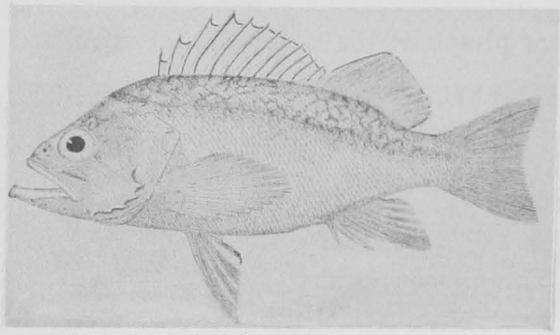
CHEMICAL COMPOSITION OF PACIFIC COAST FISH AND SHELLFISH

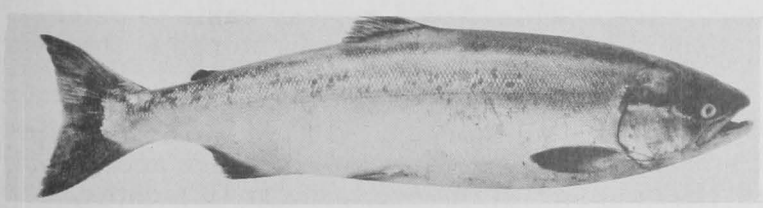
A two-year study of the proximate composition of halibut meat was completed earlier this year. Long-term studies on rockfish and sole are nearing completion. Composition studies of cod, salmon, and sheepshead are being continued; and composition studies on tuna are still under way.

A report on variations in the composition of halibut meat was presented at the annual meeting of the Institute of Food Technologists in Philadelphia May 20. The paper is scheduled for publication in the May 1960 issue of Food Research. Halibut meat is low in oil and sodium, and high in protein, thus providing an excellent food for a wide variety of regular and special diets.



Vermilion Rockfish (Sebastodes miniatus)

During the 3-month period covered by this report over 200 specimens have been collected for analysis. They include sheepshead, rockfish, sole, cod, silver salmon, and tuna. The analyses on rockfish should be completed this year, and those on sole early next year. The silver salmon represent the first series in a proposed study of that species, following the same general outline as was employed in the study of pink salmon.



Silver Salmon (Oncorhynchus kisutch)

One week in April was spent at Terminal Island, Calif., in the preparation of a second series of tuna samples for the tuna composition studies. Analyses have been completed on these samples, and tentative plans included the preparation of a third series in August, with the intent that a preliminary report on this first research phase can be available for presentation at the annual meeting of the Institute of Food Technologists in May 1960. The report on rockfish should also be ready for that meeting.

Analyses on two series of albacore have been completed. They represent frozen specimens from Japan, and iced specimens from Washington coastal waters. The fish are uniformly high in protein prior to precook averaging more than 25 percent. The Washington series had a much higher oil content than was found in the Japanese fish.

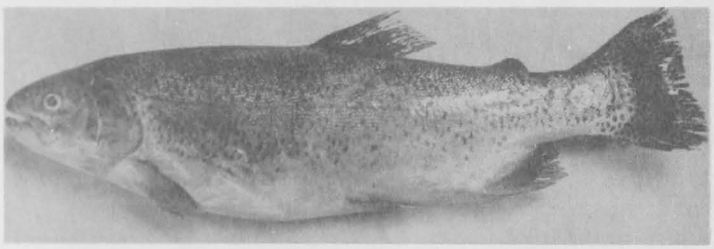
A preliminary study on the sodium content of raw commercially-frozen steaks and fillets from salmon, halibut, and rockfish has been completed. The results show that samples dipped in water before freezing have essentially the same sodium content as is found in the fish immediately after capture, but that samples dip-

ped in a salt solution before freezing have a sodium content several times higher than is normally found in the meat of those species. A paper describing the sodium content of fish meat from time of capture to serving on the table, or on a patient's tray, was presented at the national meeting of the American Dietetic Association in Los Angeles, August 27. It is being published in the journal of that association.

Note: Also see Commercial Fisheries Review, August 1959, p. 13.

FREEZING AND COLD STORAGE OF PACIFIC OYSTERS AND FRESH-WATER FISH

Research on the cold-storage qualities of commercially-reared rainbow trout has been carried out by the Bureau's Seattle Fishery Technological Laboratory in a cooperative program with the Refrigeration Research Foundation. Freezing trout destined for retail and institutional trade is becoming an increasingly more important phase of the commercial trout industry. However, very little has been published regarding the storage life to be expected from the product. In order to supply cold-storage data for trout, a test was initiated to determine the cold-storage life at various temperatures.



Rainbow Trout

Fresh rainbow trout purchased from a local trout farm were prepared in a manner being used by the industry to package frozen trout. The fish were frozen at -20° F., then ice-glazed, and packed in polyethylene bags. The bags of ice-glazed trout were packed in waxed fiber cartons which were overwrapped with waxed kraft paper. Samples were stored at -20° F., +10° F., and +20° F. Fish from each temperature were examined on a regular basis to determine the maximum storage life that could be expected from trout stored at that temperature.

The results of the tests showed that the trout stored at +20° F. were in acceptable condition up to 2.5 months of storage; those stored at +10° F. were acceptable up to 4.5 months; those stored at 0° F. or lower were acceptable at 16 months. Samples at 0° F. and -20° F. are being held for further examination. The limit of frozen storage is judged by the appearance and degree of rancidity of the sample.

NEW PRODUCTS FROM FISH OILS--MONOGLYCERIDES

Development of new products from fish oils is one of the objectives of fish-oil research of the Seattle Fishery Technological Laboratory. Fish oils are chemically unique as compared to animal and vegetable fats. They possess molecular characteristics such that application of certain chemical processes may be expected to result in the production of chemical derivatives not possible from these other fats.

Recent research has involved the synthesis of monoglycerides--used as emulsifiers and as intermediates in the production of certain detergents and plasticizers. The fish oils used were from sardine, herring, menhaden, pink salmon eggs, and tuna.

During the development stage of the synthesis of fish-oil monoglycerides, several problems were encountered during the analyses and the determinations of their states of purity. Attempts were made to determine the purity of the products by analytical fractional distillation, using a molecular-type still. It was readily learned that fish-oil monoglycerides did not lend themselves well to such a distillation method. More recently, work has indicated that distillation of a monoglyceride derivative (the acetylated product) could very satisfactorily be distilled at the desired conditions. It was shown that such a physical separation analysis compared quite favorably with results obtained from chemical tests.

In the beginning of this investigation, it was not definitely known whether or not the conversion of fish oils to monoglycerides proceeded in a random manner. That is to say, did the fatty acid portions of the oil react in a manner that could be described as following a statistical probability pattern? If this was not the case for our synthesis of monoglycerides, then chemical tests were unreliable. However, it was shown by good agreement with the distillation data, that the chemical tests were valid. The conclusion was, therefore, that fish oils with their inherent range of fatty-acid chain lengths do not react in any selective pattern, but do react randomly. This conclusion substantiated other reports of a similar process involving vegetable oils.

Note: Also see Commercial Fisheries Review, August 1959, p. 15.

STUDY OF CHEMICAL COMPOUNDS FORMED DURING SPOILAGE OF FISH

A number of the classes of chemical compounds that could be present in spoiling fish have received little research attention. Some of these are neutral carbonyls, acidic carbonyls (keto acids), and esters.

Recently, the content of neutral carbonyls, keto acids, and volatile esters was determined in samples of cod meat of different degrees of spoilage. Volatile esters were not found in fresh or spoiled cod, whereas neutral carbonyls and keto acids were present in both the fresh and spoiled samples. Paper chromatographic analysis of the keto acids indicated that pyruvic and alpha-ketogluteric acids were present in approximately equal concentrations in the fresh and spoiled samples. Quantitative colorimetric tests have shown that benzene-soluble carbonyls (mainly neutral carbonyls) increase in cod during spoilage. Preliminary results indicate that a sharp increase in carbonyl content occurs in cod at about the time that the fish would be judged organoleptically unacceptable. Additional work on the neutral carbonyls is being planned for the future. Consideration will be given to the carbonyl content of spoiling fish as it affects mechanism of spoilage and its potential usefulness as a condemnation test.

Note: Also see Commercial Fisheries Review, August 1959, p. 17.

THREAD HERRING MEAL NUTRITIONAL STUDIES

Studies on the nutrional value of the Gulf of Mexico thread herring meal have been started by the U. S. Bureau of Commercial Fisheries technological laboratory at College Park, Md.

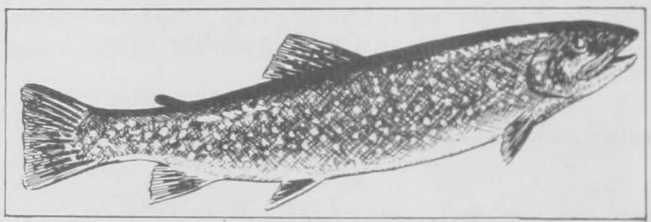
The studies involve (1) nutritional tests with rats within the laboratory, (2) metabolizable energy, and (3) digestibility of the meals. Metabolizable energy and digestibility studies are to be carried out under contract by Lime Crest Laboratory in New Jersey.

The Gulf thread herring, since it is available in large schools and possesses a high fat content during the winter, promises to develop into a winter industry to supplement the summer menhaden industry in the Gulf. A total of 55 vessels are reported agreed to fish for thread herring. There are two species available; one with a fat content of 21 percent is suitable and the other, with a fat content of 3 percent, has no practical use now.

SPLAKE--HYBRID PRODUCED BY CROSSING LAKE TROUT AND BROOK TROUT

New or exotic fish species have a certain appeal. One of these is the splake, a hybrid, which is produced by crossing a lake trout with a brook trout.

Although sometimes reported as a new species, the splake was described at a meeting of the American Fish Cultural Association in 1880. The report at this meeting stated that an R. B. Roosevelt gave a paper on hybrids in which he described the cross of lake trout female by brook trout male and indicated that hybrids of this type were being held in a hatching house in New York State. Wisconsin also crossed female lake trout and male brook trout in 1884.



Splake (hybrid trout)

Records are incomplete, but apparently little was done with this species for a number of years. Interest in the splake was revived in the last decade.

In 1957 Wisconsin obtained some splake fingerlings from Marquette, Mich., through the courtesy of the Michigan Conservation Department. During 1958, 4,000 of these splake were stocked in Little Bass Lake, Oneida County. A 17-inch size limit was imposed on this species and it will take several years for them to reach legal size.

The Crystal Springs trout hatchery recently completed stocking 1,000 6-inch splake from the same source in Crystal Lake, Vilas County. These hybrids were produced by fertilizing lake trout eggs with brook trout sperm. This hatchery also has on hand 3,800 lake trout female-brook trout male hybrid fingerlings and 7,300 fingerling hybrids obtained by crossing brook trout female-lake trout males.

The lake trout eggs fertilized by brook trout sperm apparently produce the hardiest splake. Progeny resulting from a reversed cross are frequently weak and crippled, since the brook trout egg is too small for a lake trout embryo. A great percentage of the weaknesses are evidenced in the form of deformed tails.

In appearance the splake resembles both parents. It retains the square tail of the brook trout, but the red speckles are not as prominent. Its body shape is slimmer than that of the brook trout. This is especially true of young splake.

The introduction of splake in Little Bass Lake has been too recent to determine its success. However, the State of New York has been managing several lakes for this species since 1954. Fingerlings from 3.5 to 5 inches were stocked in the fall. In one year, they had increased in length by $2\frac{1}{4}$ to 8 inches.

In the upper peninsula of Michigan splake were introduced in one lake three years ago which are now 17 inches in length.

The splake is an avid feeder and therefore makes rapid growth gains. Canada reports excellent growth of fingerling splake stocked in Agnes Lake in 1951. By 1953 some of the fish weighed almost 2 pounds.

Canadian fish culturists report that these hybrids are fertile and have successfully spawned in lakes in which they have been introduced. The Michigan Department of Conservation has successfully fertilized splake eggs with sperm from splake males.

This fish has the reputation of being a good fighter and a tasty fish as well. Habitat requirements of this hybrid are intermediate between the lake trout and the brook trout. Reports indicate that this fish utilizes the upper regions of a lake more frequently than does the lake trout. These attributes make him very popular with anglers. If the splake introduction in Wisconsin lakes is successful, some excellent fishing is in store for our fishermen.