, by the initiative and enterprise of individuals working generally on a slender shoestring for capital. The distances to travel and the hazards to be met and overcome are too great in proportion to the profits to be realized for the effort to be undertaken by any except adequately financed ventures. The Japanese have proven the practical nature of the mother ship and auxiliary fishing boat combination in these very waters, as did the British in the Greenland halibut fishery, and the various whaling ventures in the Antarctic. It is without doubt that the development of the crab, cod, pollack, and flounder fisheries of the Bering Sea will need to develop along these lines. The hand line will go, and in its place will be the great otter trawl, and the miles of gill and tangle nets. In the mother ship the flounders will be filletted and sharp frozen the cod cured and packed, the crab canned, and every scrap of offal saved for vitamins, meal and fertilizer. It will also be necessary for the industry to quit treating every fish that is caught as salmon or halibut, and to develop for the new products new techniques of processing, new ideas in packaging, and new methods of marketing which will be individually suited to each product. In this we would not go far wrong in following the experimental initiative shown by the Japanese in developing their export fish trade. They were able at least to catch our own fish and shellfish and sell them back to us at a nice profit. These, however, will be large undertakings, and the companies which start them must be well enough financed so that they can stand the losses that will almost inevitably ensue during the first year or two, while a background of experience is being built up.

With the resumption of a peace economy, if it ever is resumed, the fisheries of the Gulf of Alaska will develop naturally with the present methods as the markets develop.

May I interject here a few remarks concerning the treatment that our valuable and heavily exploited fisheries should receive during the period when the economy of total war is in effect. Until the last iota of effort is necessary to keep the people of our country and of our allied countries from starving to death no one would be willing to advocate the slaughter of our herds of cattle, the brood sows, the setting hens, or any other of our live stock that is needed for the reproduction of their kind. Yet it is inevitable that with the artificially high prices brought about by the war every administrator of fisheries in all of our maritime States will be under heavy and continuous pressure to relax the regulations which in too many cases are the only things that are keeping the now so badly needed fisheries from being destroyed entirely. Have we not got enough National sense to treat our fish stocks with the same amount of care that we give our live stock, and can we not forego the joy of the immediate profit for the greater long term good?

It is also necessary that in our vast new industrial developments we provide adequate safeguards for the fish stocks which will be affected. Anyone who has watched with his eyes open our rapid transi-

Common and Scientific Names of Organisms Mentioned in This Report

Abalone (green)	*Haliotis wallalensis*
Anchovy	*Engraulis mordax*
Alaska pollack	*Theragra chalcogramma*
Arrowtooth halibut	*Atheresthes stomias*
Atka "mackerel"	*Pleurogrammus monopterygius*
Barracuda	*Sphyraena argentea*
Bellingham sole	*Isopsetta isolepis*
Black cod	*Anoplopoma fimbria*
Bullheads	Cottidae
Cape sole	*Eopsetta jordani*
Chimaera	*Chimaera colliei*
C-O sole	*Pleuronichthys coenosus*
Dogfish	*Squalus suckleyi*
Dolly Varden	*Salvelinus malma*
Dungeness crab	*Cancer magister*
English sole	*Parophrys vetulus*
Flathead sole or Flounder	*Hippoglossoides elassodon*
Gray or True cod	*Gadus macrocephalus*
Hake	*Merluccius productus*
Halibut	*Hippoglossus stenolepis*
Herring	*Clupea pallasii*
Hybrid sole	*Inopsetta ischyra*
King crab	*Paralithodes camtschatica* and *P. platypus*
Korean or horse crab	*Erimacrus isenbeckii*
Lemon flounder	*Pleuronectes quadrituberculata*
Lingcod	*Ophiodon elongatus*
Mackerel	*Pneumatophorus diego*
Octopus	*Polypus* sp.
Oysters	*Ostrea gigas*
Red cod, Red snapper or Rock cod	*Sebastodes* and *Sebastolobus* sp.
Rex sole	*Glyptocephalus zachirus*
Rock sole or flounder	*Lepidopsetta bilineata*
Sablefish or skilfish	*Anoplopoma fimbria*
Salmon	*Oncorhynchus* sp.
Sand dab, sole or flounder	*Citharichthys* sp.
Scallop	*Pecten* sp.
Sea cucumber	*Stichopus californicus*
Sea poacher	Agonidae
Skate	*Raja* sp.
Slender sole	*Lyopsetta exilis*
Slippery sole	*Microstomus pacificus*
Smelt	Osmeridae
Soup-fin shark	*Galeorhinus zyopterus*
Squid	*Loligo opalescens*
Starry flounder	*Platichthys stellatus*
Steelhead trout	*Salmo gairdnerii*
Tanner crab	*Chionocetes bairdii*
Tom cod	*Microgadus proximus*
Turbot	*Atheresthes stomias*
Wolf fish	Annarichidae
Yellowfin flounder	*Limanda aspera*

tion from an economy of superabundance to an economy of the strictest scarcity, and who has followed the struggle of our British allies to provide themselves with the minimum necessities of food, will realize that there will be times in the future of our country when ten million pounds of salmon from, say, the Columbia River, will be of more value to us than the same number of kilowatts of electricity from that stream. By this I do not mean that the industrial effort should be impeded by a sentimental desire to protect fish to the exclusion of all else. But there is seldom a case where industrial development and fisheries protection clash that both, by the reasonable use of judgment and engineering skill, can not be developed side by side satisfactorily. The objection always brought up is the amount of money that it takes to provide the necessary protection for the fish. Fortunately we often have been able to show that saving the fish is a money making proposition, but I feel that it is time for us to face the fact that values are relative, and that they may change in these days with startling swiftness. You will go a long way today to find a man who will sell you a set of tires for twice what he paid for them six months ago. Fish are food and there come times when food is more valuable than money or electricity in any quantity. A salmon run once destroyed is not easily replaced, if at all.

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TABLE 3. SUMMARY OF OTTER TRAWL CATCHES (OTHER THAN KING CRABS) BY AREA, 1941 *

Area	Number tows	Pounds										
		Dungeness Crab	Tanner Crab	Gray Cod	Alaska Pollock	Halibut	Starry Flounder	Rock Flounder	Lemon Flounder	Yellow Tail Flounder	Sand Flounder	Flathead Flounder
Southeastern	5	5	1,552	6	342	17	3,100	1,000	30	20	0	0
Yakutat	6	9	10	0	0	10	1,950	100	25	25	0	0
Kayak Island	11	111	120	53	50	35	20	0	0	55	0	25
Prince William Sound	40	1,559	1,169	17	18	80	2,985	1,375	965	1,450	150	275
Cook Inlet	43	161	6,173	83	120	142	12,300	125	3,450	3,500	2,750	125
Shelikof Straits (west side)	31	19	532	62	0	57	345	250	80	350	0	75
Kodiak Island	133	1,960	9,300	380	25	90	22,000	15,300	6,900	18,800	0	9,000
Shumagin Islands and Alaska Peninsula	59	121	143	155	0	123	14,500	9,500	3,500	13,500	0	7,000
Pavlof Bay	44	42	2,425	400	75	50	6,500	17,700	1,800	38,000	0	2,500
Canoe Bay	88	0	10,066	57	5	15	36,500	8,000	1,300	44,200	0	1,000
Bering Sea (Area XI):												
Inshore	133	0	700	3,021	49,000	408	23,500	93,000	7,500	110,000	0	9,000
Offshore	80	0	2,800	3,200	13,300	259	0	54,000	8,000	123,000	0	16,000
Bering Sea (Area XII)	26	0	2,700	300	11,000	5	0	850	50	9,700	0	0
Totals	699	3,987	37,690	7,734	73,935	1,291	123,700	201,200	33,600	362,600	2,900	45,000

* These figures were taken from Table 6 of the Report of the Alaska Crab Investigation. In addition to the above, miscellaneous items were caught in approximate amounts as follows: 2,000 Korean or horse crab (all from Bering Sea); 4,617 pounds of shrimp (practically all from Olga Bay, Kodiak Island); 590 scallops (practically all from Shelikof Straits); 11,800 pounds of Rockfish (of which 11,000 pounds was from Kodiak Island); 210 pounds of sablefish (practically all from the Shumagin Islands); 276 pounds of tom cod (Bering Sea); 155 herring; 16,340 pounds of bullheads (mostly from the Bering Sea); 90 dogfish; 700 sea poachers (Bering Sea); 1,011 skates (mostly from the Bering Sea); 2,775 pounds of turbot; and 6 wolf fish (Bering Sea).