Schmitt, W. R.

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DEPARTMENT OF COMMERCE

BUREAU OF FISHERIES

HUGH M. SMITH, Commissioner

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By WALDO L. SCHMITT, E. C. JOHNSTON, E. P. RANKIN and EDWARD DRISCOLL

U. S. Bureau of Fisheries

APPENDIX VII TO THE REPORT OF THE U. S. COMMISSIONER OF FISHERIES FOR 1914

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INTRODUCTION.

In the spring of 1914 the United States Bureau of Fisheries steamer *Albatross* was detailed to make an investigation of the fishing banks reported off the Oregon coast for the purpose of developing their location and extent and supplying definite information as to the character of the fishing grounds, especially those for halibut, the abundance of fish thereon, and the season at which they appear. That the investigation should be as conclusive as possible, it was at first restricted to that section of the coast lying between the Columbia River and Heceta Bank, but later was extended northward to a point off Grays Harbor and southward to include a section of the coast off Coos Bay. This is practically the same region covered by the *Albatross* in her survey of the offshore fishing grounds in 1888–89, and by various commercial fishing ventures both before and after that time, the results of which are narrated hereafter.

The present investigation included a preliminary reconnoissance by Mr. E. C. Johnston, of the *Albatross*, in July, 1913; three fishing trips by the steamer, April 27 to May 16, May 25 to June 1, and August 27 to September 10, 1914, respectively; a visit to the various fishing ports in the latter part of June, by Mr. Edward Driscoll, an expert commercial fisherman, who had charge of the fishing trials during the survey; and a series of fishing trials conducted from a chartered launch out of Newport, Oreg., from July 11 to August 17, 1914, during a period in which the *Albatross* was engaged in other duty.

In order to form a correct estimate of the commercial value of the fishing banks explored, it has been considered necessary to epitomize what was known of them before this investigation was undertaken; but the essential part of the report is embraced in the section, "Results of the investigation." This includes various charts and tables, in which are embodied details of the depths and character of the bottom; the results of sets for fish; the results of trials for scallop beds; and the actual commercial yield of the fishing banks after their value became known as a result of this investigation.

The charts are intended particularly to supply, at a glance, the information desired by fishermen, the depths, and the general char-

acter of the bottom. The principal banks are also indicated as such, the position of each set is shown by Roman numerals, and certain fishing trials by two commercial fishing schooners prior to this investigation are plotted, approximately.

Although his name does not appear as an author, no small part of the credit for the results of the survey is due the commanding officer of the *Albatross*, Lieut. L. B. Porterfield, United States Navy. The authors also express their thanks for the information so generously and freely furnished by Capt. Quinn, of the *Idaho;* Capt. Johansen, of the *Chicago;* Capt. Johnson, of the *Daisy;* Capt. Edwards, of the *Helgoland;* and Capt. Churchill, of the New England Fish Co.; and for the many courtesies extended by Mr. Edward Cuningham, of the Pacific Net & Twine Co., of Seattle.

RÉSUMÉ OF THE HISTORY OF THE BANKS.

About the beginning of the year 1885 sea fisheries were commenced off the coast of Washington by the Portland Deep Sea Fish Co. of Portland, Oreg., with a small schooner, the *Carrie B. Lake*, which operated a 40-foot beam trawl between Cape Disappointment and Shoalwater Bay. The catch consisted principally of soles, flounders, and red rock cod, but the venture was brought to an untimely close when the captain, John Exon, an expert beam trawler out of Grimsby, the mate, and cook were lost overboard January 3, 1886. Later the schooner *Dolphin* was built and made 40 trips between April and October, 1887, but she proved a failure, because, it is stated, she could not promptly market her catch, which consisted of soles, flounders, hake, rock cod, and a very few cod and halibut. The "cod" mentioned were probably not *Gadus macrocephalus*, the true cod, but the cultus or ling cod (*Ophiodon elongatus*).

During the fall of 1888 and in the summer and fall of 1889 the *Albatross*, as mentioned before, made quite an extensive survey of the region dealt with in the present report, although but few fishing spots and small banks were developed.[a]

In summation of the investigation, Mr. Rathbun, in the Report of the Commissioner of Fisheries for 1889–1891, page 105, says:

> Only occasional specimens of halibut were taken off Flattery Rocks and Tillamook Rock and on Heceta Bank. Several species of rock-cod were generally distributed along the coast, as well as on the banks, and flounders were found everywhere, being especially abundant in depths of 50 to 100 fathoms. The flat surface of the plateau is particularly rich in the latter group of fishes, * * * Cultus cod occur on all the banks and on Orford Reef, while black cod inhabit the deeper waters, half-grown individuals also being found in moderate depths, together with the ling or Pacific whiting. Large red prawns of excellent quality are likewise very abundant and widely distributed, having been captured frequently in considerable numbers in the beam trawl.

[a] Summary of the fishing investigations conducted in the North Pacific Ocean, by Richard Rathbun, Bulletin U. S. Fish Commission, vol. VIII, 1888.

In the latter part of 1888 the Yaquina Deep Sea Fishing Co. was incorporated and purchased the auxiliary steam schooner *George H. Chance*, of 71 tons net register, and in 1889 was reported to be making preparations to actively engage in sea fisheries off the coast, but inexperience led to the abandonment of the enterprise.

With reference to a trip of this vessel to the southern part of Heceta Bank, it is stated that on the evening of August 7, 1889, she took several small halibut, and that on a trawl line set overnight the heads of 11 halibut were found the next morning, the bodies apparently having been destroyed by sharks and dogfish.

For a number of years there are no other reports of fishing ventures, but the statistics of the Bureau of Fisheries record 25,000 pounds of halibut taken with lines in Coos County, Oreg., in 1904.

From that time until about 1911 apparently no further attempts to institute fisheries off the Oregon coast were made, but about this year, in September, Capt. A. Edwards, with the steamer *Wieding Bros.* (later known as the *Wieding*), prospected as far south as Heceta Bank. He found practically no good bottom until he made a set on the western edge of the bank and secured 25,000 pounds of fish, but rough weather and the lack of a good near-by harbor caused the abandonment of the trip.

In the 1912 file of the Pacific Fisherman various sporadic and desultory attempts to prosecute halibut fisheries in the region under discussion are mentioned, but none met with success.

On August 31, 1912, the *Ollie S.*, Capt. Carner, a local gasoline passenger boat about 68 feet long, under the guidance of R. E. Voeth, caught several hundred pounds of halibut 12 to 14 miles southwest of the whistling buoy off the Yaquina Bar. This catch and the continued interest of Capt. Voeth, who had prospected for halibut at various times, called attention to the possibility of developing a fishery and finally resulted in the present investigation.

The season's catch from August 31 until about the middle of September, was reported as 20,000 pounds for the *Ollie S.*, and 24,000 pounds for another vessel operating out of the same port.

In May, 1913, the *Idaho*, Capt. Quinn, a 7-dory boat out of Seattle, undertook a prospecting trip beginning under Cape Lookout and ending on Heceta Bank. In all, seven sets were made, the total yield of fish being less than 6,000 pounds. A great many dogfish were taken at every set, and a few black cod in the sets on the shoulder of Heceta Bank. The locations of the sets are plotted on the accompanying charts as rectangles from data furnished by Capt. Quinn.

Returning in March, 1914, from a northern trip, the steamer *Chicago*, Capt. Johansen, 12 dories, of Seattle, also made a short prospecting trip on the reported Oregon fishing banks, hoping to make a quick trip to supply the Good Friday market. About eight

trials were made, beginning in deep water off the mouth of the Columbia, running down over the continental shelf, and ending in deep water off Newport, Oreg. The total return from these eight sets, four days' fishing, was about 5,000 pounds, and to make the trip the vessel resorted to the well-known Flattery Banks, where 68,000 pounds of fish were picked up. The approximate location of the sets have been indicated by circles on the accompanying chart.

The reports of the masters of these two vessels on the prospect of developing a lucrative halibut fishery in this region were very unfavorable, and they were confirmed by the results of the operations of the schooner *Decorah*, which in May, 1914, caught but 6,000 pounds of small halibut in 10 days of fishing.

Partly corroborative evidence was furnished also by Capt. E. Clyde Chase, formerly of Marshfield, Oreg., who stated:

> While I was engaged in the salmon fisheries at Marshfield I did considerable experimenting on the halibut grounds off Coos Bay. During the close season in the summer and winter I filled in the time with halibut fishing, and can say that we made some good catches during the months of August and September. The fish did not seem to run in schools. They were mostly caught in scattered spots, and we hardly ever would fish the same ground the second day in succession and achieve good results. We did most of our fishing on a fine gray sand bottom, and we found no ground I would consider good halibut banks.
>
> What halibut we caught were small, not averaging over 15 pounds. I fished most of the ground from the Heceta Banks to Cape Blanco. We found the ground practically the same. During our summer fishing we would catch a few halibut almost anywhere along these sets, but during the months of December and January there seemed to be no halibut at all on the same ground we fished in the summer, but we got dogfish and skates on nearly every hook we set. I believe the halibut come inshore during the summer onto these grounds and can be caught more or less on any of the grounds during that time. But during the winter they go off again and you are unable to find them. I don't consider any ground that I found good halibut banks that would hold the fish.

THE "ALBATROSS" INVESTIGATION IN 1914.

Preliminary to the investigation proper as conducted by the *Albatross*, the fishery expert of the vessel was detailed to make a reconnoissance covering the Oregon coast towns, from which reports of catches of halibut had come, namely, Newport and Bay City. His trip was made for the purpose of obtaining first-hand information regarding the fishing season, weather conditions, and harbor facilities, upon which definite instructions regarding the survey could be based.

At Newport, Oreg., it was ascertained that halibut fishing had been engaged in by the owners and masters of various small freight and pleasure craft belonging to Newport and Yaquina, practically all of it by means of hand lines. During the inquiry in Newport, the *Sea Dog*, a 20-foot boat using three hand lines, caught about 500 pounds of halibut in a 10-hour day; and the *Wanderer*, a 60-footer, reported making a catch of about 1,000 pounds with the same number of hand

lines from the afternoon of July 16 to the afternoon of the day following. The best catch of the season was said to have been 1,800 pounds taken by Capt. R. E. Voeth, of the *Wanderer*, with two regulation halibut trawls.

The fishing season out of Newport was found to be usually from April to early September, being limited by the rough weather prevailing during the late fall and winter. The local fishermen alleged that halibut can be taken the year round; as they are able to make but very few trips from September to March they were not sure as to the abundance of the fish in winter.

It was learned that there was practically no halibut fishing at Bay City. Only once in a while, in smooth weather, a boat goes out for halibut as a pleasure trip. There were rumors of several notable halibut catches, but little of which could be traced to an authentic source.

The primary interest in both places seems to be to ascertain if there be a sufficient supply of fish to warrent the building of cold-storage plants with which to make a bid for the Portland and other markets.

In the main, the inquiry developed that, at least off Newport, a scattered run of fish during the summer months could be obtained; that the weather conditions, other than from April to September, were too uncertain and severe to warrant an investigation during any other time; and that harbor facilities for a vessel the size of the *Albatross* were not available. As a consequence, the survey was deferred until the following spring.

On April 12, the *Albatross* left Sausalito, Cal., for Seattle, Wash. At Seattle, Mr. Edward Driscoll, expert fisherman, and four other practical fishermen were engaged, and after taking aboard the necessary gear and equipment the ship left Seattle April 24 on her first trip over the ground.

On April 29 actual operations were begun on Heceta Bank, selected at the time as the southern limit of the field of investigation, and continued northward, with several interruptions due to stormy weather, until May 8, when a return was made to replenish the coal bunkers.

Most of the soundings and trials were confined to the deeper water, 90 to 100 fathoms, as during the spring halibut are more likely to be found on the offshore edges of the banks. On the completion of this line it was found that the plan of operations would permit working over a portion of the inshore ground, and a series of trials of the bottom was made along the 50-fathom curve, beginning off Yaquina Head to a point off Tillamook and thence in a northwesterly direction to deep water off the Columbia. Three sets of the trawls were made on this line of soundings.

This trip failed to demonstrate the occurrence of good bottom, bottom that would hold fish, and also an apparent absence of fish in paying quantities in the spring of the year. Three possible spots were located, sets I, II, and IV (chart I, table I), of which only the first seemed to be at all favorable with respect to the bottom. Unfortunately, because of the rough weather prevailing at the time, a more thorough trial could not be given.

The results led to the expectation that halibut, if they were to be found off the Oregon coast, would occur only in the nature of a seasonal (summer) run when the fish come inshore in search of food, irrespective of the character of the bottom. Such appearances of fish on poor and unfavorable bottom are usually incidental and do not continue throughout the year.

One indication of the occurrence of scallops, also reported from these banks, was brought up at set VI in the shape of several dead valves to which sea anemones were attached.

On leaving Seattle May 25, on the second trip, it was the intention to give the spots developed on the previous trip more conclusive tests and to pay particular attention to the section just off Newport, from which most of the reported fish were said to have been taken. Through an accident this trip was brought to an abrupt end on May 29, after but two days' fishing, necessitating an immediate return to Seattle for repairs.

From June 12 to August 27 the *Albatross* was engaged in Alaska, but the halibut investigation was continued by other means. From June 15 to 29 Mr. Driscoll made a tour of the Washington and Oregon fishing ports in the region under investigation for the purpose of obtaining information regarding catches which might otherwise not be reported and which might be indicative of a summer run of fish. He visited Newport, Portland, Tillamook, and Astoria, Oreg.; and Aberdeen, Wash.

At Newport Capt. Reeder, of the *Orabell*, on June 17, caught 25 halibut, averaging about 20 pounds, although some weighed but 6 pounds, "a very uneven run, which looks as though there were not many where these were caught." On June 10 the same craft took 4 halibut, averaging about 15 pounds, 2 redfish, and 2 ling cod, about 7 miles off the bar, and the *Pilgrim*, Capt. Chambers, brought in 1 halibut, 2 red cod, and 2 ling cod from about 8 miles offshore. Capt. Chambers stated that "the fish are not plentiful now, but later on they bunch up, and many can be caught when they strike in in August. There are no large banks such as have been reported, but there is one fishing spot 15 miles southwest by west from Newport bar and another 16 miles west."

In Portland it was learned that the *Decorah* had brought in 2,200 pounds of good fish, averaging about 15 pounds, from Heceta Bank.

At Tillamook no fish were being caught. No information regarding halibut was to be obtained in Astoria, the fishermen there being engaged wholly in salmon fishing, and at Aberdeen a schooner, the *Zilla May*, was being fitted with an otter trawl, her owner having a market for miscellaneous fish such as are caught with that implement.

From the information secured by Mr. Driscoll, in addition to that already at hand, it was concluded that a paying run of fish had not yet occurred, and that if it were to be found fishing trials should be continued without interruption. A part of the *Albatross* staff and Mr. Driscoll, with the practical fishermen previously mentioned, were therefore transferred to Newport, where fishing trials were carried on from July 13 to August 17, 1914, from a gasoline launch chartered for the purpose.

Contrary to all earlier indications, a nice run of halibut was found within an area of about 250 square miles—between about 8 miles northwest by north (magnetic) of Yaquina Head Light and approximately 15 miles southwest (magnetic) from the whistling buoy on the Newport bar. Within this area 14 sets were made, varying from one to three hours in duration and using from one to three skates of gear, with salt herring, surf perch, frozen herring, and fresh salmon bait. From 200 to 500 pounds of halibut, dressed weight, were taken to the skate, and from this it was estimated that a dory running a line of six to eight skates and using fresh salmon bait could take 1,500 to 2,000 pounds of fish with a five to six hour soak anywhere within the area indicated, an estimate verified by the results of commercial fishery operations, as shown in table IV of this report.

Several trials for scallops made in connection with some of the sets have been dealt with in detail under the heading "Scallops."

During this period of the investigation the schooner *Daisy* (three dories), induced by the representations of the owners of the local cold-storage plant, made several successful trips, and the schooner *Decorah* also operated off Newport, but with indifferent success.

As yet the Seattle fleet had not been made acquainted with the results of the investigation; but one of the fishermen in the Bureau's service resigned to take command of the *Decorah*, and with his return to Seattle, to secure a competent and experienced crew, full information as to the various prospects was given to the public. Thereupon several schooners made trips netting returns as good as those made on the various well-known Alaska banks during the same period, and a small but profitable fishery was definitely established on Newport Bank.

The Newport cold-storage plant on two occasions took over a portion of the *Daisy's* catch, 19,000 pounds on July 11 and 17,000 pounds on July 30; but owing to the limited size of the sharp freezer

it could handle only the fresh, iced fish for immediate shipment to near-by towns. Neither the plant nor the market seemed able to take care of even such limited quantities of fish except occasionally, and so far as known no landings other than by small local craft were subsequently made at Newport.

A few halibut, in no case exceeding 29, were caught by local fishermen in July, but in August, after the productiveness of Newport Bank had been partially demonstrated, three fares of 1,400, 1,500, and 1,900 pounds, respectively, were taken.

During the time spent by the party at Newport it was noted that the local fishermen did not avail themselves of all opportunities presented, nor was any great energy displayed in prosecuting the little fishing that was carried on. This was in part due to the lack of a sufficient local demand; to high express rates to outside points, i. e., Portland; and undoubtedly to uncertain and unfavorable bar, weather, and fog conditions which necessarily would result in a very irregular and fluctuating supply.

There is also lack of an adequate supply of bait. The surf perch which were used on several occasions proved to be good, but, though apparently occurring in great abundance, they doubtless would become depleted in a short time if extensively used, even if seining for them could be carried on without detriment to the local crab fishery. Spring and fall runs of herring take place in Yaquina Bay, and though no definite data were procurable concerning their abundance, the local fishermen, who salt them for their own use, hardly had enough to last through the fishing season. There is a limited run of salmon of such late occurrence that it could not be utilized as a source of bait and the quantity is very questionable as most of the fish displayed for sale in the local markets had been shipped from Alsea Bay.

The *Albatross* made its final run over the ground, leaving Seattle August 27, returning September 8. On this occasion fishing trials were begun as far south as Coos Bay to ascertain if a run of fish such as was developed off Newport might occur in that vicinity. One set as successful as many off Newport, was made on a likely piece of bottom upon which further prospecting should show good fishing. More intensive investigations were carried on during this trip than was possible on the previous ones. Former sets were checked up and gaps in the various lines of soundings filled in wherever possible; and results of a more positive nature were obtainable regarding the abundance of fish, inasmuch as the best of bait, fresh salmon, was employed, and as a long soak was given.

Trials were also made for scallops both off Yaquina, where launch work had been attempted during the summer, and off Cascade Head, where evidences of the presence of scallops had been found on the occasion of the first *Albatross* trip. Here a bed of scallops possibly

in sufficient abundance to warrant private investigation was touched upon, while off Newport, though no scallops were secured, a great abundance of the smaller flatfishes was demonstrated.

The northern limit of the field of investigation was also extended so as to take in a section of the coastal banks off Grays Harbor, where one set and a number of soundings were made. After touching at Seattle and coaling at Union Bay, British Columbia, the *Albatross* proceeded to Sausalito, Cal., where she arrived September 15, 1914.

RESULTS OF THE INVESTIGATION.

WEATHER CONDITIONS.

While en route to the field of investigation the *Albatross* was compelled to heave to for 17 hours, and several times during the survey boisterous seas necessitated the cessation of fishing operations.

That fishing trials were made at Newport on so few days was not due solely to the state of the weather, but also to the condition on the bar off the mouth of Yaquina Bay. Sets were made on but 14 of 36 possible days of the time spent there. On 16 of the remaining 22 days the fog was very thick or threatening, and on the other 6 days either tidal conditions or, more frequently, breakers rendered the bar impassable. During practically one-third of the time spent at Newport the state of the bar, aside from other conditions, prevented fishing.

The United States Coast Pilot, Pacific Coast (second edition, 1909) says:

> The channel over the bar (at Newport, Oreg.) has a depth of 11 to 14 feet, but is narrow and winding and should not be attempted by strangers without a pilot. A reef extends for nearly 1½ miles northward of the entrance about ½ mile offshore; and southward of the entrance at a distance of about 1 mile, is a patch of sunken rocks, usually showing a breaker. In the approach to the entrance, which is between these rocks and the reef, the bottom is irregular, with several depths of 4 fathoms and less. Inside the entrance the channel is subject to frequent change. * * * The entrance in winter is exceptionally bad on account of the heavy swell and the place is not recommended.

The channel over Newport bar, as far as our experience with it indicated, has a depth of about 9 feet at low water, but it is claimed locally that a channel carrying 14 feet can be followed. There is a gap in the reef through which small craft can approach the bar channel from the west, avoiding taking the seas broadside on in northwesterly weather. This gap usually can be readily picked up by one familiar with its position, provided the breakers are not so high as to completely obscure it.

There are two partially completed breakwaters off the harbor entrance, but they are almost worse than useless, ending well within the most dangerous ground. Until they are extended into suffi-

ciently deep water, possibly across the reef, Yaquina Bay will be handicapped as a fishing port.

Somewhat similar conditions obtain off Tillamook, concerning which the Coast Pilot says:

> Sixteen feet have been carried over the bar at high tide with a smooth sea. * * * The position of the channel can not be depended upon and is liable to change in heavy weather. * * * North of San Francisco, Humbolt and Coos Bays, Columbia River, Willapa Bay, and Grays Harbor afford good shelter, but must be made before the sea rises, as afterwards the bars are impassable.

The *Albatross* did not begin work until well into spring, owing to the severe weather conditions prevailing during the winter. Throughout the spring and early summer fresh, brisk gales were of frequent occurrence, usually lasting for several days at a time, and, if from the southeast, accompanied by fog. During the late summer and early fall much less rough weather was experienced, but the fogs, on the other hand, were denser and more troublesome, and with the end of September winter conditions were ushered in.

On the whole, both small boat and vessel fishing, irrespective of the run of fish, is restricted by weather conditions to the five months, late April to early September, and even then a great many days during the summer are much too rough or foggy to permit the smaller craft to operate with any degree of safety.

For the convenience of those using this report, the following very excellent recapitulation of weather, wind, and fog conditions is quoted from the United States Coast Pilot, Pacific Coast (second edition, 1909, pp. 10–11):

> *Weather.*—There are two seasons—the summer or dry season, which begins about May and continues until October, and the winter or rainy season, covering the remainder of the year. These seasons vary in length in different parts of the coast as well as in different years.
>
> Northward of San Francisco the rainy season increases in length and amount of rainfall, and as Juan de Fuca Strait is approached showers of short duration and generally local may be looked for at any time. Snow falls at rare occasions in San Francisco and vicinity, but is frequent and at times heavy in the vicinity of Juan de Fuca Strait. From San Francisco northward the winter gales increase in severity, frequency and duration, while in summer the northerly and northwesterly winds at times reach almost hurricane strength.
>
> *Winds.*—The prevailing winds in summer are from northwest and west, on the northern part of the coast. * * * The northwest winds in summer frequently reach a velocity of 70 miles an hour and extend as far south as Point Conception. * * * As a rule, the northwest wind begins about sunrise and reaches its maximum velocity about 3 or 4 p. m., moderating toward sunset and dropping to light airs or calms by daylight. The severe northwesterly gales generally last two or three days and continue throughout the night with little or no diminution.
>
> In winter the heaviest weather is from the southeast and southwest, with an occasional northerly gale of short duration. These gales, with the heavy southwest swell prevailing during the winter months, cause a confused, irregular sea that taxes the weatherly qualities of a vessel to the utmost. They spring up gradually from southward and increase in strength, with a rapidly falling barometer. When the barometer

becomes stationary the wind shifts to southwest and blows heavily, with clearing weather and frequent rain squalls. The barometer rises when the wind hauls to southwest, from which point it generally blows from 12 to 20 hours.

When the southwest gale of winter is not preceded by southerly weather the barometer seldom falls, but either remains stationary, when the gale may be expected to continue longer, or rises slowly, when it will gradually subside and fine weather follow.

Fog.—On the outside coast fogs are liable to occur at any time, but are more frequent in July, August, and September. * * * In the northern parts of the coast they are more frequent and at times very dense, and have been known to extend several hundred miles seaward. They are generally brought in toward sundown, from seaward, by light westerly winds, and ordinarily continue until noon of the following day and sometimes later.

CHARACTER AND TOPOGRAPHY OF THE BOTTOM.

On the accompanying two charts the character and topography of the bottom have been graphically represented by means of contour lines and colors, the significance of the latter being explained in the legend on the chart. The contour lines are based almost wholly on the Coast and Geodetic Survey charts Nos. 5900, 6000, and 6100, which in turn have been compiled largely from the *Albatross* data secured in 1888–89. The curves are spaced at 10-fathom intervals, beginning at 30 and ending with 100 fathoms, omitting the 90-fathom contour, which nearly approximates the 100-fathom line. The fishing sets and scallop trials made during the survey are indicated by means of Roman numerals, the exact location being the center of the space covered by the letters. The location of sets of the *Idaho* are shown approximately by a series of dotted rectangles numbered in order, and those of the *Chicago*, by numbered dotted circles.

For convenience of treatment the bottoms surveyed are discussed under the following heads: (1) Grays Harbor section, (2) Tillamook section, (3) Newport section, (4) Heceta Bank section, (5) Coos Bay section. The intervening stretches are considered with the sections with which they can be most readily treated.

Grays Harbor section.—Off Grays Harbor the continental shelf, which here attains a width of about 25 to 30 miles, is covered from shore outward to between the 40 and 50 fathom curves with fine gray sand, and beyond that line out into deep water is composed almost uniformly of green mud. An outcrop of shale was found on one sounding about 25 miles west of Point Chehalis. In the vicinity of Chehalis Bank, reported by Capt. Tanner, the soundings increased regularly in depth offshore, and showed nothing but green mud from the 46-fathom mark to a depth of 64 fathoms and doubtless beyond that.

To the northward of this reported bank, and between 10 and 15 miles offshore, a patch of gravel bottom was found in 38 to 40 fathoms. It is apparently of considerable extent, and though no halibut were

taken on it (set XXXVIII), it is rich in bottom life and may be found to be productive at times.

The Tillamook section.—On this silt area off the Columbia River but little sounding was done for obvious reasons. The mud beginning at the mouth of the river runs out to and apparently follows the 50 or 60 fathom curves throughout the greater part of this section. South of the river and inshore of the mud the bottom was found to be fine gray sand, except at one sounding.

In the mud area there are two outcrops of shale. One is a small ridge about 25 miles off Tillamook Rock, where the least depth was 78 fathoms. One-half mile beyond this sounding green mud was found in 94 fathoms, and 3 miles inshore the same material in 83 fathoms was recorded. The second sounding showing the occurrence of shale was in 98 fathoms, about 18 miles off the entrance of Tillamook Bay. It is believed that a great many of these outcrops are to be found, as the Miocene shales seem to be the principal formation of the continental shelf off the Oregon coast.

On the fine gray sand within the 60-fathom curve, about 9 miles south of Tillamook Rock, a small patch of shale resembling hard mud was discovered, but an attempt to relocate it later proved unsuccessful. Between Cape Falcon and Tillamook Bay coarse gray sand was found on a single sounding, in 32 fathoms. From all indications it is doubtful if halibut will be found here in paying quantities, although it is the most promising bottom found off Tillamook.

Conditions apparently similar to those off Tillamook seem to obtain in the stretch between Cape Lookout and Cape Foulweather. Under Cape Lookout, on an area not tried out by the *Albatross*, both the *Daisy* and the *Idaho* report very good appearing gravel bottom, although none but small fish have been taken there. Below Cape Lookout the continental shelf has a width of but 10 miles, and in this vicinity, just off Cascade Head, there is a patch of fine gravel adjoining one of coarse gray sand in 42 and 30 fathoms, respectively. Though two unproductive sets of the trawl lines (VI and XXXV) were made just offshore from these patches, it was in the vicinity of set VI, off the gravel patch, that the best scallop catch was made.

The bottom throughout the Tillamook section seems to be generally unfavorable for halibut, though it supports a great many of the smaller flatfishes and other, at present, less marketable species.

Newport section.—South of Cape Foulweather, off Yaquina Head, the regular progression of increasingly deeper soundings from the shore outward is no longer found and green mud or fine gray sand bottoms lose their predominence. In this region the mud line is generally found at 90 fathoms or beyond.

Between Yaquina and Alsea Bays and about 12 miles off shore, a ridge was discovered on which 30 fathoms was the minimum sounding

made by the *Albatross*, although Capt. Carrol, until recently of the *Decorah*, reports that he made one sounding of 20 fathoms in this vicinity. This ridge is the outer wall of a submarine valley having, so far as sounded, an extreme depth of 47 fathoms, shoaling at its mouth to 42 fathoms and merging with the flat of the continental shelf at the 50-fathom curve. On both sides of the ridge, and principally at the upper end of the submarine valley formed by it, the late summer run of halibut, developed by this survey, was found. The bottom across the head of and through the greater extent of the floor of the valley is of coarse gray sand, carrying a very rich growth of such organisms (sea anêmones and pennatulids) as are typically found on good halibut bottom.

Over the ridge and principally on its northwestern and southern slopes is found what has been designated as broken bottom—composed of materials of a mixed character, shale, gravel, sand, and mud—in patches varying in size and composition, but all very rich in bottom-living organisms. On the western slope is a patch of coarse gray sand and another of gravel, apparently of considerable extent, though no great number of soundings were made there. On this patch a good lot of fish were taken (set XXXIV).

Heceta Bank section.—Similar to the ridge off Newport, but larger and in somewhat deeper water, there is a large, roughly triangular plateau called Heceta Bank, between 25 and 30 miles offshore to the southwestward of Heceta Head. It is composed largely of shale too hard for good halibut bottom, while the submarine valley formed by it is too soft, having a bottom of soft green mud. Several patches each of broken bottom and black sand occur both on the flat of the bank and on the offshore slopes. The most promising broken bottom is in the vicinity of set XI, where a lot of fish were taken in the spring of the year (set I). Black sand is considered good black cod bottom and on one patch of it (set X) a fair catch was made.

Between Heceta Bank, Alsea Bay, and Heceta Head is a large area of fine gray sand which below Heceta Head is encroached upon by the green mud of the submarine valley formed by Heceta Bank. Off the mouth of the Siuslaw River is a small isolated patch of gravel surrounded by fine gray sand. The mud line trends in from the 70-fathom line toward the Umpqua River, where it reaches the 30-fathom curve less than $2\frac{1}{2}$ miles offshore. Another gravel patch about 7 miles below the Umpqua lies within this mud area but 6 miles from shore, and south of this the mud recedes until it lies beyond the 70–80-fathom line 10 miles off Coos Bay.

Coos Bay section.—In a line between the Umpqua River and Coos Bay, three sets (XXVII, XXIX, and XXX) were made on fine gray sand, which occurs everywhere in this region inshore of the mud. As developed by the above sets, this sand bottom seems to carry a thin

surface film of mud or else the line of demarcation between the two extends much nearer shore than has been shown either by the chart or the soundings.

Southward of Coos Bay, extending well toward the Coquille River, is a comparatively extensive outcrop of shale, rich in bottom organisms, in which the soundings developed two areas of good halibut bottom, fine gravel. The soundings, together with the yield of set XXVIII, seem to indicate that more detailed examination might locate areas of so-called broken bottom, which is more productive of fish than shale alone.

DISCUSSION OF THE SETS.

In table I will be found all pertinent information regarding the various fishing trials made during the survey, with the exception of those made exclusively for scallops, which are shown in table II.

In some cases, instead of making a double-banked set, the dories were spaced about a half mile apart and acted independently, although for all practical purposes they were making but a single set. Double-banked sets primarily were made in rough and threatening weather and later for the purpose of saving time and making several sets a day in addition to the routine of sounding. These are indicated in the column "Addenda," table I.

The skate used was the regular 8-line trawl as rigged and used by commercial fishermen, carrying about 250 hooks spaced 9 feet apart. At Newport, July to August, in addition to the regular gear, a single line rigged with small hooks and light gangings was set for soles, flounders, and other small-mouthed bottom fish. This gear was not very effective and such fish as were taken with it have been included in the regular columns of the table.

The bait throughout the first two trips and in part during the Newport trials was salt herring purchased in Seattle, not in preference to fresh or frozen fish, but because of the lack of facilities on the *Albatross* to care for a sufficient quantity of cold-storage bait. At Newport, clams, surf perch, and salmon were obtained from the local fishermen, but were not always to be had in sufficient quantity, and salt herring were used to make up the deficiency. A small stock of frozen herring was obtained from a supply left by the schooner *Daisy*. On the last trip of the *Albatross*, through the special efforts of the commanding officer, several boxes of iced salmon were carried in the ship's very limited cold-storage space.

The weights of the halibut taken are given under different classifications in table I. To give an idea of the proportion of first-class fish, weighing from 11 to 80 pounds, inclusive, the number of these has been given in one column and their average weight in another.

Set I.—April 29, on Heceta Bank, in 88 to 92 fathoms, broken bottom. The offshore dory, which fished in the deeper water, on

gravel bottom, took one 72-pound halibut; the inshore dory took the remainder of the total catch of 296 pounds of fish, which averaged about 31 pounds. Of these, 8 were first-class fish, weighing between 11 and 80 pounds, averaging about 37 pounds each. All were nice looking, blue-meated halibut. Though salt herring bait was used and a one-hour set made, the result would seem to indicate that in this vicinity a good catch of fish might be expected in the spring. The result of the *Idaho's* sets Nos. 5 and 6, in the spring of 1913, do not bear out this assumption, but at times a distance of a half mile will put a schooner off a very good spot. This set was near the probable location of Capt. Edwards's very successful trial in 1911 or 1912. The dogfish were quite troublesome, 21 being taken, together with 34 red rock and 1 ling cod. Rock cod usually frequent a bottom somewhat more rocky than that preferred by halibut.

Set II.—May 2, off Newport, well on the edge of the bank in 96 fathoms; bottom green mud with an admixture of black sand, underlaid by siliceous shale. The mud adhered in stringy masses to the trawl lines, an evidence of soft, unfavorable bottom. One 20-pound halibut, 1 dogfish, 4 skates, 8 red rock, and 3 ling cod were taken.

Set III.—May 5, on Heceta Bank, about 15 miles north of set 1, in 61 fathoms; on broken bottom composed of granular shale and fine gravel. One small fragment of rock caught on the trawl. Two skates were set from each dory. Of the 4 halibut taken, 3 were first-class fish, averaging 26 pounds, and the other 10 pounds. The spring run of dogfish was again encountered, 80 being taken.

Set IV.—May 6, about 13 miles off Newport, in 54 to 57 fathoms; fairly good bottom, composed fine black sand, broken shells, and coarse gray sand. A basket star, indicative of "live" bottom, was brought up at this station. Of the 8 halibut caught, 7, averaging 21 pounds, were first-class fish. Thirty-six dogfish and 9 red fish were taken.

Set V.—May 6, off Newport in 62 fathoms, on granular shale and some fine gravel, rather too hard bottom for halibut. Twenty-one rock cod and 4 small halibut of an average weight of 14 pounds were caught.

Set VI.—May 7, off Cascade Head, in 48 fathoms; the sounding indicated fine gray sand, and 4 large sea anemones attached to scallop shells were brought up on the trawl line. No halibut were taken, 1 flounder, 1 ling cod, 2 red rock-cod, and 6 skates constituting the total catch. It was hardly expected that halibut would be found on the fine gray sand indicated by the sounding lead, and the set was made merely to determine what might be expected on bottom of that character. A later set (xxxv) in the same general locality was hardly more productive. Farther inshore the bottom gets better, being composed of fine gravel, but the *Chicago* made a set (5) there on April 2, in 12 fathoms, with but poor success.

To the northward, under and near Cape Lookout, the *Idaho* made two sets (I and VII), both on sand bottom, on May 11 and 14; although Capt. Quinn said that the last set was on the best bottom he had seen on his entire trip, he caught only 500 or 600 pounds of fish, practically all small. The *Daisy*, on gravel bottom under Cape Lookout, about July 30, caught 4,000 pounds of halibut, all too small to market.

Set VII.—May 8, off the Columbia River; picked up granular shale, obviously a very small patch, as in the immediate vicinity of the dories the *Albatross* bottom sampler brought up a core of soft green mud 2½ feet long. The total catch yielded but one 32-pound halibut, 15 dogfish, 1 skate, 1 sole, and 1 octopus.

Of the above seven sets, I and III offer possibilities of good fishing spots. The bottom is very much alive, as found by the *Albatross* on this and her 1888–89 trips, carrying a great variety of bottom organisms. Set IV also has good bottom, of a coarse gray sand, tending toward that later found just off Newport and carrying a good run of fish during the months of July, August, and September. It is very probable, in view of later developments, that had fresh herring or salmon been employed instead of the salt bait used and a longer soak given, a materially larger catch might have been returned in each case. The other sets, with the possible exception of set V, on granular shale and fine gravel, were made on unfavorable bottom.

Dogfish were taken in nearly every set and, as can be seen, are a great pest in the spring. The great number of "dogs" at this season was the one great difficulty encountered by the *Idaho* in her attempt to make successful fishing trials.

Set VIII.—May 27, off Newport, in 31 to 34 fathoms; bottom, fine gray sand. As but 3 halibut, averaging 23 pounds each, were taken, this was considered poor bottom, but after completing the chart of the fishing grounds it was seen that this set was on the edge of the fishing ground proper, and the 6 sea pens, or pennatulids, taken on the trawl line show the presence of bottom life of a character to warrant the inclusion of this area in the bank.

Set IX.—May 28, on Heceta Bank, in 66 to 68 fathoms; bottom, granular shale, part of a large siliceous shale area, which is to be generally considered as poor bottom. Five halibut, including 4 first-class fish, averaging about 25 pounds each, were taken.

Set X.—May 28, on Heceta Bank, in 109 fathoms; bottom, fine black sand and some fine gravel, apparently good halibut ground, but tending in character and depth to be more favorable for black cod, as indicated by the results of the set. Twenty-six black cod weighing 276 pounds, the fish ranging from 7 to 18 pounds and averaging 10.6 pounds each, were caught. Only 1 halibut, weighing 16 pounds, was taken.

Set XI.—May 29, on Heceta Bank, in 100 fathoms, bottom, fine black sand. No halibut were taken and but 5 black cod, ranging from 5 to 16 pounds and averaging 12 pounds each.

Sets XII–XXVI.—Were made out of Newport during July and August, gear being set and hauled from a launch chartered for the purpose.

Sets XII–XVIII and XX–XXIII.—July 13 to August 14, off Newport, in 25 to 47 fathoms, on coarse gray sand. This was rich bottom, numerous pennatulids, sea anemones, and sun stars being brought up on the trawl lines. The bait used consisted of surf perch, fresh salmon, frozen and salt herring. All of these sets were on good fishing ground, from 5 to 45 halibut, weighing from 132 to 1,867 pounds, total weight, being taken on from 1 to 3 skates of gear in from 1 to 3 hours. The fish averaged 20 to 48 pounds each. There are some living scallops scattered over this bottom, but so far as could be ascertained, in about a dozen trials with an oyster dredge, they were widely scattered.

Sets XIX, XXIV, and XXVI.—July 27, August 15, and August 17, respectively, off Newport, in 35 to 40 fathoms, on broken bottom consisting of rocky shale, coarse gray sand, fine gravel, and foraminifera, in patches of various degrees of admixture, and resembling the bottom found on Heceta Bank in sets I and III. One to two skates of gear were used in sets of two hours' duration, with octopus, salt herring, and salmon as bait. The yields were from 559 to 935 pounds of halibut, consisting of 27 to 36 fish, averaging 20 to 32 pounds. First-class fish averaging as high as 40 pounds each for 22 out of a total of 29 were taken. All sets were on good fishing ground. Set XIX is the only one in July where more than 8 dogfish were taken. A total of 13 were taken here.

Set XXV.—August 16, off Newport, in 37 fathoms, on fine gray sand, with 1 skate of gear, fresh salmon bait, set two hours; resulted in a catch of 355 pounds of fish—9 halibut, all first-class and averaging about 39 pounds each. Ordinarily this kind of bottom does not carry fish; but on the fishing ground off Newport the patch of fine sand which extends along the submarine valley floor between the inshore coarse gray sand and the offshore broken bottom apparently is an exception. Twenty-eight dogfish were caught, the only case in August in which the catch exceeded 4.

The following sets, made on the last trip of the *Albatross*, were of two hours duration, double-banked, one skate to each of the two dories, using fresh salmon as bait, excepting set XXXVIII, in which each dory used two skates of gear and operated independently one-half mile apart, bait and duration of set otherwise being the same.

Set XXVII.—August 29, off Coos Bay, in 36 fathoms; bottom, fine gray sand, covered with a layer of slimy mud, which came up in

stringy masses on the ground line. This set was evidently very near the mud, and the same kind of bottom was also found on sets XXIX, XXX, and XXXI. Two halibut weighing 12 and 20 pounds, respectively, were taken in addition to 3 skates, 3 soles, and 1 ratfish.

Set XXVIII.—August 30, off Coos Bay, in 65 fathoms; bottom, granular shale. The bottom here differs from the others found at the sets made between Coos Bay and Heceta Head, which were of the character described under set XXVII. In the catch this set is comparable to those on the broken bottom on Heceta Bank and off Newport, 13 halibut, totaling 375 pounds, being taken. Twelve of these were first-class fish and averaged 24 pounds each; the other weighed 85 pounds. This set was just north of a promising patch of gravel bottom, which will doubtless carry many more fish than were taken here. The whole area comprising the shale and gravel bottom in this vicinity should be considered a possible fishing ground, and more extensive soundings might develop even more favorable bottom.

Sets XXIX–XXXI.—Sets XXIX and XXX were made off Coos Bay, August 30 and 31, in 30 and 37 fathoms, respectively; set XXXI was off Heceta Head, August 31, in 42 fathoms. All have the same character of bottom as set XXVII and were as barren of fish. At set XXIX only were any halibut taken, and here but three, weighing 9, 10, and 90 pounds, respectively. Otherwise a few skates and soles constituted practically the entire catches.

Set XXXII.—September 1, on Heceta Bank, in 82 fathoms; on granular shale and fine black sand approaching broken bottom in appearance. This set was in the vicinity of sets I and IX, on the point of Heceta Bank. Seven halibut, totaling 259 pounds, were taken in a two-hour double-banked set of two skates, using fresh salmon bait. Six of these were first-class fish, averaging about 41 pounds. As previously noted, on April 29 (set I) we took 296 pounds of fish on one skate, one-hour set, salt herring bait, 9 fish all told, 8 first-class, averaging 37 pounds each. Though not very plentiful when this trial was made, it is safe to predict that fish in paying quantities will be found on or near this spot during some time of the year, but the area is very small and must be picked up largely on soundings. Twelve dogfish were taken in addition to 30 blue sharks, 18 skates, 1 ratfish, 2 black cod, 3 ling cod, 3 soles, and about 150 red rock-cod. The quantity of red fish was most remarkable. When they were cast overboard from the dories they attracted numerous dogfish and blue sharks.

Set XXXIII.—September 1, on Heceta Bank, in 87 fathoms, off shore from set III; on broken bottom composed of shale of varying degrees of hardness, with patches of fine black sand. The bottom here is apparently rich, as a 16-inch-high basket sponge was brought

up on the trawl. Three halibut averaging 55 pounds were taken, and 5 black cod averaging 16 pounds each; the rest of the catch comprised 2 blue sharks, 6 skates, 2 rock-salmon, and only 31 red rockfish; only 7 dogfish were brought up.

Set XXXIV.—September 2, off Newport, more on the flat of the bank than the preceding sets and in the general direction of the Newport fishing ground, at a spot where coarse gray sand, fine gravel, and broken shells were found in 63 fathoms. Nine halibut, averaging slightly over 32 pounds each, were taken, the total weight being about 290 pounds. With a catch such as this, of good fish, the Newport fishing ground prospected over in sets XII to XXVI can with good reason be extended so as to include this spot.

Set XXXV.—September 3, off Cascade Head, in 45 fathoms, on fine gray sand. The bottoms at this and the two succeeding stations were given trials to fill in what otherwise would be a questionable gap, but no halibut fishing of consequence is to be expected on continuous fine gray sand bottom. One 57-pound halibut was taken, together with 10 dogfish, 4 skates, 3 ling cod, and 2 soles.

Set XXXVI.—September 4, off Tillamook, in 43 fathoms, on fine gray sand. Two halibut weighing, respectively, 9 and 16 pounds were taken, in addition to 6 dogfish, 2 blue sharks, 3 skates, 4 young black cod, 1 sole, and 1 arrow-toothed halibut. The latter was the only one of the species taken on the entire cruise, in marked contrast to Tanner's previous trip over the ground, when he thought that this would be the species of halibut most likely to be found in fishing off this coast.

Set XXXVII.—September 4, off Tillamook, in 56 fathoms, on fine gray sand, apparently barren bottom; yielded 2 dogfish, 4 blue sharks, 1 small black cod, and 1 sole.

Had the bottom of the Tillamook section been more varied or more favorable other sets would have been attempted. The results of the early *Albatross* trials, given in the introduction, are in very close agreement with those obtained in sets XXXVI and XXXVII.

Set XXXVIII.—September 5, off Grays Harbor north of Chehalis Bank, reported by Tanner in 1888, in 38 fathoms, on a rich bottom of fine and coarse gravel. Several sea anemones were brought up on the trawl, a favorable indication. No halibut were taken, the total catch being 1 dogfish, 1 skate, 1 blue shark, and 1 red rock-cod. Even with this poor showing, fish are to be expected on bottom of this character at some time during the year, and it might repay schooners on the way to and from the Newport ground to make several prospect sets in this vicinity in passing.

Though in 1888 and 1889, and again during the present survey, no halibut were taken in this vicinity by the *Albatross*, Capt. J. W. Collins, in his "Fisheries of the Pacific Coast," states that "Capt. John

Reed reported that often when waiting outside the harbor to tow vessels in, on or near the fishing bank, he has caught a fine lot of fish. Frequently halibut are taken, and on one occasion 22 were caught in a few hours fishing with hand lines over the rail; the largest weighed 87 pounds." Regarding the banks, Capt. Collins says they "are located outside the harbor heads, about 10 miles offshore in a northwesterly direction from the whistling buoy off the entrance. There is a depth of 30 fathoms * * * with a gravelly and rocky bottom." The other fishes listed by Capt. Collins were taken by the *Albatross* in 1888–89 and in 1914.

YIELD OF THE BANKS.

Halibut.[a]—So far as possible, a detailed record was kept of all commercial fishing trips made off the Oregon coast during approximately the period covered by the present investigation. The data obtainable (tables III and IV) are for the period beginning May 10, 1914, the date of the first trip of the year, and ending about September 15 with the last, so far as could be ascertained.

An inspection of table III shows that a total of 853,300 pounds of halibut were caught in 1 steamer and 20 schooner trips. Of this total, 235,000 pounds were thrown out as mushy, leaving a total of 618,300 pounds of sound, marketable fish, for which a value of $23,646.25 was received. To these returns there might be added, in computing the year's yield of the bank, over 10,000 pounds taken by the *Albatross* during the survey and about 6,000 caught, it is estimated, by local Newport craft during the fishing season. There were also several trips made to the banks concerning which no definite information could be had, but which, if known, might have materially increased the total given above. Among these were two made in August, one by the steamer *Starr* (12 dories) and the other by the schooner *La Paloma* (4 dories), both of Seattle.

In table IV separate columns have been devoted to totals and averages inclusive of mushy fish. Statistics published in Seattle apparently give the total fare, inclusive of mushy fish, for which there was no sale, thus crediting the vessels with a fare greater than that for which actual value was received. For purposes of comparison these data are also included in tables III and IV. For the months of May, June, and July no averages were drawn, as practically no figures were obtainable with respect to mushy fish. In the August returns the lack of one or two complete reports has resulted in giving a figure which errs on the side of being too low, but the average for the month has not been omitted, as it doubtless very nearly approximates the truth. The September returns are complete so far as they

[a] The halibut yield herein discussed deals with that from the Newport Bank only, as this was the only place where they were caught by commercial fishermen.

could be secured, but toward the end of the season the fishermen became uncommunicative as to the locality of their operations.

To give an idea of the relative abundance of halibut on the Newport Bank and on the Alaska banks, the yield of the former is compared with the total landings in Seattle during the two months for which the most complete statistics were obtainable, namely, August and September. The Seattle statistics[a] for 1914 include not only the Alaska catch but also the Oregon trips landed at that port, and as the comparison is not quite accurate, the returns for 1913, when no Oregon halibut were landed there, have also been cited. On the other hand, the quantity of halibut from Newport Bank taken to Seattle in 1914 was so small compared with the total receipts, that the average catches based on these data are sufficiently accurate for the purposes of this report.

In August, 1914, the average schooner trip (inclusive of mushy fish) from Oregon was 42,800 pounds, 3,000 pounds less than the average schooner fare landed at Seattle during the same month. Compared with the average trip for the same month of the previous year, the Oregon catch was about 100 pounds greater

In September the average trip from Newport Bank exceeded by over 15,000 pounds the average of all schooner trips landed in Seattle in September in either year. The average catch of sound fish alone from off Newport during this month compares favorably with the average Seattle fare including mushy fish, being 34,667 as against 38,343 pounds at Seattle in 1914 and 38,657 pounds in 1913. The Seattle averages are based on 38 trips in 1913 and 70 in 1914; whereas the Newport data include but 6 trips.

To all appearances, within the fishing area off Newport, halibut are as plentiful, at least in August and especially in September, as on the various northern banks fished by the Seattle schooners. It may be said that with the great number of northward trips there is greater possibility for making poor ones; but a few of these would not materially reduce the Seattle average, based on so many trips, whereas a few from Newport would have reduced that average to an insignificant quantity.

Relative to the time taken in making trips off Newport, in August the *Decorah* (4 dories) caught fish at the rate of 10,000 to 11,000 pounds a day; during the early part of the same month the *Daisy* (3 dories) secured a trip of about 40,000 pounds in a little over three days; later the *America* (4 dories) arrived off Newport August 14 and returned to Seattle August 21 with 57,000 pounds, taking 13,000 pounds on her best day; and the *Alaska* (8 dories), beginning to fish

[a] The Alaska landings are practically all from the various well-known Alaskan fishing banks, though a number of the smaller fares are still obtained off Cape Flattery.

off Newport on August 17, took a fare of slightly over 80,000 pounds into Seattle on August 24.

Though doubtless the entire Seattle fleet could clean out the Newport grounds in one or two trips, there is every indication that it will easily yield twice to three times the number of trips made thereon during July, August, and September, and possibly as early as May and June there may be a good run on certain spots indicated on the edge of Heceta Bank.

Regarding the percentage of mushy fish taken off Newport as compared with catches made in Alaskan waters, there are very few figures available. Of the four Newport trips made in August for which we have complete data, from 23 to 31 per cent, and in one fare of 57,000 pounds 43 per cent, were mushy. In September, taking all of the returns into consideration, about 37 per cent of the fish were mushy. Of Alaskan trips, but two of which can be cited here, both from the Portlock Bank, one in September of 50,000 pounds, and the other in October of 240,000 pounds, of which 40 and 29 per cent, respectively, were mushy.

These fish, called at times milk halibut, have been variously described. The fishermen say that when cut the flesh is so soft that it can be shaken away from the skin and bones, a condition that does not make itself apparent until after the fish has been packed in ice for several days or more. Mr. A. B. Alexander, of the Bureau of Fisheries, says that when mushy fish are cut they exhibit sac-like bodies in the muscular tissue varying in size from that of a marble to a walnut, of the consistency of hard fat, and which, when ruptured, exuded a whitish fluid of the consistency of condensed milk. Fish so affected are mushy to the touch, the flesh does not return to the original shape after being subjected to pressure, as from a finger end.

Several theories as to the causes of this condition have been advanced. One is that related to spawning, but the facts do not appear to support this idea. The suggestion that it is due to disease, or rather parasitism, seems more probable. Dr. Johan Hjort gives the results of a study of the life history of a crustacean parasitic in the flesh of *Molva abyssorum*, commonly known as the ling in Europe, and of very common occurrence on halibut banks. About 3 per cent of the ling taken are infected with the parasite, which has a whitish or yellowish egg-shaped body about the size of a walnut ($1\frac{3}{4}$ by $\frac{7}{8}$ inches) filled with a blackish fluid (digestion products) which, when the animal is cut, contaminates the flesh of the fish, rendering it unfit for sale. It is possible that the mushy halibut may have a similar causation, as Mr. Alexander speaks of the occurrence of hard, fatty lumps in their flesh.

This matter might well be made a subject for research, as unfortunately no way of detecting the affected fish at the time of taking

has been discovered. Only after the fish have been in ice for several days, or upon cutting them, is the mushiness apparent, and for fish so cut there is at present no sale.

Red rock-cod.—This fish, more properly called red rockfish, which is especially abundant on Heceta Bank, is common throughout the region surveyed and was taken practically at every set of the fishery gear. It is not marketed by the halibut vessels, but is taken by the local fishermen, it is found in the markets of Seattle and especially San Francisco, and from the latter place it is shipped to more or less distant interior points. It is excellent both as a pan fish and for chowder, and the demand for it should increase.

Black cod.—As far as indications go, black cod can profitably be fished in the deep water just off the southern and western slopes of Heceta Bank.

Flounders, sole, etc.—Of the smaller flatfishes, there seems to be an untold wealth throughout the greater part of the region surveyed. One needs but to refer to the records of the earlier *Albatross* investigation and to the returns of several of the fishing ventures, listed in the "Résumé of the history of the banks," and the tabulation of the scallop trials in the present report to become convinced of their abundance.

Dogfish.—Though not properly considered a commercial fish at the present time, the question of the utilization of dogfish for fertilizer and other purposes renders notes regarding their occurrence and abundance of more than passing interest.

From the results of the *Albatross* trials and the reports of the fishermen, there seems to be a more or less defined spring and summer run. In the course of the various sets, dogfish were taken rather more frequently in April, May, and September than during the intervening months of July and August, although on one occasion in the latter month 28 were taken, the greatest number to one skate of gear.

At practically all times the dogfish proved a great nuisance. The *Idaho* spoke of taking great numbers of them at every prospect in the spring of 1913. Capt. Tanner was also impressed by their abundance in 1888.

Whales.—At Grays Harbor the American Pacific Whaling Co. operates the only shore whaling station located on the coast, conducting operations between Cape Lookout and Cape Flattery. In 1912, 261 whales were taken and in 1913, 211, of which 6 were sperm whales. During the last *Albatross* trip, August 27 to September 10, one or more whales were sighted each day, and on August 29, a school of about 10 humpbacks was seen, the largest of which had a spread of about 30 feet between the tips of the flukes. Another small school was noted on September 5.

Scallops.—From time to time the taking of scallops off Newport has been reported, and in connection with the present investigation trials were made for them as opportunity presented. The first evidence of their occurrence obtained by the *Albatross* was at set VI, May 7, when several sea anemones attached to large scallop shells were brought up on the trawl line. As the weather was too foggy and threatening to warrant the towing of apparatus over the bottom in such close proximity to shore, the dredge was not used at the time, and it was not until July 20 that a scallop trial was made. At first an improvised dredge with a galvanized iron (chicken) wire bag, and later a light oyster dredge with a similar bag, was employed, the opening in each having an effective width of 3 feet.

During three days in the latter part of July, while working out of Newport, eight tows of varying duration were made with the oyster dredge, yielding but three living scallops, 3, 6, and 7 inches, respectively, in diameter. During one of the hauls a living scallop 6 inches in diameter was picked up on a hand line which was dragging over the bottom. The evidence of the occurrence of scallops thus obtained was, though positive, very scanty, and five hauls made in this vicinity by the *Albatross* with the oyster dredge and a 9-foot Agassiz beam trawl were wholly unproductive. Though failures so far as scallops were concerned, these hauls demonstrated a great abundance of flounders and soles. In four of them, of between 15 and 20 minutes duration each, over 300 small flatfish were taken all told, of which 187 were sand dabs (*Citharichthys sordidus*). These hauls confirm the results of the early fishing ventures off the Oregon coast and are indicative of an abundance of the species listed in the summary of the scallop trials, table II.

As mentioned above at set VI, May 7, off Cascade Head, several dead scallop shells were brought up on the halibut trawl. Four tows were made in this vicinity on September 3. In the first (VI) 50 living scallops were caught, 30 ranging from $4\frac{1}{2}$ to 6 inches, the remainder from $2\frac{1}{4}$ to 4 inches. The second haul (XLI), 2 miles farther inshore, yielded 3 small living scallops. At the third (XLII), about a mile to the southeast of the first, no scallops were caught, and at the fourth (XLIII), about a mile north of the first, 15 living scallops, 2 large and 13 small, were taken.

The results point to the existence of a scallop bed extending over at least 2 square miles. When considered with the few scattered individuals picked up off Newport and several specimens in the National Museum labeled as having come from the Siuslaw River, Oreg., they indicate that a more detailed search than it was possible to make in connection with this halibut investigation will reveal one if not several scallop beds of sufficient extent to warrant establishing along the Oregon coast a fishery similar to that for the giant scallop

off the coast of Maine. The depth of water, 50 to 60 fathoms, is greater than on the Maine beds; but the use of small gasoline winches make the depth of less moment than when the dredges were wound in by hand. Scallops to a certain extent are migratory, which must be taken into consideration by anyone contemplating undertaking a market fishery. A possible lack of a wide demand on the west coast is also a factor requiring careful investigation, notwithstanding that scallops are quoted in Seattle markets at a price at times as high as $3 a gallon.

The living adult scallops taken during the investigation averaged four to the pound, shell included. The eyes or muscles, which are the edible portion, were from 1 to 1½ inches in diameter and about ½ inch thick, and weighed, fresh, approximately 16 to the pound. All told, 17 hauls were made for scallops, the data for which are set forth in table II.[a]

SUMMARY.

The investigation developed the existence of a nice run of halibut during a period of at least two months, on a bank having an area of approximately 250 square miles, off Newport, Oreg. The run attained its maximum in August and September, but fish were present in June and July. A profitable fishery probably could be conducted at that time, and at certain places might possibly be engaged in as early as the latter part of April. Irrespective of the abundance of fish, however, the weather conditions and lack of shelter will restrict fishing to the period from April to September. In 1914 this run yielded commercial catches totaling over 850,000 pounds of halibut in 21 trips, for which $23,646.25 was received by the fishermen. Average trips of 40,000 pounds were caught in four days or less, the fish averaging 27 pounds in weight.

Mushy fish occur to the extent of 30 to 40 per cent of the total catch, but in view of certain returns from Alaska during the same year (1914), this proportion does not seem greater than on other Pacific coast grounds.

Halibut may be expected in limited quantities off Coos Bay, on a considerably smaller and less developed patch of bottom, and possibly off Grays Harbor at some season of the year, as a good piece of bottom was located in that vicinity, although not a halibut was caught thereon. With respect to halibut and halibut bottom, the section of the coast lying off Tillamook seems to be the least favorable.

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[a] For a detailed account of scallops and scallop fisheries see:

Smith, Hugh M.: The giant scallop fishery of Maine. Bulletin U. S. Fish Commission, vol. IX, 1889, p. 313–335.

Belding, David L.: A report upon the scallop fishery of Massachusetts. Published as a special report by the Commonwealth of Massachusetts, 1910, 150 pages.

Both papers are well illustrated, a chart accompanying the former.

On the other hand, throughout practically the entire reach of the Oregon coast, there seems to be an abundance of the smaller flatfishes, some of which are food fishes of great excellence. The red rock-cod and doubtless black cod occur in great abundance. Dogfishes are so numerous at times as to be a nuisance.

Scallops apparently are to be found over a wide range of territory and in some places probably form beds thickly enough populated to warrant fishing, though the depth in which they lie may militate against taking them commercially.

In conclusion, the harbor and market facilities, bait supplies, transportation, and cold storage are perhaps too limited and uncertain to enable any of the Oregon coast ports to become fishing centers of any great consequence under present conditions. The limitation of the fishing season by weather conditions is possibly the greatest handicap in competition with Seattle and its proximity to the vast, year-round Alaska fishery resources. No doubt the Newport Bank will provide a valuable addition to the available supply of halibut, and the greater part of the Oregon coastal region will furnish a future source of supply of flounders, sole, black cod, and red rockfish, which at present find but a limited market, if any.

TABLE I.—LOCATIONS AND RESULTS OF HALIBUT FISHING TRIALS OFF THE COAST OF WASHINGTON AND OREGON BY THE STEAMER ALBATROSS, 1914.

Set No.	Position. (All bearings magnetic.)	Date	Depth.	Character of bottom.[a]	Number of skates of gear used	Duration of set.	Bait	Fish taken (catch). Halibut: Number taken	Halibut: Range of size	Halibut: Total weight	Halibut: Average weight	Halibut: First class (between 11 and 50 lbs.)	Halibut: Average weight of first-class fish	Dogfish (Squalus sucklii)	Blue sharks (Prionace glauca)	Skates (Raja spp.)	Rockfish (Sebastodes spp.)	Black cod (Anoplopoma fimbria)	Greenling (Ophiodon elongatus)	Flatfish, Hippoglossoides spp.)	Flatfish, Atheresthes stomias	Flatfish, Lepidopsetta bilineata	Sole (Parophrys vetulus)	Addenda
								Number.	Inches.	Pounds.	Pounds.	Number.	Pounds.											
	FIRST ALBATROSS TRIP.	1914																						
I	Heceta Bank (Heceta Light bears NE. by E., distant 31.5 miles)	Apr. 29	88–92	Shale, rky., grav., blk S.	2	1	Salt herring.	9	10–25	29	3.2		17.2	21		1		4		1				1 carnoid, several starfish, 1 Pycnopodia (many-rayed starfish), 1 rock, honeycombed, full of sea worms.
II	Off Newport (Yaquina Light bears E. by S., distant 10.8 miles)	May 2	96	Gn M, fine blk S.,	2	1	do	1		21				1		1		8						Double-banked set.
III	Heceta Bank (Heceta Light bears E. ½ N., distant 29.2 miles)	May 5	61	Shale, grav., fine G.	4	1	do	34	18–38	88	2.6	30	2.8	80		4		1		1				Cultus cod weighed 21 lbs., 42 in. long. On trawl: Starfish, 4 Cucumaria.
IV	Off Newport (Yaquina Light bears NE. ½ E., distant 14.7 miles)	May 6	54–57	Fine blk S; brk shells, crs gy S.	3	1	do	8	7–31	157	19.6	7	21.4	6		2		9		1				Average sized red rockfish weighed 11 lbs. Cultus cod weighed 20 lbs., 49 in. long. On trawl: 1 basket star.
V	Off Newport (Yaquina Light bears NE. by E., 11 miles)	Jly.	62	Shale, grav., fine G.	2	1	do	4	10–2	47	11.2	4	11.7				1	24		9		1		Double-banked set. Red rockfish, 1 small one, 7 lbs., 22 in. long; stomach contents saved. Cultus cod, one to lbs., 33 in. long; two 22 lbs., 38 in. long. Sole, 4 lbs., 8 in. long. 3 red rock cod, 1 ling cod, 1 rock salmon taken on hand lines.
VI	Off Cascade Head (Cape Kiwanda bears N. ½ E., distant 12.7 miles)	May 7	48	Fine gy S.	2	1	do											6		2		1	1	Double-banked set. Sole, 14 lbs.; 2 red rockfish (S. pinniger), 6 lbs., 22 in. long. Cultus cod, 14 lbs., 36 in. long, stomach contents saved. Skates, one 29 lbs., 50 in. long, one 36 lbs., 54 in. long. On trawl: Anemones, dead scallop shells, 1 Pycnopodia (many-rayed starfish).
VII	Off Columbia River (Tillamook Light bears NE. by E. ½ E., about 25.1 miles)	May 8	70	Shale, grav.,	2	1	do	1						15		1		1					1	Double-banked set. Lo topius. Dogfish, one 20 lbs., 43 in. long, two 17 lbs., 42 in. long. Skate, 4½ in. long, 30 lb. wide. On trawl: 1 starfish.
	SECOND ALBATROSS TRIP.																							
VIII	Off Newport (Yaquina Light bears N. ½ E., distant 10.8 miles)	May 27	61–61	Fine gy S.	2	1	do	3	17–28											1				Cultus cod, 11 lbs., 33 in. long. On trawl: 6 pennatulids, 2 starfishes.
IX	Heceta Bank (Heceta Light bears NE. ½ N., distant 27.8 miles)	May 28	66–68	Shale, grav.	2	1	do	5	9–40															Double-banked set. Black cod, grayish, 10.6 lbs., range 7–18 lbs. Seven small rockfish, 7 in. long, 12 lbs., 32 in. long, 1 11 lbs., 34 in. long, 7 lbs., 26 and 22 in. long.
X	Heceta Bank (Heceta Light bears NE. by N., distant 30 miles)	do.	109	Fine blk S., fine G.,	2	1	do	1						1		1								Double-banked set. Black cod, averaged 12 lbs., range, 5–16 lbs., 30 lbs., 38 and 46 in. long, 15 lbs., 36 in., 8 lbs., 28 in.; 5 lbs., 22 in. Shark approximately, 6 in. long.
XI	Heceta Bank (Heceta Light bears NE. by E., distant 11.6 miles)	May 29	100	Fine blk S.,	2	1	do	1								1								
	OPERATIONS CONDUCTED OUT OF NEWPORT																							
XII	Off Newport (approximately as indicated on chart)	July 15	60	Crs gy S.,																			2	Halibut and 1 sole taken on hand lines. On trawl, 9 pennatulids.
XIII	Do	July 15	50	do.	3	1	Surf perch, salt herring	1																2 halibut and 1 rock salmon taken on hand lines, no weights taken. On trawl: 10 pennatulids, 2 anemones, 1 pennatulids.
XIV	Do	July 20	25	do.	1	1	do																	
XV	Do	do	48	do.	2	1	Surf perch, salt herring	2																1 live crab in scallop on hand line. 5 halibut, 4 red rockfish, and 3 sole taken on hand lines. 1 dogfish, 42 in. long, 1 pennatulid, 1 anemone, 4 starfish, 1 Pycnopodia (many-rayed starfish).
XVI	Do	July 2	45	do.	3	1	do	17	16–26	45	2.6	3	8.0					4		1		1	1	1 pennatulid, 5 starfish, 4 Pycnopodia (many-rayed starfish), 5 anemones.
XVII	Do	Jly. 24	36–41	do.	2	1	do	20				1	6.9					11		2				1 live crab in 2 scallops taken with oyster dredge, 15 min. tow. 2 other tows, 15 and 30 mins. respectively, unsuccessful. 2 halibut and 2 red rockfish taken on hand lines, 11 pennatulids, 2 Pycnopodia (many-rayed starfish).
XVIII	Do	July 3	47	do.	2	1	Fresh herring											1						5 rockfish, 2 skates, and 1 red rockfish taken on hand lines. 1 skate, 48 in. wide, 1 octopus, arms 54 in. long. 2 Pycnopodia (many-rayed starfish).
XIX	Off Newport (approximately as indicated on chart)	July 3	50–60	Shale, rky., crs. sn, fine gy G.	2	1	Octopus, salt herring							1		1				1				1 halibut taken on hand line. 1 Pycnopodia (many-rayed starfish).
XX	Do	July 28	45–45	Crs gy S.,	2	2	Salmon, salt herring																	1 Pycnopodia (many-rayed starfish).
XXI	Do	Aug. 1	40	do.,	1	1	Surf perch, salt herring																	1 Pycnopodia (many-rayed starfish).
XXII	Do	Aug. 2	45	do.,	2	1	do																	2 live crabs and 7 in 2 scallops taken with oyster dredge, 20 min. tow. Another unsuccessful tow, 15 min. 2 halibut on hand lines, 1 red rockfish taken on hand lines. 1 octopus, arms 54 in. long. 2 Pycnopodia (many-rayed starfish).
XXIII	Do	Aug. 14	60	do.,	1	1	do																	1 live crab and 1 in 2 scallops taken with oyster dredge, 15 min. tow. 1 halibut taken on hand line. 1 Pycnopodia (many-rayed starfish).
XXIV	Do	Aug. 17	35	Shale, rky.	1	2	do	29	16–35	93.1	12.2	22	13.1	8	1	4		13						1 halibut, 1 dogfish, 1 blue shark, and 1 red rockfish taken on hand lines; 1 skate, 54 in. wide, 2 anemones.
	THIRD ALBATROSS TRIP.																							
XXVII	Off Coos Bay (Umpqua River Light bears S. ½ E., distant 14.4 miles)	Aug. 29	30	Fine gy S.,	2	2	do	2	17–19	37	18.0	2	18.0			1							6	Double-banked set. Soles, 18, 19, and 22 in. long, 1 starfish.
XXVIII	Off Coos Bay (Cape Arago Light bears NE. ½ E., distant 9 miles)	Aug. 30	65	Shale, grav.	2	2	do	13	11–35	87.5	28.8	12	24.2	4	2					2		3		Double-banked set. One shark was "snap fin" (Galeorhinus zyopterus, blue shark, 56 in. long.
XXIX	Off Coos Bay (Cape Arago Light bears NE. ½ N., distant 27 miles)	do.	30	Fine gy S.,	2	2	do	3	9–30	10.0	30.3					2		15					3	Double-banked set.
XXX	Off Coos Bay (Cape Arago Light bears NE. ½ E., distant 5.5 miles)	Aug. 31	47	do.	2	2	do									1		7					1	Double-banked set. One shark was "snap fin" (Galeorhinus zyopterus).
XXXI	Off Heceta Head (Heceta Light bears N. ½ E., distant 10.8 miles)	do.	42	do.	2	2	do											6		3		2	2	Double-banked set.
XXXII	Heceta Bank (Heceta Light bears NE. by E., distant 11.4 miles)	Sept. 1	82	Shale, gray; fine blk S.	2	2	do	7	10–30	59	37.0	6	41.5	12	30	18	1	150	2	3		3		Do.
XXXIII	Heceta Bank (Heceta Light bears NE. by E., distant 12 miles)	do.	87	Shale, rky., fine M, fine blk S.	2	2	do	3	30–36	105	35.0	3	35.0	7	2	6		2	31	5				Double-banked set. Black cod averaged 10 lbs., 44 in. long, 1 basket comb sponge.
XXXIV	Off Newport (Yaquina Light bears NE. ½ N., distant 26.2 miles)	Sept. 2	63	Crs gy S., fine G., brk. Shells	2	2	do	9	16–64	288	32.1	9	32.1	7		6			14				5	Double-banked set. One silver salmon taken on gear.
XXXV	Off Cascade Head (Cape Kiwanda bears N. ½ E., distant 12.8 miles)	Sept. 3	45	Fine gy S.,	2	2	do	1		37					10	4				3		2		Double-banked set.
XXXVI	Off Tillamook (Cape Meares Light bears SE. ½ E., distant 9.1 miles)	Sept. 4	43	do.	2	2	do	2	9–16	25	12.5	1	16.0	6	2	3				4		1		Double-banked set. One arrow-toothed flatfish (Atheresthes stomias) taken on gear.
XXXVII	Off Tillamook (Tillamook Light bears N. by E. ½ E., distant 13.2 miles)	do.	50	do.	2	2	do							2	4				1		1			Double-banked set.
XXXVIII	Off Grays Harbor (Cape Shoalwater Light bears ESE. ½ E., distant 20.9 miles)	Sept. 5	38	Fine gy, crs gy,	1	2	do							1	1	1		1						1 silver salmon taken on gear. Anemones.

[a] Abbreviations denote relative proportions of the bottom: blk, black; brk, broken; crs, coarse; fine, fine; G, gravel; gn, green; gran, granular; gy, gray; hd, hard; M, mud; rky, rocky; S, sand.

[b] Also 1 line, flounder gear.

[c] Lost gear.

TABLE II.—LOCATIONS AND RESULTS OF TRIALS FOR SCALLOPS OFF THE COAST OF WASHINGTON AND OREGON BY THE STEAMER "ALBATROSS," 1914

Number of trial	Position	Date	Time of day.	Depth.	Character of bottom.[a]	Apparatus	Haul: Length.	Haul: Direction.	Haul: Duration.	Scallops (Pecten caurinus Gld.) taken: Total, living	Scallops (Pecten caurinus Gld.) taken: Large, 4½ in. or more	Scallops (Pecten caurinus Gld.) taken: Small, 2½ to 4½ in.	Scallops (Pecten caurinus Gld.) taken: Dead valves	Flounder taken: Sand dab (Citharichthys sordidus)	Flounder taken: California sole (Psettichthys melanostictus)	Flounder taken: Longfin dart sole (Glyptocephalus pacificus)	Flounder taken: Flathead sole (Hippoglossoides elassodon)	Flounder taken: Flounder (Platichthys stellatus)	Flounder taken: Starry flounder (Platichthys stellatus)	Flounder taken: Dover sole (Parophrys vetulus)	Addenda
	OFF NEWPORT	1914		Fms.					Minutes.												
XV	Approximately as indicated on chart	July 29	9.55 a. m. to 10.6 a. m.	48	Crs gy S.,	Oyster dredge.			20 to 60	1	1										1 large jelly fish.
XVI	Do	July 31	10.15 a. m. to 11.15 a. m.	48	do.	do.			15 mins.	1	1										1 lobe in. long; 6 albacore brought up on hand line during this haul; several worm tubes.
XVII	Do	July 31	11 a. m. to 11.15 p. m.	48	do.	do.			15 mins.	1	1										6 in.
XVIII	Do	do.	11.15 a. m. to 11.30 a. m.	48	do.	do.			15 mins.												
XIX	Do	do.	11.30 a. m. to 11.45 a. m.	48	do.	do.			15 mins.												
XX	Do	do.	11.45 a. m. to 12 m.	48	do.	do.			15 mins.												
XV	Yaquina Light bears N. ¼ N., distant 9.4 miles	Sept. 2	1.57 p. m.	41	do.	do.	1 mile.	S. 12° E.	17 mins.					10	2				3	12	Hermit crabs, algæ, worm tubes, starfishes.
XVII	Yaquina Light bears NE. by E., distant 9.4 miles	do.	4.00 p. m.	42	Crs gy S., fine G., brk. shells	Scallop dredge.	1 mile.	S.	19 mins.					10				1		2	2	Worm tubes, algæ, medusæ, 1 starfish.
XVIII	Yaquina Light bears ESE. ½ E., distant 8.1 miles	do.	4.07 p. m.	41	do.	do.	1 mile.	S. 11° W.	17 mins.					90	2				20	43	1 tomcod, 1 eel, 7 young black cod, 11 starfish, barnacles, 3 sponges, dead shells, large, thin mud crab.
XIX	Yaquina Light bears ESE. ½ E., distant 8.1 miles	do.	5.05 p. m.	28	do.	Oyster dredge.	0.7 mile.	N.	4 mins.											2	3 starfish, 1 flesh, pieces Polynoe sp. ? use.
XXXIX	Yaquina Light bears NE. ½ E., distant 4 miles	do.	5.34 p. m.	51	do.	do.	1 mile.	S. 62° E.	14 mins.					27	1				18	22	1 shark egg case, 1 Polynoe egg case, 1 Polynoe living, shells, 12 hermit crabs, 2 starfish, several pennatulids, 1 dead Schizothærus valve.
	OFF CASCADE HEAD																				
XL	Cape Kiwanda bears N., distant 12.3 miles	Sept. 3	11.51 a. m.	50	Fine gy S.,	do.	1 mile.	S. 62° E.	20½ mins.	50	30	20	28		24						28 starfish, sea-mouses, crustaceans, worm tubes, medusæ, sponges.
XLI	Cape Kiwanda bears N., distant 10.5 miles	do.	12.30 p. m.	52	do.	do.	1 mile.	S. 21° E.	15 mins.	3		3		4	1	8	1	2	4	15 starfish, 1 dead Schizothærus valve.
XLII	Cape Kiwanda bears N., W. ½ N., distant 11.5 miles	do.	2.28 p. m.	41	do.	do.	1 mile.	S.	5 mins.					1					19	2 C. magister crabs, 1 skate, 1 starfish, 1 anemone.
XLIII	Cape Kiwanda bears N. by E., 10.4 miles	do.	3.40 p. m.	41	do.	do.	1 mile.	S.	5 mins.	17	2	14		9						1 young black cod, 11 starfish, 1 mollebranch.

[a] Abbreviations denote relative proportions of the bottom: blk, black; brk, broken; crs, coarse; fine, fine; G, gravel; gn, green; gran, granular; gy, gray; hd, hard; M, mud; rky, rocky; S, sand.

TABLE III.—QUANTITY AND VALUE OF HALIBUT CAUGHT BY COMMERCIAL FISHERMEN OFF THE COAST OF OREGON, MAY 10 TO SEPTEMBER 15, 1914.

Date.	Vessel.	Landed at—	Sound fish.	Price per pound.	Value received.	Mushy fish.	Total catch.
			Pounds.	*Cents.*		*Pounds.*	*Pounds.*
May 10	Decorah	Portland	4,500	3	$135.00	Unknown.	4,500
28	do	do	13,700	4	548.00	Unknown.	13,700
June 16	do	do	22,800	3	684.00	Unknown.	22,800
July 6	do	do	32,500	3½	1,056.25	Unknown.	32,500
11	Daisy	Newport	19,000	3½	617.50	Unknown.	19,000
16	do	Seattle	30,000	5½	1,650.00	5,000	35,000
22	Decorah	Portland	21,000	4	840.00	Unknown.	21,000
30	Daisy	Newport	17,000	5½	935.00	Unknown.	17,000
Aug. 10	Decorah	Portland	14,000	3½	455.00	Unknown.	14,000
12	Daisy	Seattle	27,800	4¾	1,320.50	12,000	39,800
21	America	do	32,000	3¼	1,040.00	25,000	57,000
22	Decorah	do	30,000	3	900.00	Unknown.	30,000
24	Alaska	do	56,000	3¾	2,130.00	25,000	81,000
25	Daisy	do	27,000	4	1,080.00	8,000	35,000
Sept. 1	San Juan	do	60,000	3½	2,100.00	50,000	110,000
5	Athena	do	54,000	3½	1,890.00	27,000	81,000
7	Senator	do	28,000	3¼	910.00	15,000	43,000
8	Magnolia	do	30,000	3¼	975.00	10,000	40,000
11	Panama	do	46,000	3	1,380.00	22,000	68,000
15	Omaney	do	40,000	4¼	1,700.00	10,000	50,000
—	Daisy	San Francisco	13,000	10	1,300.00	26,000	39,000
Total (21 trips)			618,300		23,646.25	235,000	853,300

TABLE IV.—QUANTITY OF HALIBUT CAUGHT (SCHOONERS ONLY) ON THE NEWPORT BANK, MAY TO SEPTEMBER, 1914, AND THE AVERAGE CATCH PER TRIP COMPARED WITH THE AVERAGE CATCH PER TRIP LANDED AT SEATTLE FROM ALL BANKS IN 1913 AND 1914.

Month.	Newport, 1914.					Seattle.	
	Number of trips.	Sound fish.	Average trip based on sound fish.	Total fish, sound and mushy.	Average trip based on total fish.	Average trip based on total fish, sound and mushy.[b]	
						1913	1914
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
May	2	18,200	9,100	(a)	(a)	.....	.....
June	1	22,800	22,800	(a)	(a)	.....	.....
July	5	119,500	23,900	(a)	(a)	.....	.....
August	6	186,800	31,133	a 256,800	a 42,800	42,729	45,701
September	6	208,000	34,667	321,000	53,500	38,657	38,343

[a] Returns of mushy fish are incomplete in a number of instances, hence figure given is not sufficiently high. Averages and totals, owing to number of such omissions, have not been included in returns by months for May, June, and July.

[b] Taken from the Pacific Fisherman.

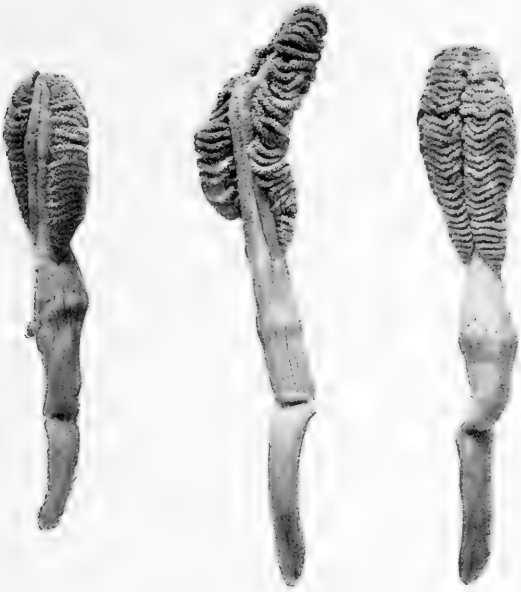
EXPLANATION OF CHARTS.

The character of the bottom is indicated by stippling in three colors, the significance of which is explained on the charts, but the following further explanation of the terms appears advisable. Shale is a siliceous (sandy) or calcareous (limey) hard pan, which occurs as honey-combed bowlders or easily crumbled rocks (designated in

this report as rocky) as a species of gravel (described as granular shale) and as a hard mud. Broken bottom consists of mixed materials, shale, gravel, sand, and mud, in patches of varying sizes and composition, but always rich in bottom-living organisms.

The depths are indicated by curves drawn at 10-fathom intervals, but the soundings which have been made off this coast are not sufficiently numerous to permit more than approximate location of the lines in many cases.

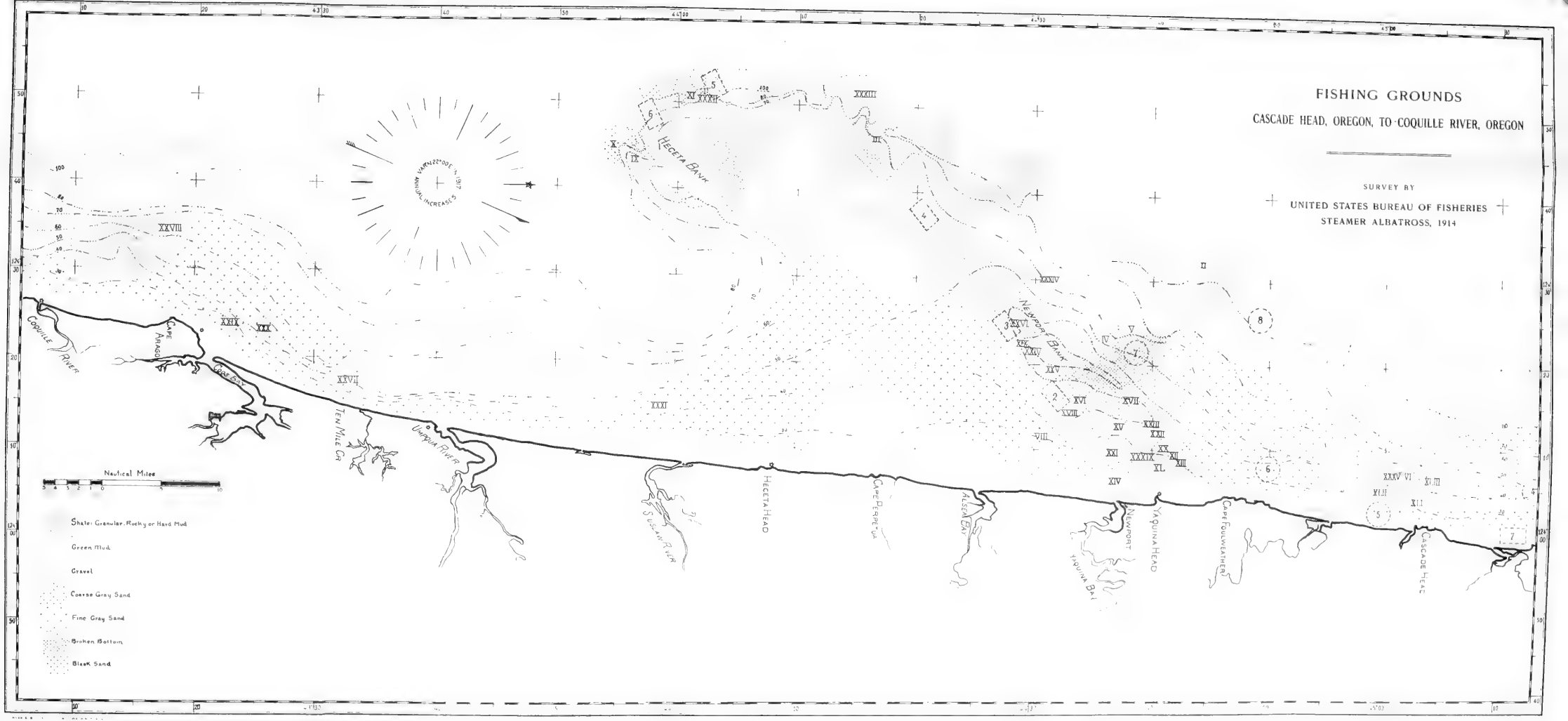
The locations of the sets made during the survey are shown by Roman numerals (I to XLIII), the center of the space covered by the numeral being the position of the set. Fishing trials made by the *Idaho* and the *Chicago* prior to the investigation are shown by numbered rectangles and circles, respectively.



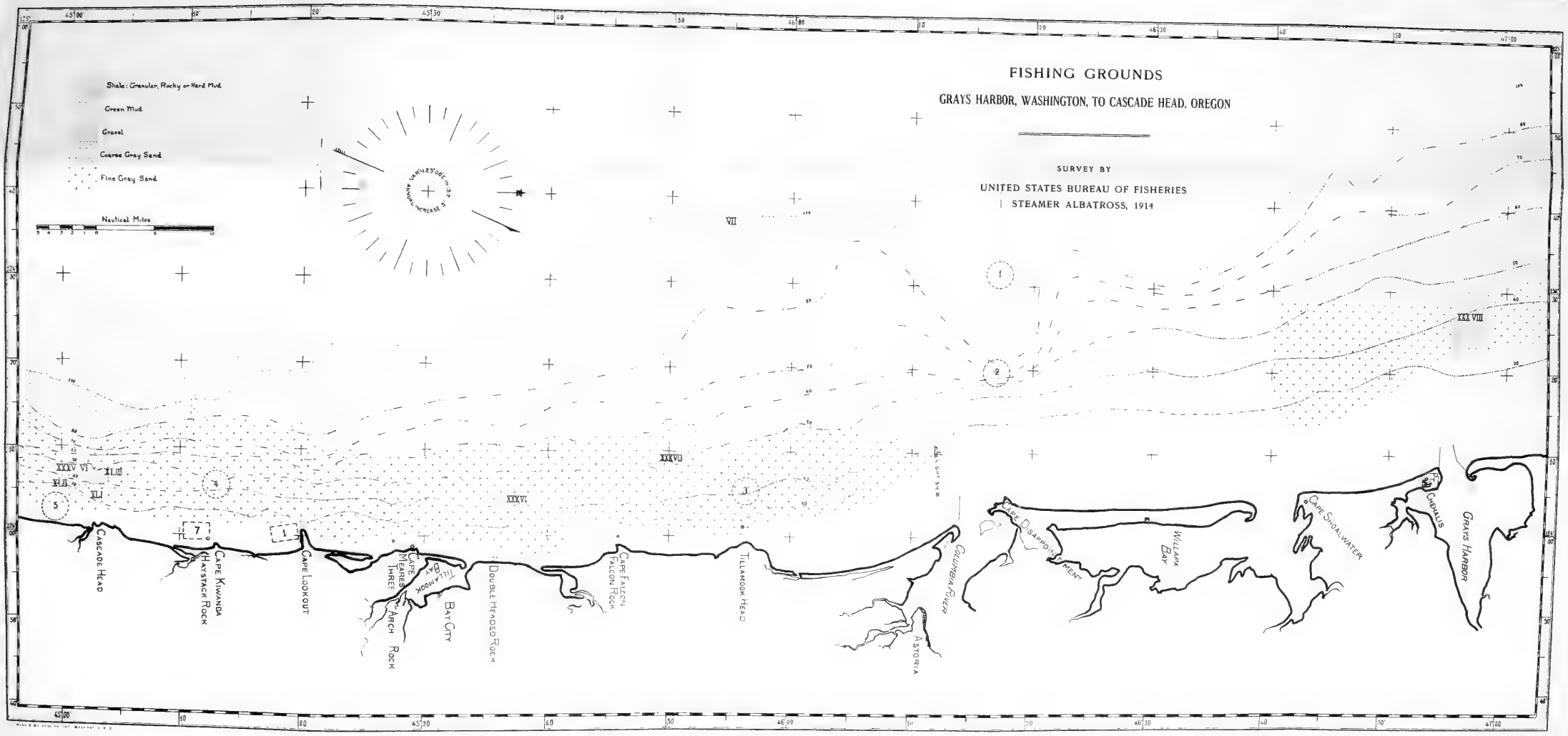
1. PENNATULIDS (PENNATULA SP.).

2. SEA ANEMONES (CRIBRINA SP.) (METRIDIUM SP.).

20'
80
70
60
10'
50
40
30
XXXV VI
XLIII
XLII
XLI
4
5
7
124° 00'
50'
40'
CASCADE HEAD
RIVER
44° 00'
45° 00'
10'


FISHING GROUNDS
CASCADE HEAD, OREGON, TO COQUILLE RIVER, OREGON
SURVEY BY
UNITED STATES BUREAU OF FISHERIES
STEAMER ALBATROSS, 1914
VAR. N 22° 00' E. - 1917
ANNUAL INCREASE 5
HECETA BANK
NEWPORT BANK
COQUILLE RIVER
CAPE ARAGO
COOS BAY
TEN MILE CR
UMPQUA RIVER
SIUSLAW RIVER
HECETA HEAD
CAPE PERPETUA
ALSEA BAY
YAQUINA BAY
NEWPORT
YAQUINA HEAD
CAPE FOULWEATHER
CASCADE HEAD
Nautical Miles
Shale: Granular. Rocky or Hard Mud
Green Mud
Gravel
Coarse Gray Sand
Fine Gray Sand
Broken Bottom
Black Sand

XXVII
Pt.
Chehalis
Cape Shoalwater
Grays Harbor
10'
124°
00'
50'
40'
50'
50'
47° 00'


FISHING GROUNDS
GRAYS HARBOR, WASHINGTON, TO CASCADE HEAD, OREGON
SURVEY BY
UNITED STATES BUREAU OF FISHERIES
STEAMER ALBATROSS, 1914
Shale: Granular, Rocky or Hard Mud
Green Mud
Gravel
Coarse Gray Sand
Fine Gray Sand
Nautical Miles
CASCADE HEAD
CAPE KIWANDA
HAYSTACK ROCK
CAPE LOOKOUT
CAPE MEARES
ARCH ROCK
TILLAMOOK BAY
BAY CITY
DOUBLE HEADED ROCK
CAPE FALCON
FALCON ROCK
TILLAMOOK HEAD
COLUMBIA RIVER
ASTORIA
CAPE DISAPPOINTMENT
WILLAPA BAY
CAPE SHOALWATER
GRAYS HARBOR
GRAYSVILLE