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NOAA Technical Report NMFS CIRC-377

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Fishery Publications, Calendar Year 1970: Lists and Indexes

MARY ELLEN ENGETT and LEE C. THORSON

SEATTLE, WA
December 1972

National Marine Fisheries Service, Circulars

The major responsibilities of the National Marine Fisheries Service (NMFS) are to monitor and assess the abundance and geographic distribution of fishery resources, to understand and predict fluctuations in the quantity and distribution of these resources, and to establish levels for optimum use of the resources. NMFS is also charged with the development and implementation of policies for managing national fishing grounds, development and enforcement of domestic fisheries regulations, surveillance of foreign fishing off United States coastal waters, and the development and enforcement of international fishery agreements and policies. NMFS also assists the fishing industry through marketing service and economic analysis programs, and mortgage insurance and vessel construction subsidies. It collects, analyses, and publishes statistics on various phases of the industry.

The NOAA Technical Report NMFS CIRC series continues a series that has been in existence since 1941. The Circulars are technical publications of general interest intended to aid conservation and management. Publications that review in considerable detail and at a high technical level certain broad areas of research appear in this series. Technical papers originating in economics studies and from management investigations appear in the Circular series.

NOAA Technical Reports NMFS CIRC are available free in limited numbers to governmental agencies, both Federal and State. They are also available in exchange for other scientific and technical publications in the marine sciences. Individual copies may be obtained (unless otherwise noted) from NOAA Publications Section, Rockville, Md. 20852. Recent Circulars are:

315. Synopsis of biological data on the chum salmon, *Oncorhynchus keta* (Walbaum) 1792. By Richard G. Bakkala. March 1970, iii + 89 pp., 15 figs., 51 tables.

319. Bureau of Commercial Fisheries Great Lakes Fishery Laboratory, Ann Arbor, Michigan. By Bureau of Commercial Fisheries. March 1970, 8 pp., 7 figs.

330. EASTROPAC Atlas: Vols. 4, 2. Catalog No. I 49.4:330/(vol.) 11 vols. ($4.75 each). Available from the Superintendent of Documents, Washington, D.C. 20402.

331. Guidelines for the processing of hot-smoked chub. By H. L. Seagran, J. T. Graikoski, and J. A. Emerson. January 1970, iv + 23 pp., 8 figs., 2 tables.

332. Pacific hake. (12 articles by 20 authors.) March 1970, iii + 152 pp., 72 figs., 47 tables.

333. Recommended practices for vessel sanitation and fish handling. By Edgar W. Bowman and Alfred Larsen. March 1970, iv + 27 pp., 6 figs.

335. Progress report of the Bureau of Commercial Fisheries Center for Estuarine and Menhaden Research, Pesticide Field Station, Gulf Breeze, Fla., fiscal year 1969. By the Laboratory staff. August 1970, iii + 33 pp., 29 figs., 12 tables.

336. The northern fur seal. By Ralph C. Baker, Ford Wilke, and C. Howard Baltzo. April 1970, iii + 19 pp., 13 figs.

337. Program of Division of Economic Research, Bureau of Commercial Fisheries, fiscal year 1969. By Division of Economic Research. April 1970, iii + 29 pp., 12 figs., 7 tables.

338. Bureau of Commercial Fisheries Biological Laboratory, Auke Bay, Alaska. By Bureau of Commercial Fisheries. June 1970, 8 pp., 6 figs.

339. Salmon research at Ice Harbor Dam. By Wesley J. Ebel. April 1970, 6 pp., 4 figs.

340. Bureau of Commercial Fisheries Technological Laboratory, Gloucester, Massachusetts. By Bureau of Commercial Fisheries. June 1970, 8 pp., 8 figs.

341. Report of the Bureau of Commercial Fisheries Biological Laboratory, Beaufort, N.C., for the fiscal year ending June 30, 1968. By the Laboratory staff. August 1970, iii + 24 pp., 11 figs., 16 tables.

342. Report of the Bureau of Commercial Fisheries Biological Laboratory, St. Petersburg Beach, Florida, fiscal year 1969. By the Laboratory staff. August 1970, iii + 22 pp., 20 figs., 8 tables.

343. Report of the Bureau of Commercial Fisheries Biological Laboratory, Galveston, Texas, fiscal year 1969. By the Laboratory staff. August 1970, iii + 39 pp., 28 figs., 9 tables.

344. Bureau of Commercial Fisheries Tropical Atlantic Biological Laboratory progress in research 1965-69, Miami, Florida. By Ann Weeks. October 1970, iv + 65 pp., 53 figs.

346. Sportsman's guide to handling, smoking, and preserving Great Lakes coho salmon. By Shearon Dudley, J. T. Graikoski, H. L. Seagran, and Paul M. Earl. September 1970, iii + 28 pp., 15 figs.

347. Synopsis of biological data on Pacific ocean perch, *Sebastodes alutus*. By Richard L. Major and Herbert H. Shippen. December 1970, iii + 38 pp., 31 figs., 11 tables.

Continued on inside back cover.

U.S. DEPARTMENT OF COMMERCE
Peter G. Peterson, Secretary
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Robert M. White, Administrator
NATIONAL MARINE FISHERIES SERVICE
Philip M. Roedel, Director

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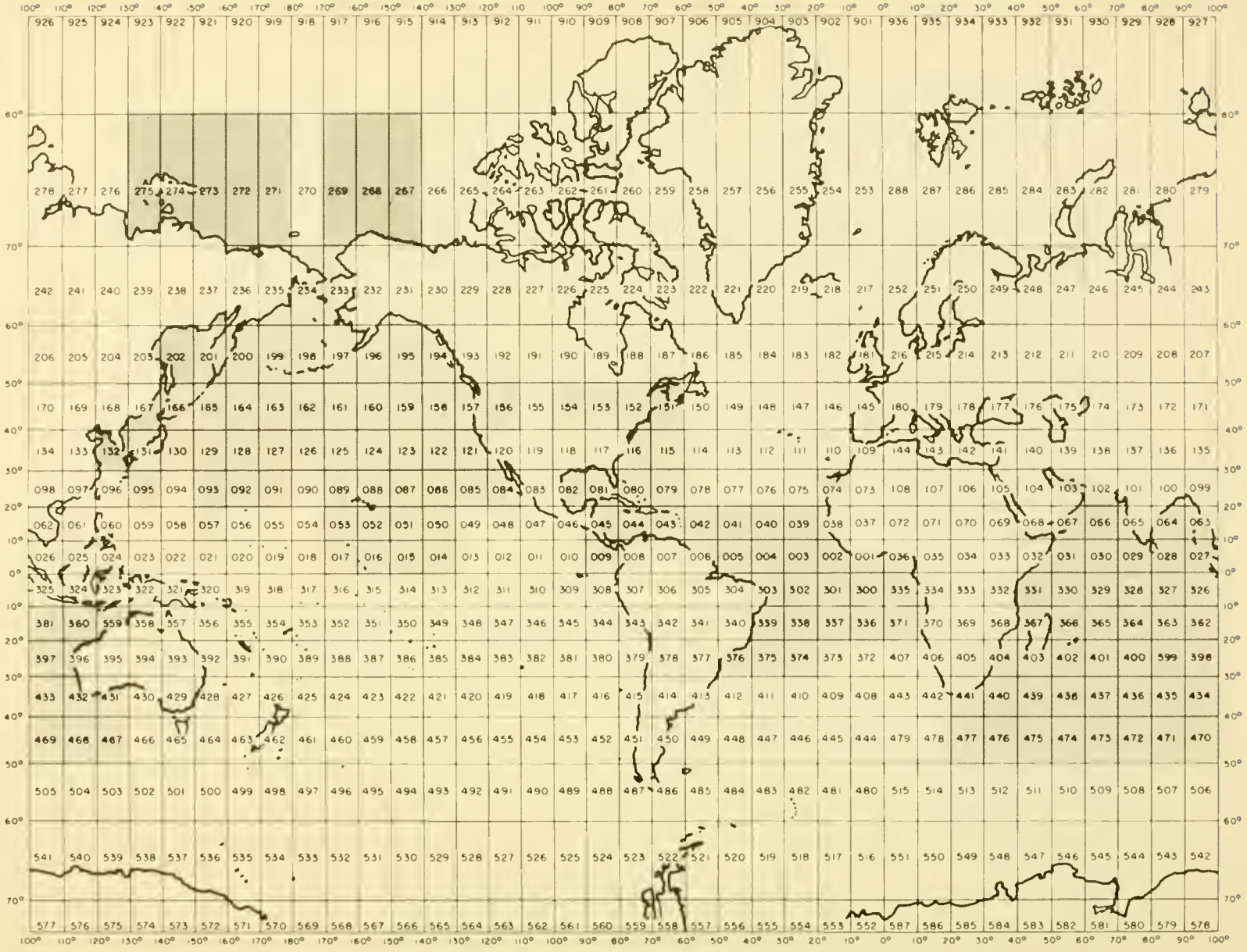

FIGURE 1. — Marsden square grid showing geographic areas (shaded) covered by fishery publications, calendar year 1970.

FISHERY PUBLICATIONS, CALENDAR YEAR 1970:

LISTS AND INDEXES

By

MARY ELLEN ENGETT and LEE C. THORSON

Scientific Publications Staff
National Marine Fisheries Service

ABSTRACT

The following series of fishery publications of the National Marine Fisheries Service, National Oceanic and Atmospheric Administration (until October, 1970 the Bureau of Commercial Fisheries of the U.S. Fish and Wildlife Service) in calendar year 1970 are listed numerically (with abstracts) and indexed by author, subject, and geographic area: Circular, Data Report, Fishery Industrial Research, Fishery Leaflet, and Special Scientific Report—Fisheries.

INTRODUCTION

This document provides for calendar year 1970 numerical lists (with abstracts) and indexes by author, subject, and geographical area, the following series of publications of the National Marine Fisheries Service, National Oceanic and Atmospheric Administration, which until October 1970 was the Bureau of Commercial Fisheries of the U.S. Fish and Wildlife Service:

Circular
Data Report
Fishery Industrial Research (ceased publication with Vol. 6, No. 4, October 1970)
Fishery Leaflet
Special Scientific Report—Fisheries

A separate listing has been issued of material appearing in the Fishery Bulletin for 1970.

The document is divided into four principal sections:

Numerical listing of series (with abstracts)
Author index
Subject index
Index by Marsden squares

The last section has been included to afford easy access to the publications for those persons interested in specific geographical areas. Figure 1 shows the Marsden squares treated in the several publications.

The series abbreviations used in the indexes are:

Circular	C
Data Report	D
Fishery Industrial Research	FIR
Fishery Leaflet	FL
Special Scientific Report—Fisheries	S

LISTS
Circular

315. Synopsis of biological data on the chum salmon, *Oncorhynchus keta* (Walbaum) 1792. By Richard G. Bakkala. March 1970, iii + 89 pp., 15 figs., 51 tables.

ABSTRACT

Information presented on the chum salmon includes nomenclature, taxonomy, morphology, distribution, ecology and life history, population dynamics, fishery, and protection and management.

316-318. Published in 1969.

319. Bureau of Commerical Fisheries Great Lakes Fishery Laboratory Ann Arbor, Michigan. Anonymous. March 1970, 4 fan-fold.

(No abstract)

320-329. Published in 1969.

330, Vol. 4. EASTROPAC Atlas: Biological and Nutrient Chemistry Data from Principal Participating Ships, First and Second Monitor Cruises, April-July 1967. By Cuthbert M. Love, (editor). November 1970, viii + 125 pp., 165 charts. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 — Price $4.75 per volume.

ABSTRACT

This atlas contains charts depicting the distribution of physical, chemical, and biological oceanographic properties and associated meteorological properties observed during EASTROPAC. EASTROPAC was an international cooperative investigation of the eastern tropical Pacific Ocean (20° N. to 20° S., and from the west coasts of the American continents to 119° W.) which was intended to provide data necessary for a more effective use of the marine resources of the area, especially tropical tunas, and also to increase knowledge of the ocean circulation, air-sea interaction, and ecology. The Bureau of Commercial Fisheries (now National Marine Fisheries Service) was the coordinating agency. The field work, from February 1967 through March 1968, was divided into seven 2-month cruise periods. During each cruise period one or more ships were operating in the study area.

On completion of the field work the data seemed too numerous for a classical data report. Instead, it was decided to produce an 11-volume atlas of the results, with 5 volumes containing physical oceanographic and meteorological data from the principal participating ships, 5 volumes containing biological and nutrient chemistry data from the same ships, and 1 volume containing all data from Latin American cooperating ships and ships of opportunity.

Extensive use was made of a computer and automatic plotter in preparation of the atlas charts. Methods used to collect and process the data upon which the atlas is based are described in detail by the contributors of the following categories of charts: temperature, salinity, and derived quantities; thickness of the upper mixed layer; dissolved oxygen; meteorology; nutrient chemistry; phytoplankton standing stocks and production; zooplankton and fish larvae; micronekton; birds, fish schools, and marine mammals.

331. Guidelines for the Processing of Hot-Smoked Chub. By H. L. Seagran, J. T. Graikoski, and J. A. Emerson. January 1970, iv + 23 pp., 8 figs., 2 tables.

ABSTRACT

Attention is called to the importance of plant sanitation and of raw material quality and handling in the preparation of an acceptable, safe smoked chub product. Suggested procedures for brining and smoking the fish are included, together with a brief discussion of related variables and processing equipment. The application of these guidelines should help industry prepare smoked chub that will meet known requirements of public regulatory agencies.

332. Pacific Hake—Importance of the Worldwide Hake, *Merluccius*, Resource. By Richard B. Grinols, and Michael F. Tillman. March 1970, iii + 1-21 pp., 12 figs., 2 tables.

ABSTRACT

Aspects of hake taxonomy, biology, and world fisheries are reviewed from the literature. Of the 11 nominal hake species, 6 represent a substantial segment of the total gadoid species landed in the world and play an important role in world fisheries economy. The historical development of the fishery for six species of hake is discussed.

(332.) Pacific Hake—Distribution and Biology of Pacific Hake: A Synopsis. By Martin O. Nelson, and Herbert A. Larkins. March 1970, pp. 23-33, 2 figs., 1 table.

ABSTRACT

Pacific hake occur from the Gulf of Alaska to the Gulf of California. Genetic studies suggest that a single population inhabits the ocean region from British Columbia to Baja California.

Studies of the abundance of hake larvae have shown that spawning is mainly during December to April in offshore areas along the coasts of southern California and Baja California. The morphological characteristics of larvae are comparable to other fish with pelagic eggs. Larvae are most often encountered within or near the thermocline at temperatures of 47.5° to 65.3° F. Little is known about the distribution of juvenile (ages 1-3) hake.

Except when spawning, adult hake are primarily residents of the upper Continental Slope and Shelf. It is hypothesized that adult hake undertake an annual migration northward in the spring and summer and southward beginning in the fall to the offshore spawning region. During the late spring to fall, feeding adult fish are found from British Columbia to northern California and are most abundant off Washington and Oregon. By December most fish have moved out of the Vancouver Island-Oregon area.

Adult hake feeding in inshore areas during the spring to fall period characteristically form long narrow schools just off bottom. They make pronounced diel vertical migrations. Hake feed on a large variety of fish and invertebrates. In the Washington-Oregon region, euphausiids appear to be their primary food.

Hake grow rapidly to age 6. Preliminary age composition analysis suggests that after age 5 their annual natural mortality rate is about 43 percent. Apparent fluctuations in year class strength have been observed.

(332.) Pacific Hake—Food of Pacific Hake, *Merluccius productus*, in Washington and Northern Oregon Coastal Waters. By Miles S. Alton and Martin O. Nelson. March 1970, pp. 35-42, 2 figs., 4 tables.

ABSTRACT

Examination of the stomach contents suggests that Pacific hake feeds principally on pelagic organisms during its seasonal residence (spring to fall) off the Washington and northern Oregon coasts. Euphausiids, *Thysanoessa spinifera* and *Euphausia pacifica*, were the leading food items of Pacific hake in both frequency of occurrence and contribution by weight. Other important forms were fish and pandalid shrimp. Similar to Pacific hake, several of the prety of hake (euphausiids, pandalid shrimp, and *Sergestes similis*) undergo a vertical movement during the evening and early morning. A high incidence of empty stomachs in fish captured late in the day may suggest that hake resume feeding sometime between sunset and the following morning.

(332.) Pacific Hake—Pacific Hake Fishery in Washington and Oregon Coastal Waters. By Martin O. Nelson. March 1970, pp. 43-52, 2 figs., 2 tables.

ABSTRACT

In 1966 both United States and Soviet vessels began harvesting hake from coastal waters. Egg and larvae and trawl surveys have shown the hake resource to be large and capable of supporting a sizeable fishery. In offshore waters hake are fished from May to November between northern California and Vancouver Island. Four U.S. vessels participated in the offshore fishery in 1966, and 10 vessels in 1967. Total U.S. catches reported by fishermen were 3.7 million pounds in 1966 and 18.5 million pounds in 1967. The increased U.S. production in 1967 was due to increased fishing and increased catch-per-hour-trawled. Most of the U.S. production came from the region between lat. 46° and 48° N. in waters between 20 and 80 fathoms deep. Highest catch rates were during June and July. As the season progressed the fishery shifted to the north and to deeper water. Conspicuously few species were mixed in with the hake catches. The size of the offshore fishery is difficult to predict and will be greatly influenced by economic factors and fluctuations in stock abundance.

(332.) Pacific Hake—Operation of the Soviet Trawl Fleet off the Washington and Oregon Coasts during 1966 and 1967. By Charles R. Hitz. March 1970, pp. 53-75, 16 figs., 4 tables.

ABSTRACT

A large Soviet fishing fleet has been trawling for Pacific ocean perch and Pacific hake off the northwestern coast of the United States since April 1966. The report describes the types of vessels making up the fleet and the fishing techniques used.

The fleet comprised side trawlers, stern trawlers, and support ships. Details are given on the SRT, SRTR *Okean*, SRTM *Mayak*, RT *Pioneer*, BMRT *Pushkin* and *Mayakovskii*, RTM *Tropik* and *Atlantik*, *Skryplev*, and seven support ships.

The entire fleet worked as a unit with a command ship that directed the scouting and harvesting. It moved into the area in April and left in December. In 1966 the fleet reached a peak of 111 ships in July, and in 1967 it peaked at 114 ships in May.

(332.) Pacific Hake—Midwater Trawling Equipment and Fishing Technique for Capturing Hake off the Coast of Washington and Oregon. By Leonard J. Johnson, and William L. High. March 1970, pp. 77-101, 20 figs., 8 tables.

ABSTRACT

The Bureau of Commercial Fisheries has designed and developed midwater trawls, special otterboards, and a system to continuously indicate trawl depth. Cobb pelagic trawls have caught hake in midwater and the BCF Universal trawl has caught hake both on bottom and in midwater while being towed by Pacific Northwest trawlers at only 1.6 to 2.3 knots. Both Cobb pelagic otterboards and China V-doors have been used to spread the trawls. The trawls were designed to open 40 to 80 feet. Comparative fishing trials have shown that trawls of light-weight monofilament catch more fish than trawls of multifilament nylon. To trawl effectively for hake in midwater the fisherman must invest about $16,000 for equipment—two trawls, two depth telemetry systems, otterboards, cable meters, and 20-inch diameter trawl blocks.

(332.) Pacific Hake—Economic Aspects of the

1967 Offshore Pacific Hake Fishery. By Walter T. Pereyra, and Jack A. Richards. March 1970, pp. 103-119, 10 figs., 8 tables, 1 app.

ABSTRACT

The study was carried out to ascertain the economic performance of existing trawl vessels when fishing for hake with modern midwater trawl gear. Cost and revenue aspects of the 1967 operation are presented, and the economics of the fishery are discussed relative to the establishment of a viable Pacific hake fishery.

(332.) Pacific Hake—Proximate Chemical Composition of Pacific Hake. By Max Patashnik, Harold J. Barnett, and Richard W. Nelson. March 1970, pp. 121-125, 6 tables.

ABSTRACT

The composition of ocean hake varied seasonally, and fat varied most. Whole fish had about 1.5 to 3.5 percent fat during March to July and about 4 to 6 percent fat during September to November. They had 13.4 to 15.0 percent protein during March to July and 14.4 to 15.6 percent protein during September to November. They had about 3 percent ash during all periods. In contrast to the edible fillets, the waste portion had lower moisture, lower protein, and substantially higher fat contents.

The composition of Puget Sound hake varied seasonally, and again fat varied most. The fat content of whole fish was highest (6.4-7.4 percent) from about October through January. The average fat content of Puget Sound hake was higher than that of ocean hake, being 73 percent higher in the whole fish, 56 percent higher in fillets, and 68 percent higher in the waste portion. The protein content of whole fish ranged from 12.3 to 13.4 percent in early April to 16.1 percent in July. During the period January through May and during October, the livers were high in fat, averaging 44 percent fat in females and 58 percent fat in males.

The average protein content of ocean hake fillets was 16.5 percent and that of Puget Sound fillets was 16.1 percent.

(332.) Pacific Hake—Characteristics of Pacific Hake, *Merluccius productus*, That Affect Its Suitability for Food. By John A. Dassow, Max Patashnik, and Barbara J. Koury. March 1970, pp. 127-136, 3 figs., 1 table.

ABSTRACT

The expanding population and the increasing dependence of the United States on imported food fish necessitate a continuing study of latent protein sources such as the undeveloped fishery for Pacific hake off the Pacific coast.

Direct use of hake in food products is desirable to encourage diversification of the fishing industry. Hake, long considered an undesirable species, has been studied for potential application in fresh, frozen, and processed products. The factors studied include color, odor, flavor, texture (including the cause of mushy texture), keeping quality, composition, and food value. We believe that the best use of species such as hake is in processed-food products for which frozen minced fish flesh can be prepared with suitable additives that help it have desirable flavor, texture, and keeping quality.

(332.) Pacific Hake—Production of Meal and Oil from Hake. By Richard W. Nelson, and John A. Dyer. March 1970, pp. 137-142, 5 figs., 2 tables.

ABSTRACT

The chemical and physical properties of Pacific hake indicate that it is suitable for production of meal and oil. The oil content is sufficiently high so that wet rendering should be used to produce a high-quality fish meal. A plant built at Aberdeen, Wash., has operated successfully from a technical standpoint but has experienced difficulty obtaining enough hake to enable it to operate profitably and at prices the plant could afford to pay.

(332.) Pacific Hake—Preliminary Studies of the Nutritive Value of Hake Meal for Poultry. By Lawrence R. Berg. March 1970, pp. 143-148, 6 tables.

ABSTRACT

As new fish meal such as Pacific hake meal are produced and offered to the feeding industry, the value of such meals as ingredients in poultry rations needs to be determined. During 1966 and 1967, meals became available from initial hake reduction operations on the Pacific coast. The composition of three samples of hake meals and their nutritive value in poultry rations were studied. In comparative tests with British Columbia herring meal, all meals promoted good growth when added at the 5 percent level to a basal ration for broilers.

(332.) Pacific Hake—Feeding Pacific Hake to Mink. By F. M. Stout, J. Adair, and J. E. Oldfield. March 1970, pp. 149-152, 3 tables.

ABSTRACT

Pacific hake offers considerable potential as an economical protein source for mink rations. Early research demonstrated that a serious problem, "cotton-fur," a manifestation of iron deficiency, was caused by feeding raw hake to mink. This problem was identified and surmounted by heat-processing the hake. This report deals with investigation of the nutritional value to the mink of rations containing several forms and quantities of hake.

333. Recommended Practices for Vessel Sanitation and Fish Handling. By Edgar W. Bowman and Alfred Larsen. March 1970, iv + 27 pp., 6 figs.

ABSTRACT

Current practices aboard commercial fishing vessels have come about largely through trial and error, rather than through the application of research findings. As a result, fishermen have not always kept pace with the increasing demands by consumers for fishery products of higher quality. This report can provide the fishery industry with a measuring stick necessary for self evaluation, while supplying specific recommendations for improving vessel sanitation and fish handling techniques.

334. Published in 1969.

335. Progress Report of the Bureau of Commercial Fisheries Center for Estuarine and Menhaden Research, Pesticide Field Station, Gulf Breeze, Fla. Fiscal Year 1969. By T. R. Rice, and Thomas W. Duke. August 1970, iii + 33 pp., 29 figs., 12 tables.

ABSTRACT

Research activities include studies on the fate and effect of pesticides in the estuarine environment.

336. The Northern Fur Seal. By Ralph C. Baker, Ford Wilke, and C. Howard Baltzo. April 1970, iii + 19 pp.

ABSTRACT

The early history of worldwide fur sealing; the distribution and movement of northern fur seals; and their food, physical characteristics, reproduction, and mortality and disease are discussed. Information is also given on fur seal population, management, and research; sealing on the Pribilof Islands; and processing and sale of fur seal skins.

337. Program of Division of Economic Research, Bureau of Commercial Fisheries, Fiscal Year 1969. By Frederick W. Bell. April 1970, iii + 29 pp., 12 figs., 7 tables.

ABSTRACT

The Division studies the economic behavior of the U.S. fishing industry to provide information needed by Government policy makers and industry members to solve many of the problems facing the fishing industry. This first report describes briefly the organization and functions of the Division in relation to the Government's policies concerning the commercial fisheries.

The report summarizes (1) the projects completed in the Branch of Demand and Marketing Research and the Branch of Supply and Resource Use Research during Fiscal Year 1969; and (2) those projects included in Fiscal Year 1970 work program.

338. Bureau of Commercial Fisheries Biological Laboratory Auke Bay, Alaska. By U.S. Department of the Interior, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries. June 1970. (Four-Fold Flyer)

(No abstract)

339. Salmon Research at Ice Harbor Dam. By Wesley J. Ebel. April 1970. (Four-Fold Flyer, 4 figs.)

ABSTRACT

Juvenile salmon were collected at Ice Harbor Dam and transported downstream in the Columbia River. This method of bypassing dams and reservoirs may be a means of increasing the survival of the fish.

340. Bureau of Commercial Fisheries Technological Laboratory Gloucester, Massachusetts,. By U.S. Department of the Interior, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries. June 1970. (Four-Fold Flyer.)

(No abstract)

341. Report of the Bureau of Commercial Fisheries Biological Laboratory, Beaufort, N.C. For the Fiscal Year Ending June 30, 1968. By Kenneth A. Henry, and Joseph H. Kutkuhn and Staff August 1970, iii + 24 pp., 11 figs., 16 tables.

ABSTRACT

Results of biological research in the blue crab and menhaden programs are discussed. Major topics include abundance, distribution, and survival of blue crab and menhaden larvae, juveniles, and adults; results of menhaden tagging studies; and details of the 1967 menhaden fishery. Other activities of the laboratory staff, and publications for fiscal year 1968, are listed.

342. Report of the Bureau of Commercial Fisheries Biological Laboratory, St. Petersburg Beach, Florida, Fiscal Year 1969. By James E. Sykes. August 1970, iii + 22 pp., 20 figs., 8 tables.

ABSTRACT

Highlights of research in fiscal year 1969 included analysis and publication of data related to effects of engineering on the estuarine resource and completion of field work on the Florida portion of the cooperative Gulf of Mexico Estuarine Inventory. In addition, data supplied through testimony to the Florida Legislature assisted in the establishment of an aquatic preserve; and after a local hearing in which Laboratory data were presented, a municipality disapproved a potentially damaging engineering project.

343. Report of the Bureau of Commercial Fisheries Biological Laboratory, Galveston,

Texas Fiscal Year 1969. By Milton J. Lindner and Robert E. Stevenson. August 1970, iii + 39 pp., 28 figs., 9 tables.

ABSTRACT

Progress of research is reported. Emphasis is on shrimp, and the research involves the fields of mariculture, population dynamics, ecology, and oceanography.

344. Bureau of Commercial Fisheries Tropical Atlantic Biological Laboratory Progress in Research 1965-'69 Miami, Florida. By Ann Weeks. October 1970, iv + 65 pp., 53 figs.

ABSTRACT

The history, facilities, and programs of the laboratory are described. The development of the tuna fishery in the tropical Atlantic Ocean, mid-1950's to mid-1960's, is discussed. Condensed cruise reports of the research vessels *Geronimo* and *Undaunted* are included.

345. Not issued.

346. Sportsman's Guide to Handling, Smoking, and Preserving Great Lakes Coho Salmon. By Shearon Dudley, J. T. Graikoski, H. L. Seagran, and Paul M. Earl. September 1970, iii + 28 pp., 15 figs.

ABSTRACT

Since the introduction of coho salmon in Lake Michigan in 1966, little information on the proper care and use of the Great Lakes variety of this fish has been made available to the sportsman. This pamphlet gives guidelines for cleaning, hutchering, cooking, or storing coho. Emphasis is placed on smoking procedures—one of the more popular ways of preparing coho. The use of these guidelines will help the sportsman prepare satisfactory products.

347. Synopsis of Biological Data on Pacific Ocean Perch, *Sebastodes alutus*. By Richard L. Major and Herbert H. Shippen. December 1970, iii + 38 pp., 31 figs., 11 tables.

ABSTRACT

This synopsis has information on the taxonomy, life history, population structure, and harvesting of a species that is being intensively fished and studied by the United States, Canada, the U.S.S.R., and Japan. This synopsis includes data from scientific papers either printed in English or translated from Japanese and Russian into English.

348. Not issued.

349. Published in 1971.

350. Research in Fiscal Year 1969 at the Bureau of Commercial Fisheries Biological Laboratory, Beaufort, N.C. By Kenneth A. Henry, and Joseph H. Kutkuhn. November 1970, ii + 49 pp., 21 figs., 17 tables.

ABSTRACT

Research on blue crab, conducted for thirteen years at the Laboratory, is summarized briefly. Progress of research in the menhaden investigation —the life history, ecology, behavior-physiology, tagging, and population dynamics programs—is reported. Research in the Industrial Schoolfishes Program is reviewed.

351. Bureau of Commercial Fisheries Exploratory Fishing and Gear Research Base, Pascagoula, Mississippi July 1, 1967 to June 30, 1969. By Harvey R. Bullis, Jr., and John R. Thompson. November 1970, iv + 29 pp., 29 figs., 1 table.

ABSTRACT

The research activities of the Base emphasize the development of new techniques for locating and assessing unutilized marine stocks and include studies in aerial photography, multispectral photography, marine bioluminescence, fish oil film, and sonar technology. Described are the outfitting of the new research vessel *Oregon II*; the continuation of conventional exploration for shrimp and fish in the Gulf of Mexico, Caribbean, and western Atlantic; the efforts to implement the development of the Florida calico scallop industry; and the activities of the Exploratory Data Center.

352. Upstream Passage of Anadromous Fish Through Navigation Locks and Use of the Stream for Spawning and Nursery Habitat Cape Fear River, N.C., 1962-66. By Paul R. Nichols and Darrell E. Louder. October 1970, iv + 12 pp., 9 figs., 4 tables.

ABSTRACT

Studies were made of the feasibility of using navigation locks to pass anadromous fish upstream during their spawning migration in lieu of installing fishways. It was found that shad and other anadromous fish will use the locks to move upstream and locks may be used to restore, at least in part, spawning runs above barriers. Continued studies are needed to refine techniques for locking fish upstream.

Data Report

(Hard copies of Data Reports Nos. 40 thru 47 are for sale at $3.00 and microfiche copies for 65 cents each—Nos. 48 and 49 are for sale at $10.00 and microfiche copies for 65 cents each by the U.S. Department of Commerce, National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22151.)

40. Larvae of Tuna and Frigate Mackerel (Pisces, Scombridae) in the Northwestern Gulf of Guinea and Off Sierra Leone, *Geronimo* Cruise 5, 10 February to 19 April 1965. United States Department of the Interior, Bureau of Commercial Fisheries. By W. J. Richards, David C. Simmons, Ann Jensen, and Walter C. Mann. April 1970, 24 pp. on 1 microfiche.

ABSTRACT

The number of tuna and frigate mackerel larvae are given by size class, and associated station data are listed.

41. Spawning Ground Catalog of the Chignik River System, Alaska. United States Department of the Interior. Bureau of Commercial Fisheries. Duane E. Phinney. January 1970, 147 pp. on 3 microfiche.

ABSTRACT

All known information about the sockeye salmon runs and the spawning grounds of the Chignik River System, Alaska, is cataloged in this report. The system, which is composed of two lakes, Chignik and Black, supports the largest run of sockeye salmon on the south side of the Alaska Peninsula. The catalog lists for each spawning stream or beach the name, location, physical description, description of the sockeye salmon runs, and a chronological listing of the spawning ground surveys.

42. Temperature, Salinity, and Transparency Observations, Coastal Gulf of Maine, 1962-65. United States Department of the Interior, Bureau of Commercial Fisheries. By Joseph J. Graham. January 1970, 44 pp. on 1 microfiche.

ABSTRACT

The observations are plotted for 11 cruises. Temperature usually increased and salinity decreased from east to west along the coast. These trends were complicated vertically by less tidal mixing and larger river discharges in the west, causing a more pronounced vertical stratification there than in the east. Transparency usually increased from inshore to offshore, and at times the distribution of isolines of transparency agreed closely with those of temperature.

43. Temperature, Dissolved Oxygen, Total Alkalinity, and Biochemical Oxygen Demand in the Columbia River Estuary, 1966-67. United States Department of the Interior. Bureau of Commercial Fisheries. By Carl W. Sims, and Carl J. Cederholm. January 1970, 34 pp. on 1 microfiche.

ABSTRACT

These data collected at 19 locations in the Columbia River estuary are presented as a reference for researchers in fisheries or in water quality.

44. Stream Catalog of Southeastern Alaska Regulatory Districts Nos. 10 and 11. United States Department of the Interior, Bureau of Commercial Fisheries. By E. J. Huizer, T. H. Richardson, and Norman Johnston. February 1970, 268 pp. on 4 microfiche.

ABSTRACT

Information about part of Southeastern Alaska salmon streams is cataloged from the voluminous records of the Alaska Department of Fish and Game; the Alaska Salmon Industry; the Fisheries Research Institute of the University of Washington; the U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries; and other agencies. Stream descriptions, maps, and historical records of salmon escapement data are compiled for 71 salmon streams in Southeastern Alaska Regulatory Districts 10 and 11. Each stream is located geographically by latitude and longitude and by orientation to prominent landmasses. A standard numbering system, number designations formerly in use, and common names of streams are listed. Physical descriptions are presented for the intertidal zone and the upstream area of each stream. Available records of weather, water temperatures, and information useful to ground and aerial stream surveyors are presented in brief form. The species of salmon using the spawning grounds and estimates of the escapements each year for many years are given.

45. Stream Catalog of Southeastern Alaska Regulatory Districts Nos. 14 and 15. United States Department of the Interior. Bureau of Commercial Fisheries. By E. J. Huizer, and T. H. Richardson. February 1970, 209 pp. on 4 microfiche.

ABSTRACT

Information about part of Southeastern Alaska salmon streams is cataloged from the voluminous records of the Alaska Department of Fish and Game; the Alaska Salmon Industry; the Fisheries Research Institute of the University of Washington; the U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries; and other agencies. Stream descriptions, maps, and historical records of salmon escapement data are compiled for 69 salmon streams in Southeastern Alaska Regulatory Districts 14 and 15. Each stream is located geographically by latitude and longitude and by orientation to prominent landmasses. A standard numbering system, number designations formerly in use, and common names of streams are listed. Physical descriptions are presented for the intertidal zone and the upstream areas of each stream. Available records of weather, water temperatures, and information useful to ground and aerial stream surveyors are presented in brief form. The species of salmon using

the spawning grounds and estimates of the escapements each year for many years are given.

46. Stream Catalog of Southeastern Alaska Regulatory District No. 12. United States Department of the Interior. Bureau of Commercial Fisheries. By E. J. Huizer, T. Richardson, and C. C. Larson. March 1970, 223 pp. on 4 microfiche.

ABSTRACT

Information about part of Southeastern Alaska salmon streams is cataloged from the voluminous records of the Alaska Department of Fish and Game; the Alaska Salmon Industry; the Fisheries Research Institute of the University of Washington; the U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries; and other agencies. Stream descriptions, maps, and historical records of salmon excapement data are compiled for 58 salmon streams in Southeastern Alaska Regulatory District 12. Each stream is located geographically by latitude and longitude and by orientation to prominent landmasses. A standard numbering system, number designations formerly in use, and common names of streams are listed. Physical descriptions are presented for the intertidal zone and the upstream areas of each stream. Available records of weather, water temperatures, and information useful to ground and aerial stream surveyors are presented in brief form. The species of salmon using the spawning grounds and estimates of the escapements each year for many years are given.

47. Stream Catalog of Southeastern Alaska Regulatory District No. 13. United States Department of the Interior. Bureau of Commercial Fisheries. By James W. Parker. March 1970, 326 pp. on 5 microfiche.

ABSTRACT

Information about part of Southeastern Alaska salmon streams is cataloged from the voluminous records of the Alaska Department of Fish and Game; the Alaska Salmon Industry; the Fisheries Research Institute of the University of Washington; the U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries; and other agencies. Stream descriptions, maps, and historical records of salmon escapement data are compiled for 99 salmon streams in Southeastern Alaska Regulatory District 13. Each stream is located geographically by latitude and by orientation to prominent landmasses. A standard numbering system, number designations formerly in use, and common names of streams are listed. Physical descriptions are presented for the intertidal zone and the upstream area of each stream. Available records of weather, water temperatures, and information useful to ground and aerial stream surveyors are presented in brief form. The species of salmon using the spawning grounds and estimates of the escapements each year for many years are given.

48. Physical-Chemical Oceanographic Data from the North Pacific Ocean, 1966-68. United States Department of the Interior, Bureau of Commercial Fisheries. W. J. Ingraham, Jr. and D. M. Fisk. June 1970, 683 pp. on 10 microfiche.

ABSTRACT

Temperature and salinity data collected during six cruises of the RV *George B. Kelez* and one cruise of the RV *Miller Freeman* in the central and northeastern Pacific Ocean are presented. These data were compiled from 156 Nansen bottle casts and 494 STD casts.

49. Materials for the Study of Changes in Apparent Abundance of Tunas in the Indian Ocean, 1952-65. United States Department of the Interior. Bureau of Commercial Fisheries. B. J. Rothschild and M. Y. Y. Yong. June 1970, 349 pp. on 6 microfiche.

ABSTRACT

Data have been summarized on CPUE (catch-per-unit-of-effort) for the yellowfin tuna, bigeye tuna, southern bluefin tuna, and albacore, for each 10-degree quadrangle of the Indian Ocean. The summarization includes (1) estimates of CPUE of each tuna species for each month (1952-65) and 10-degree quadrangle of the Indian Ocean; (2) plots of a least-squares polynominal showing the observed and fitted points of CPUE as a time-series for each 10-degree quadrangle; and (3) tables giving the actual values of CPUE, the predicted values, and the residual values as functions of time for each 10-degree quadrangle.

Fishery Industrial Research

Vol. 6, No. 1. Commercial Feasibility of Irradiating Haddock and Cod Fillets: Introduction. By John D. Kaylor and Edward J. Murphy. pp. 1-3, 1 fig.

ABSTRACT

In the studies introduced by this report, three questions were asked: Is a high enough proportion of haddock and cod, as landed in New England, fresh enough to justify their being irradiated? (2) Is the temperature of fish during commercial distribution by common carrier sufficiently low to preserve the quality of the fish? (3) Can haddock and cod fillets be irradiated and shipped on a commercial scale and still exhibit a significantly increased shelf life at iced temperatures? The data collected in the studies indicate that the answer to each of the three questions is "yes."

Vol. 6, No. 1. Recommendations for Handling and Icing Fresh Pacific Halibut Aboard Vessels. By Wayne Tretsven and Harold

Barnett. pp. 5-13, 5 figs., 1 table.

ABSTRACT

The icing of halibut aboard the fishing vessel sometimes is inadequate to minimize the loss of quality during the trip. Observations made of icing and other handling practices aboard halibut vessels serve as the basis for the recommendations suggested here for improving the method of handling. Adhering to these recommendations will help the fisherman land halibut of more uniform quality.

Vol. 6, No. 1. Phycocolloids. By Norman W. Durrant and F. Bruce Sanford. pp. 15-51, 45 figs.

ABSTRACT

Although phycocolloids—gelatinous materials produced from seaweeds—are economically important, they are not widely known materials. This paper discusses the three principal phycolloids manufactured in this country—namely, agar-agar, algin, and carrageenan—and outlines the ways they are produced and the ways they are used. At the manufacturer's level, these three phycocolloids are worth about 15 million dollars a year to the United States.

Vol. 6, No. 2. Machine for Separating Northern Shrimp, *Pandalus borealis*, from Fish and Trash in the Catch. By Michael G. Corbett. pp. 53-62, 8 figs.

ABSTRACT

Because of the labor required in separating northern shrimp from the unwanted components of the catch that are taken along with it, this valuable resource in the Gulf of Maine is not harvested to the extent possible. Consequently, a machine was developed to separate the shrimp from the bulk of groundfish and other species taken in trawl catches during exploratory and commercial fishing. Its use eliminates the laborious task of sorting the catch by hand, yet the separator recovers about 95 percent of the shrimp that are fed into it, while eliminating about 90 percent of the trash.

Vol. 6, No. 2. Recommendations for the Sanitary Operation of Plants that Process Fresh and Frozen Fish. By J. Perry Lane. pp. 63-82.

ABSTRACT

The problem of sanitation in food-processing plants is receiving increasing attention from Federal and State regulatory agencies, as well as private industry. This article covers recommended guidelines that can assist the processors of fresh and frozen fish in evaluating their existing sanitation practices or in establishing new ones.

Vol. 6, No. 2. Tow-Bar System for Seining Farm Ponds. By Kenneth L. Coon and James E. Ellis. pp. 83-88, 5 figs.

ABSTRACT

The farm-pond fish-raising industry has needed mechanized methods to lower the cost of harvesting the fish. This report describes equipment and its operation for hauling a small seine with farm tractors or trucks if the pond has levees or a shore that can accommodate these vehicles. The equipment works well with ponds up to 450 feet wide and of any length.

Vol. 6, No. 2. Preliminary Study of the Proximate Composition of Meat of Fur Seal, *Callorhinus ursinus*. By Richard W. Nelson and Harold J. Barnett. pp. 89-92, 4 tables.

ABSTRACT

Finding profitable uses for the carcasses of fur seal has presented a problem to the Bureau of Commercial Fisheries. As a part of an effort to encourage use of the carcasses, several separate lots of meat and ground eviscerated carcasses were analyzed to determine proximate chemical composition. In this preliminary study, individual carcasses and samples from lots of ground carcasses were high in protein content and variable in oil content. Analyses of small samples of male and female seals taken at different times during the harvesting season indicated that variation in composition did not correlate with the time of sampling nor with the sex of the animal.

Vol. 6, No. 3. Feasibility of Using Tennessee River Fish for Fishery Products. By Richard A. Krzeczkowski. pp. 93-103, 4 tables.

ABSTRACT

Populations of reservoir fishes are dominated by species that are of no interest to sport fisherman and that are of low market value. Yet a useful outlet is needed for them. Would they perhaps be suitable for the production of fish meal?

In partial answer to this complex question, the present study investigated the nutritional aspects of some of the principal species of fishes growing abundantly in reservoirs. In this connection, carp, freshwater drum, gizzard shad, and threadfin shad from the Tennessee River (specifically, Kentucky Lake) were harvested commercially and were rendered into press cake and fish meal. The seasonal variations in proximate analyses, the composition of extracted fish oil, the presence or absence of thiaminase in the materials, the concentration of DDT and DDE, and the comparative value of the fish meal in broiler rations were determined. The study indicated that these species of fishes are nutritionally and physically suitable for the production of fish press cake, meal, and oil.

Vol. 6, No. 3. Economic Study of the San Pedro Wetfish Boats. By William F. Perrin and Bruno G. Noetzel. pp. 105-138, 11 figs., 24 tables.

ABSTRACT

The San Pedro wetfish fleet is shrinking in size and is not yielding good wages for fishermen or good returns to investors. A study was made to

determine if improvement of the economic state of the antiquated fleet might be accomplished by the construction of new, efficient vessels, both for replacements and for expansion of the fleet to harvest underused stocks of jack mackerel and anchovies in the region of the California Current. The investigation yielded two conclusions: (1) the construction of new vessels—even if subsidized—is not economically feasible at present rates of catch and prices of fish and (2) the expansion of the fleet through acquisition of surplus vessels from other fisheries at relatively favorable cost is feasible, given sufficient demand for wetfish at present prices.

Vol. 6, No. 3. Commercial Feasibility of Irradiating Haddock and Cod Fillets-1. Quality of Haddock as Landed at Boston, Massachusetts. By John D. Kaylor and Edward J. Murphy. pp. 139-145, 3 tables.

ABSTRACT

Successful commercial preservation of fresh fish fillets by irradiation requires that raw material of a level of quality suitable for irradiation be available. To determine the amount of haddock, *Melanogrammus aeglefinus*, landed in Boston by the New England offshore fleet that meet this level, we surveyed the Boston haddock fishery. About 78 percent of the haddock landed were of a level of quality high enough to warrant their being irradiated. Because haddock and cod, *Gadus morhua*, are handled similarily, this conclusion also applies to cod. Thus, the quality of fish would not be a problem in the irradiation preservation of fresh haddock and cod fillets.

Vol. 6, No. 3. Commercial Feasibility of Irradiating Haddock and Cod Fillets-2. Temperature Patterns During Shipments of Fresh Fillets By Truck and By Rail. By John D. Kaylor and Edward J. Murphy. pp. 147-154, 7 tables.

ABSTRACT

For fresh haddock and cod fillets to be irradiated and shipped commercially to distant points in the United States, the fillets must be kept near the temperature of ice during distribution. To check on the temperatures to be expected, we surveyed the principal methods of commercial distribution of fresh fishery products. We found that present commercial methods of distributing fresh haddock fillets result in fillet temperatures that average less than 40° F., a temperature that would be sufficiently low to permit shipment of irradiated fillets to the most distant parts of the country.

Vol. 6, No. 3 Author Index to Publications and Addresses—1968, Bureau of Commercial Fisheries Branch of Technology and Branch of Reports (Seattle). By Helen E. Plastino and Mary S. Fukuyama. pp. 155-162.

(No abstract)

Vol. 6, No. 4. Machine Separation of Edible Flesh from Fish. By David Miyauchi and Maynard Steinberg. pp. 165-171, 2 figs., 3 tables.

ABSTRACT

Meeting the expanding demand for fishery products will require us to utilize the undeveloped fisheries and the industrial fisheries as sources of food. This use, in turn, will require us to develop foods that are new and that are unique in appearance, palatability or nutritional qualities. One step we can take toward this goal is to recover a higher yield of edible flesh from fish economically. By use of a flesh-separating machine, such as the one reported upon here, we can significantly increase the yield of edible flesh.

Vol. 6, No. 4. Blueing of Processed Crab Meat 1. A Study of Processing Procedures That May Cause a Blue Discoloration in Fasteurized Crab Meat. By Melvin E. Waters. pp. 173-183, 3 tables.

ABSTRACT

Although the yearly economic loss due to the sporadic blueing of canned pasteurized crab meat usually is small, processors understandably are anxious to avoid this problem.

To study the causes of blue discoloration, I varied the commercial methods. Pasteurizing at temperatures above 170° F. (regardless of processing time) causes some blueing of the meat. Aging the meat before pasteurizing it shortened its shelf life but did not cause blueing. Exposing the meat to the metal of cans as well as to bits of solder placed in the meat also did not cause blueing. Heating the meat at 170° F. for 5 minutes was adequate to pasteurize meat containing 49×10^4 microorganisms per gram and resulted in a product free from blueing during a shelf life of more than 12 months.

Vol. 6, No. 4. The Ocean Quahog, *Arctica islandica*, resource of the Northwestern Atlantic. By Phillip S. Parker and Ernest D. McRae, Jr. pp. 185-195, 5 figs., 4 tables.

ABSTRACT

The ocean quahog is a species of marine clam. Some of the anatomical differences between it and the hard clam, *Mercenaria mercenaria*, are discussed. The range and population density of the ocean quahog in Continental Shelf areas off the Atlantic seaboard vary considerably with changes in water depths and bottom sediments.

Much of the basic information for this article was gathered during the survey of the surf clam, *Spisula solidissima*, by the Bureau of Commercial Fisheries. The gear, method used, procedure, and

results of the survey pertinent to ocean quahogs are presented.

The ocean quahog resource is generally unused. It is waiting for anyone willing to reap the harvest.

Fishery Leaflet

627. List of Fishery Cooperatives in the United States, 1969-70. By U.S. Department of the Interior, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries. June 1970, iii + 13 pp.

ABSTRACT

Seventy-eight fishery cooperatives in 15 States and Puerto Rico are listed. Also included in most instances are the name of one of the officers of each co-op, the number of members, the number of boats owned by members, the type of cooperative, and the major species of fish and shellfish caught.

628. Available Fishery Bulletins of the U.S. Fish and Wildlife Service. By U.S. Department of the Interior, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries. February 1970, 11 pp.

ABSTRACT

Fishery Bulletins are technical reports on scientific investigations of fishery biology. The Bulletin of the United States Fish Commission was begun in 1881; it became the Bulletin of the Bureau of Fisheries in 1904 and the Fishery Bulletin of the Fish and Wildlife Service in 1941. Separates were issued as documents through volume 46; the last document was No. 1103. Beginning with volume 47 in 1931 and continuing through volume 62 in 1963, each separate appeared as a numbered Bulletin. A new system began in 1963 with volume 63, in which papers are bound together in a single number of the Bulletin. Available Bulletins are distrubuted free to libraries and to a limited number of universities and other scientific cooperators. A listing of all Bulletins in volumes 47 through 65 is distributed free by the Division of Publications, Bureau of Commercial Fisheries, 1801 N. Moore St., Arlington, VA. 22209. If you need this complete listing, please ask for Fishery Leaflet 597.

629. Fishery Motion Pictures. By U.S. Department of the Interior, U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries. May 1970, iii + 28 pp.

(No abstract)

630. A Brief History of Commercial Fishing in Lake Erie. By Vernon C. Applegate and Harry D. Van Meter. April 1970, iii + 28 pp., 8 figs., 16 photos, 1 app. table.

ABSTRACT

Salient features of the development of the industry from about 1815 to 1968, changes in fishing gears and methods, changes in the kinds and abundance of fishes caught, and the attendant effects of disappearing species on the stability of the fishery are described. The history and present status of the walleye, yellow perch, and eight other fishes, still taken in commercial quantities, are presented in more detail and are considered in the context of their effect on the current moribund state of the U.S. fishery. Past and present contributions of Lake Erie's tributaries and northerly connecting waters to the fishery are outlined briefly. The "outlook" for the fishery under present conditions of selective overfishing for high-value species, excessive pollution, ineffective and uncoordinated regulation, and antiquated methods of handling, processing, and marketing fish are discussed, and possible solutions to these problems are suggested.

631. Alaska's Fishery Resources—The Shrimps. By Louis Barr. January 1970, iii + 10 pp., 7 figs., 1 table.

ABSTRACT

Shrimp fishing began in Alaska over 50 years ago. Recently the annual domestic catch has been as high as 40 million pounds. Japanese and Soviet Union fishermen operating in Alaska waters have caught as much as 70 million pounds annually in recent years.

The five commercially important shrimp of Alaska belong to the family Pandalidae; the most important is the pink shrimp, *Pandalus borealis*. The complicated life histories of these shrimp are all similar. The shrimp develop first as males and after several years transform to females, which they remain for the rest of their lives.

United States fishermen use otter trawls, beam trawls, and pots, and deliver their catch to ports in Alaska; foreign fishermen use larger otter trawls and process the catch at sea.

The Alaska Department of Fish and Game and the Bureau of Commercial Fisheries are studying shrimp. They are sampling the commercial catch, trying to improve the product, and conducting exploratory fishing and biological research.

632. Alaska's Fishery Resources—The Chum Salmon. By Theodore R. Merrell, Jr. June 1970, iii + 7 pp., 6 figs., 2 tables.

ABSTRACT

The chum salmon, *Oncorhynchus keta*, is the most widely distributed and second most abundant of the five Pacific salmon. It is one of Alaska's valuable fishery resources. Chum salmon spawn in late summer and fall—some in small streams near the ocean and others in large rivers in which they travel as far as 1,500 miles from the ocean. The young hatch in midwinter but stay in the stream gravel until spring, when they emerge and migrate to sea. They spend 2 to 4 years in the sea and weigh

about 10 pounds when they return to spawn and die in their native stream. Most chum salmon are taken in purse seines and are canned; hundreds of thousands are caught in gill nets and fish wheels for human and dog food. This fishery is mostly in the large rivers that run into the Bering and Chukchi Seas of northern Alaska. Little biological research has been done on chum salmon, so less is known about them than any other Pacific salmon.

633. Diversion and Collection of Juvenile Fish with Traveling Screens. By Daniel W. Bates. March 1970, 6 pp., 6 figs.

ABSTRACT

A horizontal traveling screen, suitable for screening fish or debris from powerplant water intakes or irrigation diversions, was designed and operated by the Bureau of Commercial Fisheries during 1965-69. The structure consisted of a vertically hung, endless belt or wire-cloth screen panels, flush with the face of the water intake structure or at an angle to the direction of flow.

Field tests in different water approach velocities, with the screen traveling at various rates, proved that such a facility can be operated efficiently. The horizontal traveling screen, as described here, should contribute materially to the development of an efficient, relatively low-cost diversion facility for fish and debris.

Special Scientific Report — Fisheries

586. The Trade Wind Zone Oceanography Pilot Study Part VII: Observations of Sea Birds March 1964 to June 1965. By Warren B. King. June 1970, vi + 136 pp., 36 figs., 11 tables, 2 app. tables.

ABSTRACT

Sea birds were observed by scientists of the Smithsonian Institution's Pacific Ocean Biological Survey Program on a systematic basis in the central Pacific Ocean for 15 months as part of the Trade Wind Zone Oceanography Program of the Bureau of Commercial Fisheries Biological Laboratory, Honolulu, Hawaii. Two experienced observers alternated watches each day from sunrise to sunset. Every bird sighted was identified and logged, along with the time and location of observation, the number of birds in the sighting, and, when possible, their age, sex, plumage, molt, behavior, direction of flight, and any other information that might prove pertinent. Twenty-five birds that were captured alive were banded, and 18 birds were collected to help verify sight records of species seldom or never recorded previously in the central Pacific. In 3,561.1 hours of observation, 13,080 sightings were made of 65,707 birds along the replicate cruise track covering 34,384 nautical miles (63,610 km.)

The distribution and abundance of each of the 51 species or field-recognizable subspecies observed within the study area were treated on a monthly and seasonal basis and discussed in the light of the island of origin and breeding phenology of each species. The abundance of sea birds was examined in relation to environmental conditions to show the extent of their association.

The composition, distribution, and abundance of flocks of sea birds were analyzed.

587-590. Published in 1969.

591. A Bibliography of the Lobsters, Genus *Homarus*. By R. D. Lewis. January 1970, i + 47 pp.

ABSTRACT

A total of 1,303 references are given.

592. Passage of Adult Salmon and Trout Through Pipes. By Emil Slatick. January 1970, iii + 18 pp., 8 figs., 12 tables.

ABSTRACT

Pipes, which are relatively inexpensive and easily installed, are an economical and efficient solution to certain problems of fish passage at dams and at other obstacles blocking migratory routes. The purposes of this study (1963-64) were to determine: (1) if adult salmon and trout at Bonneville Dam on the Columbia River would use a pipe as a passageway and (2) how the conditions at the entrance and within the pipe, diameter and length, illumination, and flow would influence passage. The pipes were 0.3, 0.6, and 0.9 m. in diameter and were 27.4 to 82.3 m. long. Chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon (*O. nerka*), coho salmon (*O. kisutch*), and steelhead trout (*Salmo gairdneri*) passed through unilluminated pipes up to 82.3 m. long. Of the four species tested, only steelhead trout appeared to benefit appreciably from illumination. For distances up to 82.3 m., a 0.6-m.-diameter pipe was large enough to pass all salmon and trout. The fish passed through a 0.6-m.-diameter pipe when it was flooded or partly filled with water, but did not readily enter a 0.3-m. pipe until special conditions of water velocity and transition from pool to pipe were provided.

593. Published in 1969.

594. Seasonal and Areal Distribution of Zooplankton in Coastal Waters of the Gulf of Maine, 1967 and 1968. By Kenneth Sherman. July 1970, iii + 8 pp., 6 figs., 3 tables.

ABSTRACT

The abundance, composition, and seasonal variations in the distribution of zooplankton are described. Thirteen taxa were among the more abundant zooplankters in the samples: 6 were holoplanktonic, and 7 were meroplanktonic. Copepods were the dominant zooplankters during all seasons in both years. Zooplankton volumes were highest in the western area (Cape Ann to Cape Elizabeth), inter-

mediate in the central area (Cape Elizabeth to Mt. Desert Island), and lowest in the eastern sector (Mt. Desert Island to Machias Bay). The differences in zooplankton abundance among areas and between years were caused by variations in the timing of vernal warming and coastal differences in water column stability and circulation.

595. Size, Seasonal Abundance, and Length-Weight Relation of Some Scombrid Fishes from Southeast Florida. By Grant L. Beardsley, Jr., and William J. Richards. May 1970, iii + 6 pp., 5 figs., 2 tables.

ABSTRACT

Seven species of scombrid fishes were sampled for length and weight at a taxidermy firm for 1 year (September 1967-September 1968). These data yielded information on size distribution and seasonal abundance of the species off south Florida. In addition, length-weight relations and calculated weights at given lengths are presented.

596. Fecundity, Multiple Spawning, and Description of the Gonads in Sebastodes. By John S. MacGregor. March 1970, iii + 12 pp., 6 figs., 7 tables.

ABSTRACT

More than 50 species of *Sebastodes*, an ovoviviparous genus of scorpaenid fishes, occur off the California coast. In the ovaries of nine species examined, evidence of two spawnings per spawning season was found in three (*S. ovalis, S. constellatus, S. paucispinis*) but not in the other six (*S. carnatus, S. rosaceus, S. serriceps, S. serranoides, S. atrovirens, S. ruberrimus*). Two spawnings were indicated by either (1) small numbers of advanced larvae entrapped in the ovaries and associated with full complements of developing eggs or early embyros or (2) a secondary group of developing eggs along with about equal numbers of advanced embryos. The relative number of eggs or embryos was lower in the three species that gave evidence of two spawnings (162 eggs or embryos per gram of fish) than in the other six species (280 eggs or embryos per gram of fish).

597. Fur Seal Investigations, 1967. By Marine Mammal Biological Laboratory. March 1970, vii + 104 pp., 31 figs., 79 tables.

ABSTRACT

Totals of 55,720 male northern fur seals (*Callorhinus ursinus*) and 10,471 females were killed on the Pribilof Islands in 1967. The predicted kill of males was 56,200. Counts of dead seals on the rookeries included 17,426 pups, 155 adult males, and 185 adult females. Counts of live adult males were 8,876 harem and 5,707 idle.

Major causes of death amoung 232 pups were malnutrition, liver damage-multiple hemorrhage-perinatal complex, hookworm disease, and infections. Thirty-four percent of 1,255 females age 4 and older had given birth to pups. The mean weights of pups from four rookeries differed significantly. Seals tagged included 12,472 pups, 835 yearlings, and 1,200 of ages 2 to 4; 115 pups were marked by freeze branding. A total of 5,435 seals tagged on the Pribilof Islands were recovered there in 1967 as were 31 seals tagged by the U.S.S.R. on the Commander Islands or on Robben Island.

An estimated 377,000 pups were born on the Pribilof Islands in 1965 and 385,000 in 1967. The estimate of yearling males in 1963 from the 1962 year class was 79,000; in 1965 the estimate of yearlings from the 1964 year class was 129,000. The predicted kill of 2-to 5-year-old males on the Pribilof Islands in 1968 is 49,500.

An artificial formula supplemented with selenium, vitamin E, methionine, and glycerin, was superior to an unsupplemented formula for maintaining fur seal pups in captivity.

During pelagic fur seal investigations, seals were most commonly seen within 111 km. (60 nautical miles) of land in January and February, and most were collected off Cape Flattery and westward to La Perouse Bank. Of 835 fur seals sighted off Washington, 131 were collected, 27 were wounded and lost, and 21 were killed and lost. Of 118 female seals collected, 57 percent were gravid; the youngest were three primiparous and one multiparous 5-year-olds.

Salmonidae (*Onchorhynchus* spp.) and Pacific herring (*Clupea harengus pallasi*) were the principal species eaten by seals off Washington. Shrimp were found for the first time in fur seal stomachs.

We saw 32 seals and collected 1 during studies of distribution in the Bering Sea and in waters near the eastern Aleutian Islands from 20 November to 4 December 1966.

One of us observed Japanese pelagic fur seal research in April and May 1967. We saw two fur seals off northern California in September and none off Washington and Oregon in August and September 1967.

On the basis of gastrointestinal contents and parasites, 9 of 20 pups had fed on marine organisms while still on the Pribilof Islands.

598. Published in 1969.

599. Diagnostic Characters of Juveniles of the Shrimps *Penaeus aztecus aztecus, P. duorarum duorarum*, and *P. brasiliensis* (Crustacea, Decapoda, Penaeidae). By Isabel Pérez Farfante. February 1970, iii + 26 pp., 25 figs.

ABSTRACT

Illustrated tables are presented for the identification and sex determination of juveniles (with carapace lengths of 8 mm. or more) of three grooved shrimps of the genus *Penaeus* occurring in various areas along the North American Atlantic coast, in the Gulf of Mexico, and in the Bermudas. Included

is an account of the development of the petasmata, thelyca, and appendices masculinae.

600. Birectilinear Recruitment Curves to Assess Influence of Lake Size on Survival of Sockeye Salmon (*Oncorhynchus nerka*) to Bristol Bay and Forecast Runs. By Ralph P. Silliman. March 1970, iii + 9 pp., 13 figs., 2 tables.

ABSTRACT

Comparison of the sizes of lakes and the sizes of sockeye salmon runs to Bristol Bay shows that the two variables are closely related. Birectilinear reproduction curves express quantitatively the dependence of small returns on escapement numbers and of large returns on lake capacity. Comparison of "hindcasts" from the birectilinear curves with published forecasts for 1961-67 showed that those from the birectilinear curves were closest to the actual returns. This situation changed in 1968-69. A composite of birectilinear return estimates and "probability tree" age allocations is worth considering.

601. Effect of Flow on Performance and Behavior of Chinook Salmon in Fishways. By Clark S. Thompson. March 1970, iii + 11 pp., 8 figs., 3 tables.

ABSTRACT

Adult fall-run chinook slamon (*Oncorhynchus tshawytscha*) were studied during plunging and streaming conditions of flow in a pool-and-overfall fishway that permitted recycling of fish after each completed circuit. Flows were controlled by adjustment of valves in a lock at the head of the fishway. Individual fish were timed as they ascended a specified number of pools under each condition.

Combined data on the performance of individual fish and comparisons of combined data from all fish tested suggest that plunging and streaming flows may be equally suitable for the passage of chinook salmon in a pool-and-overfall fishway. About 60 percent of the fish ascended slightly faster in the streaming flow, but the average rate of ascent for all fish was slightly higher in a plunging flow.

Orientation of the fish is described in relation to type and velocity of flow. Most fish preferred to rest in the lower downstream quadrant of the pool in the plunging flow; conversely, the lower upstream quadrant was preferred in a streaming flow. Resting fish always faced the current.

602. Biological Characteristics of Intertidal and Fresh-Water Spawning Pink Salmon at Olsen Creek, Prince William Sound, Alaska, 1962-63. By John H. Helle. May 1970, iii + 19 pp., 11 figs., 5 tables.

ABSTRACT

Prince William Sound is unique among major pink salmon-producing areas in that a significant portion of the spawning takes place in the intertidal zones of streams. Olsen Creek is one of the major spawning streams in the sound.

The percentage of fines (solids passing through an 0.833-mm. sieve) in spawning-bed materials increased progressively from higher to lower intertidal levels, i.e., higher intertidal levels contained coarser spawning gravel than lower levels.

Although less than one-third of the spawning area available in the Olsen Creek drainage is subject to tidal influence, 70 percent of the total pink salmon spawners occupied this area in 1962 and 30 percent in 1963. Late-run fish of the even-year line spawned only in the intertidal area; fish of both the early and late runs of the odd-year line spawned in both the intertidal and fresh-water areas. The size of the spawning populations was estimated by a repetitive stream survey technique, which is described and compared with the three methods used in 1960 and 1961.

The length of pink salmon was compared between sexes, between spawning areas, and between times of spawning. Fish in the even-year line that spawned in the small intertidal creeks tended to be smaller than those that used the main stream, but in the odd-year line this difference was confined to females. The mean lengths of females were about the same in 1962 and 1963, but females from the odd-year line were more fecund. In both years a significant positive correlation was shown between lengths of females and numbers of eggs.

603. Distribution and Abundance of Fish in the Yakima River, Wash., April 1957 to May 1958. By Benjamin G. Patten, Richard B. Thompson, and William D. Gronlund. June 1970, iii + 31 pp., 26 figs., 37 tables.

ABSTRACT

Fish were collected from the main stem (lower 281 km.) of the river at 2-month intervals. Native fish consisted of six families, with 23 species and three hybrids; exotic fish consisted of five families with 10 species. The water temperature from the mouth of the river to 145 km. upstream was high in summer compared with the stretch between km. 153 and 281. Eleven species were taken principally from the lower 145 km. of the river; 14 other species were taken mostly from the upper area. The greatest numbers of fish were collected from the mouth to km. 64 and from km. 120 to 177. These abundances coincided with centers of abundance of the families Cyprinidae and Catostomidae. Centrarchids were abundant below km. 97, and Cotidae and Salmonidae were most abuntant above km. 161. The fewest fish were collected between km. 72 and 89, possibly because of slow current, high summer temperatures, and a muddy bottom. Seasonal distribution and abundance of each species are discussed. Although cyprinids and catostomids were the most abundant fish, salmon (genus *Oncorhyncus*) and trout (genus *Salmo*) are the most valuable to man. Trout and juvenile salmon were most common from km. 153 to 281.

604. The Flora and Fauna of a Basin in Central Florida Bay. By J. Harold Hudson, Donald M. Allen, and T. J. Costello. May 1970, iii + 14 pp., 2 figs., 1 table.

ABSTRACT

One hundred ninety-six species of plants and animals are reported from a nursery area for pink shrimp, *Penaeus duorarum duorarum*, in a basin of central Florida Bay. Many of the organisms are benthic and associated with shallow beds of turtle grass, *Thalassia testudinum*. Although abrupt habitat variations may affect species distribution, the general distribution of organisms in the basin and bay defines environments influenced by different water masses.

605. Contributions to the Life Histories of Several Penaeid Shrimps (Penaeidae) along the South Atlantic Coast of the United States. By William W. Anderson. May 1970, iii + 24 pp., 15 figs., 12 tables.

ABSTRACT

Shrimp, the most valuable fishery resource of the south Atlantic coast of the United States, contributed about 40 percent of the $27 million exvessel value of all fishery landings in the area in 1966. Three species of shallow-water penaeid shrimps are of greatest commercial importance: white shrimp, *Penaeus setiferus*; brown shrimp, *P. aztecus*; and pink shrimp, *P. duorarum*. The shrimp fishery is reviewed for trends in yield for the area as a unit, by States, and by species, for the 10-year period 1958-67. A trend toward steady decline in total shrimp landings is indicated. During studies on the white shrimp along the south Atlantic coast of the United States in 1931-35, data were obtained on the brown shrimp; the sea bob, *Xiphopenaeus kroyeri*; and *Trachypenaeus constrictus*. Observations were also made on the pink shrimp from operations of the Bureau of Commercial Fisheries R/V *Oregon* of northeast Florida near Cape Kennedy in 1965-67. This report presents size distribution, ovary development, and sex ratios of the several species of shrimp, and includes limited information on spawning season.

606. Annotated References on the Pacific Saury, *Cololabis saira*. By Steven E. Hughes. June 1970, iii + 12 pp.

ABSTRACT

The pertinent literature on the saury is reviewed, because of the recent interest in developing a fishery for this species along the west coast of the United States. Over three-fourths of the 72 references concern Japanese or Soviet reports on their saury stocks and fishing industries. The annotations briefly describe the nature of the research and summarize the important results or conclusions.

A subject-author index is provided.

607. Studies on Continuous Transmission Frequency Modulated Sonar. By Frank J. Hester. June 1970, iii + 26 pp. 1st paper, Sonar Target Classification Experiments with a Continuous-Transmission Doppler Sonar. By Frank J. Hester. pp. 1-20, 14 figs., 4 tables.

ABSTRACT

A continuous-transmission sonar with very fine echo frequency discrimination was designed and constructed to study Doppler effects caused by the motion of fish as they relate to fish size and swimming characteristics. Although the equipment performed as theory predicted, difficulties with sea noise and trouble in maintaining contact with fish schools showed that commercial application of this approach is unsuitable without considerable additional development work. These problems and some results are discussed, and notes on target-strength measurements of several species of fishes are included in this report.

(607.) Studies on Continuous Transmission Frequency Modulated Sonar. By Frank J. Hester. June 1970, iii + 26 pp. 2nd paper, Acoustic Target Strength of Several Species of Fish. By H. W. Volberg. June 1970, pp. 21-26, 10 figs.

ABSTRACT

To design fish-finding sonar equipment it is necessary to have information about target strengths of fish. This study was made principally to determine the target strength of tunas at several acoustic frequencies. In addition, measurements were made on other living, dead, fresh, and frozen fresh-water and salt-water fishes, some without swim bladders.

608. Preliminary Designs of Traveling Screens to Collect Juvenile Fish. 1st paper, Traveling Screens for Collection of Juvenile Salmon (Models I and II). By Daniel W. Bates and John G. Vanderwalker. July 1970, v + 1-5 pp., 6 figs., 1 table.

ABSTRACT

Two horizontal traveling screens were designed and operated for 2 years at the Carson National Fish Hatchery, Carson, Wash. Deflection efficiencies were 100 percent in 37 tests of over 11,000 juvenile coho, *Oncorhynchus kisutch*, and chinook salmon, *O. tshawytscha*. The screens demonstrated their potential capacity to divert young salmon moving upstream.

(608.) Preliminary Designs of Traveling Screens to Collect Juvenile Fish. July 1970, v + 15 pp. 2nd paper, Design and Operation of a Cantilevered Traveling Fish Screen (Model V). By Daniel W. Bates, Ernest W. Murphey, and Earl F. Prentice, pp. 6-15,

10 figs., 1 table.

ABSTRACT

Model V was installed within the Stanfield Irrigation Canal near Echo, Oreg. The Bureau of Commercial Fisheries developed the screen to meet the need for improved guiding of juvenile fish of all sizes and to reduce capital and operational costs.

Field tests with the model V screen showed a head loss of only 9.1 mm. with waterflow of 73 centimeters per second. From 97 to 100 percent of the juvenile migrant coho salmon, *Oncorhynchus kisutch*, and steelhead trout, *Salmo gairdneri*, that entered the Stanfield Irrigation Canal were diverted into a bypass.

The self-cleaning screen, supported by a wire-rope suspension system, traverses the 8.5 m. wide, 1.8 m. deep, earth-lined section of the canal at a 20° angle to the waterflow. Torsion induced in the structure by water forces on the screen is resisted by a main torque tube with track support arms placed at intervals along the tube. The support arms are tied with wire rope to anchors on shore. To minimize drag, the speed of the screen in the water can be matched to water velocity and the screen returned upstream above the water. Screen panels are cantilevered from carriers on a continuous track.

609. Annotated Bibliography of Zooplankton Sampling Devices. By Jack W. Jossi. July 1970, iii + 90 pp.

ABSTRACT

The bibliography gives references to publications issued since 1873. It has information on many characteristics of these devices. The references are listed by author and by KWIC index.

610. Limnological Study of Lower Columbia River, 1967-68. By Shirley M. Clark and George R. Snyder. July 1970, iii + 14 pp., 15 figs., 11 tables.

ABSTRACT

Limnological data were collected from late July 1967 through December 1968 at seven sampling stations from above the mouth of the Willamette River to below Puget Island. Items studied were: physical (water temperature, turbidity, conductivity, and salinity), chemical (pH, dissolved oxygen, phosphate, silicate, calcium, magnesium, and sodium), and biological (chlorophyll *a* and zooplankton). Dissolved oxygen was lower in 1967-68 than it has been in previous studies in 1954-55 and 1960; water temperature was higher in 1967-68 than in the other two periods.

611. Laboratory Tests of an Electrical Barrier for Controlling Predation by Northern Squawfish. By Galen H. Maxfield, Robert H. Lander, and Charles D. Volz. July 1970, iii + 8 pp., 4 figs., 5 tables.

ABSTRACT

Northern squawfish (*Ptychocheilus oregonensis*) prey extensively on the young of sport and commercial fishes. Of particular concern to us was their heavy predation during early spring and summer on salmon (*Oncorhynchus* spp.) that are released from upstream hatcheries on the Columbia River and must pass through squawfish-infested areas on their way to the sea. Control of these predators entailed finding a means of blocking their passage into the release areas of the hatchery-reared salmon without interfering with the outmigration. For this purpose, we explored in the laboratory the effectiveness of electrical fields previously found to direct the movements of salmon fingerlings.

Electrical fields were produced by two rows of hollow aluminum electrodes suspended in the water across a laboratory tank. Exploratory tests were run to determine what combinations of electrode arrays, voltage gradients, and electrical conditions would give results warranting systematic testing. Ten fish were tested individually in each of these elimination tests.

On the basis of test results, four electrode arrays, with capacitor discharge pulses at 8 pulses per second and a pulse duration equivalent to that of 40 milli-second "rectangular pulse," were tested at three voltage gradients. A staggered array of electrodes in which the electrodes were spaced at 61-cm. intervals in rows 200 cm. apart was most effective. At the voltage gradients of 0.75, 1.00, and 1.25 volts per centimeter, 85, 93, and 96 percent respectively, of the squawfish were blocked.

612. The Trade Wind Zone Oceanography Pilot Study. Part VIII: Sea-level meteorological properties and heat exchange processes, July 1963 to June 1965. By Gunter R. Seckel. June 1970, iv + 129 pp., 6 figs., 8 tables.

ABSTRACT

Meteorological data were summarized and large-scale heat exchange processes computed, in 5° square units of the area lat. 0° to 35° N., long. 130° to 170° W., for each month. The result complement time-sequence oceanographic observations of the Trade Wind Zone Oceanography Pilot Study in the area lat. 10° to 26° N., long. 148° to 157° W., February 1964 to June 1965. The source and processing of meteorological data, and the computation of the radiation from sun and sky, the effective back radiation, the heat of evaporation, and the conduction of sensible heat are described. The results are consistent with monthly heat exchange processes computed from long-term mean meteorological properties in the North Pacific. Despite inadequacies in the distribution and quality of data, the meteorological data summaries and the derived heat exchange processes are adequate for interseason and interyear comparison of large-scale, sea-air interactions.

613. Sea-Bottom Photographs and Macrobenthos Collections from the Continental Shelf off Massachusetts. By Roland L. Wigley and Roger B. Theroux. August 1970, iii + 12 pp., 8 figs., 2 tables.

ABSTRACT

Epibenthic invertebrate animals were sampled with a large scallop dredge and photographed with a sled-mounted camera at four locations on the Continental Shelf off Massachusetts in August 1965. Sea-bottom photographs taken at a station south of Martha's Vineyard, Mass., at a depth of 59 m. revealed a sandy silt sediment with a slightly uneven microtopography. At three stations on southeastern Georges Bank, at 64 to 82 m., sediments were predominantly sand with small proportions of shell fragments and silt. The microtopography was generally rough and irregular, largely caused by feeding of fish and other biological activity. Sand ripples were common; some apparently formed by wave action and others by tidal currents.

Species composition of the large epibenthic invertebrates was similar at the three localities on Georges Bank but differed markedly from that south of Martha's Vineyard. Also, the number of specimens were substantially higher on Georges Bank than south of Martha's Vineyard. The densities of invertebrates estimated from photographs (0.7, 1.7, 1.8, and 8.6 individuals per square meter) at the four stations were substantially higher than estimates based on the dredge collections (0.02, 0.16, 0.3 and 3.3 individuals per square meter).

614. A Sled-Mounted Suction Sampler for Benthic Organisms. By Donald M. Allen and J. Harold Hudson. August 1970, iii + 5 pp., 5 figs., 1 table.

ABSTRACT

The sampler is an underwater vacuum device mounted on a sled; a venturi-type water dredge provides suction. This equipment collects quantitative samples of young pink shrimp, *Penaeus duorarum duorarum*, and is effective in capturing other small benthic organisms.

615. Distribution of Fishing Effort and Catches of Skipjack Tuna, *Katsuwonus pelamis*, in Hawaiian Waters, by Quarters of the Year, 1948-65. By Richard N. Uchida. June 1970, iv + 37 pp., 6 figs., 22 tables.

ABSTRACT

The temporal and spatial distribution of fishing effort and skipjack tuna catches are described on the basis of detailed data on catch, location, and effort obtained each year from all vessels that fish full time for skipjack tuna in Hawaiian waters. Summarized are the amount of "effective" fishing (defined as a trip on which skipjack tuna are caught), the resulting catch, and catch per standard effective trip in each statistical area and combinations of statistical areas (regions).

The fishing is highly seasonal. Usually the effort expended and the catch in the first quarter were 15 and 9 percent, respectively, of their annual totals. Fishing intensified in May and second quarter catches, produced by 32 percent of the annual effort, accounted for 33 percent of the annual catch. A further increase in effort to 36 percent of the annual total in the third quarter increased catches sharply so that they constituted 46 percent of the annual take. As the abundance of skipjack tuna declined in the fall, fishing also declined; fourth quarter effort, which was reduced to 17 percent of the annual total, produced only 12 percent of the annual catch.

616. Effect of Quality of the Spawning Bed on Growth and Development of Pink Salmon Embryos and Alevins. By Ralph A. Wells and William J. McNeil. August 1970, iii + 6 pp., 4 tables.

ABSTRACT

Among three segments of the spawning ground in Sashin Creek, southeastern Alaska, the largest and fastest developing embryos and alevins of pink salmon, *Oncorhynchus gorbuscha*, came from spawning gravels characterized by high levels of dissolved oxygen in intragravel water. The high oxygen levels occurred in a stream segment which has a relatively steep grade and coarse materials in the bed. No differences in water temperature were observed among the three segments.

617. Fur Seal Investigations, 1968. By NMFS, Marine Mammal Biological Laboratory. December 1970, iii + 125 pp., 32 figs., 53 tables, 99 app. tables.

ABSTRACT

Field investigations in 1968 were made on the Pribilof Islands from June to October, in Washington waters in November-December 1967 and January-February 1968, and in Alaska waters from May to August 1968. Data were collected during these periods for studies of population levels and the maximum sustained yield, and the distribution, feeding habits, migrations, and pregnancy rates of fur seals.

In 1968, 45,625 male and 13,335 female fur seals (*Callorhinus ursinus*) were killed on the Pribilof Islands.

Dead fur seals counted included 31,438 pups and 350 animals older than pups. The major causes of death among 379 pups were malnutrition, hookworm disease, trauma, infections, and perinatal complex.

We estimated that the Islands had 7,924 harem and 4,383 idle males in mid-July.

Pregnancy rates of females were 42 percent for 1,058 from hauling grounds in 1968 and 100 percent for 221 from rookeries in 1957.

The average weights of the pups were 9.6 kg. for males and 8.3 kg. for females. Seals tagged included

11,675 pups regardless of sex, 714 males estimated to be yearlings, and 1,495 males estimated to be 2 years old.

Of the marked seals recovered, 3,946 had been given tags or other marks as pups and 1,197 had been tagged at age 1 or older. Tag loss apparently is highest soon after tagging. The recovery rate for pups tagged in September has been higher than that for pups tagged in August. Pups marked by removing parts of flippers apparently have a higher survival rate than pups that have been given tags and flipper marks. Two different methods of estimating populations yielded similar values (400,000 and 350,000) for the number of pups born in 1965. The pup population estimates decreased annually since 1960 to less than 400,000 in 1965. Estimates of the number of yearling males for several year classes are 82,000 (1961), 79,000 (1962), 115,000 (1964), and 80,000 (1965).

After the kill in 1966, the population still included 25,000 3-year-old males from the 1963 year class and 70,000 2-year-old males from the 1964 year class.

The predicted kill of males in ages 2 to 5 was 49,000 for 1968 and is 56,000 for 1969. The actual kill in 1968 was 44,162. The recovery rate of young males tagged and recovered in 1968 was higher for those marked in June than for those marked in July. The recovery rate for seals tagged on hauling grounds inaccessible to the kill was less than that for seals tagged on accessible hauling grounds. One of ten transmitters attached to seals emitted signals for 9 days. Nearly all of 250 adult males killed from rookeries were age 10 or older, but 58 percent of 100 adult males killed from hauling grounds were less than 10 years. Researchers took 374 seals off Washington and 456 in Alaska waters; 38 of these seals had tags or other marks. About 50 percent of the female seals taken were from 1 to 7 years old. The principal fishes eaten by fur seals off Washington were salmon, *Oncorhynchus* spp.; anchovy, *Engraulis mordax*; rockfish, *Sebastodes* spp.; eulachon, *Thaleichthys pacificus*; and capelin, *Mallotus villosus*. The principal foods consumed in Alaska waters were walleye pollock, *Theragra chalcogrammus*; squids, Cephalopoda; and Atka mackerel, *Pleurogrammus monopterygius*.

618. Spawning Areas and Abundance of Steelhead Trout and Coho, Sockeye, and Chum Salmon in the Columbia River Basin-Past and Present. By Leonard A. Fulton. December 1970, iii + 37 pp., 6 figs., 11 maps, 9 tables.

ABSTRACT

Past spawning areas (those removed from use before 1969) and present ones (those in use in 1969) are described for steelhead trout, *Salmo gairdneri*; coho salmon, *Oncorhynchus kisutch*; sockeye salmon, *O. nerka*; and chum salmon, *O. keta*. The different species characteristically spawn in the following areas: (1) steelhead trout—in streams of all sizes (widely dispersed throughout the watershed) (2) coho salmon—in small streams (mostly in the lower tributaries) and in a few areas in the middle watershed, (3) sockeye salmon—in lakes and tributaries of lakes (in the middle portion of the watershed), and (4) chum salmon—in lower portions of tributaries that enter the Columbia River below the Dalles Dam. All four species have lost many spawning areas because of water-use developments and changes in the watershed resulting from logging, highway construction, agricultural cultivation, placer mining, and dumping of wastes. Serious depletion of the runs of all four species is evident from the available data (the commercial catches before 1938 and since 1938 augmented by information on escapement and sport catch).

The future prospects are fair for steelhead trout, good for coho salmon, and poor for sockeye and chum salmon.

619. Published in 1971.

620. The Trade Wind Zone Oceanography Pilot Study. Part IX: The Sea-Level Wind Field and Wind Stress Values, July 1963 to June 1965. By Gunter R. Seckel. June 1970, iii + 66 pp., 5 figs., 2 app. tables.

ABSTRACT

Wind observations and derived wind stresses are summarized in 5° square units of the area lat. 0° to 35° N., long. 130° to 170° W., for each month. The results complement time-sequence oceanographic observations of the Trade Wind Zone Oceanography Pilot Study in the area lat. 10° to 26° N., long. 148° to 157° W., February 1964 to June 1965. The sources and processing of wind observations, and the computations to obtain the zonal and meridional components of the wind velocity, the square of the wind speed, and the zonal and meridional components of the wind stress are described. The results are consistent with monthly wind stresses computed from long-term mean winds over the North Pacific. Despite inadequacies in the distribution and quality of data, the wind and wind stress summaries are adequate for interseason and interyear comparisons.

621. Published in 1971.

622. Published in 1971.

623. Apparent Abundance, Distribution, and Migrations of Albacore, *Thunnus alalunga*, on the North Pacific Longline Grounds. By Brian J. Rothschild and Marian Y. Y. Yong. September 1970, v + 37 pp., 19 figs., 5 tables.

ABSTRACT

This paper considers the dynamics of albacore, *Thunnus alalunga*, on the Japanese North Pacific longline grounds. In addition to changes in apparent abundance and distribution, the modes of immigra-

tion and emigration from the longline grounds are considered in terms of the migratory route of the albacore in the North Pacific Ocean. The data show a clear decline in apparent abundance on the longline grounds during the 1949-61 study period. This decline could not be related to changes in the average size of the fish or fishing effort. Spatial statistics were computed to describe the distribution of the albacore on the longline grounds. These show very clear cyclical changes each year. These changes reflect a net southwest movement of the two-dimensional first-moment at a velocity of about 6.5 miles (12 km.) day^{-1}. The second order spatial statistics showed a maximum longitudinal expansion and latitudinal contraction during the peak of the fishing season. The time-space coordinates of the two-dimensional first-moment of the albacore distribution appear to be highly predictable. The migration route of the albacore among North American, pole-and-line, and longline fisheries is considered. It appears that the dynamically most significant movement of albacore is from the North American fishery, to the pole-and-line fishery, to the longline fishery.

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