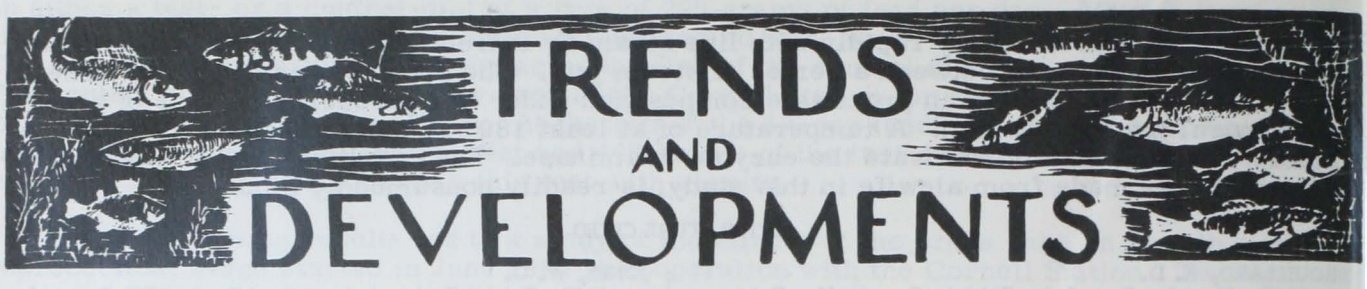

Fishery Technology Developments

TECHNICAL NOTE NO. 1--A RAPID FIELD METHOD FOR DETERMINING THE SALT CONCENTRATION IN FRESH AND SMOKED CHUB

By R. A. Greig* and H. L. Seagran**

ABSTRACT

A rapid, simple field method for determining the concentration of salt (NaCl) in fresh and smoked chub is described. The method uses an inexpensive plastic indicator device sensitive to chlorides in solution. Results obtained by the field method were compared with those obtained by use of a chemical method known to be accurate. On the basis of these comparisons, the field method was found to be sufficiently accurate for practical purposes.

INTRODUCTION

The interim smoked-fish guidelines published late in 1963 by the U. S. Food and Drug Administration called attention to the need for significant changes in existing industry procedures for smoking fish. The results of subsequent industry efforts indicated that an immediate and extreme transition in smoking techniques would make it difficult to produce a fully marketable product (Patashnik, Lee, Seagran, and Sanford 1964). Despite this practical difficulty, however, findings by various researchers since the publication of the smoked-fish guidelines suggest that the interim-thermal-process requirements set forth in the guidelines may be inadequate to ensure the complete destruction of all Clostridium botulinum Type E spores that potentially may be associated with raw fish before it is heat-processed. As a result, various research and regulatory groups have examined additional or complementary processing techniques that hold promise of providing industry and consumer protection.

Some agencies have proposed that significantly increasing the salt content of the smoked product may complement thermal processing without altering the marketability of the product. Wisconsin (McDowell 1964) has already amended its regulations to require 5-percent salt in the water phase of the finished product in order to restrict the growth of any botulinum spores surviving the heat treatment. The salt content, however, would have to be controlled within rather narrow limits because of the microbiological hazard if the salt content is too low or of the unpalatability if the salt content is too high. The salt content has been difficult for the smoked fish industry to control closely because of the variability in rate of salt uptake by the fish during brining. A need therefore exists for a rapid method of accurately estimating the concentration of salt in a product during the various steps of processing. Unfortunately, laboratory methods for determining the salt content of fish are time consuming and usually require a technician to perform the tests.

The purpose of this study was to determine if existing quality-control methods employing simple indicator devices that have been used successfully by other industries could be

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applied to the accurate measurement of the concentration of salt in chub (1) during the brining procedure, to guide processors; and (2) in the final smoked product, to determine compliance with microbiological safety requirements.

In the first part of this paper, tests made to determine the suitability of a proposed rapid, simple field method for measuring salt concentration are reported; in the second, the proposed method (having been found adequate) is described in detail.

TESTS OF THE PROPOSED METHOD

MATERIALS FOR TESTING: Chub (Coregonus hoyi) from Lake Michigan were brined in various concentrations of salt to obtain products possessing a wide range of salt contents. Half of the brined chub at each salt level was smoked in a laboratory controlled smokehouse, and the remainder of each lot was left in the fresh-brined condition. Skin-on loins from the fresh brined chub and skinless loins from the smoked chub were used as material for determining salt concentration.

Table 1 - Salt Content of Brined Fresh Chub as Determined by a Method Employing an Indicator Device and by the A.O.A.C. Method 1/

Salt Content by Indicator Device, Employing Manual Extraction 2/	Salt Content by A.O.A.C. Method	Salt Content by Indicator Device, Employing Mechanical Extraction 3/	Salt Content by A.O.A.C. Method
Percent	Percent	Percent	Percent
0.56	0.56	0.69	0.64
1.2	1.18	1.5	1.45
1.5	1.57	1.7	1.93
1.8	1.79	2.6	2.56
3.1	3.43	3.6	3.80
3.7	3.98	3.7	4.23
4.1	4.43	-	-

1/From one homogeneous fish sample (corresponding to the various salt levels), separate weight aliquots were taken for the A.O.A.C. and indicator device methods.
2/Hot water and fish mixed with stirring rod.
3/Hot water and fish mixed with electric blender.

Table 2 - Salt Content of Brined Smoked Chub as Determined by a Method Employing an Indicator Device and by the A.O.A.C. Method 1/

Salt Content by Indicator Device, Employing Manual Extraction 2/	Salt Content by Indicator Device, Employing Mechanical Extraction 3/	Salt Content by A.O.A.C. Method
Percent	Percent	Percent
0.80	0.80	0.82
1.3	1.5	1.41
1.4	1.4	1.61
1.6	-	1.69
1.7	-	1.94
2.0	1.9	2.06
2.1	-	2.19
3.3	3.2	3.29
3.5	3.7	3.57
3.6	-	3.92
4.3	4.4	4.23
5.2	-	5.32
6.3	6.0	5.99
5.7	-	6.16

1/From one homogeneous fish sample (corresponding to the various salt levels), separate weight aliquots were taken for the A.O.A.C. and indicator device methods.
2/Hot water and fish mixed with stirring rod.
3/Hot water and fish mixed with electric blender.

TESTING PROCEDURES: An indicator device 1/ used in quality-control procedures by other industries was used. The indicator is a commercially available plastic strip containing a sensitized capillary element (fig. 1).

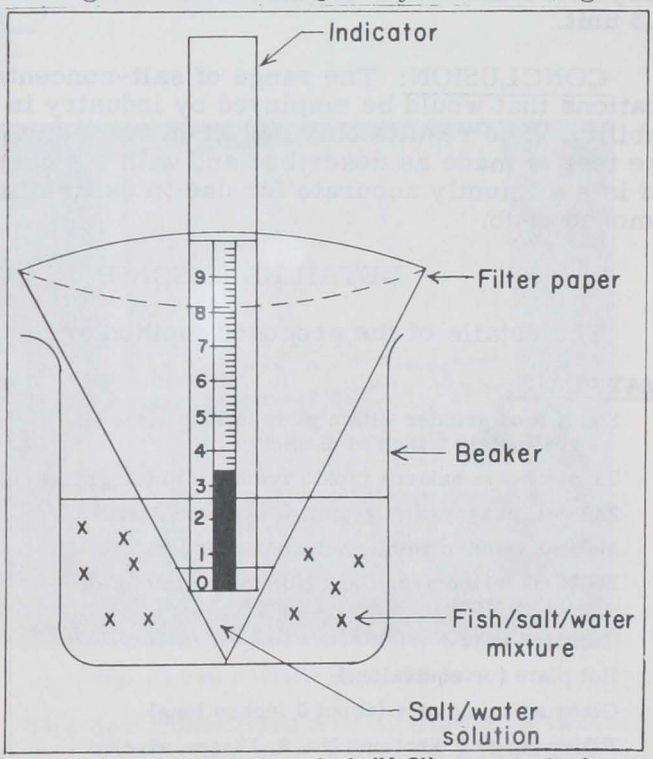

Fig. 1 - Rapid determination of salt (NaCl) concentration by a direct-reading method, showing placement of indicator inside the filter paper cone.

The indicator device, which is discarded after a single measurement, was employed as follows: 100 milliliters of boiling distilled water were added to 10 grams of well-mixed fish product. The mixture was stirred immediately, either manually with a stirring rod for 2 to 3 minutes or with an electric blender for 1 minute. Following the filtration of the fish mix-

1/Quantab, type S041; Ames Co., Elkhart, Indiana. (Trade names referred to in this publication do not imply endorsement of commercial products.)

ture, the indicator device was placed in a small portion of the filtrate. The percentage of salt was obtained from a standard curve (supplied by the manufacturer of the indicating device), which relates indicator-scale readings (on a semilog basis) to the concentration of salt in the filtered solution.

For comparison, salt concentration (by chloride analysis) was determined on replicate samples of the well-mixed fish product by the official methods of analysis of the Association of Official Agricultural Chemists (A.O.A.C.) (1960) to determine the accuracy of the indicator-test procedure.

RESULTS: Accuracy of the Indicator Test: Salt-concentration data (averages of duplicate determinations) resulting from the comparative tests employing both brined fresh chub (table 1) and brined smoked chub (table 2) show that the results using the indicator device correlated well with those obtained with the A.O.A.C. method.

With the brined fresh chub, 11 of the 13 values (85 percent) obtained with the indicator device were within 10 percent of the values obtained by the A. O. A. C. method. The other two values were within 14 percent of those of the reference method. With the brined and smoked chub, 12 of the 14 values (85 percent) obtained with the indicator device were within 8 percent of the values obtained by the A. O. A. C. method. The other two values were within 13 percent of those of the reference method. Further, over 85 percent of the values obtained (24 of the 27) were either the same as, or less than, the values obtained with the A. O. A. C. method.

Reproducibility of the Indicator Test: Over 75 percent of the duplicate readings did not vary more than 0.1 unit on the indicator-device scale; the greatest variation observed was 0.3 unit.

CONCLUSION: The range of salt-concentration data presented includes those concentrations that would be employed by industry in keeping both with public safety and with palatability. The results obtained when the indicator-test procedure was used show that, when the test is made as described and with the care described below, this simple and rapid method is sufficiently accurate for use in estimating the concentration of salt in both fresh and smoked chub.

DETAILED DESCRIPTION OF THE PROPOSED METHOD

The details of the proposed method are as follows:

MATERIALS:

- Small food grinder with a plate having holes approximately $\frac{1}{4}$ inch in diameter
- Triple-beam balance (scale readings to 0.1 gram)
- 250-ml. beakers (or $\frac{1}{2}$-pint, wide-mouth jars)
- 100-ml. wide-mouth, graduated cylinder
- 1500-ml. erlenmyer flask (for the boiling of distilled water)
- Distilled water
- Hot plate (or equivalent)
- Glass stirring rods (about 8 inches long)
- Filter paper (Whatman No. 2, 12-cm. size)
- Plastic bags (about 8 by 12 inches)
- Indicator devices

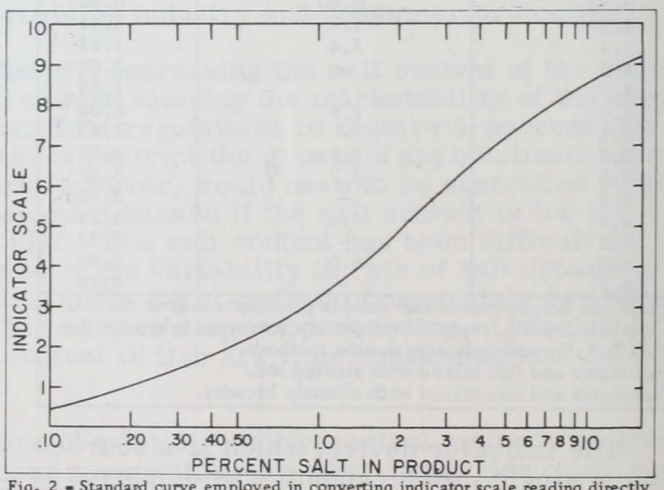

Fig. 2 - Standard curve employed in converting indicator scale reading directly to concentration of salt in product.

PROCEDURE:

1. Grind the skinless loin portion 2/ from smoked chub (or the skin-on loin portion from unsmoked chub, depending on the material to be analyzed) through the food grinder at least two times.

2/Results of recent unpublished work by this laboratory indicates that, for smoked chub, the proper portion of the product to be taken for salt determinations is the loin muscle (the thick meaty part adjacent to the backbone, rather than the meat adjacent to the ribcage). This portion of the fish will contain the minimum salt concentration and maximum moisture and is therefore that part most likely to support the growth of C. botulinum.

2. Place the ground sample in a plastic bag and mix well by kneading the bag.

3. Place 10 grams (accurately weighed to ± 0.1 gram) of the ground fish in a clean, 250-ml. beaker (or ½-pint wide-mouth jar).

4. Add 100 ml. of boiling distilled water to the 10 grams of fish.

5. Mix the fish and water thoroughly with a stirring rod for 2 to 3 minutes, carefully breaking apart any lumps.

6. Fold the filter paper into a cone shape and insert it, pointed end first, into the mixture of fish and water (fig. 1).

7. After a sufficient amount of water passes through the filter paper to wet the bottom of the indicator device, insert the device into the filtered solution. (The indicator device can be read after about 5 minutes. A marker area at the top of the device turns dark blue to indicate when a reading can be taken. The device contains a printed scale, which is calibrated from 0 to 10).

8. Accurately note the scale reading.

9. Find this number on the indicator scale of the standard curve employed in converting the indicator-scale readings directly to salt content of product (fig. 2).

10. Draw a horizontal line from the number on the indicator scale to intersect the curve.

11. At this point of intersection, draw a vertical line to intersect the percent-salt-in-product scale.

12. Record this value as being the percentage of salt in the product.

Note: The salt concentration determined with the standard curve supplied by the manufacturer of the indicator device must be multiplied by 10 to give the salt content of the fish product. This factor has been incorporated in the scale of figure 2.

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PATASHNIK, MAX; CHARLES F. LEE; HARRY L. SEAGRAN; and F. BRUCE SANFORD
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Transportation and Marketing Aid

NEW PLASTIC FISH BOXES TO AID FRESH FISH MARKETING:

A new lightweight re-usable plastic fish box for transporting fresh and frozen fish has been developed by a firm in Seattle, Wash. A high-density polyethylene material is used in the new boxes to make them tough and flexible. You can jump on them at 40 degrees below zero without cracking them. They will also withstand steam-cleaning heat.

Particularly adaptable to air shipment, the new containers may offer an excellent opportunity to expand fresh fish markets. The weight of the polyethylene containers is about half that of fiberglass, and they have been approved for re-use by the U. S. Food and Drug Administration. By August 1965, over 2,000 of the new boxes had been sold or leased to 2 airlines based in Seattle, and other airlines were testing the boxes. Using the new containers, an airline transported over 500 tons of fresh fish from Alaska to Seattle during June and July 1965 without a claim for spoiled or damaged fish. In September 1965, an airline announced a one-year experimental rate reduction of 40 percent on Northwest fishery shipments to eastern points.

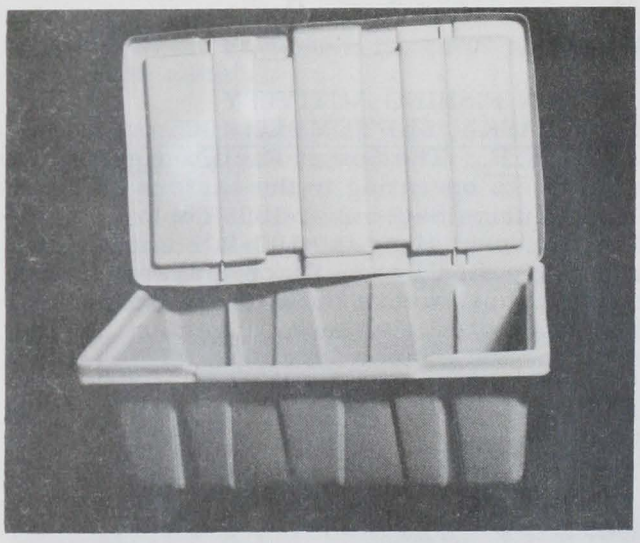

Fig. 1 - New re-usable plastic fish box.

The new containers are available in two sizes. The larger size will hold 250 to 300 pounds of fresh fish and has outside dimensions of $41\frac{3}{4}$ x $21\frac{3}{4}$ x 18 inches. The smaller size holds 125 to 175 pounds of fresh fish and has outside dimensions of 32 x 20 x 11 inches. Minimum monthly lease costs are said to be 68 cents a box for the larger size and 50 cents a box for the smaller size.

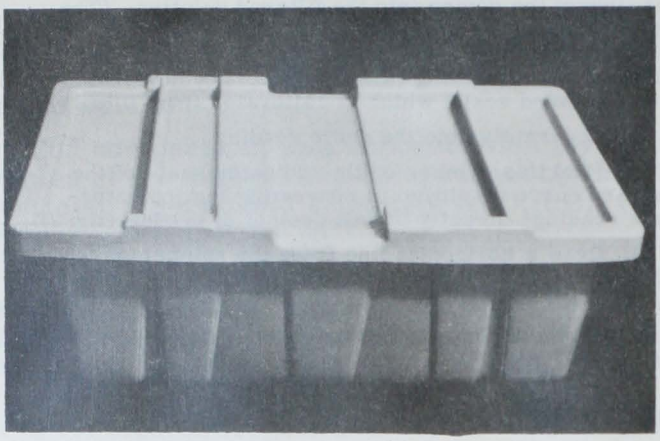

Fig. 2 - Bale-reinforced lid for plastic box gives added strength.

The new boxes are vacuum formed. Strength and rigidity are provided through structural ribbing and bale-reinforced lid. The boxes can be stacked when full and nested when empty.

Notes: (1) Additional information is available from the Marketing Office, U.S. Bureau of Commercial Fisheries, 2725 Montlake Blvd. East, Seattle, Wash.

(2) See page 44 of this issue for a report on an airline's reduced rates for Northwest fishery shipments to eastern points.

Alaska

FOREIGN FISHING ACTIVITY OFF ALASKA, SEPTEMBER 1965:

U.S.S.R.: The Soviet Pacific ocean perch trawl fleets operating in the eastern Gulf of Alaska during September 1965 deployed their fishing efforts along the 100-fathom curve from Cape St. Elias to Dixon Entrance. For the first three weeks in September one major fleet of about 41 trawlers, 10 reefers, 1 factoryship, and 1 tanker operated off Yakutat.

Fig. 1 - Soviet trawler transferring Pacific ocean perch to reefer vessel in Gulf of Alaska.

The second fleet of about 27 trawlers, 5 reefers, 1 tug, and 1 cargo vessel was dispersed between Cape Spencer and Cape Ommaney. Those two major fleets gradually moved south along the coast of Alaska and by the end of the month both fleets had merged into one concentration off Dixon Entrance.

Fig. 2 - Soviet salvage tug.

The Soviet trawl fishery in the central and western Aleutians remained fairly stable throughout September. The fishery in the central Aleutians, composed of 12 trawlers and 3 reefers, remained relatively fixed in the vicinity of Amukta Pass during the month.

In the western Aleutians there was a major concentration of Soviet vessels made up of 16 BMRT factory trawlers, 2 SRT trawlers, 2 reefers, and intermittent support vessels. A notable increase in the size of that fleet occurred during September.

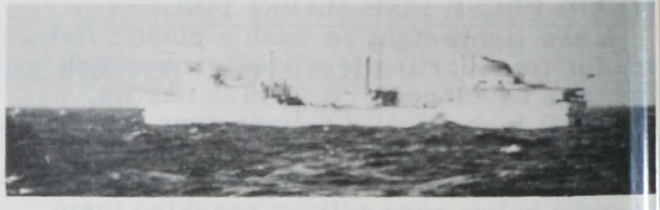

Fig. 3 - Soviet whale factoryship Vladivostok in western Gulf of Alaska.

The two Soviet SRT-M trawlers engaged in shrimp fishing east of the Shumagin Islands ceased operations during the second week of September. It was not known whether those trawlers returned to their home port or were transferred to another fishery.

During September the Soviet whale factoryships Dalniy Vostok and Aleut, each accompanied by 9 whale killer vessels, were operating south of the Aleutian Islands between Adak and Attu. The whale factoryship Vladivostok and its fleet worked in the western Gulf of Alaska during the first week of September. That vessel gradually moved westward and by the end of the month was

working in the Bering Sea north of Semisopochnoi Island.

Japan: During the first week of September, the Japanese vessels Taiyo Maru No. 37, Takachiko Maru, Takachi Maru, and Fukuho Maru No. 2, trawled east of the Trinity Islands; and were joined by the Akebono Maru No. 53. The Daishin Maru No. 12 and the Fukushin Maru No. 1 trawled on Portlock Bank south of Middleton Island throughout the month. The second week of September the Akebono Maru No. 53 moved from Albatross to Portlock Bank and fished in the same general area as the Daishin Maru No. 12. The stern trawler Akebono Maru No. 71 continued to fish in the central Aleutians in the vicinity of Amukta Pass.

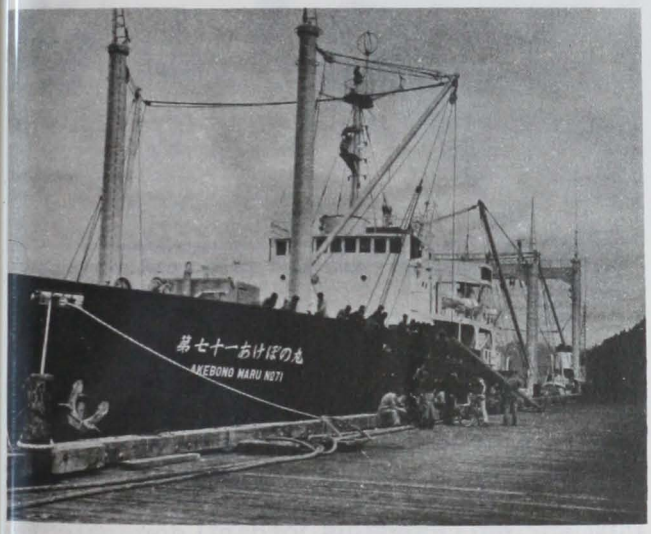

Fig. 4 - Japanese stern trawler Akebono Maru No. 71.

In early September the Chichibu Maru and 8 accompanying trawlers returned to the western Aleutians. She fished for Pacific ocean perch in the area around Amchitka Pass until mid-September when she moved to north of the Pribilof Islands and began fishing for shrimp

Late in September the factory trawlers Aso Maru, Akebono Maru No. 72, and Tenyo Maru No. 3 arrived in the area east of Buldir Island in the western Aleutians. Those vessels were presumably fishing for Pacific ocean perch.

The Japanese fish meal factoryships Gyokuei Maru, Hoyo Maru, and Tenyo Maru continued to fish on the grounds north of the Pribilofs during early September. The Gyokuei Maru and Hoyo Maru, accompanied by

Fig. 5 - Japanese fish meal factoryship Tenyo Maru.

26 and 29 trawlers, respectively, ended operations in mid-September and returned to Japan. The Tenyo Maru and her 10 trawlers remained on the grounds throughout the remainder of the month.

Another Japanese fish meal factoryship, the Shikishima Maru, accompanied by 23 trawlers, arrived in the western Aleutians during the first week of September. She fished in the region east of Attu Island and Amchitka Pass until about September 20 when she presumably returned to Japan.

Fig. 6 - Japanese trawler fishing north of the Pribilofs for the fish meal factoryship Gyokuei Maru.

Throughout September the shrimp factoryship Einen Maru and her 15 trawlers fished in the area about 100 miles north of St. Paul Island. That fleet had been fishing for shrimp in that area since late April 1965.

About the end of the month two Japanese long-line vessels were fishing in the Gulf of Alaska. The Kiku Maru No. 25 was sighted about 25 to 30 miles west of Middleton Island during the second week of September and remained in the Gulf until the end of that month. A second Japanese long-line vessel (IG 1-189) was seen on September 23 south of the Trinity Islands.

The Japanese whale factoryships Nitto Maru and Kyokuyo Maru, each accompanied by 7 catcher boats were reportedly operating in the western Aleutians during the entire month of September.

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NEW FISH PROCESSING PLANT AT HOMER: The Homer city council has granted a year's option on about two acres of city-owned land to an Alaska fish-processing firm. The land lies on the Kachemak Bay side of Homer Spit next to the Homer city dock. Initially the plant will handle salmon, halibut, shrimp, and king and Dungeness crab. The anticipated annual capacity will be about 20.5 million pounds. If the first stage proves successful, the firm will then begin processing scallops, herring, and clams.

Alaska Fisheries Explorations and Gear Development

SHRIMP AND BOTTOMFISH RESOURCES OFF SOUTHEAST ALASKA SURVEYED: M/V "Commando" Cruise 65-2--Shrimp (July 7-August 2); Bottomfish (August 6-24, 1965): To locate trawlable fishing grounds and to delineate commercial concentrations of shrimp were the primary objectives of this 4-week exploratory cruise in southeastern Alaska by the University of Washington research vessel Commando, which was chartered by the U.S. Bureau of Commercial Fisheries. Secondary objectives included the collection of data on the seasonal distribution and abundance of shrimp in waters off southeastern Alaska.

In the areas of explorations, echo-sounding transects were made to locate trawlable fishing grounds. Areas shown on the echo-recorder to be reasonably level and of soft consistency were fished with the 40-foot Gulf of Mexico-type shrimp trawl.

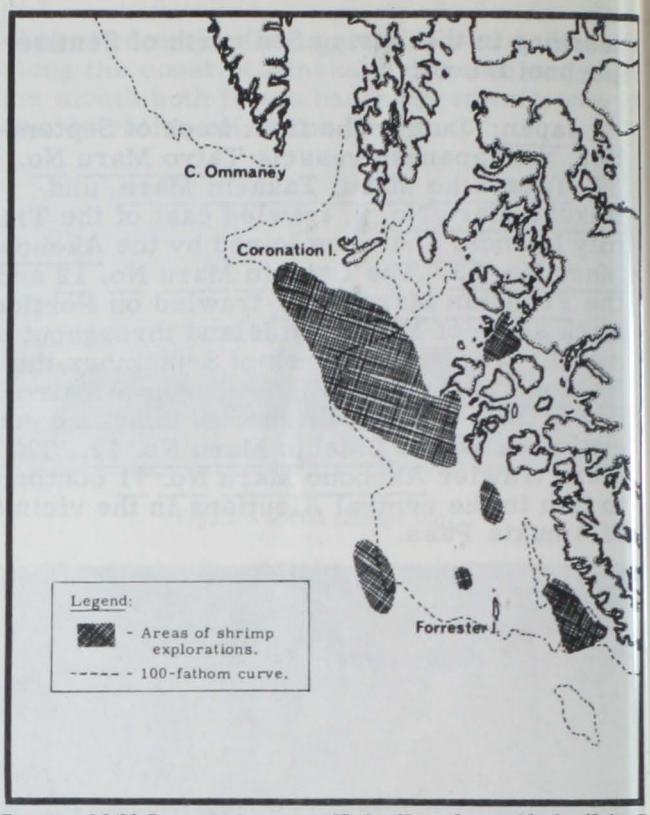


Fig. 1 - M/V Commando cruise 65-2 off southeast Alaska (July 7 - August 2, 1965).

A total of 55 drags lasting about 30 minutes each were made during this cruise. Of those, 40 drags were made on the Continental Shelf between Coronation Island and Dixon Entrance in depths ranging from 38 to 153 fathoms. Shrimp catches of 0 to 180 pounds were taken in those offshore areas. Ocean pink shrimp (Pandalus jordani) dominated the shrimp catches, accounting for 83 percent of the total shrimp catch. Side-stripe (Pandalopsis dispar), spot (Pandalus platyceros), and other shrimp accounted for 13 percent, 1 percent, and 3 percent, respectively.

The remaining 15 drags were made in the Gulf of Esquibel (9 drags), Carroll Inlet (4 drags), and Affleck Canal (2 drags) in depths from 22 to 115 fathoms. Shrimp catches ranged from less than a pound to 100 pounds. In those inshore areas, pink shrimp (Pandalus borealis) accounted for 56 percent; side-striped shrimp, 41 percent; and other shrimp, 3 percent of the total shrimp catch.

After a brief layover in June, the Commando began the summer phase of a general bottomfish survey off southeast Alaska. The cruise ended on August 24, 1965, after 2½ weeks of exploratory fishing operations.

Primary objectives of the bottomfish survey were to determine the ability of roller-rigged otter trawls to fish on rough bottom. Secondary objectives were to locate trawlable fishing grounds and to delineate commercial concentrations of bottomfish.

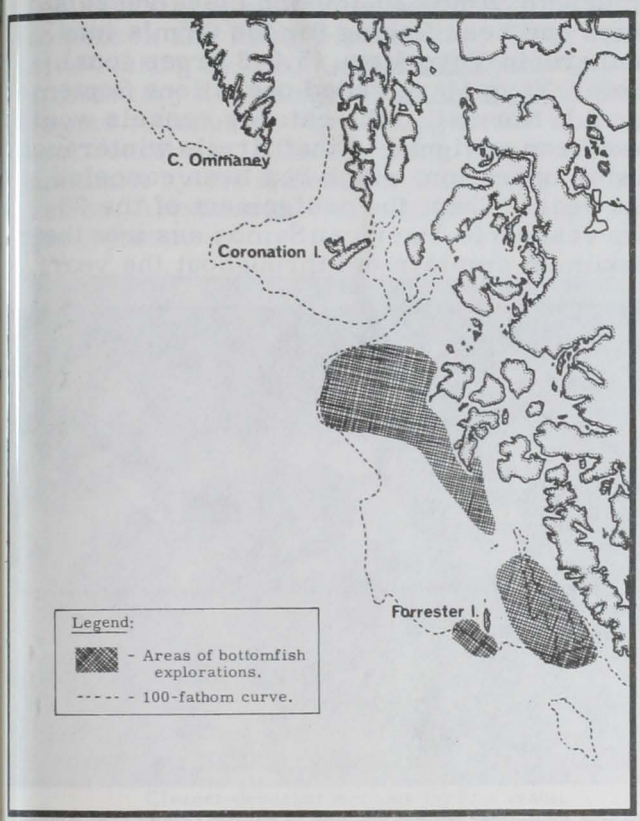


Fig. 2 - M/V Commando cruise 65-2 off southeast Alaska (August 6-24, 1965).

Sampling gear used was the 400-mesh eastern otter trawl. Accessory gear consisted of a 96-foot length of $\frac{3}{4}$-inch diameter wire rope, 18-inch and 14-inch hard rubber rollers, 9-inch rubber wing bobbins, 6-inch rubber spacers, and brass snap purse rings. The rollers, spacers, and purse rings were threaded on the wire rope and the two ends attached to the footrope ends by shackles. Snap purse rings were spaced along the roller gear at one-fathom intervals permitting the entire assembly to be attached or removed from the trawl footrope in a matter of minutes. Total length of the roller gear section was 42 feet--or slightly less than half the length of the trawl footrope.

Echo-sounding transects were made to locate trawlable fishing grounds and areas which appeared to be reasonably level were fished, regardless of the consistency of the bottom. Sounding effort was concentrated on the Continental Shelf between Noyes Island and Dixon Entrance. A total of 25 drags lasting about one hour each were attempted on bottoms ranging from soft to hard, as shown by the echo-recorder. Though hang-ups were encountered on nine occasions, the net was damaged in only two drags. On several occasions, the roller-rigged trawl was dragged over bottom considered marginal for ordinary trawls without damage to the net. However, further modifications to the trawl and roller gear will be necessary to reduce the high incidence of hang-ups. These include the lightening of the footrope of the trawl; the addition of rollers and spacers to cover the entire length of the footrope; and the use of a single dandy-line hook-up between door and trawl.

No large catches of commercially important bottomfish were made during the cruise. The largest catches were made in a drag two miles south of Cape Addington, where 200 pounds of petrale sole and 120 pounds of English sole were taken; and in another drag in Bucareli Bay, where 200 pounds of rock sole were caught.

* * * * *

SHRIMP AND KING CRAB RESOURCES STUDIED:

M/V "John R. Manning" Cruise 65-3 (October-December 1965): Shrimp and king crab explorations in the inside waters of southeastern Alaska were to be conducted during a 10-week cruise starting October 4, 1965, by the U. S. Bureau of Commercial Fisheries exploratory fishing vessel John R. Manning. Principal objectives were to: (1) locate commercial concentrations of spot shrimp (Pandalus platyceros) and king crab (Paralithodes camtschatica), (2) test the relative fishing efficiency of 7 types of shrimp pots, and (3) collect data on the distribution and abundance of those species.

Plans called for explorations in depths ranging from 10 to 150 fathoms in the inside water surrounding Kuiu Island, the west coast of Kupreanof Island, northwest coast of Prince of Wales Island, and the lower east coast of Baranof Island. Shrimp pots were to be fished using a long-line system having 7 pots to each line; king crab pots were to be fished individually using separate buoys and buoy lines.

Alaska Fisheries Investigations

VERTICAL MOVEMENTS OF SHRIMP:

At the Kasitsna Bay biological research station of the U. S. Bureau of Commercial Fisheries, another 24-hour period was spent during September in following the vertical migration of pandalid shrimp. Two vertical strings of pots were fished in 50 fathoms of water. The pots were pulled, emptied, and reset every three hours. As in August, vertical ascent and descent of shrimp coincided with dusk and dawn. Unlike August, when pink shrimp dominated the catch, "humpies" made up most of the catch in September. Also present in larger numbers were male coonstripes which showed night distribtuion from surface to bottom. Female coonstripes did not leave bottom at any time.

* * * * *

LOW ABUNDANCE OF NORTHERN SOUTHEASTERN ALASKA YOUNG PINK SALMON:

The 1965 cruise series in southeastern Alaska by the research vessel Heron ended on September 10. The absence of juvenile pink salmon in Peril and Chatham Straits was noted. This was considered to show the completion of the 1965 seaward migration of young pink salmon in northern southeastern Alaska. Young pink salmon were present until mid-September in 1963 and 1964.

In 1965 it was only the second year of these comprehensive surveys. However, observations in 1965 confirmed those made in 1964 that local juveniles emigrate through lower Chatham Strait. Following a severe winter, the 1965 salt-water temperatures were as much as 4° F. colder than during summer 1964 and growth of pink fingerlings was significantly less. Euphausids, which were the major late summer food supply in 1964, were not available in 1965 and large copepods became the primary food. Because the 1965 abundance of northern southeastern Alaska young pink salmon was considerably less along the salt-water migration routes than in 1964, and because the 1964 juveniles produced a low harvest, it might be expected that the harvest in 1966 will again be low and will be comparable to 1960 and 1962.

American Samoa

JAPANESE ASSIGN 20 TUNA LONG-LINE VESSELS:

A large Japanese fishing firm in September 1965 assigned to the tuna fishing base at American Samoa 20 100-ton class vessels which had been fishing for the firm's tuna mothership Yuyo Maru (5,043 gross tons). (Note: Yuyo Maru ended operations September 2.) Normally, the catcher vessels would have been assigned to that firm's winter mothership operation, which has been canceled this year. Thus, the assignment of the 20 tuna vessels to American Samoa assures their maximum employment throughout the year.

Japanese long-liner fishing for tuna in Pacific Ocean near American Samoa.

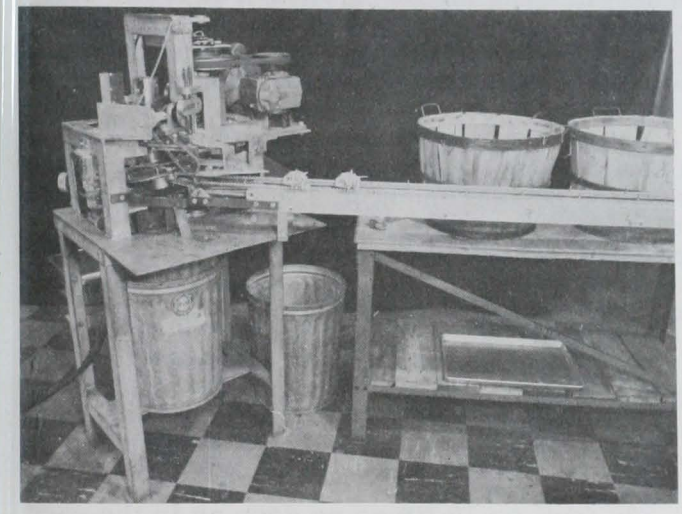
It is reported that the Japanese firm, in arriving at the decision to base the 20 vessels at American Samoa, took into consideration the fact that Japan needs to regain the initiative in negotiating ex-vessel prices with the United States firms operating canneries on that island. The dwindling strength of the Japanese tuna fleet and the increasing strength of the Formosan and South Korean vessels based on that island reportedly had created a situation wherein Japan was steadily losing the initiative in conducting price negotiations.

It is also reported that the Japanese firm is now seriously considering canceling all future mothership-type tuna operations. (Suisan Keizai Shimbun, September 21, 1965.)

Blue Crab

CLEANER-DEBACKER MACHINE TO BE TESTED UNDER COMMERCIAL CONDITIONS:

The U. S. Bureau of Commercial Fisheries recently accepted delivery of a machine to deback and clean blue crabs. After extensive testing by the Bureau's Technological Laboratory at College Park, Md., it will be loaned to industry for testing under commercial conditions. The machine was designed and built by the American Scientific Corporation, Alexandria, Va., under a contract with the Bureau.



Cleaner-debacker machine for blue crabs.

Blue crabs now are debacked and cleaned entirely by hand. Because of rising labor costs and the loss of skilled labor to other employment, the shellfish industry along the East and Gulf coasts has experienced diminishing returns in recent years. The machine is equipped to punch through the shell of precooked crabs, taking an amount of lump and flake meat equal to that picked by hand. The crab meat from the punched out portion can then be easily removed by hand. Tests have shown that the machine eliminates several steps of the hand operation.

Research is being continued to develop attachments to the machine which will further automate the blue crab cleaning process. Further research is aimed at devising machinery to remove any flake meat remaining in the crab as well as meat from the claws.

Note: See Commercial Fisheries Review, August 1965 p. 25.

California

LONG-RANGE PLAN FOR FISH AND WILDLIFE CONSERVATION AND DEVELOPMENT:

A Fish and Wildlife Plan for California, completed in fall 1965 by that State's Department of Fish and Game, is considered one of the most significant steps yet taken in the management of California's fish and wildlife resources. The Plan includes, for the first time, all the fish and wildlife resources of the State, and all the uses that are made of them. The Plan has been submitted for inclusion in the overall State Development Plan now under way.

Among others, some of the specific programs on major fish species as contained in the Plan include salmon and steelhead. The Plan points out that State control of salmon and steelhead spawning areas must be obtained in order to meet increased recreational demand and maintain the commercial fishery at least at its present level. Also, that greater attention will be given to land-use problems which cause sedimentation and turbidity.

The program for marine resources emphasizes that the problems of marine species are problems of managing human use, rather than managing or protecting habitat. Species use will be managed to produce maximum sustained yield, and methods will be sought to make greater use of underutilized species such as hake through experimental gear development and exploratory fishing. These and other approaches will be used toward the growth and economic development of the commercial fisheries in harmony with the recreational fisheries and other users. Included in the Plan is the establishment of a shellfish research laboratory to devise techniques needed for fuller development and utilization of California's shellfish resource. (California Department of Fish and Game, October 9, 1965.)

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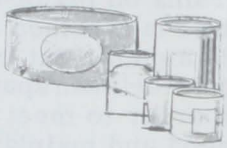
ANCHOVY FISHING UNDER REDUCTION PERMITS CONSIDERED BY STATE FISH AND GAME COMMISSION:

Proposed regulations governing anchovy fishing for reduction purposes were to be considered at a meeting of the California Fish and Game Commission, October 1, 1965, in Los Angeles, Calif. Eight fish processing firms have submitted applications for permits

to take anchovies off California for reduction into fish meal and other byproducts. The proposed regulations concerning permits for anchovy fishing are in the nature of a substitute for anchovy fisheries legislation vetoed by the Governor of California earlier in 1965. (News Release, California Department of Fish and Game, September 25, 1965.)

Cans--Shipments for Fishery Products, January-July 1965

A total of 1,765,898 base boxes of steel and aluminum was consumed to make cans shipped to fish and shellfish canning plants in January-July 1965 as compared with 1,586,934 base boxes used during the same period in 1964. In 1965, there was an increase in the U. S. canned pack of Maine sardines and Gulf shrimp.



Note: Statistics cover all commercial and captive plants known to be producing metal cans. A "base box" is an area 31,360 square inches, equivalent to 112 sheets 14" x 20" size. Tonage figures for steel (tinplate) cans are derived by use of the factor 23.7 base boxes per short ton of steel.

Central Pacific Fisheries Investigations

OXYGEN STUDIES IN RELATION TO CATCHING TUNA:

Skipjack tuna in the eastern Pacific Ocean are caught in profitable commercial quantities with purse seines. In the central Pacific, where skipjack tuna also abound, purse seines are ineffective, and the fishing industry must continue to use the more expensive technique of pole-and-line fishing.

There are several theories as to why that should be true. One holds that sharply decreasing temperatures serve as a barrier, that is, that the thermocline, the thin layer of rapid temperature change between the warm surface layer and the underlying cold water, is not penetrated by the skipjack. During summer 1965 two high school boys, working under the direction of a professional scientist at the U. S. Bureau of Commercial Fisheries Biological Laboratory, Honolulu, Hawaii, gathered interesting data touching on another theory, that skipjack tuna avoid water of low oxygen content.

The two boys served as Hawaii Junior Science Apprentices in a summer science training program supported by funds from the National Science Foundation. Their supervisor was the head of the Laboratory's investigations in tuna behavior. The object of the study was to investigate the effects of water of low oxygen content on skipjack tuna.

One of the noteworthy differences between the eastern Pacific Ocean and the central Pacific is that in the east the mixed layer of the ocean is quite shallow--about 100 feet. The mixed layer is the uppermost layer of water. In it, temperature maintains a uniform value, and so do salinity and oxygen content.

In the eastern Pacific, oxygen values decrease sharply at the thermocline. From a surface measurement of 4.0 milliliters per liter or more (oxygen content is usually expressed in terms of volume), oxygen valued within and below the thermocline drop to 2.0 or less milliliters per liter.

In the central Pacific, the mixed layer is 200 to 400 feet thick. The oxygen content is as high as it is in the eastern Pacific, but declines only slowly with depth, reaching a value of 2.0 or less milliliters per liter at about 1,500 feet, or 15 times as deep as in the east.

A purse seine is essentially a flexible, floating fence about 200 feet deep. When tuna are surrounded in the central Pacific, they sound beneath the net and dart away. In the eastern Pacific they remain in the upper layers and can be caught. It has occurred to some scientists that in the eastern Pacific the low oxygen levels beneath the thermocline might serve as a floor to the tuna which like the majority of living creatures must have oxygen to survive. The creatures, they suggest, may avoid waters in which the oxygen content is so low that they risk death on entering them. Other kinds of fish have been found to actively avoid water with oxygen concentrations that are lethal to them. In the central Pacific, the creatures could find ample oxygen to 1,500 feet and thus would not be prevented escaping the nets by sounding.

To test the reactions of skipjack tuna to waters differing in oxygen concentrations, the Laboratory's tuna behavior expert and the boys made use of experimental tanks at

the Kewalo Basin facility of the Honolulu Biological Laboratory. Those tanks are supplied with water from a salt-water well. In the experiments, which the high school boys ran, the tanks were filled with oxygenated water. De-oxygenated water was then introduced and mixed to bring oxygen concentration down to a desired level. Next, a skipjack tuna was transferred to the tank. The boys noted the swimming speed of the skipjack and the amount of time it could survive in waters differing in oxygen concentrations.

In discussing the results obtained, the Laboratory's tuna behavior expert emphasizes that the experimental methods need to be much refined before the oxygen concentration lethal to tuna and avoided by them can be determined. Preliminary results suggest, however, that waters with as much as 3 milliliters per liter could be lethal.

In the 10 experiments that were run, it was found that all the fish died that were placed in waters with an oxygen level of 2.0 milliliters per liter. The time the fish survived varied from a few minutes to more than 2 hours, depending possibly on the hardiness of the individual fish or the way in which they were transferred to the experimental tanks. The fish increased their swimming speed, almost doubling the rate they maintained in water that was amply oxygenated.

In water in which the oxygen content was 3.0 milliliter per liter, the one fish tested died after a few minutes. Its swimming speed increased. When the water had an oxygen content of more than 3.4 milliliters per liter, the fish tested survived until removed from the tank at the end of the test period (about 8 hours).

Having completed their experiments and summarized them in technical papers, the boys returned to school. Meanwhile, plans are to follow up the interesting clues the boys' summer work provided.

Further problems are faced if it is proved that avoidance of oxygen-poor waters is an aspect of tuna behavior: How else can the fish be kept near the surface, so that they can be caught by seines? Or, if this proves completely infeasible, what methods can be devised to entrap these deep-swimming schools? The Honolulu Biological Laboratory is already conducting research aimed at answering those questions, for other research has pointed to the existence of large tuna resources in the central Pacific that are at present untouched, and those fish for the most part seem to be in the subsurface layers. The Laboratory's research vessel Townsend Cromwell is being equipped with new sonar equipment in order to study better the vertical and horizontal distribution of tuna of the central Pacific.

Note: See Commercial Fisheries Review, July 1965 p. 20.

* * * * *

SUBMARINE FOR UNDERWATER RESEARCH BRINGS NEW DISCOVERIES:

A small and compact two-man research submarine was leased and used in September and October 1965 by the U. S. Bureau of Commercial Fisheries Biological Laboratory, Honolulu, Hawaii, for a 4-week period of research dives. The 16-foot Asherah carries a pilot and one scientist, has a speed of 2.5 knots, and can operate to a depth of 600 feet.

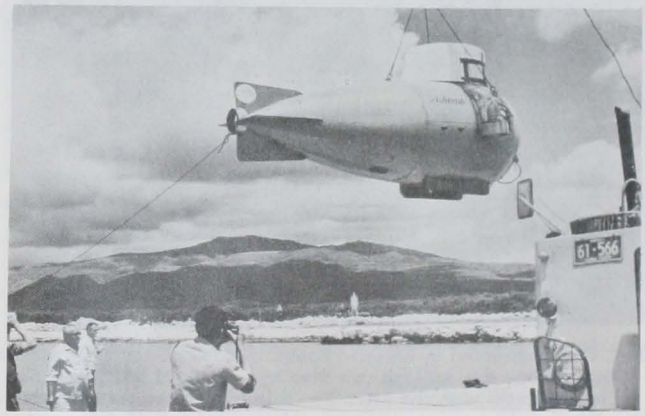


Fig. 1 - The two-man research submarine Asherah was used by the U.S. Bureau of Commercial Fisheries Biological Laboratory, Honolulu, for investigations of marine resources off the island of Oahu, Hawaii.

Working only about a mile from shore off the Island of Oahu, she has dramatically shown that submarines offer vast new research opportunities, according to the Bureau's Area Director in Hawaii. He also said that the Asherah has proved the limitations of scientific knowledge gained only by use of traditional surface craft.

Some of the submarine's findings bear directly on underdeveloped fishery resources of the central Pacific. Discoveries made during the Asherah's research dives included: (1) Schools of skipjack tuna, one of the great potential fishery resources of the Pacific, were observed at a depth of approximately 600 feet. It has never been known that they went to such depths. The commercial catch

depends on schools at the surface. (2) The small animals that constitute a part of the floating community (plankton) of the sea and on which fish feed were estimated to be 50 to 100 times as plentiful as data collected from surface vessels indicated them to be. (3) Large lobsters of a size not commonly caught in Hawaii were found in crevices several hundred feet beneath the sea surface. (4) Precious coral never harvested in the islands was believed to have been found growing at great depths.

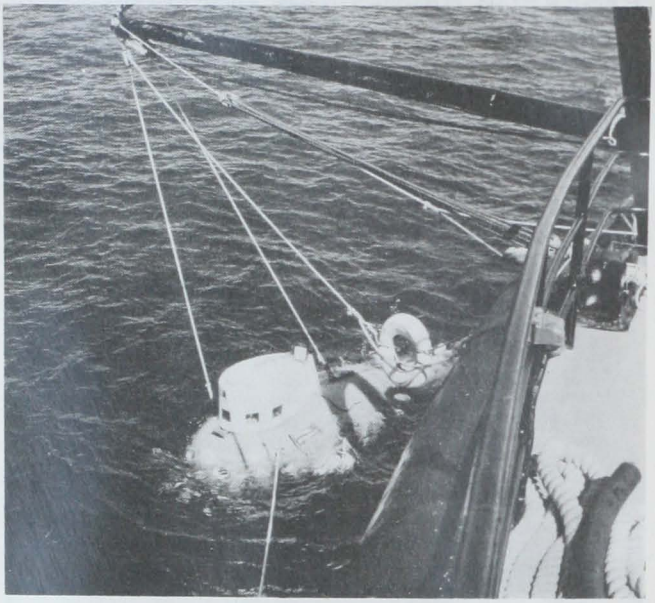


Fig. 2 - Constructed by Electric Boat Division of General Dynamics Corporation, the Asherah can dive to a depth of 600 feet. She communicates with the attending ship by underwater telephone.

The Asherah was delivered to the Honolulu Biological Laboratory on September 16 and began diving on September 18. By the end of that month she had completed 28 dives. These were divided into seven categories: deep-light station, night-light patrol, plankton and forage survey, gear evaluation, bottom resource survey, current measurement, and acoustic survey. In addition, shakedown and demonstration dives were conducted.

Among the other more interesting findings of those dives were: The diving area consisted of a shelving sandy bottom, which deepens from 90 to 380 feet by a series of shallow ledges. Each ledge is a congregating point for fish, and often also represents a cleaning station for the wrasse Labroides. Many of the sandy slopes contain dense beds of Pinna oysters. Sometimes as much as two-thirds of the bottom is devoted to Pinna, with about 50 shells to the square foot. Beyond the 350-foot level, the bottom drops away precipitously at an angle of 60° to 80°. Small ledges and boulders provide scant shelter for deeper water fish. Myriads of small fish occur as dense bands along this cliff face from 400 to 600 feet deep, and schools of small tuna, amberjack jack, and snappers prey upon them. Skipjack tuna were observed feeding at about 600 feet. Many animals commonly regarded as inshore forms range down to the deepest diving depth, 630 feet. Plankton were found to be very dense from 200 to 600 feet, with some indications of layering at night. Peculiar behavior (inverted swimming) was noted for opelu (Decapterus pinnulatus) between 290 and 360 feet. Current measurements were made by allowing the submarine to drift at selected depths, and the craft was also used for evaluating expendable bathythermographs. Acoustic surveys were undertaken, and various biological sounds, such as fish noises, were recorded. Dives were made both in the daytime and at night.

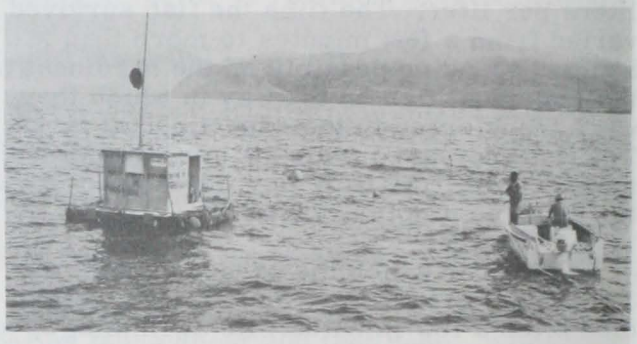


Fig. 3 - At night, the Asherah is tied to the raft Nenue, seen here. Operations are being conducted close to shore on the leeward side of Oahu.

Limited though the capacities of the Asherah were, the craft has shown the scientific benefits that will reward the more extensive use of submarines in research.

Federal Purchases of Fishery Products

DEFENSE DEPARTMENT AMENDS INSPECTION REQUIREMENTS FOR FROZEN RAW BREADED FISH PORTIONS:

New inspection requirements, effective November 1, 1965, for frozen raw breaded fish portions purchased by the U. S. Department of Defense were announced in Headquarters Notice to the Trade No. 110(65) of September 10, 1965, issued by the Defense

Personnel Support Center, Philadelphia, Pa. (That agency absorbed the Defense Subsistence Support Center on July 10, 1965.)

The new inspection requirements are contained in DPSC Articles 341 of October 1, 1965 (which replace DSSC Articles 341 of June 1, 1965), and will be effective with awards made on and after November 1, 1965.

Among other changes indicated in the revised Articles is one that permits an increased weight tolerance for the fish portions.

Copies of the revised inspection requirements for fish portions may be obtained from regional offices of the Defense Personnel Support Center.

Note: See Commercial Fisheries Review, Sept. 1965 p. 22, June 1965 p. 19.

Fisheries Laboratory

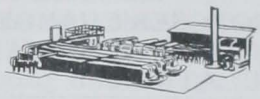
NEW GAME FISH RESEARCH LABORATORY FOR FLORIDA GULF COAST:

Panama City in Florida was selected by the U. S. Department of the Interior as the site for a new Federal marine game fish research laboratory to be operated by the Bureau of Sport Fisheries and Wildlife, announced Interior's Secretary Stewart L. Udall, October 8, 1965. Estimated cost of the new facility is about $2 million.

The new laboratory is expected to make a major contribution to sport fishing in the eastern Gulf of Mexico through studies of migratory species of marine game fishes, Secretary Udall said. It will be the latest in a system of coastal research centers authorized by Congress in 1959 to undertake a national research program on salt-water game fish. The goal of this program by the Bureau of Sport Fisheries and Wildlife is to get the answers needed to provide wise conservation and sound management for marine game fish resources.

Marine game fish research laboratories already have been established at Sandy Hook, N. J.; Tiburon, Calif.; and Narragansett, R. I. The fourth and fifth laboratories--the one in Panama City for the eastern Gulf of Mexico and the other in Texas to cover the western Gulf areas--were in the planning and design stages at the time of the announcement. The exact location of the Texas laboratory has not been determined.

When completed, the five laboratories will provide for a coordinated, nationwide research program aimed at answering many of the problems affecting the Nation's salt-water sport fishing resources, Secretary Udall said.



Fur Seals

PRIBILOF ISLANDS FUR SEAL SKIN HARVEST, 1965:

During the 1965 sealing season, the harvest of fur seal skins by the Pribilof Islands staff of the U. S. Bureau of Commercial Fisheries amounted to 51,020 skins. Of that total, 41,216 skins were from males, 6,352 immature females, and 3,452 mature females. In addition, about 1,500 skins were taken for experimental purposes.

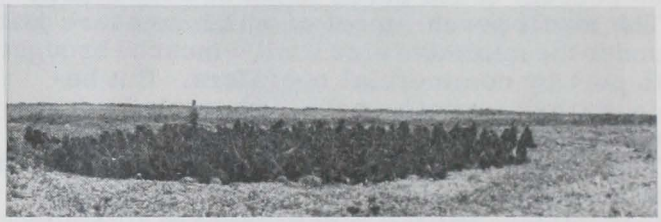


Fig. 1 - A large reserve "pod" of fur seals awaiting selection and harvesting.

The fur seal skin harvest in 1965 was below the 1964 harvest by 13,186 skins. In 1964 a total of 64,206 skins was harvested.

Fig. 2 - Driving a group or "pod" of Pribilof fur seals to the killing field on St. Paul Island.

The fur seal herds on the Pribilof Islands are managed and harvested by the Interior Department's Bureau of Commercial Fisheries which cures the seal skins before shipping them to a processor. Seven-eighths of the harvest goes to the Fouke Fur Company, Greenville, S. C., for processing and sale for the account of the United States. One-eighth

of the harvest is set aside for experimental processing by interested firms.

Note: See Commercial Fisheries Review, November 1964 p. 30.

Great Lakes

MICHIGAN PROPOSES CHANGE IN YELLOW PERCH COMMERCIAL FISHING REGULATIONS:

A change to liberalize commercial yellow perch fishing in Saginaw and Tawas Bays to prevent a potentially heavy fish waste is being considered by fisheries officials of Michigan's Conservation Department. The Department would like to loosen regulations so that commercial operators in those waters could be allowed to keep and sell all yellow perch they catch in gill nets of $2\frac{1}{2}$-inch mesh size.

The yellow perch size limit for those nets now is $8\frac{1}{2}$ inches. Experience is showing that the regulation is too restrictive, since about 50 percent of the perch taken are too small. The small perch--most of which measure just under the minimum size limit--must be brought to port by commercial operators. But because they cannot be sold commercially, large numbers of them never reach the market. The Conservation Department is authorized to dispose of undersized perch to charitable institutions, but the supply appears likely to exceed demand if current trends continue, and this points to the possibility of a large waste.

The problem of too many sublegal size fish is tied to the fact that the yellow perch population of the two Bays is stagnated. According to the Conservation Department, those fish grow rather rapidly to about 8 inches but it takes them six years to reach legal size. The Department's fisheries officials say the best way to correct the problems for sport fishermen as well as commercial fishermen is by removing the present size restriction for taking yellow perch with commercial gear. The liberal change, they explain, would encourage more commercial fishermen to profitably harvest perch and, with fishing pressure increased, there would be a more rapid turnover in the perch populations of Saginaw and Tawas Bays. This, in turn, would provide conditions for healthier, faster-growing perch to be harvested by both commercial and sport fishermen.

Another point in the Department's plans is that a revitalized population of yellow perch would be in better condition to resist competition from alewives, members of the herring family which are crowding Great Lakes waters and fast becoming a major nuisance.

A formal recommendation on the matter was scheduled to come before the State of Michigan's Conservation Commission meeting held in Lansing. (Michigan Department of Conservation News Bulletin, Lansing, October 1, 1965.)

* * * * *

MICHIGAN PLANS TO INTRODUCE STRIPED BASS IN SOUTHERN WATERS:

Plans of the State of Michigan's Conservation Department to introduce striped bass in the southern Great Lakes were approved in September 1965 by that State's Conservation Commission. The Conservation Department planned to submit its proposed striped bass program to other fishery agencies and the Great Lakes Fishery Commission in late 1965 in hopes of also getting their approval.

According to the Conservation Department's fishery chief, striped bass plantings are scheduled to be started in spring 1966 as a two-in-one approach aimed at providing a new brand of sport fishery and at the same time control alewife populations which are overrunning the Great Lakes. The "striper," a spectacular long-lived fish which grows to 15-20 pounds in 4 or 5 years, is considered the best single hope for weeding out excessive alewife numbers which now account for an estimated 95 percent of the Great Lakes' total fish volume.

It was pointed out to the Commission that the successful introduction of the "striper" is no sure-fire thing, but all signs indicate that the State of Michigan has everything to gain by trying to establish that salt-water species which has made the grade in some fresh waters. Waters of the upper Great Lakes are considered too cold for striped bass, but the Department is attempting to cover all aspects by also introducing coho (silver) salmon during spring 1966 in northern areas. The coho salmon, like the striped bass, feeds heavily on alewives.

In relation to the Department's plans for the striped bass program, the fishery chief stated that Michigan must take a leadership

role in providing recreational fishing in the Great Lakes. With control of the sea lamprey now in prospect, he stressed that the time now is ripe to reorient management goals toward sport fishing interests in the Great Lakes. He noted that state and Federal agencies are very much involved in efforts to reestablish the lake trout in the Great Lakes. But he said the lake trout's recovery may never reach its full potential unless the alewife situation is also controlled because eggs and the young of lake trout may be subject to predation by the alewives. Both the striped bass and coho salmon spawn in streams where their young should be safer from alewife attacks, added the Department's fishery chief. (Michigan Department of Conservation, Lansing, September 23, 1965.)

Note: See Commercial Fisheries Review, April 1965 p. 21.

Gulf Fisheries Explorations and Gear Development

SHRIMP GEAR STUDIES CONTINUED:

M/V "George M. Bowers" Cruise 61 (July 21-October 1, 1965): Studies to determine the electrical parameters necessary to deburrow shrimp from various bottom types were continued during this cruise in the northern Gulf of Mexico by the U. S. Bureau of Commercial Fisheries exploratory fishing vessel George M. Bowers. The major objective was to obtain motion picture records of the escape behavior of individual shrimp burrowed in a soft sand substrate when stimulated with different electrical voltages and pulse rates. Another objective was to determine whether or not shrimp escape behavior is affected by the type and compaction of bottom sediments.

Using motion picture cameras, SCUBA divers recorded rates of deburrowing and escape behavior of electrically-stimulated shrimp burrowed in four types of substrata. This consisted of filming more than 600 individually stimulated shrimp on 3,100 feet of 16-millimeter colored movie film. The escape reactions were recorded from white sand, light gray sand, dark gray sand, and soft black mud bottoms. Samples of the bottom sediments were taken at each station and were to be processed to determine sediment size and percent water content. In addition, bottom temperature, salinity, current velocity, and direction, as well as the attenuation coefficient of light, were obtained for each locality. Diver observations tend to indicate little difference between the escape behavior of shrimp stimulated from the different sand substrata tested up to that time. However, it appears that shrimp escape more readily from black mud substrata than from sand sediments. Further, observations indicate that it is possible to alter shrimp escape reaction by changing the voltage intensity.

Preliminary information on the escape reactions of electrically-stimulated shrimp burrowed in soft and hard sand type bottoms has been obtained from earlier cruises. Data collected on this cruise, when combined with information collected from those earlier cruises, will provide a comprehensive record of the optimum electrical requirements necessary to force shrimp to deburrow from a white sand substrata. Objectives for future cruises of this type will be to determine similar requirements for clay and other type mud and sand bottoms.

Note: See Commercial Fisheries Review, September 1965 p. 28.

Gulf Fishery Investigations

SHRIMP DISTRIBUTION STUDIES:

M/V "Gus III" Cruise GUS-33 (September 8-19, 1965): Brown shrimp were predominant in the catches made during this cruise by the chartered research vessel Gus III of the U. S. Bureau of Commercial Fisheries Biological Laboratory, Galveston, Tex. Catches of 21-30 count brown shrimp were good at 25-fathom stations off western Louisiana, although the best catches of 21-30 count brown shrimp were taken off Texas at 11-20 fathoms. White shrimp catches were light, but showed some improvement over those taken during sampling in August 1965. Pink shrimp catches were negligible.

As part of a continuous Gulf of Mexico shrimp distribution study, 7 statistical areas were covered and 24 standard 3-hour tows with a 45-foot flat trawl were made. Other work in the survey area included 41 plankton tows, 34 bathythermograph (BT) and 182 water (Nansen bottle) casts, and 55 bottom grabs.

The largest catch of the cruise was taken in area 18 which yielded 80 pounds of 26-30 count brown shrimp from 11-20 fathoms and

58 pounds of 26-30 count brown shrimp from depths over 21 fathoms. Area 20 produced 72 pounds of 26-30 count brown shrimp from 11-20 fathoms and 46 pounds of 26-30 count brown shrimp from depths over 21 fathoms. Other good catches of brown shrimp (all taken in over 21 fathoms) included 68 pounds of 21-25 count from area 17; 24 pounds of 21-25 count from area 16; and 22 pounds of 41-50 count from area 13.

The best white shrimp catches were taken in areas 13 and 16, both of which yielded 11 pounds of small (over 51 count) white shrimp from depths under 10 fathoms.

After sampling was completed in the eastern survey area, the research vessel Gus III traveled to Key West, Fla., to carry out shrimp-staining experiments for about 1 month. While crossing, an extensive oceanographic survey was made to determine the effects of Hurricane Betsy on the underlying water mass in the northeastern Gulf of Mexico; 41 hydrographic stations were occupied, and 166 bathythermograph casts were made. In addition, 70 Secchi disc readings were obtained.

Notes: (1) Shrimp catches are heads-on weight; shrimp sizes are the number of heads-off shrimp per pound.
(2) See Commercial Fisheries Review, Nov. 1965 p. 22.

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Some of the highlights of studies conducted by the U. S. Bureau of Commercial Fisheries Biological Laboratory, Galveston, Tex., during July-September 1965:

SHRIMP BIOLOGY PROGRAM: Shrimp Larvae Studies: During the quarter, 190 plankton samples collected from January through May 1964 were examined for planktonic-stage penaeid shrimp. Analysis of catch data for this period revealed that planktonic-stage penaeids were distributed throughout most of the survey area and that the overall catch was slightly higher over the western portion of the shelf (Galveston to Port Mansfield) than in the eastern portion (Galveston to the Mississippi River). In addition, the relative abundance of planktonic-stage penaeids showed a distinct decrease from the abundance in the fall of 1963.

Enumeration of the catch of planktonic-stage Penaeus spp. by developmental stage showed that 61 percent were postlarvae, 13 percent myses, 11 percent protozoeae, and 15 percent nauplii. Postlarvae occurred each month, with peak abundance in March, followed by a decrease in numbers through May. They were about three times more abundant in the waters to the east of Galveston than to the west. A gradual shift in postlarval abundance from waters seaward of 25 fathoms to waters shoreward of 15 fathoms was evident after March. Mysis stages were taken throughout the period but with no apparent depth pattern. Naupliar and protozoeal stages (spawning indicators) did not occur in the catch until April followed by a slight increase in numbers during May. These stages were most abundant in the 15- to 25-fathom depth range.

Larvae of the seabob, Xiphopeneus krøyeri, were reared to postlarvae in mass culture, and sufficient numbers of larvae were preserved for future taxonomic studies. In a feeding experiment, seabob larvae given Gymnodinium splendens, Thalassiosira sp., and Exuviella sp. had better survival than those fed Skeletonema sp. Also, additions of mixed algal cultures gave better survival than additions of their iidividual components.

Data on the seasonal distribution and abundance of 32 species of fish caught in trawling operations during monthly U. S. Bureau of Commercial Fisheries research cruises off Louisiana and Texas during the period 1962-64 were analyzed during the quarter. All data acquired from biological sampling stations in the waters off Louisiana have been analyzed. Atlantic croaker, Micropogon undulatus, and sea catfish, Galeichthys felis, usually constituted the greatest catch (by weight) on the commercial white shrimp fishing grounds (under 10 fathoms) off Louisiana from 1962 to 1964. Greatest seasonal variation in catches occurred off western Louisiana and the least off central Louisiana.

Cultivation of Shrimp in Artificial Ponds: Mass mortality of the brown shrimp, which were stocked as postlarvae, occurred in the circulating-water pond on July 3-4, 95 days from the date of stocking. This kill appeared to be due to a combination of several factors, namely, a phytoplankton bloom, inadequate water circulation, and high water temperature. Approximately 2,000 shrimp (average total length 97.4 mm.), weighing 22.8 pounds, were recovered from the pond. Projection of these figures reveals that the culturing method (circulating water and daily feeding) employed resulted in the production of 210 pounds of shrimp per acre in a 95-day growing period.

In our second pond, in which water is not circulated and food is provided by inducing plankton blooms through the application of fertilizer, excellent shrimp growth was observed for a short period of time. During a 55-day growing period, shrimp made gains equivalent to approximately 118 pounds per acre. They failed, however, to make further gains.

In an attempt to determine whether food was the limiting factor, one-half of the shrimp (1,058 individuals) were transferred from the static pond to the circulating-water pond and fed at the rate of 2 pounds per day. Over a 5-week period, those shrimp revealed a 20-mm. length and 4.5-g. weight increase over those remaining in the static-water pond. Further experiments in which food levels were varied between alternate weeks, showed corresponding growth fluctuations proportional to the level of food supplied.

Postlarval white shrimp were stocked inadvertently with brown shrimp postlarvae in the static-water pond. The growth of white and brown shrimp, expressed as average weight and length at the end of a 120-day period, is compared in this table:

Species	Average length (mm.)	Average weight (g.)
Brown shrimp	79.6	3.5
White shrimp	126.5	14.6

These results suggest that it may be more feasible to rear white shrimp than brown shrimp under semi-natural conditions.

Movements, Growth, and Mortality of Commercial Shrimps: The recovery phase of the pink shrimp mark-recapture experiment which started early last spring on the Florida Tortugas grounds is now complete. Of the 11,555 stained shrimp released, 6,059 (52.4 percent) have been recovered. This unusually high proportion of recoveries apparently resulted from the fact that the marked shrimp were released in the center of the fishery during its most active period.

Several groups of stained white shrimp were released in Galveston Bay during July to obtain information concerning their growth and movements. By mid-September, recaptured shrimp amounted to only 7 percent of the 9,448 released.

Commercial Catch Sampling: Commercial catch sampling methods at Aransas Pass, Freeport, and Galveston, Tex., were altered during the quarter. A randomized sampling schedule is now being followed in order to reduce biases created by oversampling the landings at some shrimp houses. This sampling scheme is designed to give all vessels an equal chance of being sampled and to provide a means for establishing confidence limits for estimates of catch per unit of effort and the size composition of landings. Agents stationed at the three ports obtained interviews from 49 percent of the 3,613 vessels landing during July and August. Length measurements from a sample of shrimp were collected from 9 percent of the landings.

A cruise was made during the quarter to compare catches made by the Bureau's chartered research vessel Gus III with those of commercial shrimp boats. Thirteen 2-hour trawls and three 1-hour trawls were made in an area off Freeport which was being heavily fished by the commercial fleet. Two 45-ft. flat nets were towed in a manner similar to that used by commercial vessels. The 16 trawl samples made by the Gus III averaged 41.4 pounds of headless shrimp per hour. Information from port samplers shows an average of 40.0 pounds per hour taken by 11 vessels seen fishing in the same vicinity. Forty vessels, whose interviews indicate that they too were fishing near the Gus III, had an average catch of 38.1 pounds of headless shrimp per hour. These findings suggest that interviews provide accurate catch/effort information for specific areas, and that the Gus III can be used satisfactorily as a sampling device to estimate the relative abundance of shrimp in a given area.

Surveys of Postlarval Abundance and Fisheries for Bait (Juvenile) Shrimp: Higher than usual numbers of postlarval brown and white shrimp were caught in tows at Galveston Entrance and Sabine Pass during the quarter. In fact, average numbers of postlarval brown shrimp taken at Galveston Entrance during September were higher than the catches for any month of the spring peak of postlarval shrimp movement.

Bait shrimp production in the Galveston Bay system during July and August rose by less than 1 percent from that recorded for the same period in 1964. Effort expenditure for those months, however, increased by 5 percent indicating that fewer shrimp were available to commercial bait-shrimp fishermen during the quarter. Bait-shrimp landings for July and August contained higher percentages of juvenile brown shrimp than during the same period in 1964, indicating a smaller crop of white shrimp this year.

ESTUARINE PROGRAM: Ecology of Western Gulf Estuaries: Regular hydrological and biological sampling in the Galveston Estuary continued during the quarter at the established sampling locations. The sampling frequency was reduced from weekly to semimonthly after most of the brown shrimp returned to the Gulf. Semimonthly sampling were to continue until late fall, or until the white shrimp leave the estuary.

The bay anchovy was the most numerous of the major species caught during the quarter, followed in descending order by the brown shrimp, white shrimp, croaker, sand sea trout, sea catfish, spot, and blue crab. The relative abundance of those species was considerably different than during the same quarters of 1963 and 1964 when white shrimp ranked first and brown shrimp fifth and fourth, respectively.

Postlarval brown shrimp entered the Galveston Estuary throughout the late winter and spring of 1965 in relatively large numbers. In contrast, during 1964 the invasion was in March and lasted for only a short time. During the period of postlarval recruitment (January-May), more portlarvae were caught per tow during 1965 than in 1964.

We can only speculate at this time that there may be a correspondingly larger harvest in the Gulf of Mexico. A preliminary look at the offshore harvest statistics so far indicates that large volumes of brown shrimp are being caught.

EXPERIMENTAL BIOLOGY PROGRAM: Behavior and Ecological Parasitology: Observation of living shrimp under laboratory-controlled conditions has provided new information on burrowing behavior in the two most important commercial species of the northwest Gulf of Mexico. Results indicated that juvenile brown shrimp will burrow in response to gradually reduced temperature. The data suggested a relationship between size of animal and temperature at which burrowing occurs--the larger shrimp (78-80 mm.) responding before the others (50-63 mm.) as temperature declined from 25° to 15° C. (77° to 59° F.).

The suggestion that burrowing is a size-related shrimp response to cold prompted us to extend the size range of test animals to include the smallest shrimp readily available to us. Thus, similar experiments were conducted using postlarval brown shrimp ($8\frac{1}{2}$-13 mm.). Those also burrowed when water temperatures were lowered to $16\frac{1}{2}$°-12° C. (61.7°-53.6° F.), if the substrate was sufficently soft and the rate of temperature change was not too rapid. (Change rates of 1° C. per 5, or more, minutes were satisfactory for the induction of burrowing.) It is particularly interesting to note that postlarval white shrimp collected with the brown postlarvae were unable to burrow under our experimental conditions. Thus, the burrowing habit in postlarval brown shrimp may have special significance as a protective behavioral mechanism which has adapted these organisms, better than white shrimp postlarvae, for survival at reduced temperatures.

Such an interpretation is certainly in keeping with what is presently known of the seasonal differences in postlarval distribution of the two species. The fact that soft substrate texture is required for successful burrowing suggests that physical characteristics of natural

substrates may be an important determinant of brown postlarval survival at late winter or early spring water temperatures.

Growth and Survival Studies: Two studies using laboratory-reared postlarvae were conducted--one with pink shrimp and the second with brown. Two temperatures were checked, 25° C. (77° F.) and 33° C. (91.4° F.), with 120 individuals of each species. The salinity in each experiment was about 20‰, which is salinity to which the shrimp were accustomed.

Temperature had a great effect on the growth of both species. Pink shrimp increased, in weight, 120-fold at 25° C. and 770-fold at 33° C. The brown increased, in weight, 460-fold at 25° C. and 1,535-fold at 33° C. The difference in weight increase between the species can be explained partially by the disparity in the initial weights of the animals. The pink initially weighed 0.70 mg. and the brown 0.25 mg.

The survival of the pink shrimp at the temperatures tested was 85 percent at 25° C. and 77 percent at 33° C. The brown shrimp did not survive as well--58 percent at 25° C. and 32 percent at 33° C. This may have been related to the small initial size of the animals.

A study was conducted on the effects of temperature on growth of white shrimp. Nine temperatures were tested in 2.5° increments from 15° C. (59° F.) to 35° C. (95° F.). Growth rate increased generally with temperature from 15° to 32.5° C., with some fluctuation at 27.5°, 30.0°, and 32.5° C. At 35° C., growth rate was between that at 22.5° and 25.0° C. Survival at the two extremes tested (15° and 35° C.) was similar--31 percent and 37 percent, respectively. Survival at all other temperatures was 70 percent or better. The differential effects of temperature on the two species become evident when the results of this experiment are compared with those of a similar study using brown shrimp. At the lowest temperature (15° C.), brown shrimp fared much better than the white. Survival rates of the two species were comparable at temperatures from 17.5° to 27.5° C. The white shrimp survived much better than the browns at 30°, 32.5°, and 35° C.

In the continuing search for a better diet for juvenile and subadult shrimp, further tests were conducted using frozen brine shrimp and fish flour. Neither of those diets gave encouraging results. Animals fed frozen brine shrimp had a mean increase of 1.14 mg. in 27 days, and animals fed fish flour showed a mean increase of 0.71 mg. for the same period. Further studies will be conducted to learn of a suitable diet.

Note: See Commercial Fisheries Review, June 1965 p. 22.

Industrial Fishery Products

U. S. FISH MEAL, OIL, AND SOLUBLES:

Production, August 1965: During August 1965, a total of 40,946 tons of fish meal and 37.7 million pounds of marine-animal oil was produced in the United States. Compared with August 1964 this was an increase of 7,413 tons of fish meal and about 9.4 million pounds of marine-animal oil. Fish solubles production amounted to 18,351 tons--an increase of 3,683 tons as compared with August 1964.

U. S. Production of Fish Meal, Oil, and Solubles, August 1965 1/ with Comparisons

Product	August 1/1965	August 1964	Jan.-Aug. 1/1965	Jan.-Aug. 1964
	(Short Tons)			
Fish Meal and Scrap:				
Herring	2,944	2,138	9,654	7,098
Menhaden 2/	33,307	25,973	136,031	125,421
Tuna and mackerel	2,911	1,854	17,163	13,030
Unclassified	1,784	3,568	14,233	29,811
Total	3/40,946	3/33,533	3/177,081	3/175,360
Fish solubles:				
Menhaden	15,876	11,944	57,132	54,306
Other	2,475	2,724	13,915	17,401
Total	18,351	14,668	71,047	71,707
	(1,000 Pounds)			
Oil, body:				
Herring	1,870	3,256	6,125	9,193
Menhaden 2/	34,286	23,513	139,759	122,838
Tuna and mackerel	629	852	2,936	2,839
Other (inc. whale)	951	743	3,764	5,896
Total oil	37,736	28,364	152,584	140,766

1/Preliminary data.
2/Includes a small quantity of thread herring.
3/Does not include a small quantity of shellfish and marine animal meal and scrap because production data are not available monthly.

* * * * *

Major Indicators for U. S. Supply, August 1965: United States production of fish meal

Major Indicators for U. S. Supply of Fish Meal, Solubles, and Oil, August 1965

Item and Period	1/1965	1964	1963	1962	1961
	(Short Tons)				
Fish Meal:					
Production:					
August	40,946	33,533	43,609	40,440	57,537
Jan.-Aug. 2/	177,081	175,360	172,613	217,878	223,474
Imports:					
August	13,856	36,543	43,987	28,253	19,026
Jan.-Aug.	242,407	321,835	269,144	194,996	145,562
Fish Solubles 3/:					
Production:					
August	18,351	14,668	19,532	16,811	19,685
Jan.-Aug. 2/	71,047	71,707	80,066	90,525	82,474
Imports:					
August	168	125	-	422	318
Jan.-Aug.	3,521	3,682	2,769	5,018	2,245
	(1,000 Lbs.)				
Fish Oils:					
Production:					
August	37,736	28,364	34,610	33,401	49,671
Jan.-Aug. 2/	152,584	140,766	133,189	176,718	195,935
Exports:					
August	21,206	9,664	37,455	33,272	13,304
Jan.-Aug.	67,521	106,252	164,604	96,405	85,853

1/Preliminary.
2/Data for 1965 based on reports which accounted for the following percentage of production in 1964: Fish meal, 89 percent; solubles, 89 percent; and fish oils, 99 percent.
3/No homogenized fish was produced in 1964 or during the first 8 months of 1965.

and fish oil in August 1965 was higher by 22.1 and 33.0 percent, respectively, as compared with August 1964. Production of fish solubles was higher by 25.1 percent.

* * * * *

Production by Areas, September 1965: Preliminary data as collected by the U. S. Bureau of Commercial Fisheries:

U.S. Production 1/ of Fish Meal, Oil, and Solubles, September 1965 (Preliminary) with Comparisons

Area	Meal	Oil	Solubles
	Short Tons	1,000 Pounds	Short Tons
September 1965:			
East & Gulf Coasts	15,989	15,046	7,214
West Coast 2/	2,320	540	1,428
Total	18,309	15,586	8,642
Jan.-Sept. 1965 Total	192,140	163,784	78,680
Jan.-Sept. 1964 Total	198,178	160,546	81,655

1/Does not include crab meal, shrimp meal, and liver oils.
2/Includes American Samoa and Puerto Rico.

* * * * *

U. S. FISH MEAL AND SOLUBLES:

Production and Imports, January-August 1965: Based on domestic production and imports, the United States available supply of fish meal for the first 8 months in 1965 amounted to 419,488 short tons--77,707 tons (or 15.6 percent) less than during the same period in 1964. Domestic production was 1,721 tons (or 1.0 percent) more but imports were 79,428 tons (or 24.7 percent) lower than in January-August 1964. Peru continued to lead other countries with shipments of 201,358 tons.

U. S. Supply of Fish Meal and Solubles, January-August 1965

Item	Jan.-Aug. 1/1965	Jan.-Aug. 1964	Total 1964
	(Short Tons)		
Fish Meal and Scrap:			
Domestic production:			
Menhaden	136,031	125,421	160,349
Tuna and mackerel	17,163	13,030	21,113
Herring	9,654	7,098	8,881
Other	14,233	29,811	44,909
Total production	177,081	175,360	235,252
Imports:			
Canada	28,987	38,678	54,769
Peru	201,358	257,604	348,025
Chile	5,128	11,082	12,942
Norway	49	-	-
So. Africa Rep.	2,900	11,938	18,581
Other countries	3,985	2,533	4,826
Total imports	242,407	321,835	439,143
Available fish meal supply	419,488	497,195	674,395
Fish Solubles:			
Domestic production 2/	71,047	71,707	93,296
Imports:			
Canada	1,095	1,162	1,553
So. Africa Rep.	-	860	987
Other countries	2,426	1,660	1,965
Total imports	3,521	3,682	4,505
Available fish solubles supply	74,568	75,389	97,801

1/Preliminary.
2/50-percent solids.

The United States supply of fish solubles during January-August 1965 amounted to 74,568 tons--a decrease of 1.1 percent as compared with the same period in 1964. Domestic production dropped 0.9 percent and imports of fish solubles decreased 4.4 percent.

Inland Fisheries Explorations and Gear Development

OAHE RESERVOIR TRAWLING STUDIES:

Reservoir Research Vessel "Hiodon" Cruise 2 (August 1965): To delineate areas for effective bottom trawling and collect catch and biological data was the primary purpose of this exploratory cruise in Oahe Reservoir located in South and North Dakota. This intermittent 20-day trawling operation by the reservior fishery research vessel Hiodon of the U. S. Bureau of Commercial Fisheries was completed on August 17, 1965.

Bottom tows were made in zones 3, 4, and 6 between reservior miles 70 to 124. Only 22 tows lasting 15 minutes each were completed during the cruise. Large quantities of organic debris were taken in some tows which greatly reduced fish catches. Six tows were incomplete due to large trees taken in the trawl. All but one trawl was torn badly during the cruise.

FISHING OPERATIONS: Twelve 15-minute tows were made with a 55-foot (headrope length) bottom trawl and 9 tows were made with a 35-foot bottom trawl. Mesh size (extended measure) of the cod end of both trawls was $1\frac{1}{4}$ inches but the 35-foot trawl contained a $\frac{1}{2}$-inch mesh liner in the cod end. All but one tow was made over inundated bottomlands or pastures, with depths trawled ranging from 12 to 85 feet.

FISHING RESULTS: With the 35-foot trawl, 9 tows were made at depths less than 61 feet which yielded 5,883 fish (age group II or older) weighing 1,252.6 pounds. Average catch

per 15-minute tow was 654 fish and 139 pounds. The total weight of the catch consisted of 38.9 percent yellow perch (6-7 inches long--mostly the 1963 year-class), 30.7 percent carp (1 to 2 pounds--mostly the 1962 year-class), 6.8 percent carpsuckers, 5.7 percent black bullheads, 4.7 percent drum, and 4.0 percent goldeye. One tow fished at 80 feet caught 5 fish that weighed 2.3 pounds. The rate of catch tended to decrease with an increase in depth. The largest single catch of yellow perch was 398.2 pounds and of carp 132.9 pounds.

Young-of-the-year and yearling fish were counted and weighed in the catches of 8 tows with the 35-foot trawl. The 8,050 young-of-the-year fish caught consisted of 7,261 yellow perch, 780 crappie, 7 northern pike, and 1 each of goldeye and burbot. The 83 yearling fish consisted of 29 yellow perch, 21 carpsuckers, 12 black bullheads, 8 each of crappie and sauger, 3 common suckers, 2 goldeye, and 1 carp.

A total of 12 tows with the 55-foot trawl yielded 1,598 fish that weighed 861 pounds. The average catch per tow was 133 fish and 71.8 pounds. The average catch in pounds for different depths was: 181.0--12 to 30 feet; 14.0--35 to 60 feet; and 26.5--80 to 85 feet. The total weight of the catch consisted of 66 percent carp (53 pounds per tow, primarily fish of the 1962-year class), 9.4 percent perch, 6.9 percent goldeye, 5.8 percent bigmouth buffalo, 3.0 percent burbot, and 6.4 percent other species. The largest single catch was 471.5 pounds of carp.

Catches of single tows ranged from 2.5 to 586.5 pounds. Since the primary object of the cruise was to delineate areas for successful trawling, no attempts were made to duplicate good catches in the same area or at the same time. Plans were to confine tows in a later cruise to the best trawling grounds to determine the probability of sustained high catches under intensive trawling in a given area.

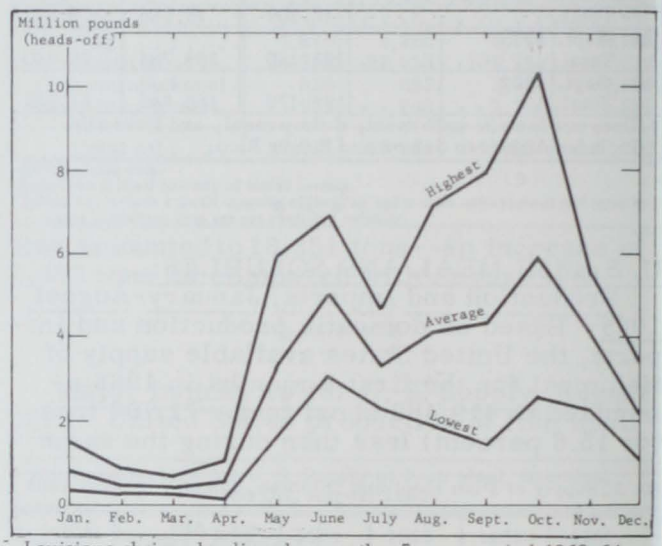
Buffalofish (the most abundant species in Oahe Reservoir) were not often taken in the trawl probably because that species tends to remain in the upper stratum of deeper waters in the summer months. Since this may apply to other species as well, catch rates and character of the catches presumably may change considerably in the fall of the year.

Note: See Commercial Fisheries Review, November 1965 p. 24.

Louisiana

LANDINGS AND FISHERY TRENDS, 1964:

Summary: Commercial landings of fish and shellfish in Louisiana during 1964 totaled 703.6 million pounds with an ex-vessel value of $34.7 million--down 57.1 million pounds (8 percent) and $511,000 (1 percent) from 1963. The major species (menhaden, shrimp, oysters, and crab) reflected light to moderate declines. In spite of the decline, Louisiana retained its number one position as the nation's leading State in volume of fisheries landings, and ranked fourth in value. Empire, Cameron, and Morgan City, La., ranked fourth, fifth, and eighth, respectively, among the leading U. S. ports in terms of quantity landed.



Louisiana shrimp landings by months, 5-year period 1960-64.

The 1964 Louisiana catch was taken by 10,408 fishermen operating 1,602 documented vessels (5 net tons and over) and 4,417 other boats. Louisiana manufacturing establishments in 1964 produced fishery products valued at over $55 million at the wholesale level.

Shrimp: Louisiana shrimp landings in 1964 of 59.4 million pounds heads-on (38.1 million pounds heads-off weight) were 27 percent below the exceptionally good landings in 1963. However, the ex-vessel value of the 1964 shrimp landings ($18.8 million) was down only 5 percent. White shrimp comprised 73 percent of the 1964 shrimp landings, and brown shrimp 27 percent. Sea bob and royal-red shrimp made up less than 1 percent of the catch. During the early months of 1964, a "wintering over" population of white shrimp yielded profitable catches to fishermen, which exceeded comparable catches in early 1963.

Louisiana Total Landings of Shrimp by Size (Heads-off) and Average Ex-Vessel Prices, 1964 and 1963

Size (heads-off per pound)	1964			1963		
	Landings (heads-off)		Average Price Per Pound	Landings (heads-off)		Average Price Per Pound
	Quantity	Percent of Total		Quantity	Percent of Total	
Number	1,000 Lbs.	%	Cents	1,000 Lbs.	%	Cents
Under 15	827.4	2.2	87.0	259.2	0.5	86.3
15 - 20	4,361.1	11.5	82.3	2,602.2	5.0	89.1
21 - 25	3,260.9	8.6	73.6	3,409.8	6.6	70.6
26 - 30	2,634.7	6.9	63.9	4,080.4	7.9	57.2
31 - 40	6,639.8	17.4	52.3	9,660.6	18.7	47.7
41 - 50	4,171.0	10.9	44.1	5,830.2	11.3	39.6
51 - 67	6,774.0	17.8	36.8	10,209.2	19.8	26.4
68 & Over	9,145.3	24.0	27.6	14,961.0	28.9	18.8
Sea Bobs	280.8	0.7	22.6	689.6	1.3	9.2
Total	38,095.0	100.0	49.3	51,702.2	100.0	38.3

Research conducted by the Louisiana Wild Life and Fisheries Commission indicated that the movements of postlarval brown shrimp into nursery areas in the early spring of 1964 greatly exceeded those of the 1963 banner year. Early hopes for a good brown shrimp crop dwindled, however, when later sampling revealed heavy losses of young brown shrimp from mid-March to mid-April. Below normal water temperatures coupled with low salinity in nursery areas during that period may have been major factors in the shrimp losses.

When the brown shrimp season opened on May 15, catches were disappointing. Catches taken from the inside waters were below normal and far lower than those of 1963. Landings continued at a slow pace until the inside waters closed to trawling on July 15. Large quantities of shrimp were trucked in from neighboring states during that period of low production.

In contrast with the spring brown shrimp failure, the 1964 fall white shrimp season was exceptional--the total ex-vessel value of that catch was at a record level and the quantity of the catch was surpassed only by the 1963 record harvest. Higher prices accounted for the greater value in 1964. The 1964 fall white shrimp season started slowly on August 17 with each succeeding month registering substantial increases through November. White shrimp of the larger sizes made up a greater portion of the 1964 landings than during the previous year. A strong demand resulted in sharp price increases, particularly for smaller-size shrimp.

Oysters: The oyster harvest in 1964 yielded 11.4 million pounds of meats with an ex-vessel value of nearly $3 million. Compared with 1963, that was a decline of 1 percent in quantity and 20 percent in value. The decline in value was due to a poor market for canned oysters coupled with a poor yield of meats. Canning plants used 47 percent of the 1964 Louisiana oyster harvest and produced 198,000 standard cases of canned oysters. The catch was taken by 1,560 fishermen operating 224 vessels (5 net tons and over) and 577 other boats.

Crab: Landings of hard blue crab in 1964 amounted to 5.7 million pounds with an ex-vessel value of $379,000. Compared with the previous year, the 1964 landings were down 29 percent and were the lowest recorded since 1931. The reason for the continuing decline in abundance of blue crab is not known. Louisiana crab plants produced approximately 447,000 pounds of fresh-picked crab meat with a wholesale value of $578,000 in 1964.

Menhaden: The 1964 Louisiana menhaden landings of 599.6 million pounds were down 5 percent from 1963. Hurricane "Hilda" was primarily responsible for the decline. Catches were exceptionally good until late September when "Hilda" approached the northern Gulf area disrupting fishing operations. After the hurricane passed, spotter planes were unable to locate large menhaden schools. As a result, about 6 weeks of fishing were lost. There were 50 vessels employing 900 fishermen engaged in the fishery. Menhaden products produced in Louisiana during 1964 amounted to 63,400 tons of meal, 9.9 million gallons of oil, and 4.5 million gallons of solubles. Plans have been announced for the construction of two new manhaden processing plants in Louisiana, one located at Dulac and the other at Abbeville.

Edible Finfish: Landings of finfish for human consumption in 1964 totaled 15.6 million pounds with an ex-vessel value of $2.6 million--down 8 percent in quantity and 4 per-

cent in value from 1963. Fresh-water catfish, the leading species, with 1964 landings of 7.8 million pounds was valued ex-vessel at $1.8 million--a drop of 10 percent in quantity but a gain of 2 percent in value from 1963. Among the salt-water items, the 1964 landings of red drum (311,700 pounds), spotted sea trout (290,500 pounds), and red snapper (309,900 pounds)--species which ordinarily command the highest prices--were also well below the levels of the previous year. Landings of flounder and king whiting were higher in 1964.

North Atlantic

SOVIET FISHING ACTIVITY OFF COAST, OCTOBER 1965:

Soviet fishing activity on Georges Bank declined during October 1965. The decline was observed by the staff of the Resource Management Office, U. S. Bureau of Commercial Fisheries, Gloucester, Mass., which conducts weekly reconnaisance flights cooperatively with the U. S. Coast Guard. During the aerial observations in October, a total of 74 Soviet vessels were sighted and identified as 32 fish-factory stern trawlers, 6 "Skryplev-class" processing and refrigerated stern trawlers, 29 "Pioneer-class" side trawlers, 5 refrigerated fish transports, 1 base ship, and 1 fuel and water carrier. That compares to 112 vessels sighted in September 1965 and 47 vessels in October 1964.

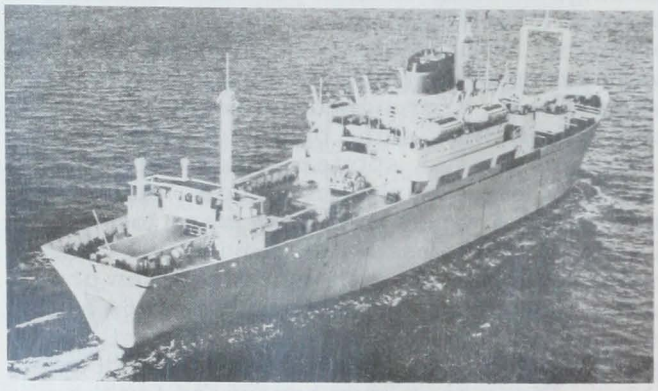


Fig. 1 - Soviet refrigerated fish-factory stern trawler of the "Skryplev" class.

Weekly estimates to mid-October 1965 showed that 50 to 60 Soviet vessels were operating in the Georges Bank area. However, by the month's end the number had decreased, temporarily at least, to less than ten. In 1964, Soviet fishing on Georges Bank declined from October until late in November when Soviet stern trawlers and support vessels reappeared, though in fewer numbers.

Fig. 2 - Load of whiting and red hake on the deck of a Soviet stern trawler.

In October 1965, a number of Soviet vessels appeared to have shifted their operations from Georges Bank to eastern Nova Scotia areas. A temporary lag in fish production on Georges Bank may have prompted the move. The Soviets may also have reduced their fleet on Georges Bank in order to recondition vessels that have been operating in the Northwest Atlantic areas since late in the winter of 1965.

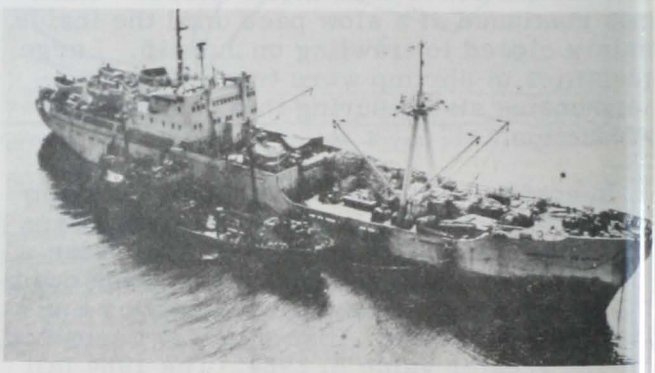


Fig. 3 - Soviet fish transport in North Atlantic.

Soviet fleet operations on Georges Bank during October 1965 were generally confined to the "Southwest Part" and "Southeast Part. Smaller groups and single vessels were widely scattered between the Cultivator Shoals and the "Northern Edge." The majority of vessels were actively engaged in fishing. Heavy to moderate catches of fish observed on decks and in their trawls appeared to contain both whiting and small haddock. Crews on both stern trawlers and large side trawlers continued to cull and dress fish on deck.

such handling was not seen prior to 1965 and has raised questions as to the type of processing being done. The Soviets did not emphasize herring fishing during 1965. Previously, herring ranked either first or second in their total fish catch on Georges Bank.

In addition to Soviet activity, two Rumanian stern trawlers were sighted on Georges Bank.

Several Polish stern trawlers previously reported were not sighted during October.

Note: See Commercial Fisheries Review, Nov. 1965 p. 32.

North Atlantic Fisheries Investigations

LOBSTER AND SEA HERRING POPULATIONS AND LARVAE STUDIED:

M/V "Delaware" Cruise 65-11 (September 27-October 6, 1965): Lobster and herring investigations were conducted during this cruise in the North Atlantic Ocean (northern part of Georges Bank, Corsair, Veatches, and Hudson Canyons) by the U. S. Bureau of Commercial Fisheries research vessel Delaware. Objectives were to: (1) sample sea herring and lobster populations and obtain related environmental data, (2) obtain lobster blood samples, and (3) make plankton tows for herring and lobster larvae.

FISHING OPERATIONS: Herring: Six herring trawl sets were made at designated stations. The sets (1 hour each) made in waters of 35 to 40 fathoms yielded a total of 22 bushels (1,600 pounds). The herring obtained were from 24.7 to 36.1 centimeters (9.4 to 14.2 inches) long. The 1960 year-class was dominant in the catches, followed in percentage occurrence by the 1961 year-class. Examination of gonadal development showed that many of the herring had recently spawned. Herring that had not spawned were in a late stage of gonadal development. Species of fish obtained, other than herring, were scrod haddock (52 bushels), butterfish (1 bushel), lemon sole (1 bushel), whiting (3 bushels), cod (1 bushel), hake (3 bushels), and cunner (1 bushel).

Lobster: A total of 9 trawl sets were made at the 2 lobster stations worked. The sets made in waters ranging from 55 to 150 fathoms yielded 78 lobsters (37 females and 41 males). Only one lobster was soft-shelled. All lobsters caught were from waters of eastern Veatches Canyon (55 to 70 fathoms). The average weight of the lobsters was about $1\frac{1}{2}$ pounds, and the range in weight was from $\frac{1}{8}$ to 12 pounds. A total of 25 blood samples were obtained for analysis.

PLANKTON OPERATIONS: Herring: Eleven 1-meter net plankton tows lasting 15 minutes each (5 minutes at 10 meters, 5 minutes at 5 meters, and 5 minutes at the surface) were made during the cruise. A total of 390 yolk-sac larvae with an average length of 6.5 millimeters or about 0.2 inches was obtained at one station and 8 yolk-sac larvae of the same average length were obtained at another station. Larvae obtained at other stations measured 0.6 and 0.7 inches long. Lobster: Two 1-meter net plankton tows of 15 minutes each (at the surface) were made during the cruise, but no lobster larvae were obtained.

HYDROGRAPHIC OBSERVATIONS: Five sea-bed drifters and 5 drift bottles were released at hydrographic stations, and at each station bathythermograph (BT) casts were made, surface salinities collected, and weather observations recorded.

Note: See Commercial Fisheries Review, November 1965 p. 31.

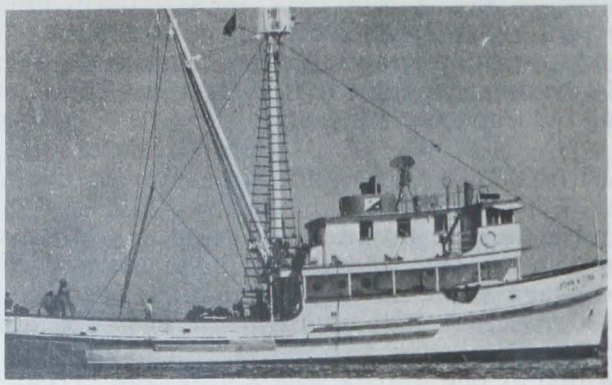
North Pacific Fisheries Explorations and Gear Development

HAKE POPULATION SURVEY CONTINUED:

M/V "John N. Cobb" Cruise 73 (August 30-October 1, 1965): This five-week pelagic exploratory cruise for Pacific hake (Merluccius productus) along the coast of California by the U. S. Bureau of Commercial Fisheries exploratory fishing vessel John N. Cobb was conducted cooperatively with the Bureau's biological and technological laboratories at Seattle, Wash., and with the California Department of Fish and Game.

To determine the geographic and bathymetric distribution of schools of hake along the California coast during the month of September was the primary objective. Secondary objectives were to: (1) obtain biological data on that species, and (2) obtain additional data relative to the catching efficiency of the Mark II "Cobb" pelagic trawl.

GEAR USED: The principal gear used was a standard Mark II "Cobb" pelagic trawl con-



Exploratory fishing vessel John N. Cobb.

structed of 3-inch mesh multifilament webbing. It was fished with the standard two aluminum hydrofoil-type otter boards on 60-fathom bridles. A 12-foot liner constructed of $\frac{9}{16}$-inch mesh webbing was placed in the cod end of the net to retain small fish. A high-resolution, low-frequency echo-sounder was used to locate the fish and a dual electrical depth-telemetering system was used to monitor the fishing depth of the net.

METHODS OF OPERATION: Onshore-offshore echo-sounding transects were made at oblique angles to the coast between the 30- and 200-fathom contours. When hake were observed on the echo-sounder, closely spaced echo-sounding transects coupled with pelagic trawl hauls were made to determine the size of the schools. Length frequency, maturity, and sex ratio data were obtained from random samples of the catch. A bathythermograph (BT) cast was made after each haul, and plankton and bottom sediment samples were taken at selected localities.

RESULTS: The region surveyed with the echo-sounder extended along the California coast from its northern border to Santa Barbara Channel. Hake were found in two areas--off Fort Bragg and off Bodega Head. The sounding transect made off Fort Bragg, which is some 120 miles north of San Francisco, indicated the presence of a moderately large school of hake near the 70-fathom depth contour. The school was about 2 miles wide and 10 miles long. An hour haul made through the school yielded a catch of 21,000 pounds of hake. Two distinct size groups of hake were taken in the haul--a small group with a mode at 28 centimeters (11.0 inches), and a larger group with a mode at 44 centimeters (17.3 inches). Hake taken in past explorations off the Washington coast were represented by a single size group of modal length 54 centimeters (21.3 inches); those caught off Oregon were made up of two size groups with modal lengths of 44 and 51 centimeters. The only area other than California where small hake have been taken was in Puget Sound, Wash.

Sounding transects made off Bodega Head (about 40 miles north of San Francisco) indicated a number of small scattered hake schools were present along the 90- to 130-fathom contours. Hour hauls made through such schools generally yielded from 800 to 9,000 pounds of hake; one haul yielded 30,000 pounds. The largest haul occurred when the pelagic trawl was fished through several closely adjoining small schools. Hake caught off Bodega Head were similar in size to those taken off Fort Bragg.

Ten tons of hake were delivered for testing purposes to a reduction plant in San Francisco, Calif. Samples of the fish meal produced were to be analyzed by the Bureau's Seattle Technology Laboratory.

Note: See Commercial Fisheries Review, October 1965 p. 45.

Oceanography

COAST GUARD CUTTER "NORTHWIND" COMPLETES MAJOR STUDY IN SIBERIAN ARCTIC:

In early October 1965, the U. S. Coast Guard cutter Northwind completed an intensive oceanographic study in relatively unexplored Arctic waters north of the Soviet Union.

During her 2-months stay in the Arctic above the Soviet Union, the Northwind became the first United States oceanographic vessel to traverse the Kara Sea. Soviet destroyers stayed near the Northwind during much of the voyage, but did not interfere. The study was conducted in cooperation with the Intergovernmental Oceanographic Commission (IOC) of the United Nations. The information gathered by the Northwind will be made available to World Data Center A for Oceanography in Washington, D. C. World Data Center B is in Moscow. The two centers exchange oceanographic information.

During the Arctic cruise, the Northwind gathered information at 132 sampling stations on water temperature, salinity, dissolved oxygen, and nutrients. Bottom core

samples were taken at about half of the observation points. The core samples will be examined, among other things, for evidence of radioactivity.

The cruise also provided useful data on ocean currents in the far north region. Geological characteristics of the sea bottom in the area were determined by measuring shock waves set up by small underwater explosions.

The scientific party aboard the Northwind consisted of teams from the U. S. Naval Oceanographic Office, and the Geophysical and Polar Research Center of the University of Wisconsin.

After completing the Arctic cruise, the Northwind called at Oslo, Norway, and then sailed on October 10, 1965, for New York City and her home port of Seattle, Wash. The vessel had begun the cruise about $3\frac{1}{2}$ months earlier when it sailed from New York City on June 27, 1965. Before entering the Arctic, the Northwind carried out a North Atlantic study from the southern tip of Greenland to Iceland to Scotland) in order to monitor boundary conditions affecting the circulation between the North Atlantic Ocean and the Arctic Basin.

The cruise of the Northwind should make a major contribution to the world's knowledge of northern waters.

Note: See Commercial Fisheries Review, Sept. 1965 p. 40.

* * * * *

"SEA LAB II" REPORT WILL BE FEATURED AT SYMPOSIUM IN WASHINGTON, D. C.:

"Man's Extension into the Sea" is the theme of a 2-day symposium to be held in Washington, D. C., January 11-12, 1966. Sponsored by the Navy and six professional societies, the meeting will feature a report on the Navy's Sea Lab II experiment.

The Sea Lab II experiment began Aug. 27, 1965, at an underwater site about one-half mile off the coast of La Jolla, Calif. During a 45-day period, 3 groups of 10 men lived and worked for 15 days each at a depth of 205 feet in a 57-foot long undersea habitat. The aquanaut teams were made up of both Navy divers and civilian scientists. Sea Lab II is the second phase of the Navy's "Man-in-the-Sea" program.

After a special 30-day stay in Sea Lab II, Astronaut-Aquanaut Scott Carpenter said the second 2 weeks are the easiest because it takes some time to become conditioned and acclimated to the high-pressure living.

The symposium will cover many details of Sea Lab II such as aquanaut experiences, engineering problems, medical problems, training, logistics, communications, photography, scientific experiments, and instrumentation. Registration fee for the meeting is $6.00, which includes admittance to all sessions and a bound copy of the proceedings.

For additional information about the meeting contact Charles W. Covey, Undersea Technology, 617 Lynn Building, 1111 N. 19th Street, Arlington, Va. 22209. Telephone (area code 703) 524-3136.

* * * * *

CONFERENCE AND EXHIBIT TO BE HELD IN WASHINGTON, D. C., IN JUNE 1966:

The Marine Technology Society has announced plans for its 2nd Annual Conference and Exhibit to be held at the Sheraton-Park Hotel in Washington, D. C., June 27-29, 1966. Plans for the 1966 meeting were made after the success of the 1965 Ocean Science and Engineering Conference and Exhibit in Washington.

The theme of the 1966 Conference and Exhibit is "Exploiting The Ocean." The 3-day event will include over 70 presentations emphasizing both the opportunities and the problems on the marine frontier as industrial firms and Government agencies expand their programs to explore and use the vast resources of the world oceans.

The conference program will include papers on commercial fisheries, offshore drilling, chemical extraction from sea water, and ocean floor mineral recovery. Special attention will be given to the effect of State, Federal, and international maritime laws on all of those growing areas of oceanography.

Those interested in information on exhibit space at the meeting should contact Trade Associates, Inc., 5151 Wisconsin Ave. NW., Washington, D. C. 20016, Att.: Frank Masters.

For information on the conference and technical program write: Executive Secretary, Marine Technology Society, 1030 15th Street NW., Washington, D. C. 20005.

Note: See Commercial Fisheries Review, August 1965 p. 49.

* * * * *

STUDY OF UNMANNED BUOYS OFF MASSACHUSETTS:

The U. S. Bureau of Commercial Fisheries and the Coast Guard are cooperating in an experiment with unmanned oceanographic buoys off Cape Cod Light in Massachusetts waters. A section line of five orange-and-white buoys stretches out to sea for 3 miles. At depths of from 6 to 25 fathoms, sensitive instruments mounted in the buoys' concrete mooring blocks record temperatures and pressures existing on different types of ocean bottom. Those instruments are capable of recording data at hourly intervals for a continuous period of 400 days.

While the instruments are in operation, Bureau scientists will collect samples of marine animals in the vicinity of the buoys. From the analysis of the samples and of the data recorded by the instruments, they will learn more about the influence of water temperature on the distribution, abundance, and life history of a variety of marine life.

Oysters

VIRGINIA SCIENTIST RECEIVES GRANT FOR MSX STUDIES:

The National Science Foundation has awarded a $2,000 grant to finance continued research on MSX by the head of the biology department of Madison College, Harrisonburg, Va. The grant will allow the scientist to continue research during the academic year 1965/66 into the effect of MSX on respiration of oysters. He spent the summer of 1965 in a research program for college teachers sponsored by the Virginia Institute of Marine Science, where he measured the level of three enzymes and their relationship to respiration in oysters free of disease as opposed to those suffering from infection. He is interested in determining whether enzyme leakage is useful in diagnosing infections in oysters caused by MSX. Incidental to his primary study, he discovered that respiration in oysters practically ceases when the dinoflagellate bloom ("red tide") occurs in the York River. (Virginia Institute of Marine Science, October 20, 1965.)

Transportation

AIRLINE CUTS RATES 40 PERCENT ON NORTHWEST FISHERY SHIPMENTS TO EASTERN POINTS:

United Air Lines has cut rates 40 percent on perishable shipments of fish and fishery products moving from the Pacific Northwest to major midwestern and eastern markets.

The airline supported its rate reduction by revising jet freighter flight schedules. The schedule revision provides for the addition of a nonstop jet freighter flight every Sunday between Seattle and New York and a jet freighter flight every weekday between Seattle and New York with stops at Chicago and Philadelphia. The rate cut became effective September 12, 1965. The revised flight schedules were to go into effect October 12.

Announcing the 40-percent rate cut in September 1965, United's manager of perishable sales described it as a "one-year experimental rate reduction" and said, "seafood will move from Seattle, Portland, and Vancouver, B. C., to New York at $9 a hundredweight for a 2,000-pound shipment compared with the old rate of $15.05. The rate to Chicago dropped from: $11.10 a hundredweight to $7.50.

Destination cities covered by the new rate include Boston, Baltimore, Cleveland, Detroit, Kansas City, Milwaukee, Philadelphia, Pittsburgh, and Washington, D. C., in addition to New York and Chicago. (Traffic World, September 18, 1965.)

Note: See report on plastic fish boxes particularly adapted to air shipment on pages 21 & 22 of this issue.

U. S. Foreign Trade

IMPORTS OF CANNED TUNA UNDER QUOTA

United States imports of tuna canned in brine during January 1-October 2, 1965, amounted to 35,332,411 pounds (about 1,682,500 standard cases), according to preliminary data compiled by the U. S. Bureau of Customs. That was an increase of 10.8 percent from the 31,894,583 pounds (about 1,518,800 standard cases) imported during January 1-October 3, 1964.

The quantity of tuna canned in brine which can be imported into the United States during the calendar year 1965 at the 12½-percent rate of duty is limited to 66,059,400 pounds (or about 3,145,685 standard cases of 48 7-oz

cans). Any imports in excess of that quota will be dutiable at 25 percent ad valorem.

* * * * *

AIRBORNE IMPORTS OF FISHERY PRODUCTS, JANUARY-JUNE 1965:

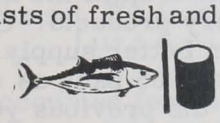
Shrimp from Venezuela continued to be the main airborne fishery import into the United States during the second quarter of 1965. In January-June 1965, airborne imports of fishery products into the United States totaled 9.3 million pounds with a value of $5.2 million. That was almost 2.5 times greater than the airborne fishery imports in the first half of 1964 when smaller quantities of shrimp were shipped by air from Venezuela.

U.S. 1/ Airborne Imports of Fishery Products, April-June 1965 and January-June 1965 with Comparative Data

Product and Origin 2/	Apr.-June 1965		Jan.-June 1965		Jan.-June 1964	
	Qty. 3/	Value 4/	Qty. 3/	Value 4/	Qty. 3/	Value 4/
	1,000 Lbs.	US$ 1,000	1,000 Lbs.	US$ 1,000	1,000 Lbs.	US$ 1,000
Fish:						
All countries	251.1	250.0	481.7	480.2	264.4	87.1
Shrimp:						
Venezuela	3,171.8	1,601.5	7,718.3	3,926.5	2,162.1	984.1
Panama	222.8	145.8	592.4	370.9	512.1	309.4
Costa Rica	75.9	35.6	104.8	50.2	188.3	108.1
El Salvador	10.7	6.0	28.1	19.1	159.1	96.8
Other countries	0.4	0.6	54.5	30.4	83.3	47.5
Total shrimp	3,481.6	1,789.5	8,498.1	4,397.1	3,104.9	1,545.9
Shellfish other than shrimp:						
Canada	23.3	8.3	23.9	8.7	207.8	113.0
Mexico	0.8	0.7	1.2	1.0	9.0	4.8
British Honduras	21.7	5.5	76.2	57 5	82.8	50.4
Honduras	5.4	1.3	15.6	5.7	12.9	9.4
Nicaragua	33.4	18.0	104.1	12.0	50.5	40.0
Costa Rica	-	-	13.9	13.3	9.3	9.5
Jamaica	16.3	19.8	25.8	35.7	43.6	36.2
Other countries	13.6	11.5	109.2	77.2	39.0	15.2
Total shellfish (except shrimp)	114.5	65.1	369.9	311.1	454.9	278.5
Grand total	3,847.2	2,104.6	9,349.7	5,188.4	3,824.2	1,911.5

1/Imports into Puerto Rico from foreign countries are considered to be United States imports and are included. But United States trade with Puerto Rico and with United States possessions and trade between United States possessions are not included.
2/When the country of origin is not known, the country of shipment is shown.
3/Gross weight of shipments, including the weight of containers, wrappings, crates, and moisture content.
4/F.o.b. point of shipment. Does not include U.S. import duties, air freight, or insurance.
Note: These data are included in the overall import figures for total imports, i.e., those imports are not to be added to other import data published.
Source: United States Exports & Imports by Air, FT 785, January through June 1965, U.S. Bureau of the Census.

The data as issued do not show the state of all products--fresh, frozen, or canned--but it is believed that the bulk of the airborne imports consists of fresh and frozen products.



Washington

TEST HERRING FISHERY OPENED OFF WHIDBEY ISLAND:

The opening of a test fishery for herring off the west coast of Whidbey Island in Puget Sound was announced October 8, 1965, by the Washington State Department of Fisheries. The area opened is that portion of Puget Sound herring fishing Area No. 1, lying easterly or inside of a line from Partridge Point on Whidbey Island to Smith Island Light to West Point on Whidbey Island.

The fishery began October 11 and was scheduled to continue (with weekend closures) until a quota of 1,000 tons was reached. The abundance of herring in the West Beach area of Puget Sound is sufficiently large to justify such a catch, and the fish are in prime condition, fat, and very high in oil content. Such herring provide a superior product for reduction into oil and meal, as well as for processing into pickled herring, fish pellets, animal food, and bait.

The Washington State Department of Fisheries has released tagged herring off Whidbey Island and will assess tag recoveries to determine migration patterns. (Washington State Department of Fisheries, October 8, 1965.)

Wholesale Prices

EDIBLE FISH AND SHELLFISH, OCTOBER 1965:

From September to October 1965 prices were up for only several items (haddock and haddock fillets, shrimp, and oysters) in the index. At 118.0 percent of the 1957-59 average, the overall wholesale price index for edible fishery products in October rose 1.5 percent from the previous month. Compared with the same month in 1964, the index this October was up 5.7 percent because prices were up substantially for large haddock and haddock fillets, fresh shrimp, oysters, and canned salmon and jack mackerel.

In the subgroup for drawn, dressed, or whole finfish, prices from September to October were down 2.9 percent--all items were priced lower except ex-vessel large haddock. With the end of the seasonal North Pacific fisheries for halibut and salmon, the frozen form of those species at New York City were priced lower than the fresh product. October prices at New York City for Great Lakes round yellow pike dropped 35.8 percent from the Jewish Holiday prices of the previous month; prices at Chicago for Lake Superior fresh whitefish were down 8.7 percent. Large haddock prices at Boston were exceptionally high (up 27.4 percent from September to October and

Wholesale Average Prices and Indexes for Edible Fish and Shellfish, October 1965 with Comparisons

Group, Subgroup, and Item Specification	Point of Pricing	Unit	Avg. Prices 1/ ($)		Indexes (1957-59=100)			
			Oct. 1965	Sept. 1965	Oct. 1965	Sept. 1965	Aug. 1965	Oct. 1964
ALL FISH & SHELLFISH (Fresh, Frozen, & Canned)					118.0	116.2	114.3	111.6
Fresh & Frozen Fishery Products:					121.7	117.9	117.4	116.6
Drawn, Dressed, or Whole Finfish:					131.9	135.8	133.4	133.4
Haddock, lge., offshore, drawn, fresh	Boston	lb.	.23	.18	181.0	142.1	147.7	135.5
Halibut, West., 20/80 lbs., drsd., fresh or froz.	New York	lb.	.48	.51	142.0	150.8	149.4	164.1
Salmon, king, lge.& med., drsd., fresh or froz.	New York	lb.	.84	.94	117.0	131.0	127.5	134.1
Whitefish, L. Superior, drawn, fresh	Chicago	lb.	.53	.58	78.3	85.8	94.8	79.8
Yellow pike, L. Michigan & Huron, rnd., fresh	New York	lb.	.61	.95	99.9	155.5	114.6	77.8
Processed, Fresh (Fish & Shellfish):					119.1	107.3	108.8	106.5
Fillets, haddock, sml., skins on, 20-lb. tins	Boston	lb.	.49	.48	119.0	116.6	99.6	97.1
Shrimp, lge. (26-30 count), headless, fresh	New York	lb.	.87	.80	101.4	93.7	100.8	96.7
Oysters, shucked, standards	Norfolk	gal.	8.38	7.25	141.2	122.3	120.2	120.1
Processed, Frozen (Fish & Shellfish):					107.6	105.3	104.8	104.7
Fillets: Flounder, skinless, 1-lb. pkg.	Boston	lb.	.40	.40	100.1	100.1	98.8	91.2
Haddock, sml., skins on, 1-lb. pkg.	Boston	lb.	.40	.38	117.3	111.4	111.4	109.9
Ocean perch, lge., skins on 1-lb. pkg.	Boston	lb.	.31	.31	107.0	108.7	108.7	103.4
Shrimp, lge. (26-30 count), brown, 5-lb. pkg.	Chicago	lb.	.87	.86	102.6	101.4	100.8	103.2
Canned Fishery Products:					113.0	113.7	109.4	103.1
Salmon, pink, No. 1 tall (16 oz.), 48 cans/cs.	Seattle	cs.	27.00	27.00	117.7	117.7	106.8	94.8
Tuna, lt. meat, chunk, No. 1/2 tuna (6-1/2 oz.), 48 cans/cs.	Los Angeles	cs.	11.56	11.56	102.6	102.6	102.6	102.6
Mackerel, jack, Calif., No.1 tall (15 oz., 48 cans/cs.	Los Angeles	cs.	7.13	7.13	120.9	120.9	120.9	105.9
Sardines, Maine, keyless oil, 1/4 drawn (3-3/4 oz.), 100 cans/cs.	New York	cs.	9.50	10.00	121.9	128.3	131.5	128.3

1/Represent average prices for one day (Monday or Tuesday) during the week in which the 15th of the month occurs. These prices are published as indicators of movement and not necessarily absolute level. Daily Market News Service "Fishery Products Reports" should be referred to for actual prices.

33.6 percent higher than in October 1964) because of light catches. As compared with the same month a year earlier, the subgroup index this October was down 1.1 percent; except for large haddock, prices were lower for all items.

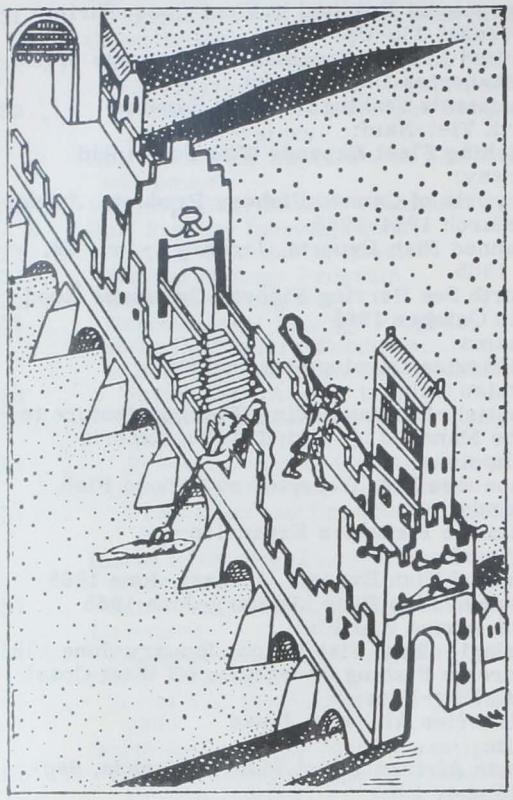
October prices were higher by 11.0 percent from the previous month for all items in the fresh processed fish and shellfish subgroup. Prices for standard shucked oysters at Norfolk were up 15.5 percent because of limited production. At New York City, wholesale prices for South Atlantic fresh shrimp were substantially higher (up 7 cents a pound), and there was some increase in prices at Boston for small haddock fillets. The subgroup index this October was up 11.8 percent as against the same month in 1964. October 1965 prices were much higher for haddock fillets (up 22.6 percent) and for shucked oysters (up 17.6 percent) than in the same month a year earlier.

Higher prices from September to October for frozen haddock fillets (up 5.3 percent) at Boston and for frozen shrimp (up 1.2 percent) at Chicago were responsible for a 2.2-percent rise in the subgroup index for frozen processed fish and shellfish. October prices for ocean perch fillets were about the same as in September while those for flounder fillets remained unchanged but were 9.8 percent higher than in October a year earlier. Compared with October 1964 the subgroup index this October was up 2.8 percent because of higher prices for all items.

Prices for canned fish were generally steady during October and mostly unchanged from the previous month. But lower prices from September to October for canned Maine sardines (down 5.0 percent) were responsible for a 0.6-percent drop in the subgroup index for canned fishery products. Canned Maine sardines were in better supply than a year earlier, with the 1965 pack as of the end of October topping the previous year's pack by nearly 50 percent. The subgroup index this October was 9.6 percent higher than in October 1964--prices for canned salmon were up 24.2 percent and for California jack mackerel up 14.2 percent. Canned tuna prices were the same as in October 1964.

IRISH SALMON HAVE BEEN VALUED FOR OVER SEVEN CENTURIES

Since early times, salmon fisheries have been regarded as a source of wealth in Ireland. Irish historical references to salmon date from the 12th century. By the 16th century, salmon fishing rights in Irish rivers were among the most valuable rewards which could be given supporters of the Crown.



Showing the spearing of salmon in 1651 from a bridge in Galway.

The spear was one of the first implements (other than bare hands) used to catch salmon. The "casting spear off the bridge in Galway" was a valuable asset mentioned in the records of the year 1538. But fisheries regulation also has a long history, and the use of spears to take salmon from rivers was banned as early as 1716. The spears were too efficient.

Other fishing methods developed early. Angling with hook and line was sufficiently well established by 1641 for a Dame Elinor Blake to have the right of "one-fourth part of every salmon and trout taken by angling betwixt the bridge and the wood quay near the town of Galway."

Before the middle of the last century, V-shaped structures called head weirs were quite common in the estuaries of many Irish rivers. An early illustration of a weir appears in Thomas Phillips' Military History of Ireland, written in 1685. Weirs in river mouths were later found to be obstructions to navigation and most were declared illegal. Fixed nets in the open sea were introduced off the coast of Ireland in about 1815. These too were later restricted, and today only about 30 are in use on the Irish coast.

The beach seine or haul net is now the most common commercial method of fishing for salmon in Ireland. It is also one of the most ancient. As far back as the reign of King John, such nets were used to supply salmon for the King's kitchen.

A detailed story of fishing for salmon in Ireland under the title "The Pursuit of Salmon in Ireland," has been recently published in the Proceedings of the Royal Irish Academy, Vol. 63, Section C, No. 6. (Irish Times reprint in the Irish Skipper, January 1965.)

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.
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