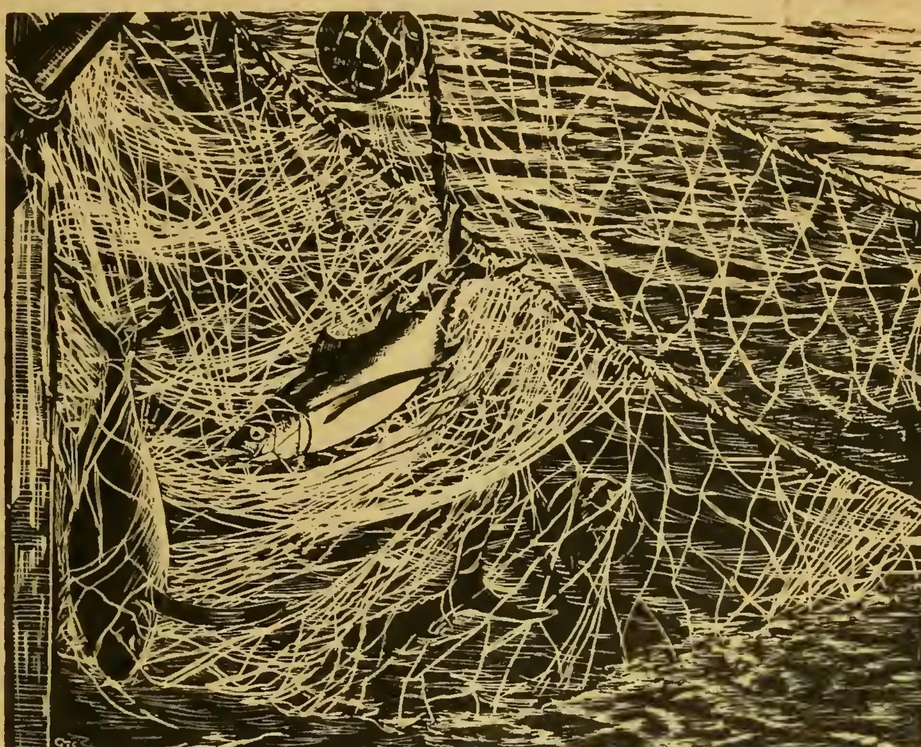
# NORTH PACIFIC ALBACORE TUNA EXPLORATION··1950



FISHERY LEAFLET 402

FISH AND WILDLIFE SERVICE

United States Department of the Interior

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United States Department of the Interior, Oscar L. Chapman, Secretary
Fish and Wildlife Service, Albert M. Day, Director

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Fishery Leaflet 402

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# NORTH PACIFIC ALBACORE TUNA EXPLORATION--1950

By Donald E. Powell,* Dayton L. Alverson* and Robert Livingstone, Jr.*

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## INTRODUCTION

The first major project assigned to the new exploratory fishing vessel, John N. Cobb (Ellson 1950), operated by the Exploratory Fishing and Gear Development Section of the Branch of Commercial Fisheries, U. S. Fish and Wildlife Service, was an exploration for the albacore tuna (*Thunnus germo*) in waters of the northeastern Pacific Ocean. Following a short shakedown cruise spent fishing for shellfish in southeastern Alaska in the early spring of 1950 (Schaefers 1951) the vessel was outfitted with several types of tuna fishing gear; and 3½ months, from June 12 to September 28, were devoted to exploratory fishing and gear-testing experiments in offshore waters of Oregon, Washington, British Columbia, and Alaska. This work was a continuation of a project begun in midsummer of 1949 (Powell and Hildebrand 1950) to study the range of the albacore and to investigate the possibilities of establishing a commercial fishery for tuna off the Alaska coast.

Because of the almost complete lack of knowledge regarding the life history of the albacore and the interrelation of factors affecting their occurrence and abundance both inside and outside the range of commercial-fishing operations, it is certain that many years of investigations will be needed before this notably inconsistent fishery may be well understood. This report presents only the results of one year's work on certain phases of the problem, and it is highly probable that different results will be obtained in subsequent seasons. The material herein is presented in the nature of a progress report and may well raise more questions than are answered. Many of the findings are inconclusive, but the data are presented for their possible interest and value to other investigators, and to assist the commercial fisherman in recognizing and utilizing various methods and devices which may increase his efficiency.

### Background

Since the first commercial landings of albacore at Oregon and Washington ports in 1937, the fishery has rapidly grown into one of the most important on the northwest coast. Well in excess of a thousand vessels are actively engaged for several months each summer in offshore trolling for the white-meat tuna. Landings in Washington and Oregon reached an all-time high of 34 million pounds in 1944, but the catch has fluctuated and decreased to less than 15 million pounds annually since 1945.[1] The major portion of this catch has been taken by surface trollers, with live-bait boats and seiners making successful trips in some years. Length of the season is normally from July to October.

As early as 1939, Canadian boats began fishing experimentally for albacore off Vancouver Island, and landings at British Columbia ports had reached over a million pounds annually by 1945. Most of these fish, however, were caught off Oregon and Washington; and large catches were not consistently made off the British Columbia coast until 1948. Patrol vessels of the Canadian Department of Fisheries in that year found schools of albacore far north of the previous commercial range, and good fishing was had off the Queen Charlotte and Vancouver Islands by Canadian and American vessels.

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1/U. S. FISH AND WILDLIFE SERVICE, FISHERY STATISTICS OF THE UNITED STATES, ANNUAL REPORT.


FIGURE 1 - THE EXPLORATORY VESSEL JOHN N. COBB TROLLING FOR ALBACORE.

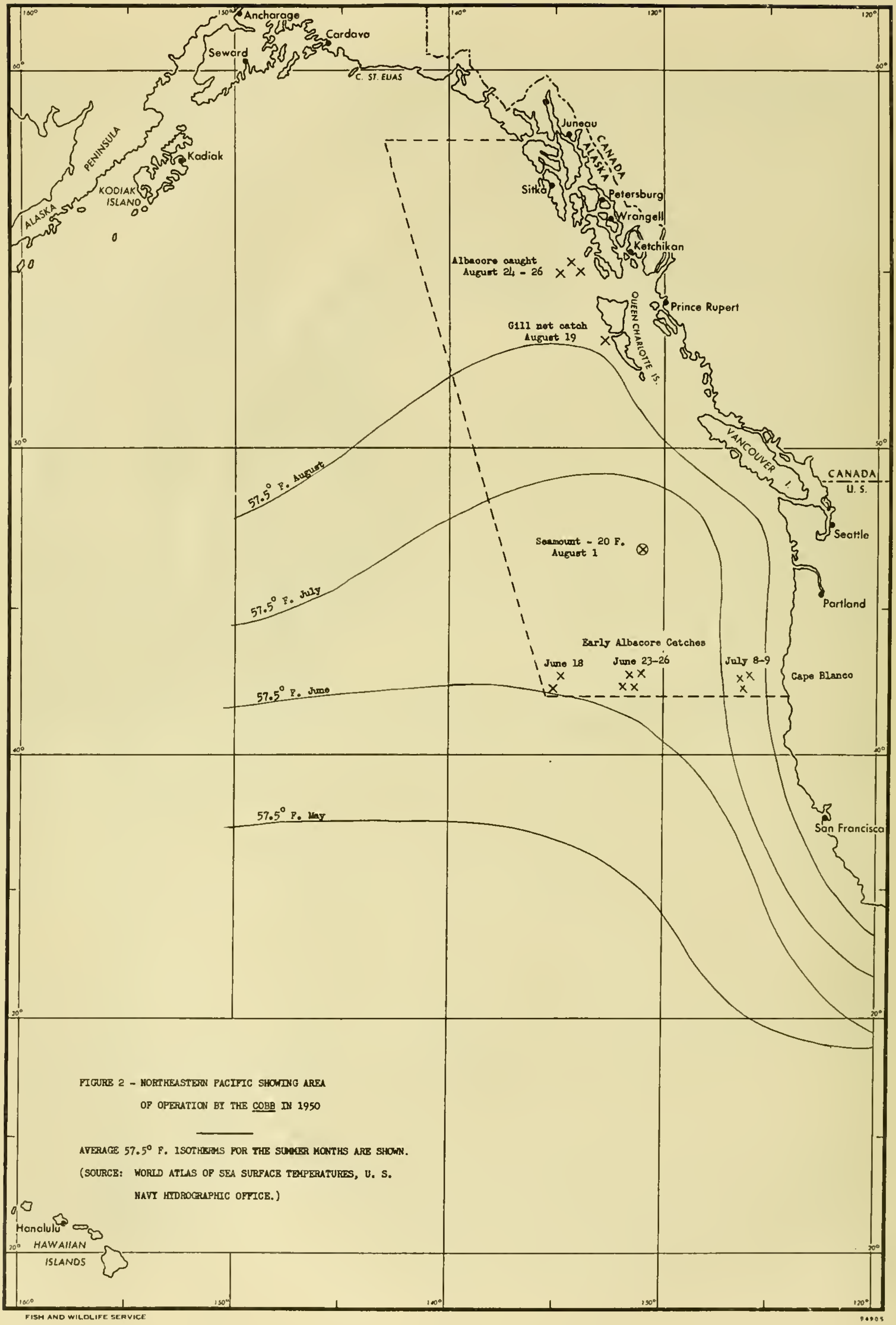



FIGURE 2 - NORTHEASTERN PACIFIC SHOWING AREA OF OPERATION BY THE COBB IN 1950

AVERAGE 57.5° F. ISOTHERMS FOR THE SUMMER MONTHS ARE SHOWN. (SOURCE: WORLD ATLAS OF SEA SURFACE TEMPERATURES, U. S. NAVY HYDROGRAPHIC OFFICE.)

One of the main objectives of the 1949 exploration by the Fish and Wildlife vessel Oregon was to determine if albacore reached Alaskan waters in commercial quantities. For years, rumors of schools of tuna being sighted in the Gulf of Alaska have been persistently repeated, and stray tuna have been reported caught from Salisbury Sound to Kodiak. Commercial landings of albacore were made at Ketchikan in 1948, but were for the most part made up of fish taken off the Queen Charlotte Islands. The Oregon caught a few scattered albacore up to 300 miles off Dixon Entrance, but no concentrations of the fish were found in Alaskan waters. Exploration as far north as Sitka revealed water temperatures in the Gulf of Alaska to be generally colder than those in which albacore are usually taken. A series of southeast storms beginning in the middle of September seriously curtailed fishing operations for that year.

## Objectives and Plan

Very little is known concerning the habits and migration patterns of albacore in the northeastern Pacific. The fish do not appear at the same time or place each summer, and the catch fluctuates from year to year. A small amount of information was gained from the 1949 survey, including the knowledge that scattered tuna may be found as far north as southeastern Alaska. The 1950 exploration was conceived as an extended operation to last the entire season and cover a large expanse of the fishery. Main objectives were:

1. To obtain information on the availability of albacore in offshore waters as a clue to their route of migration into the commercial fishing area.

2. To test various types of gear including surface-trolled jigs, gill nets, and long lines as to their effectiveness in catching albacore.

3. To further investigate the possibilities of establishing an albacore fishery in Alaskan waters.

4. To record observations on the relationship of water temperatures, currents, and marine life to the occurrence of albacore.

5. To assist the commercial fishing fleet by broadcasting daily radio information on location of albacore, water temperatures, and weather conditions.

In addition, provision was made for routine collection of related data such as lengths and weights of albacore, food analysis, and general hydrographic conditions. Experimental tagging of albacore was also planned as a possible aid in tracing the migration pattern of the fish.

In an average year, albacore have been first taken in the latter part of June or early July at various places off the Oregon coast. In planning the early scouting phase of this survey, water temperature was considered as being the main ecological factor which might influence or indicate the appearance of tuna off the northwest coast. Examination of existing surface-water temperature records showed that the 57.5° F. isotherm (see fig. 2) should be found to reach as far north as Cape Blanco, Ore., at a distance of 400 to 500 miles offshore by the middle of June. The plan was to fish along the edge of this warm-water zone as it progressed northward and shoreward, and if albacore were caught an attempt would be made to trace the progress of available schools into the area of commercial fishing.

Testing of various types of gear was to be undertaken in conjunction with the exploratory activities, whenever weather conditions perimtted, both inside and outside the limits of the existing commercial fishery. Once the fishery became established off the Oregon coast, the plan was then to move northward along the Washington and British Columbia coasts, keeping well ahead of the main fishing fleet and continuing to evaluate commercial possibilities at all stages. When the albacore were found to have arrived off the Queen Charlotte Islands, extensive exploration north of Dixon Entrance would then be undertaken in an effort to determine if the tuna migrate farther north into Alaskan waters in commercially important numbers.

## DESCRIPTION OF GEAR AND EXPLORATORY FISHING METHODS

Three types of gear were used by the John N. Cobb in exploring for albacore. These were surface-trolled jigs, gill nets, and long lines. As the majority of albacore taken in this area are caught on trolling gear, it was decided to use this equipment as the main device in locating fish; and most of the albacore caught during the cruise were by this means. The trolling jigs were of various material and construction, most of which are used in the commercial fishery. Gill nets, both linen and nylon, were fished when weather and sea conditions were satisfactory. Several experimental sets were made with long-line gear.

The usual procedure was to fish the waters during daylight hours with the trolling gear, paying special attention to water temperatures and other factors as they affected the abundance of albacore. Just before dark, if weather conditions were favorable, the gill net was set and allowed to drift until daybreak when it was hauled, and trolling was again resumed. A few experimental sets made with the long-line gear in daylight produced meager results; however, all types of gear fished caught albacore. Results of the gill-net fishing were highly informative and on some occasions were encouraging from the commercial fishing standpoint.

### Trolling Gear

Make-up of the trolling gear used in the albacore fishery has become quite standardized with the individual fisherman varying the different items of gear to suit his personal taste and opinion. Poles, lines, and gear construction used in this survey were no different from this commercial-type gear. The Cobb trolled eight lines, three from each outrigger pole and two from the stern (see figure 3). The average number of lines fished by the commercial boats usually varies from 8 to 10.

#### Make-up and specifications

The two trolling poles were of fir, 40-feet long, and tapering from 5 inches at the butt to 2 inches at the tip. These were mounted on the bulwarks just aft of the main house with conventional steel boom heel cap and pin-type fittings so that their angle with the water could be adjusted to prevent the

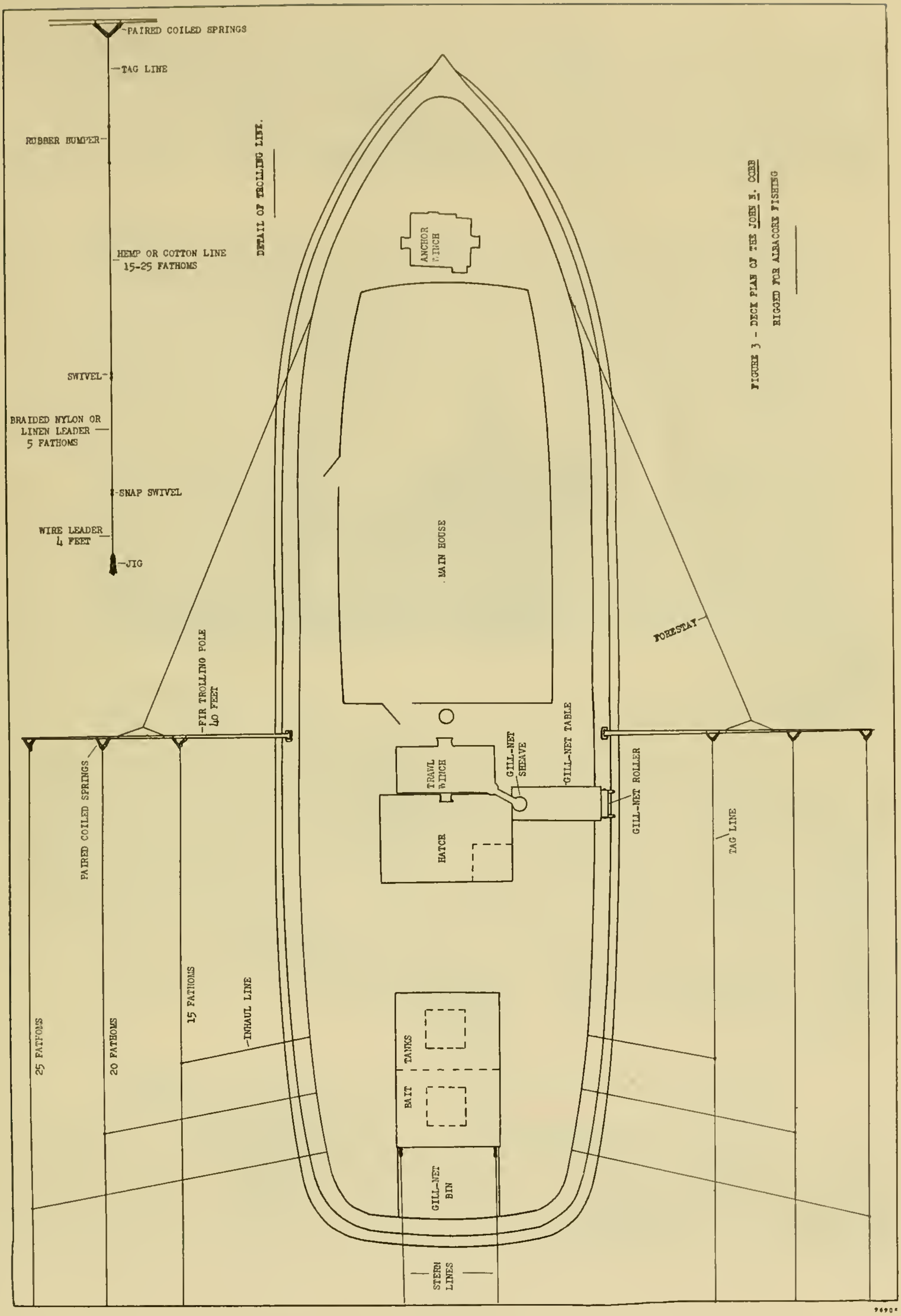



FIGURE 3 - DECK PLAN OF THE JOHN N. COBB
RIGGED FOR ALBACORE FISHING

poles from dipping into the waves and breaking in rough seas. A guy line attached to the center of each pole and run through a block in the shrouds allowed the poles to be raised and lowered to the desired angle or lashed upright against the after-shroud when not in use. Vertical rigidity was maintained with an adjustable stay run through a block attached near the butt of the pole to the guard rail, and a forestay was run from between the attachment of the center and inboard lines to the rail forward.

FIGURE 4 - TROLL-CAUGHT ALBACORE ARE PULLED AND LANDED BY HAND. THIS METHOD OF FISHING ACCOUNTS FOR NEARLY ALL THE TUNA CAUGHT OFF THE OREGON, WASHINGTON, AND BRITISH COLUMBIA COASTS.

Paired galvanized steel springs, 12-inches long and $1\frac{1}{2}$ inches in diameter set in a V-shape, were used between the poles and tag lines as shock absorbers. The tag lines were of 6-thread manila and of sufficient length to reach to the after-side rails. Main lines of hemp or cotton, No. 96 or 120, and from 15 fathoms in length on the inboard lines to 25 fathoms on the outboard, were joined to the tag lines by tapered rubber bumpers 11-inches long and 5/8 inches in diameter at the ends. These main lines connected to 5 fathoms of No. 360 braided linen or nylon leader with a brass swivel. Number 16 stainless steel wire, 4-feet long, was tied directly to the shank of the double hook, and after being threaded through the jig, was joined to the nylon or linen leader by a snap swivel. The two stern lines were 15 fathoms and hung from the after-corner supports of the bait tank canopy. This gear was fished on the surface without weights and was hauled by hand.

## Trolling methods and lure effectiveness

Trolling lines were towed during all daylight running hours when in the offshore waters, even while the Cobb was running full speed for a destination. Most of the time was spent trolling at approximately six knots, which was found to be the most productive speed. A few albacore were taken while fishing at full speed, and some also at speeds less than six knots. Fish struck in all states of sea from calm to rough, and although some of the better catches were made while

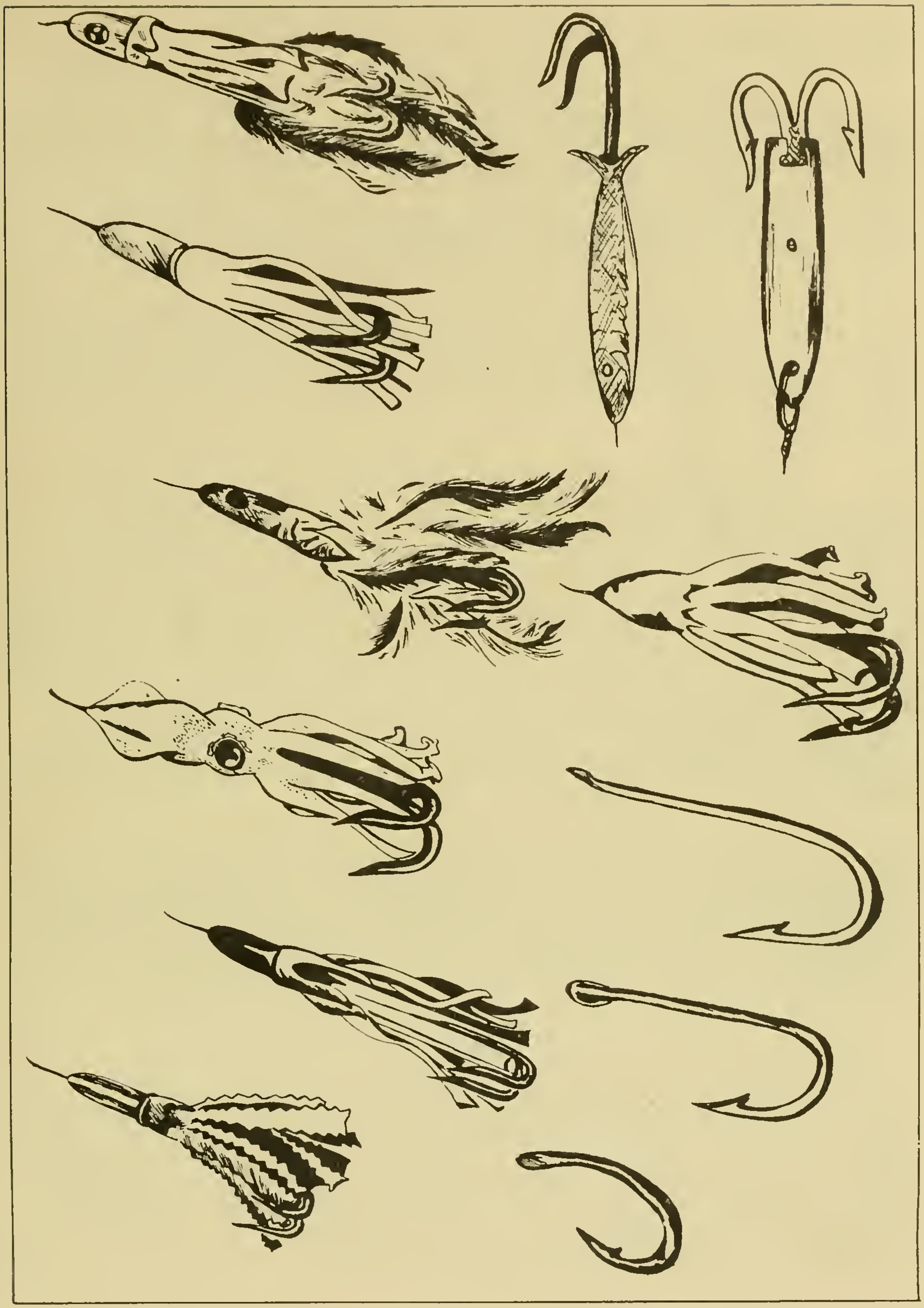


FIGURE 5 - SURFACE-TROLLED JIGS AND LONG-LINE HOOKS USED BY THE COBB.

bucking into choppy seas, the best catch (151 tuna) was in almost flat calm water off Grays Harbor on July 19.

Except on a few occasions when a good number of albacore were needed for tagging purposes, no effort was made to "load up." Various courses were run, especially in the water zones which were considered to have favorable temperatures for albacore. When tuna struck, the vessel continued on the course at trolling speed in an effort to determine the extent of the school. When strikes ceased, one or two circles were usually run back over the area where fish had been caught, and if enough were taken to indicate the presence of a considerable number of fish, the commercial fleet was notified of the position by radio, and the vessel continued on the exploration.

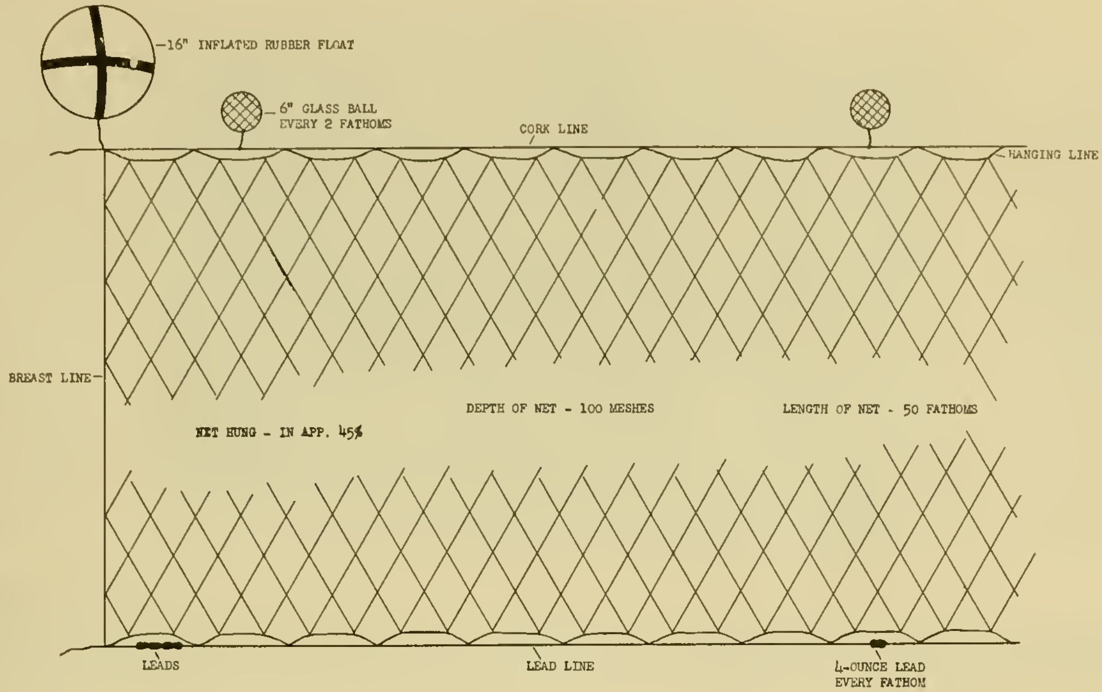
Many times the presence of fish was first noted by albacore breaking water and jumping, but no large schools were visible for any extended period of time. Most of the jumpers seen were in small schools and appeared to be travelling at considerable speeds as they were usually lost sight of in a few minutes. Quite often no surface sign of tuna was observed before or during the time fish were biting.

Effectiveness of various types of lures was taken note of, but no detailed record of strikes was kept because of the complications involved in attempting to evaluate the fishing ability of any certain jig used with a combination of eight lines of different lengths under fishing conditions which varied from day to day. One of the most consistently effective lures was the Japanese-made, 1½-ounce lead jig with pearl or red eyes and red and white feathers. Also, amber-head and green-head plastic jigs with red and white feathers produced good results. Several jigs were made up using strips of plastic ribbon of different colors approximately 1/10 of an inch wide. These proved to be very good lures. One such jig with an amber plastic head and red, white, and yellow plastic ribbon, was trolled continuously for over a month, catching its share of albacore each day and was still in good condition when it was lost on drifting kelp. This durability of the plastic is a decided advantage over feathers, which take severe punishment from trolling and strikes and must be changed often, sometimes several times daily when fishing is good.

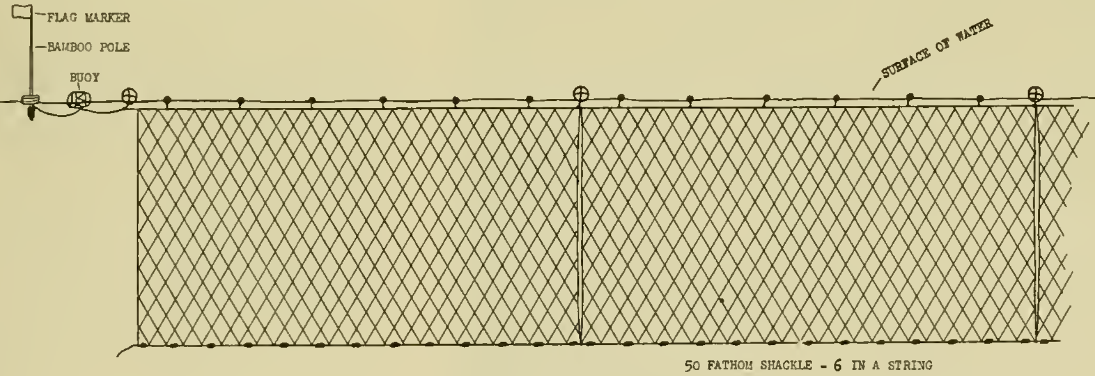
Other jigs which caught tuna in varying degrees were white or grey bone jigs, rubber squids, and hard rubber-head jigs with frayed rubber skirts. At times when the tuna were striking exceptionally well, all lures took fish. The albacore probably hit the two outside lines more consistently than any others, especially when single or paired fish were biting; but it was not uncommon for the short stern lines to take single fish, and when fishing was good, no preference for certain lines was apparent.

## Gill Nets

Shark fishermen have accidently taken albacore in their nets for years along the Pacific coast, but experiments during this survey in use of gill nets were undertaken specifically to ascertain the commercial possibilities of the gear. Besides this primary purpose, the nets also served as an exploratory tool because on several occasions the nets caught albacore when none were showing on the surface or when none could be taken with trolling gear before or after the set. By noting the depth at which the fish were entangled in the meshes, some data on their vertical distribution was also obtained.




A. DETAIL OF NET MAKE-UP




B. THE NET FLOATING FREE IN THE WATER

FIGURE 6 - DIAGRAMS OF THE GILL NET USED IN TAKING ALBACORE

Construction and specifications

The Cobb fished both nylon and linen gill nets of three sizes: 7½ inches, 8½ inches, and 9½ inches, stretched mesh measure. The nets were of 8-thread twine, 100 meshes deep, and were made up in 50-fathom shackles. The nylon nets were clear and untreated; the linen nets were a brownish-green color from the preservative used. In assembling, the nets were hung-in approximately 45 per cent. The cork line was 24-thread soft laid manila (approximately 3/4-inch diameter), and the lead line was of 18-thread soft-laid manila. Manila buoy line, 6-thread, formed the breast line, which was hung-in about 1/2 fathom; that is, the hanging loops were spaced 1/8 inch further apart on the lead line than on the cork line, thus providing approximately 3 feet more net on the lead line to compensate for the tendency of the leads to weigh down and shorten the stretch of the line. Hanging line was 44-thread, 4-ply soft-laid cotton twine. Glass floats, 6 inches in diameter, were spaced on the cork line at 2-fathom intervals and 16-inch inflated rubber floats were attached at the end of each 50-fathom shackle. Leads, 4-ounce with a 5/8-inch hole, were strung on the lead line between every ninth hanging loop, or approximately one every fathom. All lines were tarred and run previous to making up the nets.

Because double-knot nylon webbing was not available at the time, single-knot was used. Considerable slipping of the single knots was noted, which became worse when the nets were wet. It is, therefore, advised that double-knot nylon be used as a correction for this fault.

Six 50-fathom shackles, one of each mesh size of the nylon and linen nets were tied together by the cork lines and lead lines and fished in a string. The nets were set over the stern from a plywood bin behind the bait tanks. Most sets were made at night; two made in the daytime produced negative results. Because of difficulty in handling and resulting damage to the fish, the nets were not set in rough seas, but a moderately choppy sea did not seriously hamper operations.

FIGURE 7 - THE GILL NETS WERE ALWAYS SET WITH THE CORK-LINE TO WINDWARD SO THAT THE WEB WOULD BLOW OVER THE LEAD LINE AND NOT FOUL ON THE FLOATS.

Setting and hauling the nets

The nets were generally set just before dark after the day's trolling was over, weather conditions permitting. A lighted bamboo flagpole and buoy, similar to those used in the halibut fishery, was attached to each end of the string of nets, and they were allowed to drift free from the vessel all night. On setting, one flagpole buoy was first thrown overboard and the net was allowed to pay out over the stern as the Cobb maintained a very little headway. The nets were always set with the cork line to windward so that the web would blow over the lead line and not foul on the floats. A watch was kept during the night, and the lighted buoys were kept

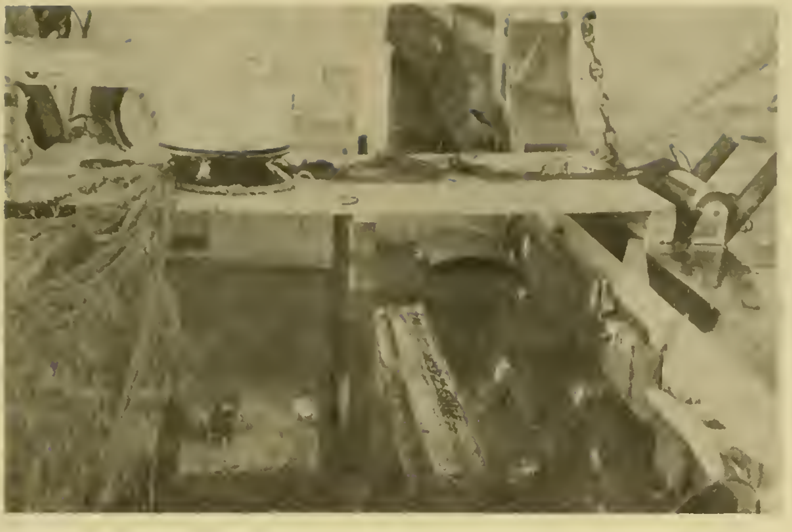


FIGURE 8 - ROLLERS AND TABLE USED IN HAULING THE GILL NETS.

in sight at all times. As the vessel ordinarily drifted faster than the nets in the wind, it was necessary to run up on the lights three or four times in a night. At dawn, the nets were hauled, the catch removed, and trolling resumed.

In hauling, the vessel approached the nets from the lee side so that it would tend to drift away and not foul in the gear. Some difficulty was experienced in maneuvering the Cobb alongside the nets, especially in choppy seas, because of the tendency of the large super-structure to catch the wind. On one such occasion the net was parted in a 20 m.p.h. northwest wind, but no other serious trouble occurred. Hauling was done from the starboard side amidships. The nets were brought in over a regular shark gill-net roller, 28 inches long and 6½ inches in diameter, and were hauled around a rubberized sheave 20 inches in diameter powered from a take-off on the main trawling winch. Most of the albacore were removed from the nets on a plywood table extending between the roller on the rail (and under the rubber sheave) to the hatch cover. When the tuna were too closely bunched in the net for removal on the table, they were hauled around the sheave and removed on deck.

FIGURE 9 - THE GILL NETS WERE HAULED FROM THE STARBOARD SIDE AMIDSHIPS. NOTE THE ALBACORE IN THE NYLON WEB IN CENTER OF PICTURE.

Most of the albacore taken by gill nets appeared to be in good condition. Nearly all were dead when hauled aboard. Occasionally, especially in choppy seas, fish were damaged in the web, either from the strain exerted on the meshes as the vessel drifted in the wind or from being hauled over the roller. A larger roller than the one used on this survey might result in less damage to the tuna. Also, the addition of a heavy warp line to take some of the strain of hauling off of the cork line might lessen the web damage to the fish. Besides

FIGURE 10 - MOST OF THE ALBACORE WERE REMOVED FROM THE NETS ON A PLYWOOD TABLE BETWEEN THE RAIL AND THE HAULING SHEAVE.

being damaged by the web, some albacore, half-eaten by sharks, were found in the net. Sharks, mostly of the blue variety, also inflicted damage to the nets, were sometimes quite numerous in the catch, and constituted a nuisance factor in removing them from the meshes.

After the fish were all removed, the net was hauled over the top of the bait tank on two wooden rollers and stacked in the stern bin in preparation for the next set. Periodically the nets were overhauled and mended.

Some hazards to gill netting albacore which were encountered are as follows: rough seas, which resulted in damage to the fish and to the gear; fog, which caused difficulty in keeping the buoy lights in sight at night; other fishing vessels which threatened to drift into and foul the nets at night; and sharks (mostly blue sharks) which were caught in good numbers and besides damaging the web, occasionally ate tuna which were caught in the nets. Observations revealed that a large percentage of the albacore were taken in the top half of the nets; therefore, it is possible that nets made up 50-meshes deep (half the depth of those used in these experiments) would catch almost the same number of fish with half the cost in gear and much less trouble in hauling and maintenance.

FIGURE 11 - CONSIDERABLE DIFFICULTY WAS ENCOUNTERED AT TIMES IN REMOVING THE ALBACORE FROM THE GILL NETS WITHOUT BREAKING THE MESHES OR INJURING THE FISH. NOTE HOW TIGHTLY THE FISH IS HELD IN THE MESH.

FIGURE 12 - THE GILL NET WAS OVERHAULED AND REPAIRED PERIODICALLY BEFORE STOWING ON THE STERN BEHIND THE BAIT TANK.

FIGURE 13 - THREE MEN IN THE STERN BIN STOW THE GILL NET IN PREPARATION FOR THE NEXT SET.

## Long Line

Long-line fishing for albacore by the Cobb was on a very restricted basis, and the gear was entirely experimental. Only four sets were made, and results were meager with one lone albacore being taken along with the ever-present blue sharks. The Japanese, during the pre-war years of 1936-40, took 25 per cent (or 100 million pounds) of their total tuna catch with surface long-line gear; and this type of gear proved especially effective in their recently-discovered winter albacore grounds in the mid-Pacific (Shapiro 1950). Although the fact that one albacore was taken on surface long line by the Cobb may be evidence that the gear will take tuna in the northeastern Pacific, this method of fishing poses many difficulties for the American fishermen. The small return per unit of gear (average 2 to 4 albacore per 100 hooks in some areas) fished by the Japanese would have to be increased many-fold to be profitable under American higher labor costs, and the primitive-type gear needs numerous improvements to increase its efficiency. The single albacore taken by the Cobb with this gear was alive when landed, and the possibility of its having taken the hook while the gear was being hauled, rather than during the gear's period of stationary fishing, should be kept in mind.

### Make-up of long line

Except for a few variations in make-up and method of setting, the long-line gear was constructed quite similar to the conventional halibut gear used on the west coast. The main line was of 32-pound halibut line, and made up in 50-fathom shots, 5 of which were tied together to form one skate. Four skates, or 1,000 fathoms of gear, were fished in a string with hooks spaced at 20-fathom intervals. Various types and lengths (from 1 to 5 fathoms) of gangions, or branch lines, were used in connecting the hooks to the main line. These included 14-pound and 16-pound hemp and cotton halibut gangions, braided green nylon leader, monofilament nylon, 75-pound test cuttyhunk, and white braided nylon leader. Hooks were of the Japanese long-line type (see figure 5) and No. 9/0 and larger halibut hooks. Regular halibut bamboo flagpoles and buoys were attached to each end of the string with 9-thread buoy line. Support for the main line was afforded by 16-inch inflated rubber floats attached by snap hooks to a ring at the end of each skate of gear. Float lines were varied in length from 1 to 10 fathoms; thus, the gear fished at all depths between the surface and 10 fathoms, probably a little deeper because of the sag in the line between floats.

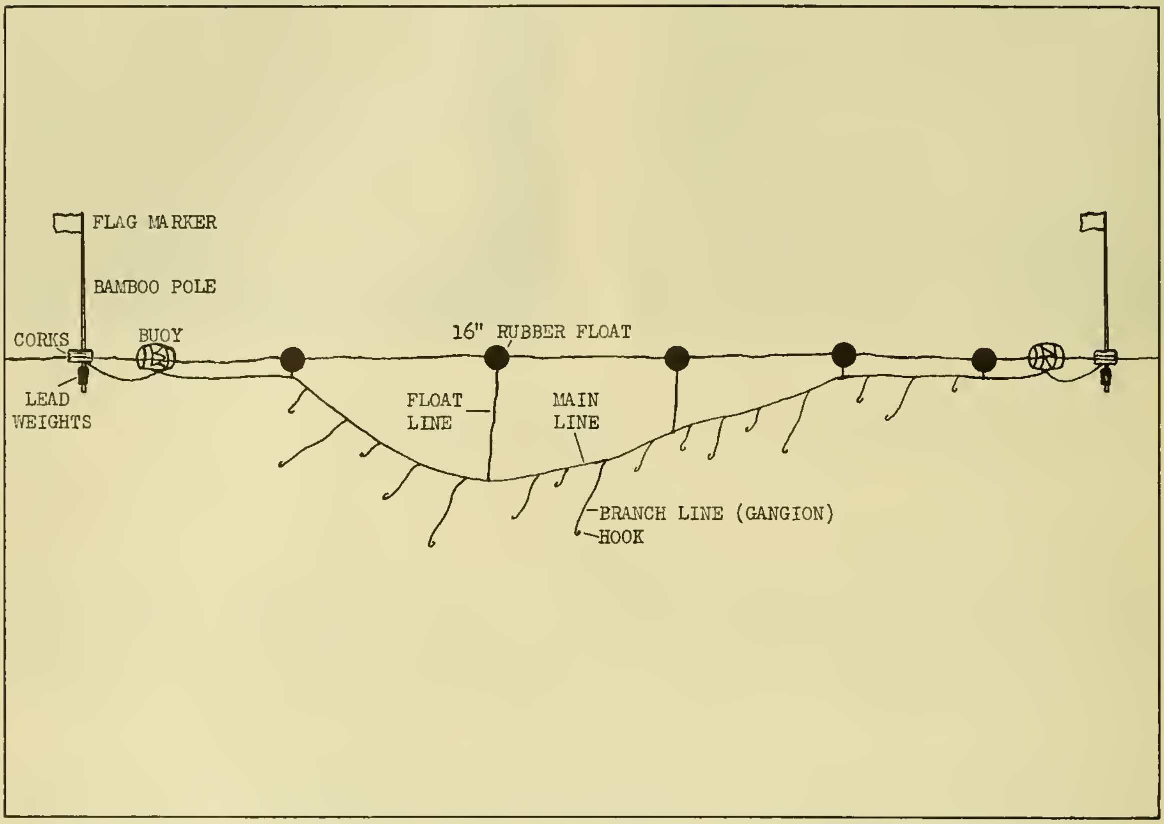



FIGURE 14 - MAKE-UP OF SURFACE LONG-LINE. THE GEAR WAS FLOATED FREE FROM THE VESSEL AT VARYING DEPTHS. (NOT DRAWN TO SCALE)

## Setting and hauling long line

All sets were made in the daytime; therefore, no data on effectiveness of this gear at night was obtained. In setting, the skates were tied together and piled on the stern deck, and the bamboo flagpole floats were tied to each end of the string. One flagpole was thrown overboard, and while the vessel maintained very slow headway, the line was paid out over the stern. Each hook was baited just before it went overboard, and the rubber floats were attached at the end of each skate. Bait was frozen herring and frozen squid, and the hook was inserted through the head or tail so that the bait would hang loosely and move in the water with the flow of the current. As each hook was baited, the gangion was attached by a snap-on connector to a 5/8-inch brass ring on the main line and thrown clear. When the string was completely out, the second flagpole was dropped overboard and the gear allowed to drift freely for the desired time.

Sets were of three to four hour duration, and during this time the vessel trolled in the general area or stood by the gear during bad weather and low visibility. On one occasion, in patch fog, it was necessary to hold on to one end of the gear for fear of losing it. As in the case of the gill-net fishing, all sets were made outside the areas where the commercial boats were concentrated because of the danger of vessels tangling in the gear. Only once was an albacore taken on trolling gear while the long line was soaking and this set produced nothing but blue sharks. At the time when the single tuna was taken on long line, none were caught trolling in the vicinity. This fish was taken on a hook fishing near the surface with only one fathom of float line and was alive when landed, possibly striking as the gear was being hauled. From seven to nine blue shark were caught in each set, and several lost hooks were attributed to these fish.

FIGURE 15 - IN HAULING THE LONG LINE REGULAR HALIBUT ROLLERS WERE USED. THE SHEAVE ON THE LEFT IS POWERED BY A TAKE-OFF FROM THE MAIN TRAWLING WINCH.

In hauling the gear, ordinary halibut rollers were used, with a power take-off from the main trawling winch. Average hauling time for the 1,000 fathoms of line was 45 minutes, with about 30 minutes required to set the gear. As the gangions (branch lines) came over the rollers, they were unsnapped from the main line and the hooks cleared of bait or the fish removed. Some trouble resulted from the tendency of the longer gangions to snarl and wrap around the main line. As a corrective measure, the gangions were finally all shortened to one fathom with two feet of stainless steel leader joining to the hook. The one albacore taken was caught on a short gangion and a Japanese-type hook.

No comparison can be made in the effectiveness of different baits due to the fact that only one tuna was taken. It is likely that some other bait would be superior to the frozen herring, which tends to be rather stiff and comes off the hook quite easily. The frozen squid appeared to have characteristics of a good long-line bait, such as freshness, durability, and a pliable, wavy motion in the water. Perhaps some of the difficulty in the gangions snarling the main line could be eliminated by use of a swivel connection in the main line at the point of gangion attachment. Success of the Japanese in taking albacore with long line at depths of 100-200 feet suggests the possibility that this gear might catch tuna when surface trolling produced nothing. However, the relatively shallow layer (usually less than 100 feet) of warm surface water existing in the northeastern Pacific probably keeps the albacore closer to the surface than in the more southern and mid-ocean waters where the thermocline is much deeper.

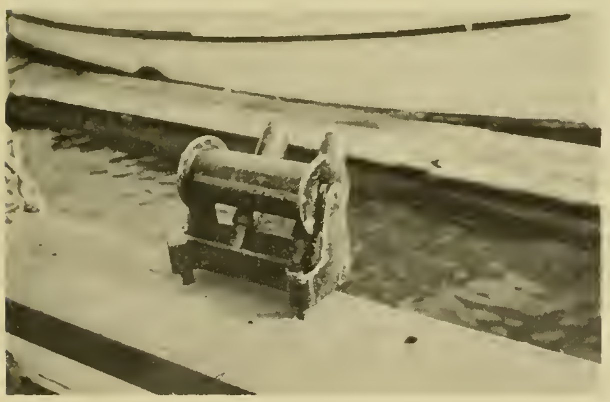


FIGURE 16 - CLOSE-UP OF HALIBUT ROLLER USED IN HAULING THE SURFACE LONG LINE.

## OCCURRENCE OF ALBACORE AND FISHING RESULTS

Fishing results of the 1950 albacore exploration indicate the following:

(1) That early in the season albacore are available to commercial fishing methods in the warm offshore water, and the occurrence of the fish follows extension of the warm-water zone shoreward and northward along the coast.

(2) That albacore may be found far from the center of the fishery over widely scattered areas; and although favorable water temperatures (57° F. and above) and presence of feed affect the movements of the fish, the existence of these two factors does not necessarily insure the presence or availability of the tuna to commercial fishing.

(3) That fishing with nylon and linen gill nets can produce albacore in substantial quantities, and at times when trolling fails.

(4) That some of the best fishing may be found along the boundaries of blue and green water or in fingers of warm water which extend into the colder green water.

(5) That the northward limit of available commercial concentrations of albacore this year was the Queen Charlotte Islands.

The John N. Cobb caught a total of 1,148 albacore in approximately 976 hours of actual fishing, or slightly more than one fish per hour. The total weight of all fish was roughly 19,000 pounds. Surface trolling accounted for 896 albacore, floating linen and nylon gill nets caught 251 albacore, and 1 albacore was taken on long-line gear.

### Indicated Migration Pattern

From the pattern of early catches made by the Cobb, there is evidence that the albacore, along with the extension of the warm surface-water zone, moved inshore from the southwest and then spread gradually northward along the coastline. The Cobb left Seattle on June 12, and steered a general southwest course from Cape Flattery. Surface water temperatures were cold (52° - 54° F.) past the mouth of the Columbia River and south until a general warming was noted three hundred miles off the southern Oregon coast. On the evening of June 17, 58° F. water was reached, and the following morning the first albacore were caught on trolled jigs at a position 42° 12' N. latitude, 135° 05' W. longitude, approximately 480 miles off Cape Blanco, Ore. (see fig. 2). The fish struck at intervals, usually in pairs, but no large concentration was found at this time. On running north of the area no fish were taken, and water temperatures declined steadily. An easterly course toward shore revealed still colder water and no fish. On June 23, 5 days later, albacore were again caught in 57° and 58° F. water, which by this time was within three hundred miles of Cape Blanco. Fish were taken in what appeared to be warm fingers of water extending in from the southwest, and surface temperatures as high as 60° F. were encountered in this area during the following few days. A run northward showed surface temperatures still as low as 52° F. 320 miles west of the Columbia River on June 26. An extremely rapid warming of the surface waters off the Oregon coast was noted during the last of June and the first few days of July; temperatures as high as 59° F. were found as far north as 35 miles off the mouth of the Columbia River on July 3. At least part of this warming was believed due to extended intervals of sunshine combined with 4 days of fairly steady southerly winds which prevailed at that time.

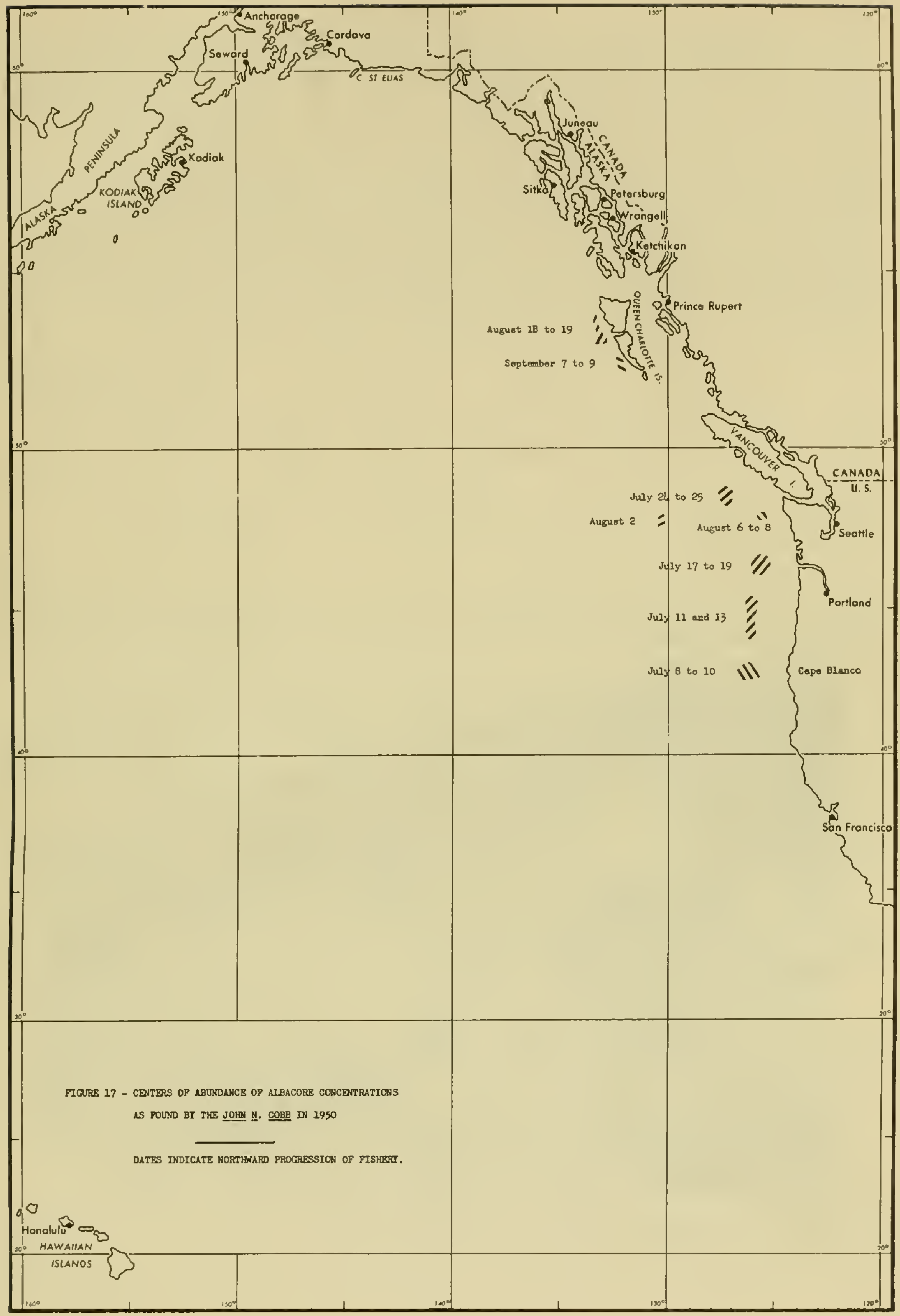



FIGURE 17 - CENTERS OF ABUNDANCE OF ALBACORE CONCENTRATIONS AS FOUND BY THE <u>JOHN N. COBB</u> IN 1950

DATES INDICATE NORTHWARD PROGRESSION OF FISHERY.

FISH AND WILDLIFE SERVICE 96905

Between July 7 and 14, the first signs of schooling were noted off Cape Blanco and Newport, Oregon, and a series of fishing efforts from Cape Blanco north to Grays Harbor, Washington, at distances of 50 to 120 miles offshore indicated the albacore were widely scattered off the entire Oregon and southern Washington coasts (see fig. 17). During this time the commercial fleet began to assemble on the grounds, and by July 16, good catches were being made 60 miles southwest of the Columbia River. On July 19, the Cobb ran across a large concentration of albacore 55 miles west of Willapa Bay, and the fleet enjoyed several days of steady fishing in this area. The northward dispersal of the fishery continued, and during the last week of July both the American and Canadian trollers had excellent fishing in a large area approximately 90 to 100 miles off Cape Flattery and Vancouver Island. Surface temperatures ranged from 57° to 60° F. During this time, many boats were still fishing off the Columbia River and Grays Harbor, although catches were less consistent than those made earlier in the season.

On August 4, the Cobb caught large albacore off the north end of Vancouver Island, within 35 miles ESE of the Dellwood Hills. Surface water temperature was 58° F., and schools of jumping tuna were seen. After the middle of August, the albacore seemingly disappeared from the Oregon and Washington coasts, and the fishing effort shifted north to the Queen Charlotte Islands, where the Canadian fleet experienced about a month of good fishing. Over a ton of albacore was taken on August 19, in a gill-net set off the Queen Charlotte Islands at 53° 00' N. latitude, 133° 17' W. longitude. Surface temperature was 57° F. and good trolling was also found in this vicinity.

Over two weeks of intensive fishing in Alaskan waters from Dixon Entrance to within one hundred miles of Cape St. Elias and up to three hundred miles offshore indicated no evidence of tuna in quantities of commercial significance.

FIGURE 18 - A CATCH OF ALBACORE IS REMOVED FROM THE GILL NETS. POMFRET WERE ALSO FAIRLY ABUNDANT IN THIS CATCH.

Only scattered albacore were taken, 50 to 80 miles off Forrester Island and Cape Bartolome on August 24 and 26, respectively. Surface temperatures in the Gulf of Alaska ranged from 51.2° to 55° F., and stormy weather added to the difficulties of judging fishing effectiveness. Similar conditions were found on the 1949 survey of Alaskan waters.

On returning south the Cobb again caught albacore off the Queen Charlotte Islands from September 7 to 10, but this was near the end of the fishery in these waters. During the last two weeks of September, the area from Cape Blanco to Cape Flattery was fished running both south and north, but no albacore were found off the entire Oregon and Washington coasts. Water temperatures appeared favorable (58° to 62° F.) and feed was noticed, but the trolling gear failed to catch a fish. During this time, and later, excellent fishing was being experienced by a large fleet of vessels off northern California. The puzzling absence of albacore from the Washington and Oregon coasts during the last of August and September greatly reduced the year's landings, which had started out so well early in the season.

## Catches by Gear with Certain Related Hydrographic Aspects

### Troll catches

The Cobb trolled an extensive area of offshore water off the Oregon coast from June 13 to July 2, in which only scattered albacore were caught. Fishing results were generally poor with 11 fish being the largest number caught on any one day. All fish taken trolling in these offshore areas in June were caught in what appeared to be edges or fingers of warm water, with surface temperature ranging from 57° - 59° F. Fish usually hit the troll jigs singly or in pairs. Stomachs examined from these fish were relatively empty, suggesting also that feed was widely scattered. Returning again to an offshore area approximately three hundred miles off the Columbia River in late July and early August, conditions were notably changed. Surface water temperatures were more stable, and from examination of albacore stomachs, there was considerable feed available. The results seemed to indicate that more suitable conditions were present later in the season.

Off the southern Oregon coast, from 80 to 120 miles offshore, on July 7 and 8, the first schooling tendency of the albacore was noted and catches increased while fishing to the northward. The troll catch results of the Cobb for certain fishing areas are shown in Table 1, which also indicates the northward movement of the fishery. As noted in column 6 of the table (No. albacore/line/hour), the catches in many cases were small; however, it should be pointed out that the Cobb did not limit fishing effort to the areas of tuna concentrations, but rather spent most of the time exploring the surrounding waters, where results were spotty.

During the 1950 investigations, it was not uncommon to hear the commercial fishermen discussing the "morning bite" and "evening bite" over the radio. Some even went so far as to say that there was little use fishing during midday. The Cobb also found that on certain days albacore would bite for several hours in the morning and then slack off until the evening. This was not always the case, however; and the best troll catch of the survey was made in midafternoon. The number of recorded strikes by 2-hour periods are presented in Table 2.

In Table 2, it is noted that morning and evening peaks occur. Actually, both the "morning bite" and "evening bite" for the fishing results in 1950 are weighted by 2 days of good fishing on August 18 and 19, when the best catches occurred around midday. If these 2 days were omitted, the peak of the "morning bite" would probably occur earlier, while the peak of the "evening bite" would be later.

Table 1.--Troll catch data for certain areas fished in 1950

| Date | Central abundance | No. lines fished | Hours trolled | No. albacore | No. albacore line/hour | Surface temperature ° F. | Wind direction & force* |
|---|---|---|---|---|---|---|---|
| July 8 | 100 miles west of Cape Blanco | 8 | 12 | 12 | .12 | 58.5 - 61.0 | NW (4) |
| July 9 | Do - - - - - - - - - - - - - - - | 8 | 15 | 27 | .22 | 57.5 - 61.0 | NW (4) |
| July 10 | Do - - - - - - - - - - - - - - - | 8 | 15 | 10 | .08 | 57.5 - 61.0 | NW (4-5) |
| July 11 | 100 miles west of Newport, Ore. | 8 | 15½ | 63 | .51 | 60.0 - 61.5 | NW (4) |
| July 17 | Off Willapa Bay, Wash., centered at 46° 28' N. and 125° 25' W. | 8 | 13 | 25 | .24 | 58.0 - 60.0 | WNW (4-5) |
| July 18 | Off the Columbia River centered around 46° 02' N. and 125° 13' W. | 8 | 15½ | 111 | .91 | 57.0 - 59.5 | NW (4) |
| July 19 | Off Grays Harbor, Wash., centered at 46° 47' N. and 125° 17' W. | 8 | 16 | 151 | 1.18 | 57.0 - 59.0 | NW (4) |
| July 23 | 86 miles NW of Grays Harbor, Wash. | 8 | 16 | 32 | .25 | 58.0 - 59.5 | NW (2-3) |
| July 24 | 87 miles SW of Cape Flattery | 8 | 11½ | 35 | .38 | 59.0 - 59.5 | WNW (2) |
| July 25 | Do - - - - - - - - - - - - - - - | 8 | 16 | 32 | .25 | 57.5 - 60.0 | WNW (2) |
| Aug. 2 | About 263 miles off the Wash. coast 47° 35' N. and 130° 10' W. | 7 | 15½ | 73 | .67 | 56.5 - 58.6 | NW (5-6) |
| Aug. 4 | 94 miles off Cape Cook, B.C., at 50° 11' N. and 130° 23' W. | 8 | 4 | 17 | .53 | 57.5 - 58.2 | NW (2-3) |
| Aug. 6 | 87 miles SW of Cape Flattery, Wash., (course varies) | 8 | 10 | 25 | .31 | 53.5 - 59.4 | NW (2) |
| Aug. 8 | 47° 46' N. and 125° 23' W. | 8 | 12 | 15 | .16 | 59.3 - 60.0 | Calm |
| Aug. 18 | Off Graham Island at 53° 00' N. and 133° 18' W. | 8 | 15 | 7 | .06 | 57.0 - 58.0 | NE (3-2) |
| Aug. 19 | Off Graham Island at 53° 25' N. and 133° 35' W. | 8 | 8½ | 22 | .31 | 57.0 - 59.0 | Calm |
| Sept. 7 | Off Moresby Is., (Tasu Sound) at 52° 30' N. and 132° 19' W. | 8 | 11½ | 25 | .27 | 56.2 - 58.0 | Calm |
| Sept. 8 | About 17 miles offshore from Tasu Sound to Cape St. James | 8 | 11½ | 18 | .20 | 57.0 - 57.3 | W (1-2) |

*Wind force is according to Beaufort scale.

Table 2.--Number of strikes and fish caught by 2-hour periods

| Time Interval | No. Fish and Strikes |
|---|---|
| 4:00 a.m. - 6:00 a.m. | 41 |
| 6:00 a.m. - 8:00 a.m. | 91 |
| 8:00 a.m. - 10:00 a.m. | 145 |
| 10:00 a.m. - 12:00 noon | 108 |
| 12:00 noon - 2:00 p.m. | 81 |
| 2:00 p.m. - 4:00 p.m. | 77 |
| 4:00 p.m. - 6:00 p.m. | 196 |
| 6:00 p.m. - 8:00 p.m. | 149 |
| 8:00 p.m. - 10:00 p.m. | 38 |
| Total | 926 |

FIGURE 19 - BLUE SHARK UP TO 6 FEET IN LENGTH WERE TAKEN IN MOST OF THE GILL-NET SETS (UP TO 57 PER SET) AND ALSO ON THE LONG-LINE GEAR.

## Gill-net catches

The use of gill nets for fishing albacore was experimented with in 1950, and results were encouraging. As far as is known, previously only a few commercial fishermen from the Pacific Northwest and the Canadian Department of Fisheries have tried fishing for albacore with gill nets. In 1939, a small number of Oregon and Washington fishermen are said to have tried gill nets, but the albacore reportedly swam right through the nets (Anonymous 1940). The Canadian Department of Fisheries vessel Laurier in 1948 caught 4 albacore in an 8½-inch salmon net which was 35 meshes deep and 75 fathoms in length (Partlo 1950).

Thirteen gill-net sets were made by the Cobb, which caught a total of 251 albacore.

FIGURE 20 - POMFRET (BRAMA RAII), A RATHER TASTY FISH, WERE TAKEN IN SEVERAL GILL-NET SETS. OVER 100 WERE REMOVED FROM THE NETS ON AUGUST 19.

Nets used were of linen and nylon of 7½-, 8½-, and 9½-inch mesh (stretched measurement). The nets were drifted free from the vessel for an average time of 7 3/4 hours per set. Sets were made in the evening usually between 8 and 9 o'clock. Two daytime sets caught nothing but 1 blue shark, indicating that the fish possibly could detect the gear in daylight and avoid it. Gill nets were particularly effective in an area 35 miles southwest of Marble Island on August 19. The catch was 169 albacore and over 100 pomfret. In this case the nets were set under rather optimum conditions: there was little swell, albacore were caught trolling just prior to setting the nets, and schools of saury (small bait fish) were seen in the area near the nets. Catch data for gill nets are presented in table 3, which shows the number of albacore taken per hour, other fish caught with the albacore, and some hydrographic data.

From table 3, it is seen that miscellaneous fish may be caught along with the albacore and sometimes in significant quantity. Of these fish the blue shark (Prionace glauca) seems to be omnipresent in the waters south of the Queen Charlottes. Blue shark occurred in 12 of the 13 sets attempted and as many as 57 in one haul on July 7. The abundance of blue sharks did not seem to have a noticeable effect on albacore catches other than as a nuisance factor in the net. They will, however, prey on albacore caught in the net, and a number of partially eaten albacore were removed from the meshes. Several pieces of albacore were also found in blue shark stomachs. On two occasions, July 13 and August 7, 33 and 25 albacore were taken along with 17 and 26 blue shark, respectively.

There were over 100 pomfret, Brama raii (many alive), intermingled with the albacore in the gill nets on August 19. Pomfrets occurred in 3 other gill-net sets but only in small numbers. Clemens and Wilby (1946) report that these fish were so numerous off the Queen Charlotte Islands in the summer of 1929 that they interfered with salmon trolling operations. Pomfrets are also reported from along the central Oregon coast where they are not uncommonly brought in by the tuna trollers in August and September.

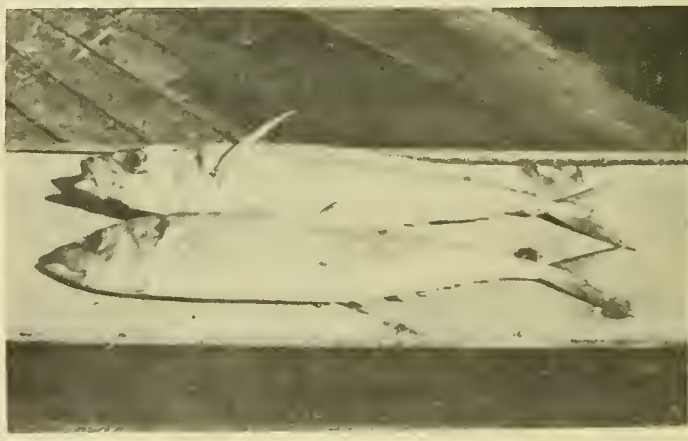


FIGURE 21 - JACK MACKEREL (TRACHURUS SYMMETRICUS), A SURFACE-SWIMMING FISH, WAS TAKEN IN THE NETS ON 5 DIFFERENT OCCASIONS.

Besides the above fish taken by gill nets, one 700-pound thresher shark (Alopias vulpinus) was taken off Cape Flattery on August 7. Four mackerel shark (Lamna ditropis) and one soupfin shark (Galeorhinus zyopterus) were also caught in the nets. The jack mackerel (Trachurus symmetricus) was also

## Table 3.—Gill net catch data—1950

| Date | Position of set | No. albacore | No. hrs. net soaked | No. albacore per hour | Other fish in nets | Surface temperature ° F. | Wind direction & force* |
|---|---|---|---|---|---|---|---|
| June 15 | 43° 56' N. 130° 15' W. | 0** | 3½ | 0 | 1 blue shark | 54° | NW (5) |
| June 19 | 43° 19' N. 132° 18' W. | 0 | 8½ | 0 | 7 pomfret | | |
| | | | | | 5 blue shark | | |
| | | | | | 3 jack mackerel | | |
| | | | | | 1 mackerel shark | 56.5° | NW (3) |
| June 24 | 42° 17' N. 132° 22' W. | 4 | 8 | .50 | 14 blue shark | | |
| | | | | | 1 jack mackerel | 58.0° | W (4) |
| June 25 | 42° 10' N. 131° 38' W. | 1 | 8 | .12 | 10 blue shark | | |
| | | | | | 1 jack mackerel | 57.0° | Calm |
| June 28 | 42° 55' N. $132^{c}$ 00' W. | 2 | 7½ | .27 | 3 blue shark | 57.0° | Calm |
| July 7 | 43° 07' N. 127° 00' W. | 7 | 7 | 1.00 | 57 blue shark | | |
| | | | | | 29 jack mackerel | | |
| | | | | | 10 pomfret | 60.0° | S (2) |
| July 13 | 46° 50' N. 125° 30' W. | 33 | 9 | 3.66 | 17 blue shark | | |
| | | | | | 2 jack mackerel | 59.0° | NW (3-4) |
| July 24 | 48° 20' N. 126° 41' W. | 0** | 4 | 0 | 0 | 59.5° | W (2) |
| July 30 | 46° 08' N. 130° 14' W. | 2 | 8 | .25 | 7 blue shark | 59.0° | W (3-4) |
| July 31 | 46° 31' N. 130° 55' W. | 8 | 8½ | .94 | 2 blue shark | 59.0° | W (3) |
| Aug. 7 | 47° 34' N. 125° 34' W. | 25 | 9 | 2.77 | 26 blue shark | | |
| | | | | | 1 soupfin shark | | |
| | | | | | 1 thresher shark | 60.0° | Calm |
| Aug. 19 | 53° 00' N. 133° 17' W. | 169 | 9 | 18.77 | Over 100 pomfret | | |
| | | | | | 3 blue shark | | |
| | | | | | 3 mackerel shark | 57.0° | NE (2-1) |
| Sept.12 | 49° 36' N. 128° 15' W. | 0 | 11 | 0 | 5 blue shark | 58.0° | W (3) |

*Wind force is according to Beaufort scale.
**Day-time sets.

taken in sets, in lots of 1 to 29; however, there seemed to be no connection between jack mackerel and numbers of tuna caught.

Condition of Gill-net Fish

Three factors found to affect the condition of albacore taken by nets are:

(1) The pattern in which the fish swim into the nets.
(2) The force of wind and state of sea during hauling of the nets.
(3) The length of time the fish are in the nets.

Most of the albacore taken in gill nets were caught near the surface and in small, scattered groups, quite often intermingled with the pomfret and jack mackerel. Especially was this bunching tendency noted on July 31, at 46° 31' N. latitude and 130° 55' W. longitude, where the nets picked up 8 albacore and 2 blue shark. The albacore were all in one bunch in the $7\frac{1}{2}$-inch linen web. Again off the Queen Charlottes on August 19, where 169 albacore and an estimated 150 pomfret were taken, the albacore were scattered at intervals with the pomfrets in bunches through the entire net. One of these clusters of fish necessitated hauling a section of the net on deck to remove the fish.

Wind force was a major problem in gill netting as the large super-structure of the Cobb lessened her ability to maneuver in a strong wind and caused considerable strain on the nets at times. Two types of injuries to albacore were noted in the gill-netting operation. These were injuries to the tail portion of fish, and bruises and cuts caused by varying amounts of tension on the meshes of the nets; a few fish were also damaged by sharks. Of the 251 albacore taken in gill nets, approximately 64, or about 25 percent, were damaged by either having broken tails or cuts and bruises. The former condition was more common, and was possibly easier to notice. The broken tails were believed to be due partly to the narrow hauling sheave through which the fish had to pass when being brought up over the rail, a condition which might be remedied by using a larger roller. Different degrees of broken or damaged tails were noted on 45 fish, or about 70 percent of those that were damaged.

Table 4 shows the number and kinds of injuries to the tuna caught in the nets on August 19.

Table 4.--Injuries to gill-net fish August 19, 1950

| Condition of fish | Number | Per Cent |
|---|---|---|
| Fish with tail injury | 42 | 24.8 |
| Fish with cuts and bruises | 3 | 1.8 |
| Fish not injured | 124 | 73.4 |
| Total fish caught | 169 | |

An important factor undoubtedly affecting the condition of gill-net-caught albacore is the length of time they are in the nets before being hauled aboard. Especially in warmer waters would this be true, as the fish tend to become soft and easily damaged after soaking for several hours. As all the night sets were of 7 to 11 hours' duration, and it was not possible to determine at what time the tuna swam into the nets, no comparison concerning time in the water can be made. But it is possible that sets of only a few hours would yield fish which would be less subject to damage from the gear.

Tests were conducted under supervision of the Service's Technology Laboratory at Seattle to determine the suitability of gill-net-caught albacore for canning. Although the results of this one series of tests cannot be considered conclusive, there was no great difference distinquishable between packs of troll-caught albacore and gill-net-caught albacore taken from the Cobb's catch and canned under identical conditions.

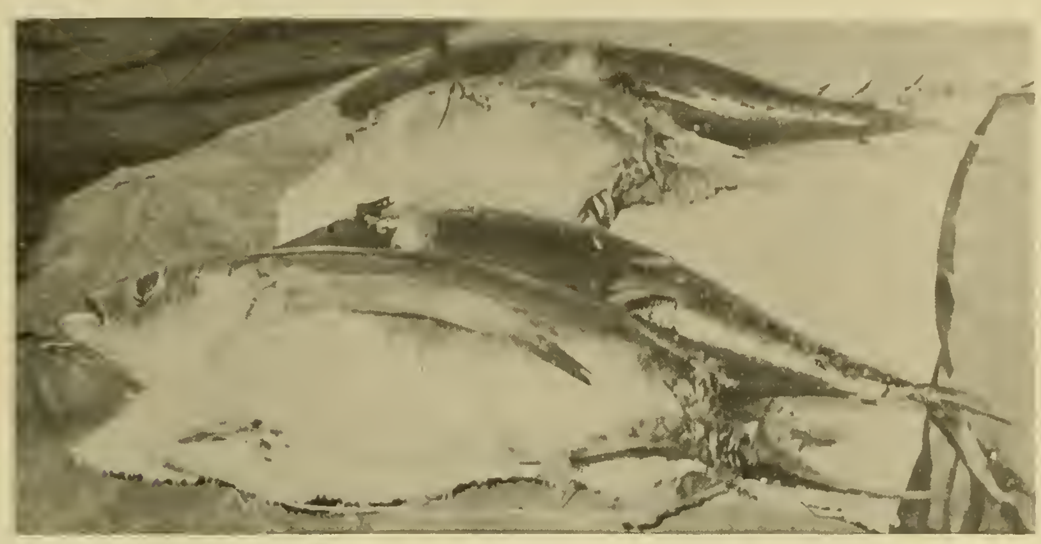


FIGURE 22 - ABOUT 25 PER CENT OF THE GILL-NET FISH TAKEN WERE DAMAGED EITHER DIRECTLY BY THE NETS, OR IN A FEW CASES EATEN BY SHARKS.

Vertical Distribution and Mesh Size

By far the majority of albacore taken in gill nets were caught in the meshes near the surface or between one and three fathoms depth. Several, however, did occur in the meshes near the lead line, which was one hundred meshes deep. The mesh sizes were 7½ inches, 8½ inches, and 9½ inches (stretched measurement). Table 5 shows the number of albacore taken with relation to each mesh size. Observations for June 24 and 25 are missing. It appears that the 7½- and 8½-inch nylon and linen is equally effective for the size albacore in this region, while the 9½-inch meshes apparently are more selective to the larger fish.

Table 5.--Number of albacore taken in each size mesh

| Date nets set | Gill netting | | | | | |
|---|---|---|---|---|---|---|
| | 7½-inch | | 8½-inch | | 9½-inch | |
| | nylon | linen | nylon | linen | nylon | linen |
| June 28 | 1 | 1 | | | | |
| July 7 | | | 3 | | | 4 |
| July 13 | 4 | 10 | 1 | 13 | 2 | 3 |
| July 30 | | 2 | | | | |
| July 31 | | 8 | | | | |
| August 7 | 1 | 5 | 3 | 5 | | 11 |
| August 19 | 44 | 22 | 40 | 28 | 15 | 9 |
| Total | 50 | 48 | 47 | 46 | 17 | 27 |

## Long-line Catches

Four long-line trials were very inconclusive; only one albacore was taken by this gear. It was alive when hauled aboard, and was caught on June 24, 360 miles west of Cape Blanco, Oregon, on a surface hook not attached to a long drop line. In addition to the albacore, there were seven blue sharks taken in this set. The other 3 long-line trials caught 15 blue sharks. These results were not encouraging; however, with improved gear and methods and a better understanding of oceanic circulation the gear might possibly be used for albacore with greater success in waters off the Pacific northwest coast. The Cobb used only frozen herring and squid for bait; other baits may prove superior. Only daytime sets were made, which also may be less effective than sets made at night. Reports of Japanese tuna long lining (which is normally a daytime fishery in tropical waters) indicate that in certain temperate waters greater catch efficiency is obtained if the gear is set in late afternoon and hauled the following morning (Shapiro 1950).

# RELATED OBSERVATIONS

## Size of Albacore

Length and weight data[2/] for troll-caught and gill-net albacore are based on 774-length measurements and 678 weights. The average length was 28 inches (71.1 cm.), and the average weight was 17.1 pounds. Albacore ranged in size from 22 inches (55.9 cm.) to 35.7 inches (90.7 cm.) and varied in weight from 8 to 35 pounds.

Floating gill nets caught somewhat larger albacore than did the surface-trolling gear. The average weight of 235 gill-net albacore was 18.5 pounds as compared with 16.3 pounds for 443 troll-caught fish. It is possible with the conventional trolling methods that some of the larger albacore are lost soon after they strike.

FIGURE 23 - ALBACORE WERE MEASURED IN A TROUGH-LIKE WOODEN BOX WITH A METER STICK ATTACHED TO ONE SIDE.

Length frequencies from progressive fishing operations and for the entire season are presented in figures 24 and 25.

In examining the composite histogram for troll-caught fish, three modal groups are suggested. Brock (1944) found that most of the exploited populations of albacore are made up of only a few (mostly 2 or 3) year classes. Canadian studies (Hart and Pike 1948, Hart 1949) pertaining to length frequencies have shown that two dominant length groups are present in the North Pacific fishery; however, Partlo (1950) found four dominant length groups present in 1949.

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2/ ALBACORE WERE MEASURED IN MILLIMETERS FROM THE TIP OF THE SNOUT TO THE CAUDAL FRINGE IN THE CENTER OF THE TAIL. WEIGHTS WERE TAKEN ON A SPRING-TYPE BALANCE AND RECORDED TO THE NEAREST ONE-HALF POUND.

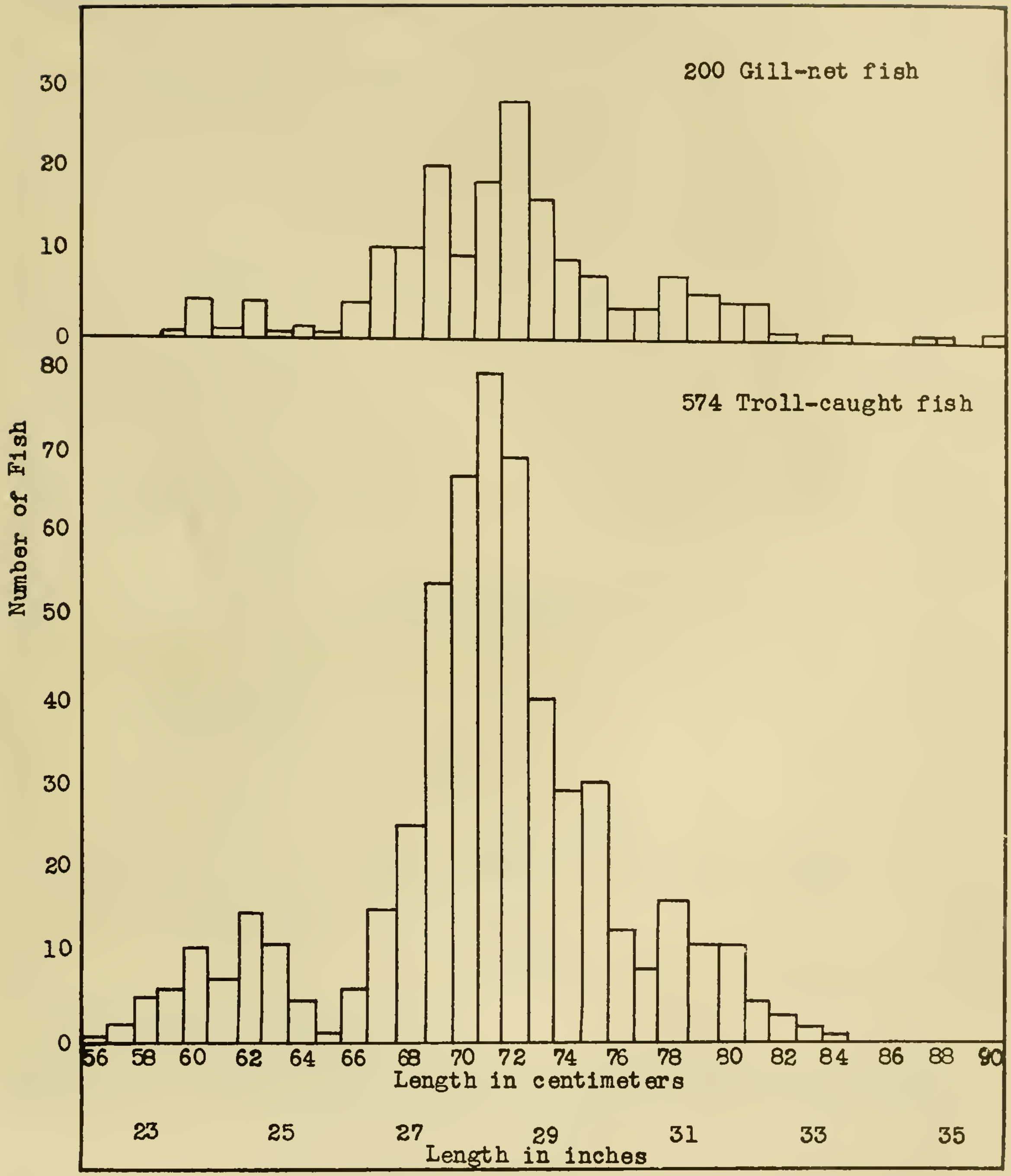


FIGURE 24 - LENGTH-FREQUENCIES OF ALBACORE CAUGHT BY THE COBB IN 1950.

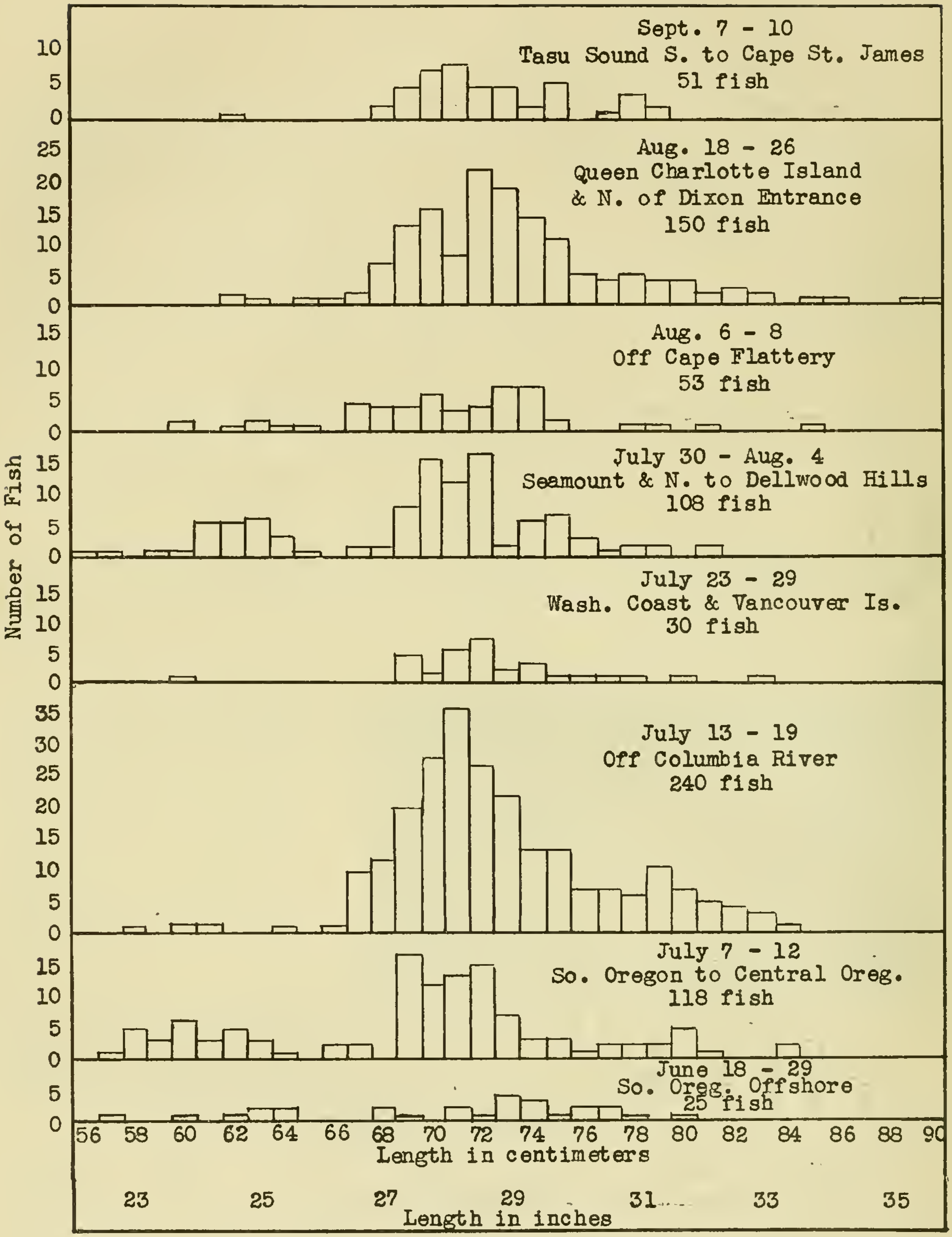


FIGURE 25 - LENGTH-FREQUENCIES OF ALBACORE TAKEN BY THE COBB IN 1950, GROUPED BY AREAS AND DATES OF FISHING OPERATIONS.

## Food of Albacore

Juvenile rockfish, approximately 3/4 to 3½ inches in length, were the predominant food item found in albacore stomachs over the entire range of the 1950 exploratory work in the offshore waters between southern Oregon and Dixon Entrance, Alaska. In one instance, 4 albacore stomachs yielded 487 rockfish.

The occurrence of small rockfish as a component of the albacore diet was noted by Canadian investigators (Partlo 1950) in 1949 when small fish believed to be *Sebastodes pinniger* constituted one of the main food items of albacore taken off British Columbia. In the same year research personnel aboard the Fish and Wildlife Service vessel *Oregon* reported that young rockfish were very common in stomachs of albacore caught off the Washington and the British Columbia coasts (Powell and Hildebrand 1950).

Two species of rockfish, identified as *Sebastodes alutus* and *Sebastodes crameri*, seemed to be the most common types found in albacore stomachs in 1950. Of one sample of 120 rockfish taken from a single albacore, 87 percent were the young of *Sebastodes alutus*.

Other important food items found in albacore stomachs in 1950 were saury and squid, but their occurrence was more sporadic than that of rockfish. Saury were noted in 53 stomachs and squid in 48. Generally, rockfish far outnumbered saury and squid; however, it should be pointed out that 1 large saury is equal in bulk to many small rockfish. Thirty-three stomachs, or 15 percent of the total number examined, were empty. Table 6 gives a record of the food items found in 220 albacore stomachs.

Table 6.--Occurrence of food items in the stomachs of albacore in 1950

| | |
|---|---|
| No. stomachs examined | 220 |
| No. empty stomachs | 33 |
| No. stomachs containing: | |
| Rockfish | 107 |
| Saury | 53 |
| Squid | 48 |
| Liquid remains (Unidentified) | 32* |
| Unidentified fish remains | 13 |
| Black cod | 8 |
| Red feed (Euphausiids) | 3 |
| Liparid | 2 |
| Lantern fish | 1 |
| Wolf-eel | 1 |
| Flatfish (Juvenile) | 1 |
| Trichiuridae | 1 |
| Jellyfish | 1 |
| Miscellaneous | |
| Feathers | 2 |
| Seaweed | 2 |
| Vertebrate egg cluster | 1 |
| Potato Peel | 1 |

*Gill-net fish

FIGURE 26 - SMALL ROCKFISH, 3/4 TO 3 1/2 INCHES IN LENGTH, WERE PREDOMINANT IN THE STOMACH CONTENTS OF ALBACORE. UP TO 167 WERE TAKEN FROM ONE TUNA.

## Tagging of Albacore

Tagging was carried out aboard the John N. Cobb in an effort to gain information concerning the migratory patterns of the albacore off the coasts of Oregon, Washington and adjoining regions. Unfortunately, a successful method of tagging tuna has not yet been developed; hence, the tags and the procedure used were of a purely experimental nature.

Two types of plastic tags were used, the Peterson plastic disc tag and a plastic strip tag. Three hundred and ninety-seven albacore were tagged with the Peterson-type tag which consisted of two circular 9/16-inch-diameter discs, one yellow and one red. These discs were placed on each side of the second dorsal fin and were joined together by a nickle pin inserted through the anterior base of the fin; others were attached to the caudal keel. Thirty-five albacore were also tagged with a red and green plastic strip tag, 5/8-inch long and 1/8-inch wide. However, these tags were difficult to affix as the narrow plastic strip offered little leverage to the thumb when the second dorsal fin base was pierced and the sharp edges of the tag cut into the albacore quite readily.

The troll-caught fish selected for tagging were generally those that showed only slight hook damage and little bleeding. Rough handling of the fish was minimized by landing the albacore on a piece of cotton netting or on a sheet of rubber stretched across the top of a fish box. The albacore were placed in a canvas-lined tagging cradle immediately after boating and hook removal. Many albacore vibrated excessively while being tagged. This vibration could be somewhat inhibited if one hand was cupped over the head of the fish so that the thumb and the forefinger rested lightly on the eyes. With few exceptions, all tagged albacore when released swam away rapidly, some sounding at once.

No tags were returned during the season, and there were indications that they were not staying on the fish. The boat Signe S., while fishing west of Grays Harbor on July 19, reported by radio that an albacore had been caught which showed signs of having been tagged. Previous hook marks were visible. Later in Astoria, Oregon, a biologist of the Oregon Fish Commission examined the same fish and the following report was received: "... There actually was no tag, just the indication that one had torn off.... The fish had very raw spots where the discs had been extending into the flesh." The letter also stated that there was no visible sign of the tag pin having been pulled through the fin and that possibly the discs had worked loose. There were two other reports during the summer from fishing vessels stating that they had caught fish which bore tag marks. From this evidence, it appears that at least some of the albacore survived the tagging process; an important problem now being the development of a suitable tag that will stay on the fish during its rapid swimming movements.

In order to observe the effects of catching, handling, and tagging, several albacore were placed in the bait tank to observe their reactions after hook removal. The small bait tank, 6 feet wide by 8 feet long by 4 feet deep, did not allow much room for the albacore to maneuver, and the majority of fish placed in the tank died in a short while. Collisions with the walls of the tank and loss of scales from scraping on the metal sides were considered the two main factors responsible for death. A few albacore, however, were held alive successfully for 12 hours or more, and 1 fish remained active for nearly 19 hours.

FIGURE 27 - AN ALBACORE SWIMMING IN THE BAIT TANK OF THE COBB. SOME WERE KEPT ALIVE UP TO 19 HOURS.

## Water Temperatures

Oceanographic data were collected daily in an effort to gain information concerning possible relationships that may exist between albacore and their environment. A knowledge of chemical and physical conditions in the ecological habitat of the fish would be of definite advantage in predicting their progressive migration patterns. Special emphasis on prevailing oceanographic conditions was placed in areas where fishing was considered good.

A continuous record of variations in near-surface temperatures was recorded from a remote-control dial thermometer mounted in the pilot house and activated by water entering the main engine intake. This intake was at a depth approximately 8 feet below the surface and, therefore, gave temperatures which at times varied from actual surface recordings. Usually this temperature difference was slight; however, on several occasions temperatures recorded from the remote-control thermometer were 2° to 3° F. lower. It is possible that temperatures taken slightly below the surface would be a better indication of "tuna water" than surface readings, as they are less subject to fluctuations resulting from daily solar warming. Readings from the remote thermometer were used chiefly to note any rapid fluctuations in temperature while the vessel was underway. A mercury thermometer having an accuracy of ± 0.1° F. was used to record actual surface temperatures. This thermometer was protected in a metal sheath and the bulb extended into a small cylindrical-shaped cup at the base which filled with water when lowered over the rail (see fig. 28) and was also used for collection of surface water samples.

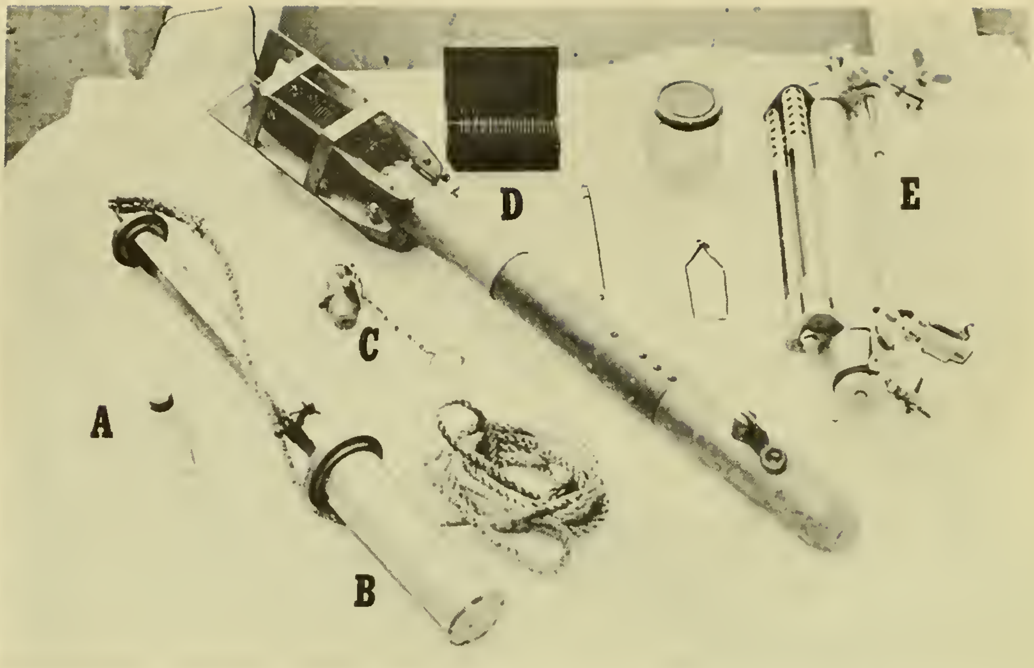


FIGURE 28 - OCEANOGRAPHIC EQUIPMENT USED IN 1950 TUNA EXPLORATION. A. WATER SAMPLE BOTTLE. B. SURFACE THERMOMETER HOLDER AND WATER SAMPLER. C. MESSENGER USED TO TRIP THE REVERSING WATER BOTTLE. D. BATHYTHERMOGRAPH AND ACCESSORIES. E. WATER BOTTLE WITH REVERSING THERMOMETER HOLDERS ATTACHED.

Subsurface temperatures were recorded with a bathythermograph (see fig. 28) having a vertical depth range of 450 feet. This instrument, used for measuring and recording water temperature versus depth, is essentially a metal tube housing pressure and thermal units. The thermal element is a 45-foot, coiled capillary tube filled with a fluid, xylene, which reacts rapidly to any change in temperature. A pen arm and a stylus are attached to the capillary tube end to record the temperature variations. The pressure element consists of an evacuated bellows which tends to compress with increased water pressure due to increased depth. In operation, a plain smoked slide is inserted in the holder at the end of the bellows and below the stylus. When the unit housing the slide is closed, the stylus is depressed and a continuous record of water temperatures at all depths within the instrument's range can be recorded on the slide. The bathythermograph is attached to the sounding wire and lowered over the side. The operation of lowering and raising the instrument was usually carried out while trolling; however, during choppy or rough weather the vessel's speed was slowed to facilitate operation. A bathythermograph cast can be completed within a few minutes under normal circumstances. The slide is removed after each lowering of the instrument and lacquered to preserve it for future examination. The bathythermograph was lowered by means of an electric sounding winch located on the starboard side of the upper deck. The winch carried 400 fathoms of 3/32-inch steel wire, spooling 50 fathoms of wire a minute.

## Surface Distribution

Results of several years of observations by commercial fishermen and research workers indicate that the main barrier directly or indirectly influencing the distribution of albacore throughout their northern range is water temperature.

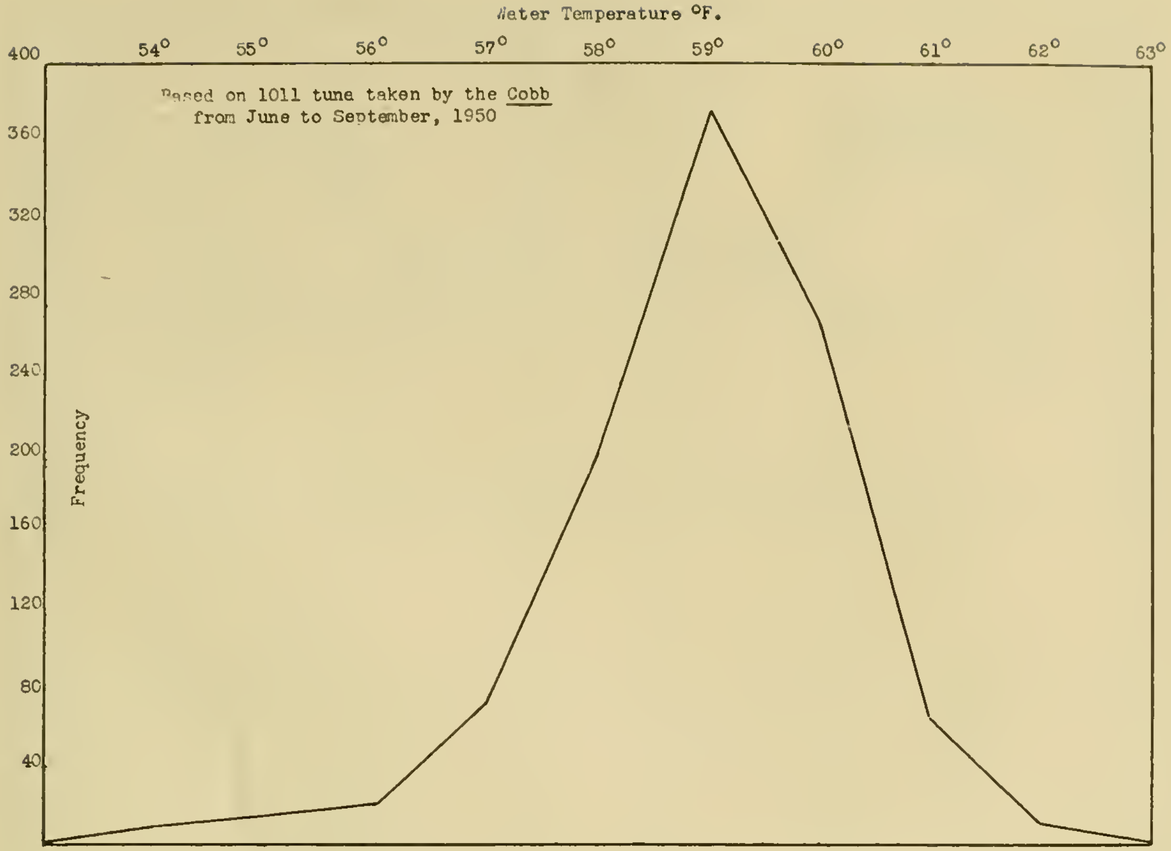


FIGURE 29 - ALBACORE CATCHES IN RELATION TO SURFACE WATER TEMPERATURES.

The progressive northward movement of the zone of warmer water as delineated by the 57.5° F. surface isotherm through the months of June, July, and August (see fig. 2) determines to a great extent the time of appearance and the inshore northerly migration of tuna in the waters of the northeastern Pacific.

An examination of figures 30 to 35 will show the northeasterly progression of the zone of warmer surface water through the late spring and summer months of 1950 and its relation to tuna catches by the Cobb. It will be noted that the 58° isotherm reached the area off the Columbia River sometime in the early part of July, which coincides closely with the usual arrival of albacore in quantities in this region. These isothermic trends tend to follow a similar pattern annually, and early or late arrival of albacore along the Oregon and Washington coasts will probably closely coincide with the appearance of warm water in the offshore regions. Note that in only one instance through this phase of the cruise, June 12 through July 26, were tuna caught in waters below 57° F. The first tuna taken by the John N. Cobb, June 18, were caught shortly after the vessel reached water of 57.5° F. (see fig. 30). The Cobb trolled southwesterly from Cape Flattery, Washington, and no fish were taken until the warmer water was reached off Cape Blanco, Ore. Continued trolling in colder waters to the east and north of this warm water produced no fish. Fishing activity throughout the summer was by no means confined to the so-called warm "tuna water," and much time was spent fishing the colder adjacent waters, with only a few scattered fish being taken.

A graph representing water temperatures in relation to tuna catches (see fig. 29) shows that the majority of the albacore were caught in the temperature range of 58° to 60° F. Although fish were taken in waters from 54° to 62° F., the

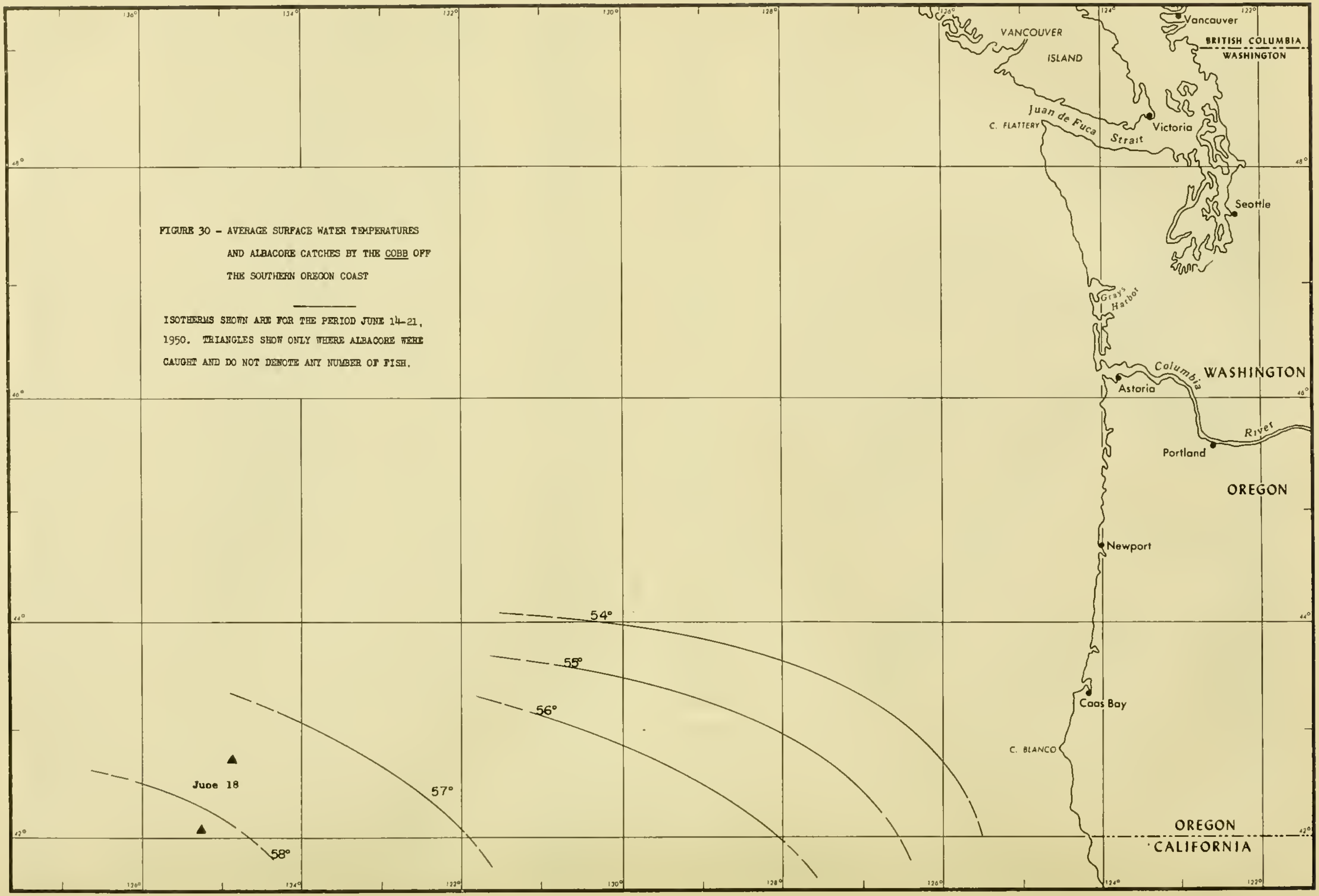


FIGURE 30 - AVERAGE SURFACE WATER TEMPERATURES AND ALBACORE CATCHES BY THE <u>COBB</u> OFF THE SOUTHERN OREGON COAST

ISOTHERMS SHOWN ARE FOR THE PERIOD JUNE 14-21, 1950. TRIANGLES SHOW ONLY WHERE ALBACORE WERE CAUGHT AND DO NOT DENOTE ANY NUMBER OF FISH.

FISH AND WILDLIFE SERVICE

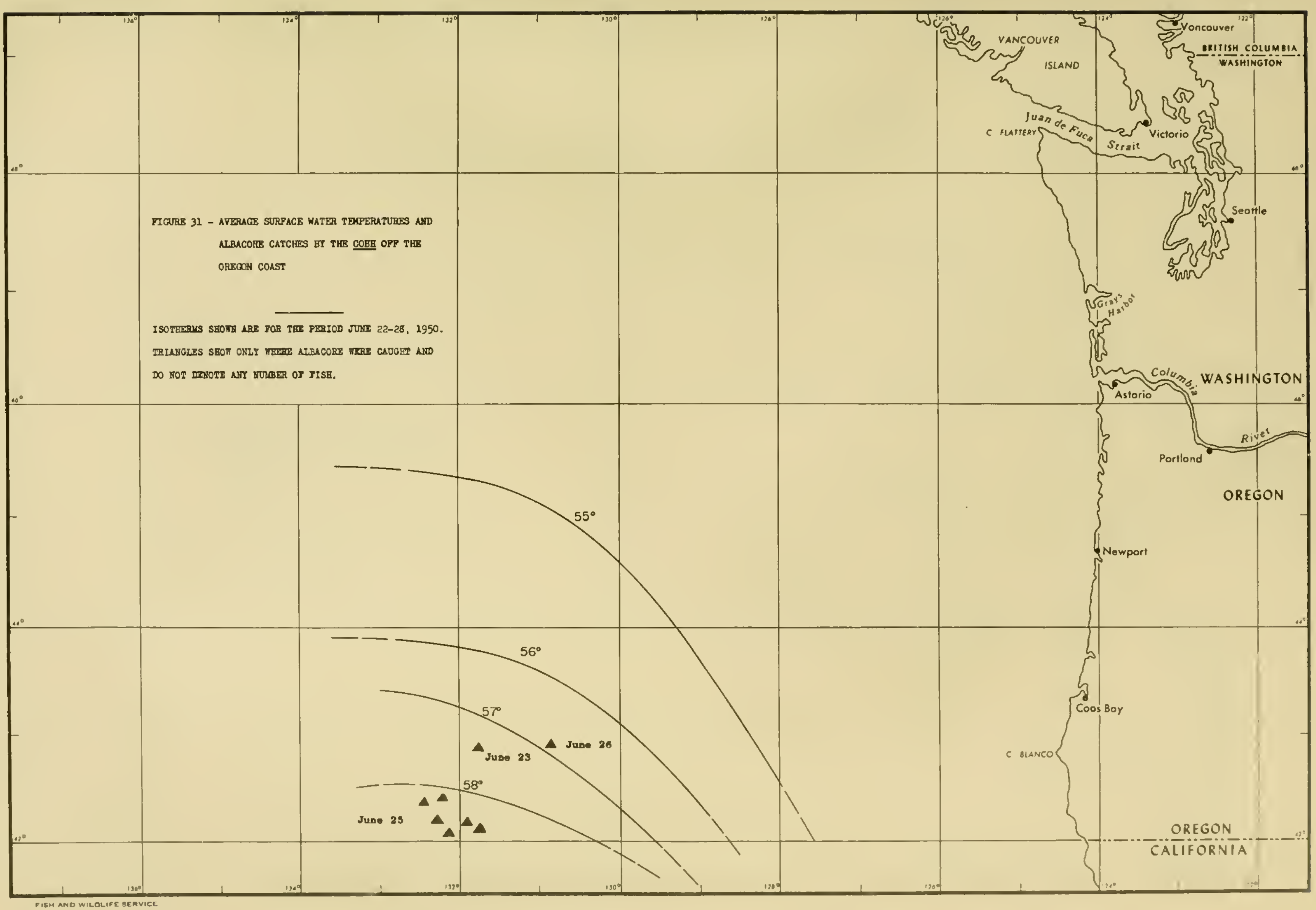


FIGURE 31 - AVERAGE SURFACE WATER TEMPERATURES AND ALBACORE CATCHES BY THE COBB OFF THE OREGON COAST

ISOTHERMS SHOWN ARE FOR THE PERIOD JUNE 22-28, 1950. TRIANGLES SHOW ONLY WHERE ALBACORE WERE CAUGHT AND DO NOT DENOTE ANY NUMBER OF FISH.

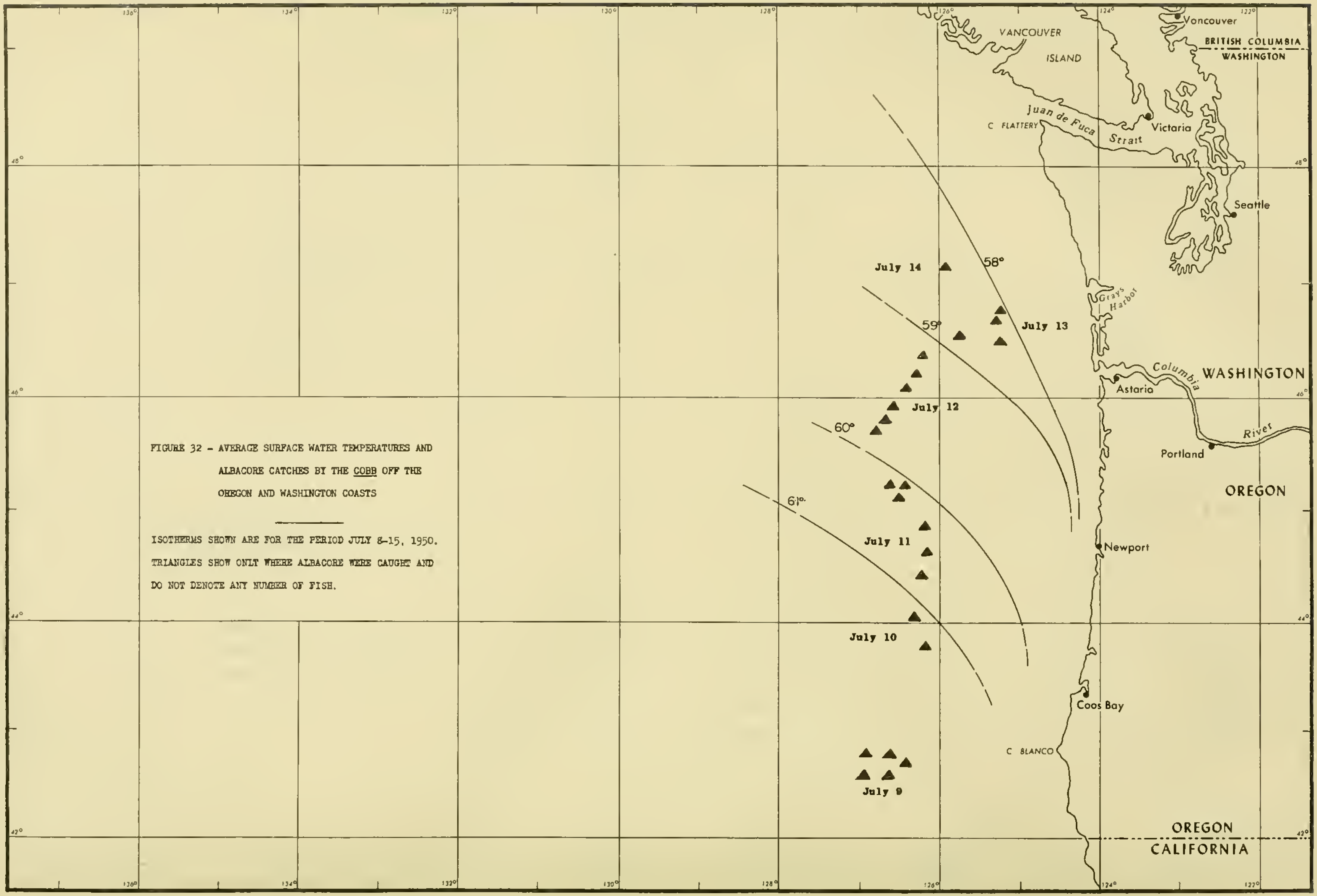


FIGURE 32 - AVERAGE SURFACE WATER TEMPERATURES AND ALBACORE CATCHES BY THE COBB OFF THE OREGON AND WASHINGTON COASTS

ISOTHERMS SHOWN ARE FOR THE PERIOD JULY 8-15, 1950. TRIANGLES SHOW ONLY WHERE ALBACORE WERE CAUGHT AND DO NOT DENOTE ANY NUMBER OF FISH.

FISH AND WILDLIFE SERVICE

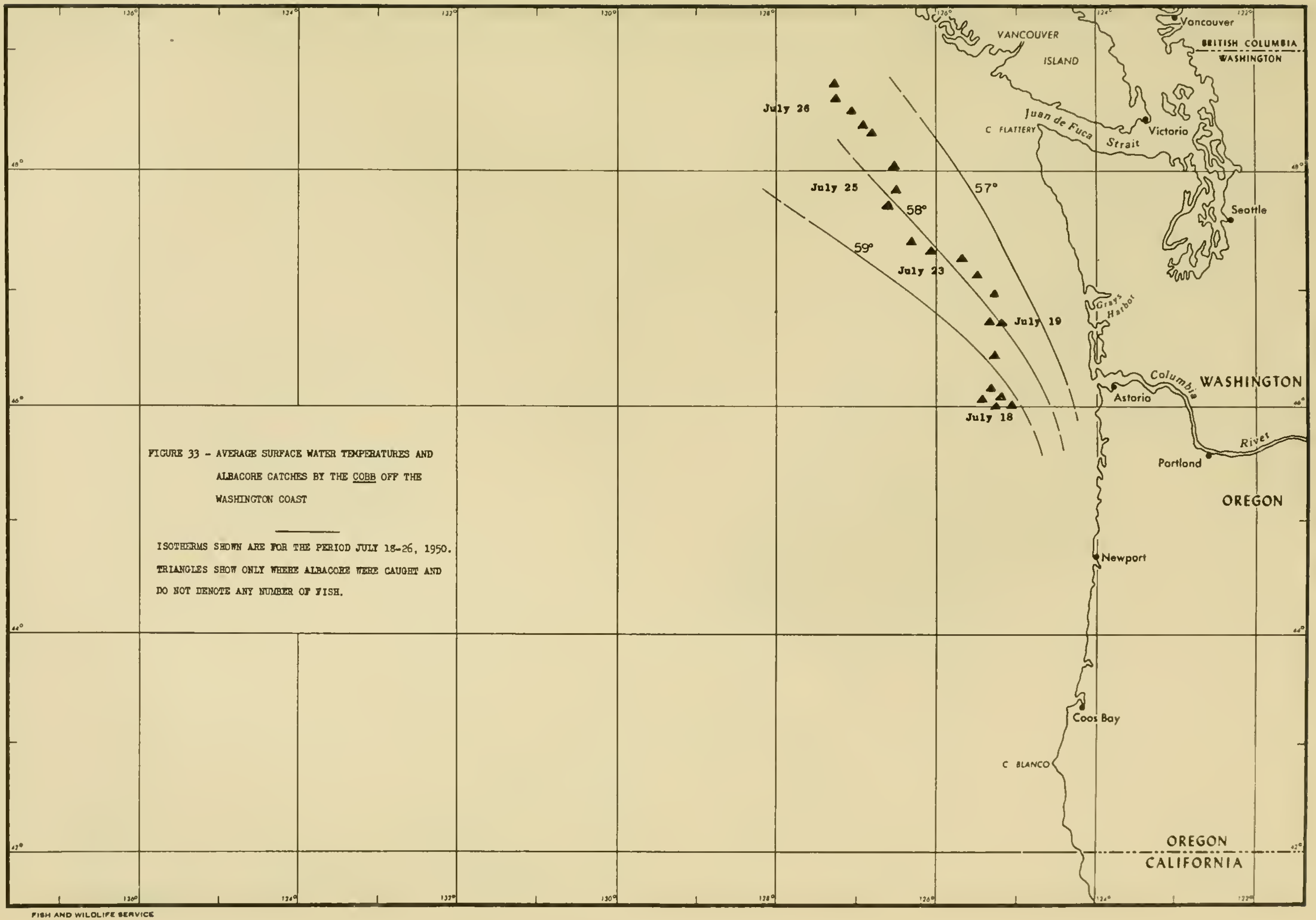


FIGURE 33 - AVERAGE SURFACE WATER TEMPERATURES AND ALBACORE CATCHES BY THE COBB OFF THE WASHINGTON COAST

ISOTHERMS SHOWN ARE FOR THE PERIOD JULY 18-26, 1950. TRIANGLES SHOW ONLY WHERE ALBACORE WERE CAUGHT AND DO NOT DENOTE ANY NUMBER OF FISH.

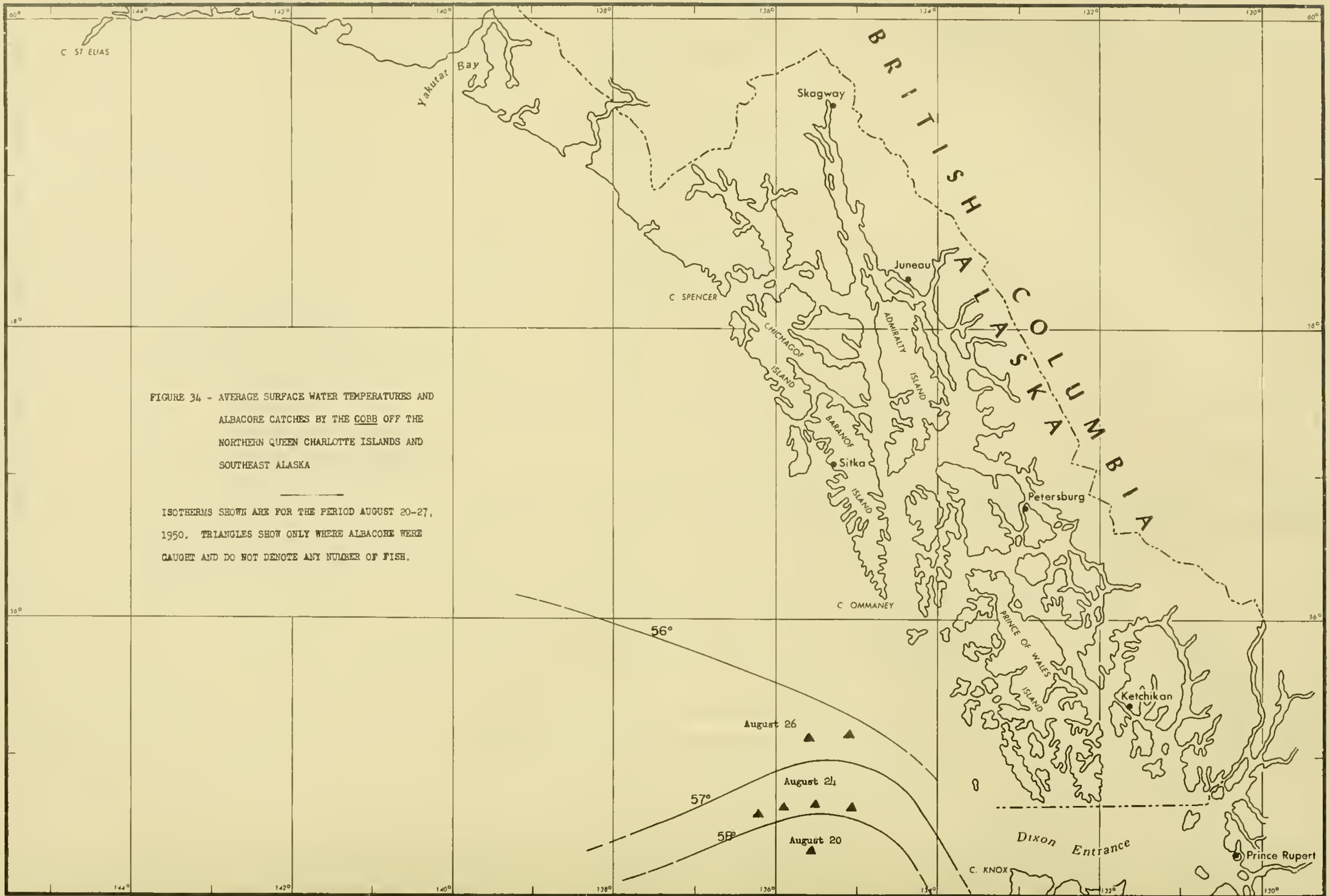


FIGURE 34 - AVERAGE SURFACE WATER TEMPERATURES AND ALBACORE CATCHES BY THE COBB OFF THE NORTHERN QUEEN CHARLOTTE ISLANDS AND SOUTHEAST ALASKA

ISOTHERMS SHOWN ARE FOR THE PERIOD AUGUST 20-27, 1950. TRIANGLES SHOW ONLY WHERE ALBACORE WERE CAUGHT AND DO NOT DENOTE ANY NUMBER OF FISH.

FISH AND WILDLIFE SERVICE

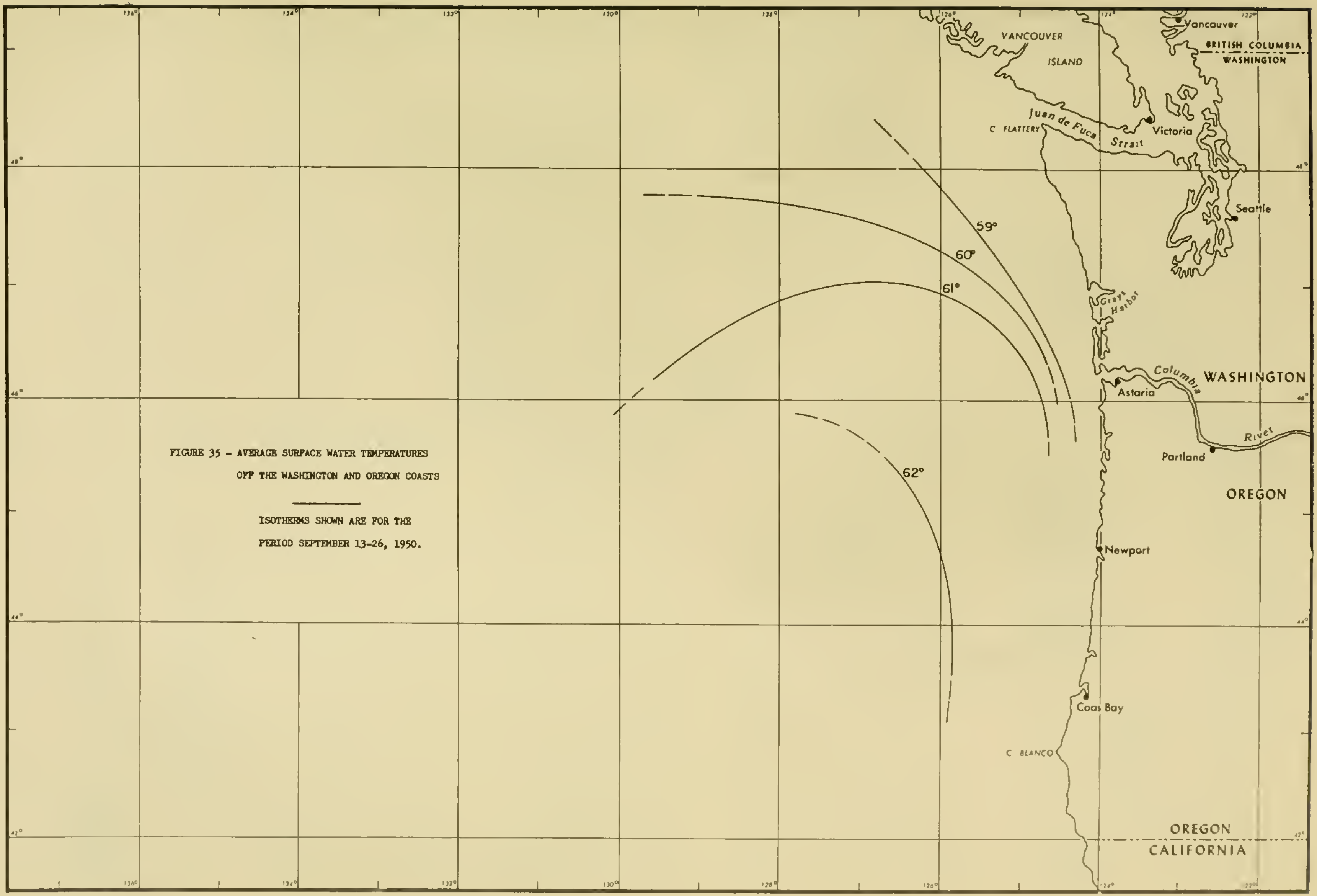


FIGURE 35 - AVERAGE SURFACE WATER TEMPERATURES OFF THE WASHINGTON AND OREGON COASTS

ISOTHERMS SHOWN ARE FOR THE PERIOD SEPTEMBER 13-26, 1950.

FISH AND WILDLIFE SERVICE

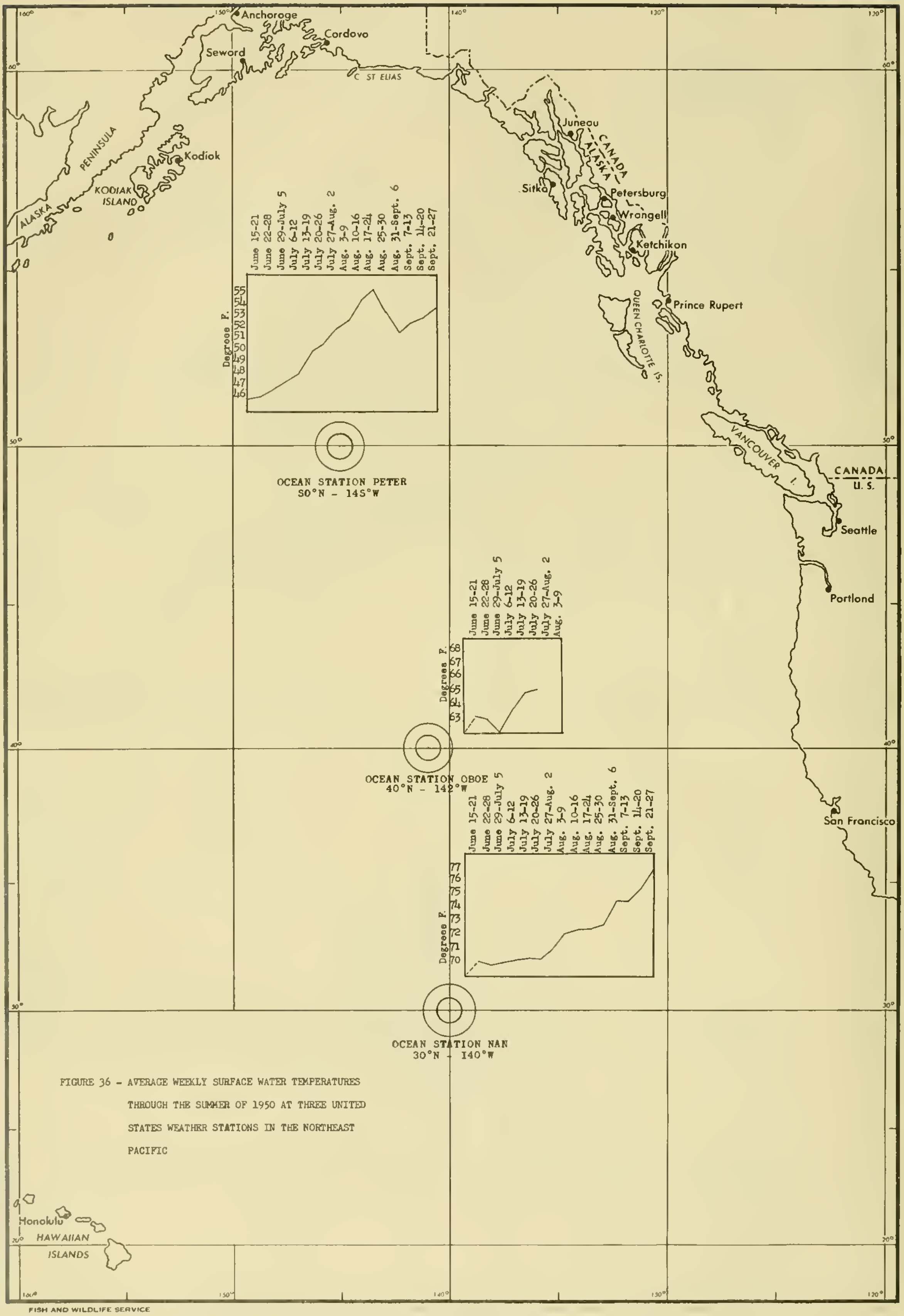


FIGURE 36 - AVERAGE WEEKLY SURFACE WATER TEMPERATURES THROUGH THE SUMMER OF 1950 AT THREE UNITED STATES WEATHER STATIONS IN THE NORTHEAST PACIFIC

number taken below 57° F. was only 3.5 percent of the summer's catch. In certain areas where a large amount of feed is present, it is likely that the fish will cross over to feed in these colder bordering regions; however, tuna taken in water below 57° F. were seldom far from the warm water. The possibility of albacore being present in large numbers in the colder waters, but not actively feeding, was not supported by results of the gill-net fishing.

An examination of figure 35, showing water temperatures off the Washington and Oregon coasts from September 13 through 26, indicates temperatures favorable for tuna, although no catches were recorded during this period. Warm water does not necessarily insure the presence of albacore, and while the main barrier to determining the extent of the tuna's habitat in the northeast Pacific is probably water temperature, the distribution and the abundance of fish in any area may be more closely related to availability of feed.

Fishing operations in Alaska waters extended from Prince of Wales Island to within 100 miles of Cape St. Elias, but water temperatures were generally cold and catches of albacore were confined to the region paralleling Dixon Entrance. An examination of the chart (fig. 34) showing isotherm and catches in southeastern Alaska during late August shows a definite offshore trend of the 57° isotherm in this region. If the conclusions reached earlier in the paper as to the effect of water temperature being a limiting factor are correct, it would seem improbable that tuna will be found in the colder waters north of Dixon Entrance in sufficient quantities to warrant exploitation. These observations would probably hold true in an average year, but it is possible that in some years oceanographic and meterological conditions may prevail which would produce warmer water farther to the north.

The northerly progression of warm water as referred to above does not imply a mass movement or northerly current of water but has reference to the seasonal warming tendency in the geographical regions mentioned. A clearer picture of this warming of surface water in the northeast Pacific can be attained by referring to figure 36. This chart plots the position of three U. S. Coast Guard weather ships off the Pacific coast. Surface temperatures were recorded daily from these stations and the mean weekly temperatures were computed and are graphed adjacent to each station. Data for Ocean Station Oboe are incomplete as this station did not maintain a fixed position after the latter part of July.

On examination of the mean water temperatures at Ocean Station Peter, it will be noted that there is a steady rise in water temperature until late August, when a sharp drop is recorded. This drop coincides with three intense summer storms in the Gulf of Alaska, which took place between August 24 and September 1. These summer storms play an important part in the cooling of surface waters by wind-mixing and interchange of warm surface layers with cooler underlying water. Because of the relative steepness and the shallow depth of the thermocline in the north Pacific waters as compared with more southern waters, the effect of wind-mixing upon the surface temperatures will be much more pronounced in this region.

It is interesting to note that the maximum summer surface temperature recorded at Ocean Station Peter is only 55° F., while water temperatures in the same latitude, closer to shore, off Vancouver Island were recorded as high as 61° F., and surface temperatures off the northern Queen Charlotte Islands were recorded up to 58° F. This would indicate a "pouching" or "sandwiching" of warm water north along the continental edge of the north Pacific coast. This condition is closely supported by the data collected by the Canadian oceanographic vessel HMCS <u>Cedarwood</u> in August 1950 (Waldie and Doe 1950). This occurrence of warm water along the British Columbia coast is probably the main factor accounting for the presence of commercial quantities of albacore in these comparatively far north latitudes.

The extent of this "pouching effect" seems to be the most important factor governing the possibilities of any quantity of albacore occurring in Alaska waters. The factors involved in producing the wedge of warm inshore water seem to be controversial and have been attributed to both solar warming and seasonal currents. By employing accurate thermometers and accurate methods for securing temperatures, fishing operations in this region could be confined to the wedge of warm water. The width of the warm water wedge will undoubtedly vary throughout the summer, and its shape will probably be modified from year to year.

## Vertical Distribution

A series of subsurface temperatures was taken with the bathythermograph in an effort to determine the average depth of warm water during the summer months and any relationship between its depth and the occurrence of albacore. In general, albacore were not found to be concentrated in regions where the warm water extended only a few feet below the surface. The average depth of the thermocline in waters of productive fishing was sixty feet, sometimes extending to 80 or 90 feet. Results of the gill-net fishing indicate that the tuna generally stay within the upper regions of the warm surface layer; very few were taken in the lower meshes of the nets (see section on gill-net catches).

## Color of Water

The color pattern of the water along the Pacific Northwest coast consists essentially of a coastal green zone which is adjoined by the deep blue of the open ocean. The coastal green zone is of variable width and is generally several degrees colder than the offshore blue water. The deep-blue color of water is said to be caused by the moleculer scattering of the shorter light-wave lengths from water molecules. Therefore, the deep blue of the open ocean is characteristic of water essentially free of particulate material or dissolved pigmented substances, and regions of green or colors other than blue in the ocean may be considered as areas of discolored water. These regions of discoloration may be the results of phytoplankton or zooplankton, suspended particles of earth carried to sea by streams and rivers, organic debris, or dissolved organic compounds of either marine or terrestrial origin.

Gunther (1936) attributes the green coastal zone of the Peru current to phytoplankton (mostly diatoms). The abundance of nutrient salts brought up by upwelling along the coastal regions of Peru makes possible a rich growth of phytoplankton, whereas the offshore surface waters are isolated by a well-defined discontinuity layer which prevents vertical mixing. Offshore waters are thus depleted of nutrient salts and have only a small phytoplankton population. A similar condition may possibly account for the coastal green zone off the Oregon and the Washington coasts during the tuna season.

Good tuna fishing is usually found in the blue water, with occasional catches being made in blue-green or green water. Much of the albacore fishing off the Oregon and the Washington coasts occurs in the blue offshore waters bordering the cooler, green, coastal zone. The apparent reluctance of albacore to enter this coastal green water probably has little or no relation to the color of the water, but may be attributed to the lower water temperatures, which are generally below those at which albacore are taken in this fishery.

## Weather Summary*

The meteorological and hydrographic conditions existing in offshore waters may play an important role in determing the success or failure of a tuna season. An unusual number of summer storms will hamper the operation of many of the smaller trollers and correspondingly reduce market landings. Although the weather may vary considerably from summer to summer, a general summary of conditions found off the northwest Pacific coast will give an index as to what could be expected in the months of June, July, August, and September.

Weather conditions during the month of June are generally fair off the northwest Pacific coast. Winds of gale force are infrequent and fog is seldom encountered. The trade winds are light to moderate along the coast from Oregon to the Queen Charlotte Straits and average winds during this period are generally from 15 to 25 m.p.h. From 50 to 500 miles offshore there is a tendency for the winds to become progressively stronger. Small trollers would at times find it difficult to operate during this period.

July and August are considered the best and safest months for offshore fishing. The prevailing winds are most frequently westerly and northwesterly throughout these months and the force is generally light to moderate. Fog will increase, particularly along the coastal areas. Vessels fishing in the more northerly waters off northern Vancouver Island and the Queen Charlotte Islands will probably find the westerly winds somewhat stronger than in the more southern areas of the fishery. However, the hazards from bad weather are minimized in this area because the fishery is generally close inshore and within several hours' running time from shelter. The month of September is usually fair; however, experienced fishermen look for the first southeast storms of the fall during the latter part of the month. At this time albacore fishing gradually tapers off in the northern waters, and fishermen turn to more southern areas.

## NEW SEAMOUNT DISCOVERY

On August 1, while investigating a report of large schools of tuna in waters offshore from the Washington coast, the Cobb discovered an uncharted seamount. A seamount is by definition a mountain which rises from the ocean floor, but does not reach the surface of the ocean. Underwater mountains are not uncommon and a number of seamounts are scattered throughout the northeastern Pacific Ocean. (See fig. 37.)

### General Description

The first soundings of the seamount were picked up on the flashing-type echo-sounder shortly after 0800 on the morning of August 1, at a depth of 860 fathoms. At this time the vessel was trolling on a course of 353° magnetic and was making close to 8 knots. By 0820 the depth had decreased to 380 fathoms, at which time the recording depth-finder was started, and a continuous record of soundings was recorded while surveying the area of the seamount above four hundred fathoms (see fig. 38). Several courses were held while making the fathogram recordings, one at 353° magnetic and reverse and the other at 270° magnetic and reverse. These

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*THIS SECTION WAS PREPARED BY CAPTAIN SHELDON W. JOHNSON, MASTER OF THE M. V. JOHN N. COBB.

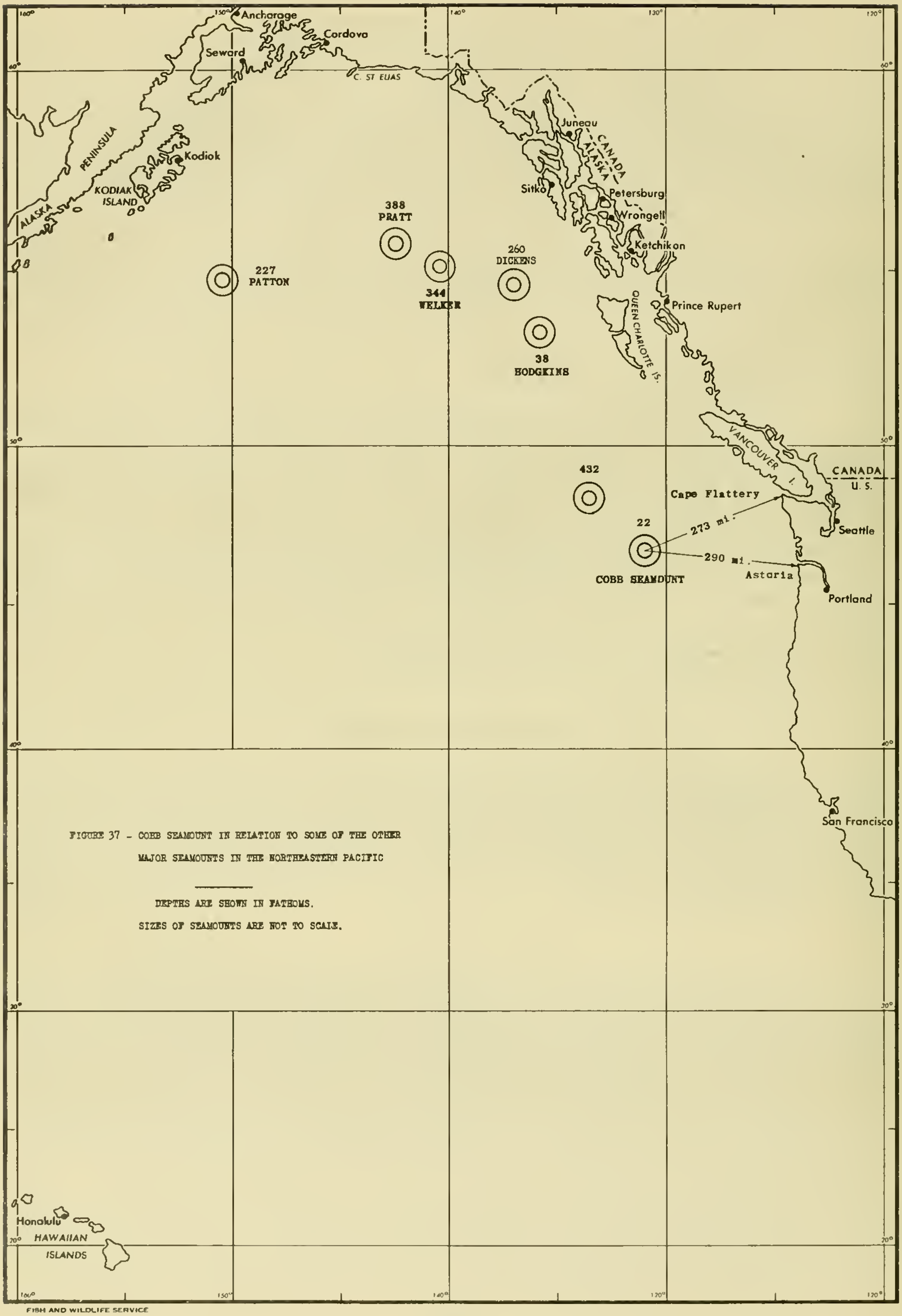


FIGURE 37 - COBB SEAMOUNT IN RELATION TO SOME OF THE OTHER MAJOR SEAMOUNTS IN THE NORTHEASTERN PACIFIC

courses gave an approximate north-south and east-west topographic picture of the seamount. A peak with a minimum depth of 22 fathoms was recorded at 46° 44' N. latitude, 130° 47' W. longitude. This position was determined by loran and sextant readings.

As the maximum depth of the recording depth-finder was four hundred fathoms, little information can be given as to the characteristics of the seamount below this depth. The portion of the underwater mountain above four hundred fathoms is approximately 35 square miles. The sides appear quite steep up to a depth of 110 fathoms where a certain amount of leveling or terracing appears. The distorted relationship between vertical and horizontal distance on the fathogram will give the impression that there is little or no level bottom; however, some relatively level ledges were found at depths of 70, 80, and 110 fathoms. These ledges, although not extensive, were large enough to make a number of long-line sets.

Numerous efforts were made to pick up samples of bottom material with a small, snapper-type, bottom sampler; but in most cases the sampler failed to pick up any material, although in several instances a coarse, white calcareous sand was obtained. It is probable that the upper portion of the seamount is mostly rock with sand and mud collecting on the terraced regions.

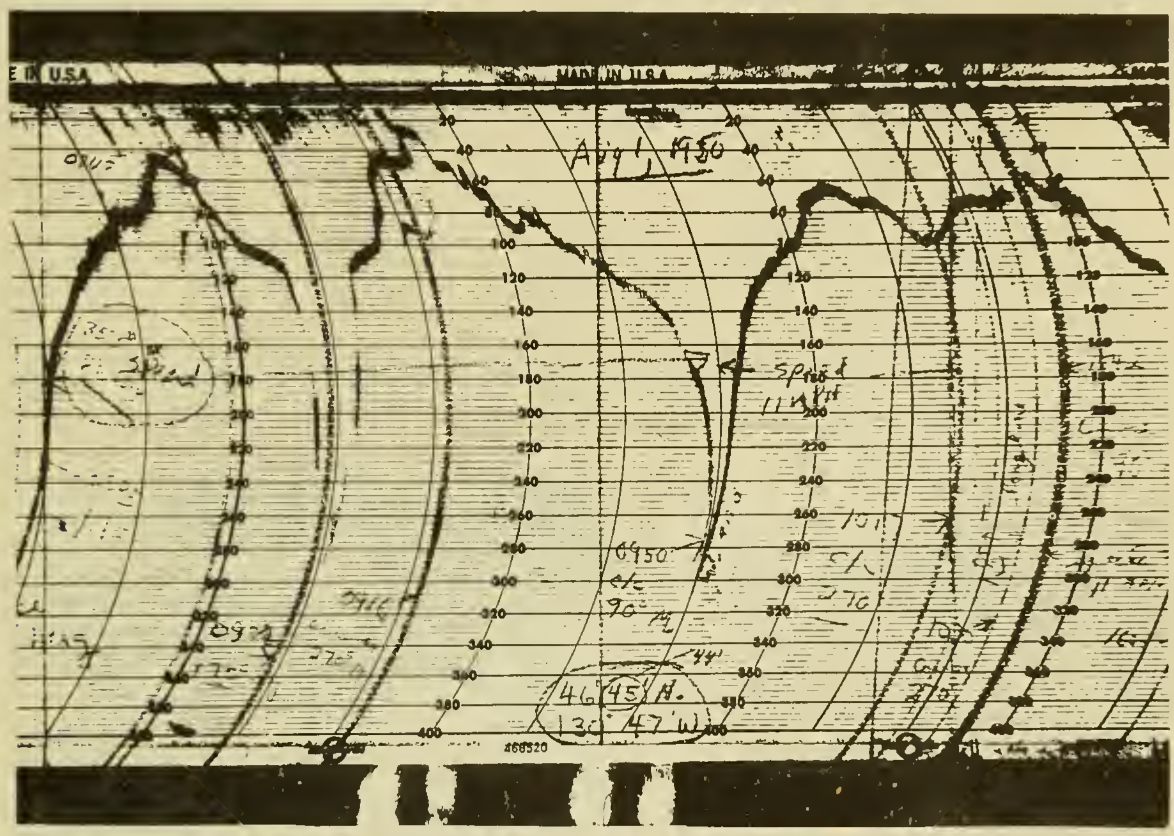

FIGURE 38 - FATHOGRAM OF SEAMOUNT. DEPTH SCALE IS IN FATHOMS. RECORDING SHOWS RESULTS OF SEVERAL COURSES RUN OVER THE PEAK.

## Commercial Fishing Possibilities

As the fishing potentialities were of definite interest to the exploratory program, sets of ground long-line gear, baited with frozen herring and squid, were made near the 22-fathom peak (see fig. 39). The long-line gear used was essentially the same as that used by Pacific coast halibut fishermen.

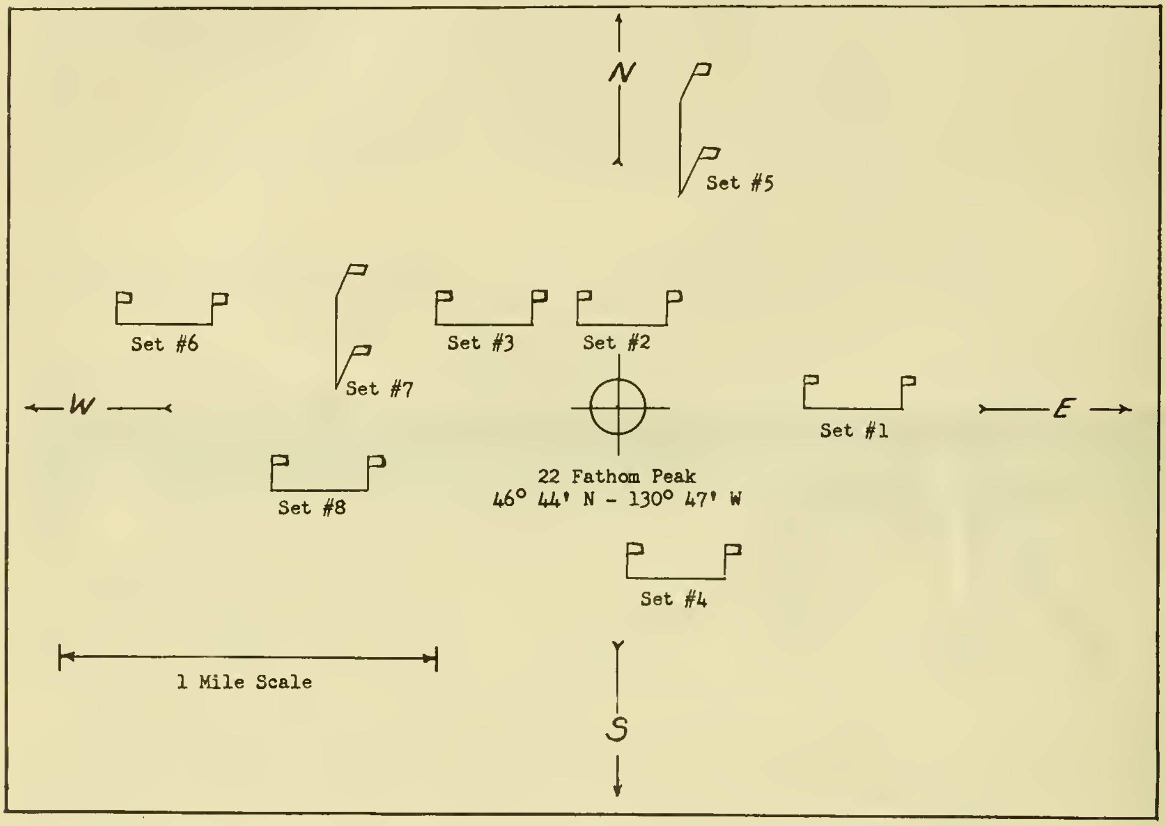


FIGURE 39 - POSITION OF LONG-LINE SETS MADE ADJACENT TO THE 22-FATHOM PEAK.

This type of gear is made up of a main ground line to which a number of offshoots (gangions), containing the hooks, are attached (see fig. 40). The ground line, with the gangions, attaches to a 7-or 8-fathom section of hook-free rope called the slipshot line which is, in turn, made fast to the anchor. The anchors which hold the gear in place are linked to surface floats, usually wooden kegs, by means of buoy lines. A marker flag at the end of a bamboo pole is connected by a short section of line to the wooden keg.

The ground line used by the Cobb was made up of a number of 50 fathoms lengths of 48-pound hemp lines.[3] Each "line" contained twenty-one 16-pound hemp gangions, spaced 13 feet apart. The gangions were 5 feet in length and held number 32 hooks. Five lines were knotted together to form a skate of gear, a skate being

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[3]SIZES INDICATED BY WEIGHT OF PACKAGE--A PACKAGE CONTAINS SIX 50-FATHOMS SKEINS, OR A PACKAGE OF SIX SKEINS OF 48-POUND LINE WEIGHS 48 POUNDS.

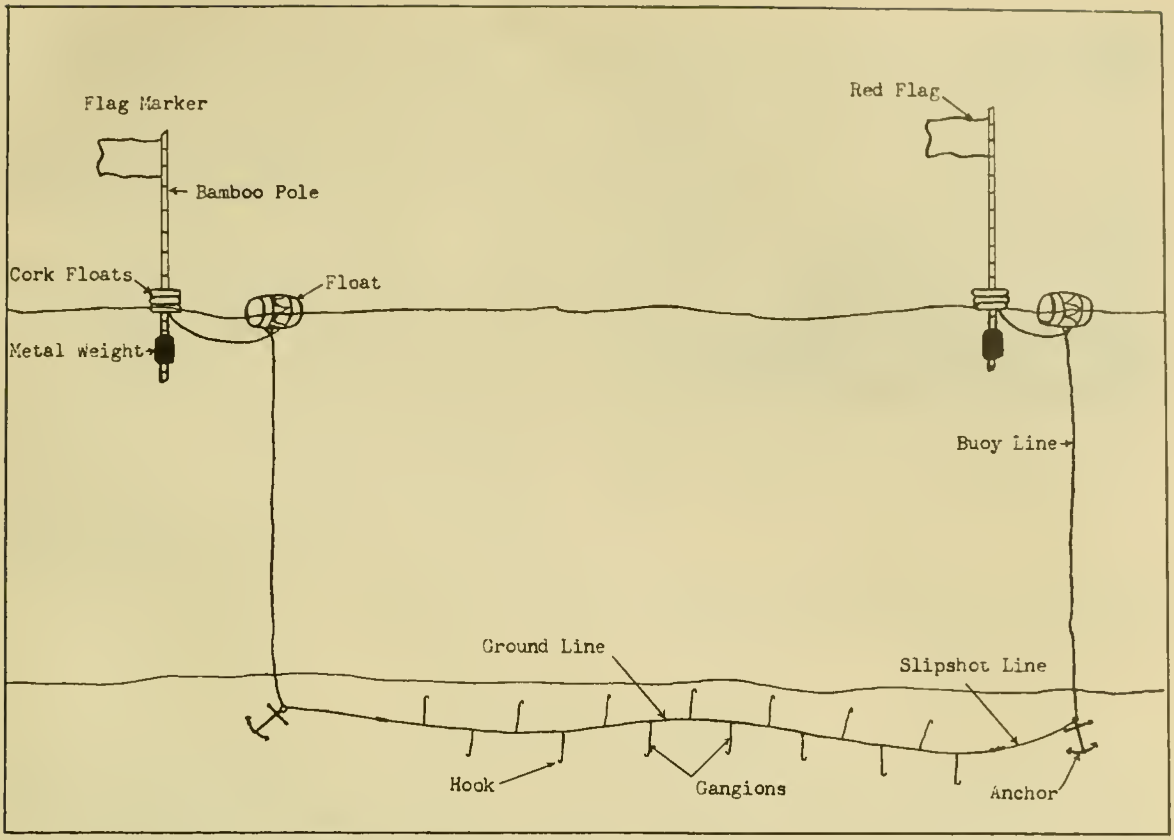


FIGURE 40 - MAKE-UP OF GROUND LONG-LINE GEAR SHOWING MAIN PARTS (NOT DRAWN TO SCALE).

one complete length of long-line gear, which is baited, coiled, and stored as an unit. Two skates were fished in all sets made by the Cobb; however, in commercial halibut fishing, any number of skates may be used in a set of gear.

FIGURE 41 - LARGE RED ROCKFISH OR RED SNAPPERS (SEBASTODES RUBERRIMUS), AVERAGING 15 POUNDS WERE TAKEN ON THE SEAMOUNT WITH LONG-LINE GEAR.

The first set of gear was made on August 1, at a depth of 70-fathoms for a period of 3 hours. When the gear was hauled, 65 large red snappers (*Sebastodes ruberrimus*), not to be confused with the Gulf of Mexico red snapper (*Lutianus* sp.), averaging 15 pounds per fish were taken. The results were considered good enough to warrant further exploration; and, as the vessel was then engaged in an important phase of the tuna research, it was decided to return to the seamount in the month of September for a further study of the region.

The Cobb returned to the area on September 14, and made long-line sets for the next 2 days. Seven sets were

FIGURE 42 - GROUND LONG-LINE GEAR READY TO BE SET FROM THE STERN OF THE COBB. THE GEAR PAYS OUT OVER THE METAL CHUTE AS THE VESSEL RUNS AHEAD.

made in the region adjacent to the 22-fathom peak which are summarized in Table 7 and plotted on figure 39. An examination of the table will reveal that the red snapper and vermillion rockfish (Sebastodes miniatus), were taken in the greatest quantities. Other fish were taken in only small amounts; however, the presence of halibut in the region indicates that possible future exploration might yield a potential fishing ground. Although some catches contained red snapper and vermillion rockfish in fair amounts, a number of difficulties stand in the way of the development of an offshore fishery in this area. The considerable distance offshore would necessitate having navigational equipment capable of ascertaining the vessel's position accurately within several miles. The cost of such a trip would require the fish to have a high market value and to be in such quantities as to make the operation worthwhile.

## Observations on Marine Life

As fishing operations were carried on only by long-line gear, the variety of specimens taken was necessarily selective to fish which could be taken by this method. It was quite apparent that rockfish were an important part of the seamount's fish population. Red snapper, Sebastodes ruberrimus, and the vermillion rockfish, Sebastodes miniatus, were the most common types taken. Other fish taken in lesser amounts included flyfish, Sebastodes rhodochloris, blue shark, Prionace glauca, big skate, Raja binoculata, halibut, Hippoglossus stenolepis, and the rock sole, Lepidopsetta bilineata. The environmental conditions generally found in regions frequented by halibut would seem to indicate the presence of a certain amount of gravel or sandy, mud bottom as concluded previously.

The surface waters in the region of the seamount were abundant with long, chain formations of diatoms of the genus Rhizosolenia. A few forms of starfish were collected which included the many-footed sun stars, Pycnopoda sp., and members of the brittle stars, genus Ophiura. The sea pen, Stylauta elongata, and a few whelks of the genus Argobuccinium were also taken.

A most notable condition throughout the period the vessel operated in the waters over the seamount was the intense increase in bird activity. At all times large numbers of Beals petrels and the forked-tailed petrels could be seen along with black-footed albatross, sooty shearwaters, and jaegers. Other birds observed were the Foresters tern and the arctic tern. One unidentified duck was also noticed. This increase in bird activity from that which is normally found in the offshore areas was an indication that the waters of the seamount were a fertile region for the production of marine life and might well be a feeding area for pelagic fishes.

Table 7.--Results of long-line sets made on the seamount

| Set number | Date | Time on bottom | Depth | Catch of commercial value | | | | Misc. Notes |
|---|---|---|---|---|---|---|---|---|
| | | | | Red snapper* | Vermillion rockfish** | Misc. | Total | |
| 1 | Aug. 1 | 3 hrs. | 70 fa. | 975 lbs. | --- | 2 lbs. | 977 | 1 big skate, 1 rock sole bottom rocky - lost one anchor |
| 2 | Sept. 14 | 3 hrs. | 50 fa. | 150 lbs. | 132 lbs. | | 282 | six blue sharks also taken |
| 3 | Sept. 15 | 2 hrs. 50 min. | 42-44 | 69 lbs. | | 64 lbs. | 133 | Two halibut, 26 lbs. and 38 lbs. |
| 4 | Sept. 15 | 4 hrs. 15 min. | 72 fa. | 168 lbs. | 95 lbs. | | 263 | Lost one skate and two lines of gear |
| 5 | Sept. 15 | 3 hrs. 30 min. | 100 to 110 fa. | 197 lbs. | 92 lbs. | 32 lbs. | 321 | One rock sole, one halibut 31 lbs. |
| 6 | Sept. 15 | 3 hrs. 30 min. | 90 fa. | 336 lbs. | 59 lbs. | | 395 | Two blue shark |
| 7 | Sept. 16 | 3 hrs. | 60 fa. | 431 lbs. | 18 lbs. | 2 lbs. | 451 | Lost 1 line and small anchor, eight blue shark, one rock sole |
| 8 | Sept. 16 | 4 hrs. | 40 fa. | 768 lbs. | 79 lbs. | 2 lbs. | 849 | Seven blue shark, one rock sole |

* Sebastodes ruberrimus
** Sebastodes miniatus also called "smoked swede".

## SUMMARY


First commercial landings of albacore were made at Oregon and Washington ports in 1937. The catch reached an all-time high of 34 million pounds in 1944, but has decreased to less than 15 million pounds annually since 1945. In the summer of 1948, the commercial range was extended northward, and good fishing was found off the Queen Charlotte Islands in British Columbia. One of the main objectives of the 1949 survey by the Fish and Wildlife vessel Oregon was to determine if albacore reached Alaskan waters in commercial quantities. Although a few scattered albacore were caught up to three hundred miles off Dixon Entrance, no concentrations of the tuna were found; and water temperatures in the Gulf of Alaska were noted to be generally colder than those in which albacore are usually taken.

Main objectives of the 1950 exploration by the John N. Cobb were to obtain information on the inshore migration pattern of the albacore; to test various types of gear on albacore; to further investigate the possibilities of establishing a tuna fishery off Alaska; to record environmental conditions affecting the availability of albacore; and to assist the commercial fleet through radio broadcasts of fishing results. Related biological and oceanographic information was also collected.

The Cobb left Seattle on June 12, and steered a southwesterly course from Cape Flattery. The first albacore were caught June 18, shortly after reaching 58° F. water 480 miles off Cape Blanco, Oregon. Catches during the following days indicated the albacore, along with the extension of the warm surface-water zone, were moving inshore and northward along the Oregon coast. Commercial catches were made 60 miles southwest of the Columbia River on July 16, off Willapa Bay on July 19, and 90 to 100 miles off Cape Flattery during the final week of July. After the middle of August, when the albacore seemingly disappeared from the Washington and Oregon coasts, the fishery shifted northward to the Queen Charlotte Islands. The Cobb caught scattered albacore off the southeastern Alaska coast on August 24 and 26, but over 2 weeks of intensive fishing from Dixon Entrance to within 100 miles of Cape St. Elias revealed no sign of commercial quantities of the tuna in Alaska waters. During this time, surface water temperatures in the Gulf of Alaska were low (51.2° to 55° F.), and stormy weather curtailed fishing activities to some extent. In the last 2 weeks of September, the Cobb twice covered the waters from Cape Blanco to Cape Flattery, and although water temperatures were favorable and some feed was observed, no albacore were seen or caught during this time.

Surface-trolled jigs were used as the main gear for locating albacore, and gill nets and long line were fished experimentally. Both linen and nylon gill nets were used in mesh sizes of 7½ inch, 8½ inch, and 9½ inch (stretched measurements). The linen and nylon were equally effective in catching albacore, over a ton being taken in one night-time set of the nets. Some damage to the gill-net-caught albacore was observed, especially when the nets were hauled in choppy seas. Four sets made in daylight with long-line gear using frozen squid and herring for bait caught only one albacore, and results with this experimental gear were considered very inconclusive.

Best fishing was usually found in the warm (58° to 60° F.) blue water, with occasional catches being made in blue-green or green water. Although albacore were taken in waters from 54° to 62° F., only 3.5 per cent of the total catch occurred in waters below 57° F. Good fishing frequently was experienced in fingers of warm, blue water extending into the coastal green zone or along the edge of the

blue and green waters. It was found that the fish at times apparently cross over into the colder, bordering regions to feed. Results of bathythermograph recordings revealed that generally albacore were not found to be concentrated in areas where the warm surface water extended but a few feet below the surface. The average depth of the thermocline in waters of productive fishing was 60 feet. Gill-net catches indicated that the albacore usually stay within the upper region of the warm surface layer.

Stomach analysis showed that small rockfish made up a significant portion of the diet of albacore, being present in 107 of 220 stomachs examined; 167 rockfish were taken from one albacore. Saury and squid were also present in sizable quantities at times. Other food samples included euphausiids (red feed), lantern fish, small black cod, a wolf eel, and miscellaneous items.

Over four hundred albacore were tagged in an effort to gain knowledge of their migration pattern. No returns have been received. In conjunction with the tagging experiment, albacore were kept alive up to 19 hours in the bait tank of the Cobb.

While investigating a report of albacore on August 1, the Cobb discovered an uncharted seamount with a peak 22-fathoms deep approximately 270 miles west of Willapa Bay, Wash. Sets of ground long-line gear caught large numbers of red snappers (Sebastodes ruberrimus) averaging 15 pounds. Several other species of fish were taken, including halibut and rock sole. Birds and other forms of sea life were numerous in the area of the seamount, indicating conditions usually considered favorable to a feeding area for pelagic fishes.

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