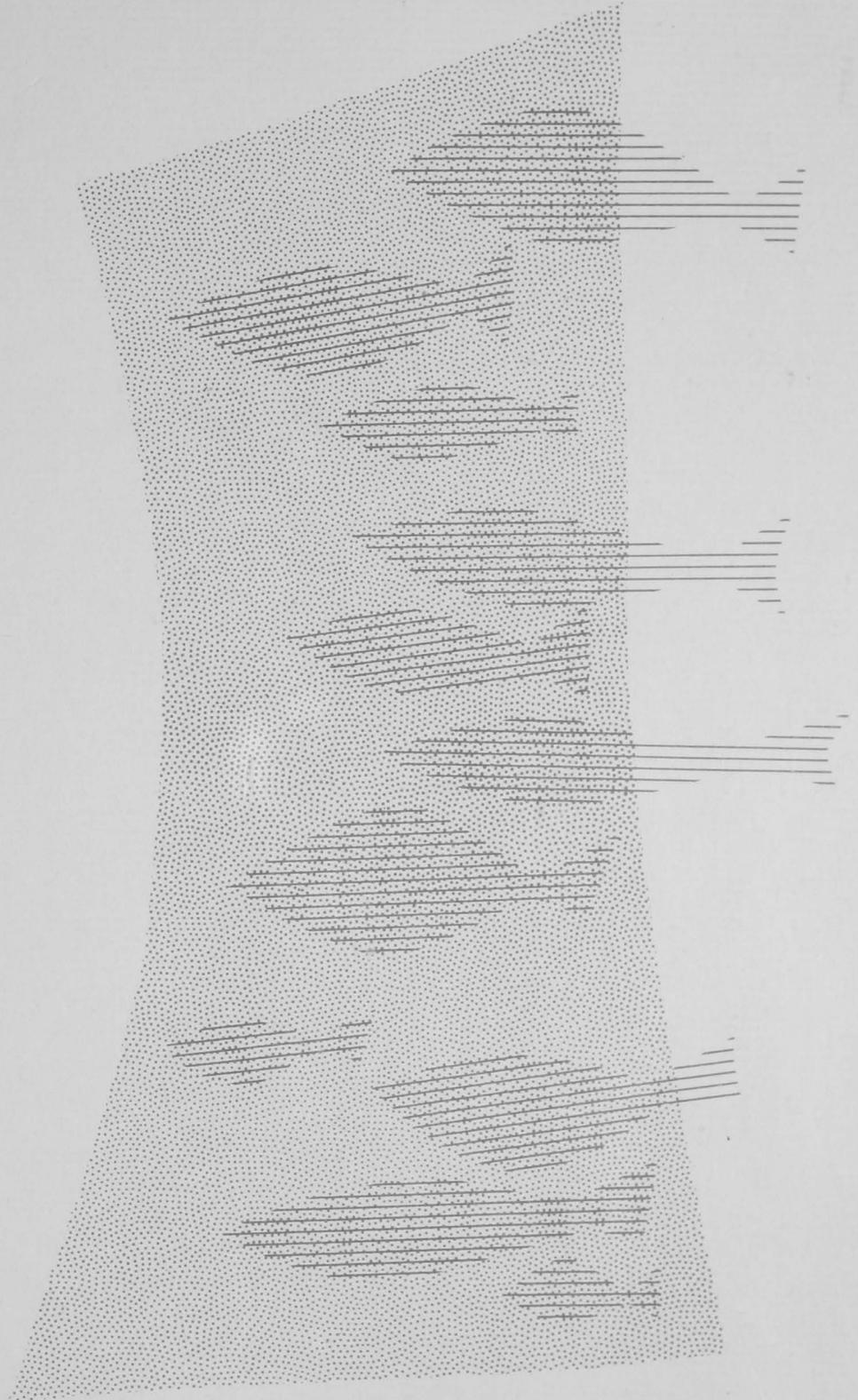


COMMERCIAL FISHERIES: RESEARCH & DEVELOPMENT



THE GREAT LAKES & CENTRAL REGION

Cir. 147

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COMMERCIAL FISHERIES: RESEARCH AND DEVELOPMENT IN THE GREAT LAKES AND CENTRAL REGION

A Long-Range Program
of the
Bureau of Commercial Fisheries

by Region 4 Staff
Bureau of Commercial Fisheries
U. S. Fish and Wildlife Service
Ann Arbor, Michigan



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AND DEVELOPMENT OF THE GREAT LAKES
BUREAU OF COMMERCIAL FISHERIES

COMMERCIAL FISHERIES: RESEARCH AND
DEVELOPMENT IN THE GREAT LAKES
AND CENTRAL REGION
A Four-Volume Program
of the
Bureau of Commercial Fisheries

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UNITED STATES DEPARTMENT OF THE INTERIOR
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WATER RESOURCES DIVISION

COMMERCIAL FISHERIES: RESEARCH AND
DEVELOPMENT IN THE GREAT LAKES
AND CENTRAL REGION
A LAND-BASED PROGRAM
of the
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UNITED STATES DEPARTMENT OF THE INTERIOR
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COMMERCIAL FISHERIES: RESEARCH AND
DEVELOPMENT IN THE GREAT LAKES
AND CENTRAL REGION
A Four-Phase Program
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Musky II



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Cisco

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COMMERCIAL FISHERIES: RESEARCH AND DEVELOPMENT IN THE GREAT LAKES AND CENTRAL REGION

A Long-Range Program of the
Bureau of Commercial Fisheries

GENERAL INTRODUCTION

The goal of the Bureau's program in the Great Lakes and Central Region is the economic betterment of the commercial fishing industry in all its phases--production, processing, and distribution--and improved products and services for the consumer. The goal cannot be attained by any one activity alone in an area in which the fisheries are so widespread and gravely depressed as the Great Lakes and Central Region and where the problems of the fisheries are so manifold and pressing. To be effective, we must have programs in many fields--biological research, exploratory fishing and gear development, statistics, technology, marketing, market reporting, and economics. Little purpose is served in finding outlets for fish if means have not been developed to land them at a profit. Nor is it useful merely to catch fish if they are not offered in a form acceptable to the consumer. Again, it is not sensible to encourage development of a fishery which, to survive, must produce catches in excess of the biological productivity of the grounds. One could continue almost without limit to cite examples where work in one field, no matter how well planned and executed, must prove ineffective unless it has the support of equally well-planned and executed programs in other fields of activity.

Thus our goal is entirely clear, but the road that leads to it is tortuous and rough. We must have adequate programs in all relevant fields; weakness in one can impair the value of all others. Yet, sound programs in individual fields are by no means enough. Those who are responsible for the adminis-

tration of the general program must be alert if the operations are to be coordinated to provide the teamwork essential to success.

Past services to the fishing industry of the Great Lakes and Central Region have been scanty. Catch statistics have been published for the Great Lakes since 1926, but before 1950 most of the records actually were compiled by the States. Statistical work on other waters has been continuous only since 1954; many of the earlier, scattered surveys were of questionable accuracy. Biological research started on a continuing basis in 1927, but the scale of operation was extremely small until 1950. It still is far from adequate. A Market News Office was started in Chicago in 1938. Services from other Branches were nil or too trivial to warrant listing. The establishment of a Regional Office in Ann Arbor in 1958 brought some improvement, but Branch programs in the Region still lack the funds, personnel, and facilities for an effective attack on their difficult problems.

If our Bureau is to fulfill its obligations to the industry and to the general public in the Region, programs must be planned and executed according to the circumstances and needs within the area to be served. Let us, then, have a look at the Great Lakes and Central Region as a market for fish and as a producer of fish. Once we have these matters clearly in mind it should be possible to lay down a program that will give an effective approach to the fishery problems of the area.

REGION IV: DESCRIPTION OF THE GREAT LAKES AND CENTRAL REGION

Region IV entirely encompasses 16 States (North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Minnesota, Iowa, Missouri, Arkansas, Wisconsin, Illinois, Kentucky, Tennessee, Michigan, Indiana, and Ohio) and those portions of Pennsylvania and New York that border the Great Lakes. This vast region contains more than 36 percent of the population, and constitutes a little more than 32 percent of the area, of the United States exclusive of Alaska.

The Great Lakes and Central Region can be divided roughly into the following general areas: the agricultural midsouth; the agricultural midwest; the densely populated and heavily industrialized southern Great Lakes area; and the thinly populated northern Great Lakes area. Division of this type is unavoidably arbitrary and to a considerable degree artificial. Industry, for example, has made and continues to make important gains in the agricultural south and midwest, and the agricultural output of even our most heavily industrialized States is significant indeed. Nor are all important concentrations of people confined to the southern periphery of the Great Lakes where we find such metropolitan areas as those of Milwaukee, Chicago, Detroit, Toledo, Cleveland, Akron, Youngstown, Buffalo, and Rochester, and such cities as Indianapolis, Dayton, and Columbus only a little to the south. At a distance from the lakes, for example, are such metropolitan areas as Minneapolis-St. Paul, St. Louis, Kansas City, Cincinnati, Louisville, Nashville, Memphis, and Tulsa.

Regardless of how one may subdivide or refuse to subdivide the Great Lakes and Central Region, it is an immense and productive area, has a tremendous population, and offers almost unlimited marketing opportunities. In the main, the region is prosperous. Some areas experience temporary depressions as business conditions fluctuate, but few are chronically depressed. In the south, the per capita income is improving as opportunities for employment are diversified, and in the industrialized north this income is the highest in the nation. Our midwestern farmers are experiencing the difficulties common to agriculture, but on the whole they seem to be adjusting well to the changing conditions. The expanding tourist business is improving greatly the

economic situation in the northern Great Lakes area.

The Great Lakes and Central Region is exclusively inland--at no point does our boundary touch the ocean. Yet the region has water resources without parallel in inland areas of the world. Both the unique Great Lakes system and the great rivers that flow across the region are deserving of special comment.

The Great Lakes

The true vastness of the Great Lakes is perhaps not well appreciated by those who have not travelled along or over them. The combined area of the lakes is 95,000 square miles--more than 1 1/2 times that of all New England and about equal to the area of Oregon. Nearly two-thirds--61,000 square miles or 64 percent--of this total lies within U.S. boundaries: one lake, Michigan, lies entirely within the United States. The shoreline, mainland and islands, totals 9,600 miles, about equally divided between the United States and Canada.

All of the lakes rank among the world's greatest. Lake Superior, by a good margin, is the world's largest fresh-water lake; Huron ranks 4th, Michigan 5th, and the smaller lower lakes--Erie and Ontario--11th and 13th.

A feature of the Great Lakes of major consequence to the North American economy is that they form a connected chain extending from the eastern seaboard States of New York and Pennsylvania westward into Minnesota. The combined long axes of the lakes amount to 1,300 miles. Adjacent to or near the lakes are some of the continent's greatest coalfields, deposits of iron and other minerals, outcrops of high-quality limestone, and vast stretches of highly productive agricultural land. It was inevitable that heavy industries and large cities would cluster about the lakes--over 10 percent of our total population lives in counties bordering the lakes and connecting waters--and the transportation and uses of water for industrial and domestic purposes would give the lakes their primary value.

Water-borne traffic on the Great Lakes now runs in the order of 300 million tons per year; the single harbor at Duluth-Superior ranks second in the entire United States in tonnage handled. Lake traffic is

receiving a sharp stimulus from the new St. Lawrence-Great Lakes Seaway, which has made ocean ports of lake ports. The effects of the seaway on Great Lakes commerce are hard to predict, but they surely will be substantial.

Increasing multiple use of water is creating problems of water quality that concern the commercial fisheries. The environment is being changed directly by toxic industrial waste and more subtly by progressive enrichment from sewage effluents and other nutrient materials.

Another important contribution of the Great Lakes is made through their effect on climate. Both summer and winter weather are tempered, the autumn lengthened, and the spring retarded, in the lee--that is east and south of these large lakes. These climatic effects are difficult to measure precisely, but unquestionably are of major significance. They are clearly evidenced in the distribution of the valuable fruit-growing enterprises of the area.

In terms of the total economy, the fisheries of the Great Lakes are admittedly of secondary value. Yet, as we shall see later, these fisheries have certain unique characteristics that give them a value out of proportion to mere dollar volume. Further, they are of real economic significance in numerous local communities, and they should be capable of increased production of fishery products badly needed in the mid-west.

Although sport fisheries are in no way a responsibility of this Bureau, any appraisal of the worth of the Great Lakes fisheries would be faulty without mention of them. The some 17-18 million people that live along the shores, and the myriad tourists that visit the lakes, make intensive use of sport fishing opportunities. Statistics on the sport fisheries are difficult to obtain, but the evidence is clear that for some species and areas the sport catch exceeds the commercial catch. Expenditures by sportsmen are such that economic returns from sport fishing well may exceed those from commercial operations by a sizeable margin. Although certain limited areas and some species have been reserved for anglers, the stocks are ample in most situations to support both sport and commercial operations. Further, a thriving, productive, com-

mmercial fishery is important to the health of sport fishing. The commercial operators are needed to keep populations in balance by capturing species not taken by sportsmen or species that sportsmen crop inefficiently.

Still another immensely significant value of the Great Lakes lies in their use for bathing, boating, and other recreational activities. Here again, exact dollar values to lakeside communities are hard to assess, but most assuredly they are high. The aesthetic values of recreation are not to be measured in terms of money.

Rivers, Reservoirs, and Inland Lakes

Here we are concerned principally with the Mississippi River system--one of the world's greatest--which drains much of the United States from the Appalachians on the east to the Rockies in the west. The main stem of the Mississippi has its source in north-central Minnesota. It flows more or less directly southward to enter the Gulf of Mexico below New Orleans. The first major, and longest, tributary is the Missouri River, which rises in Montana and flows southeasterly to join the Mississippi just above St. Louis. The largest tributary, the mighty Ohio River, is formed by the junction of the Monongahela and Allegheny Rivers at Pittsburgh. It flows southwesterly, and at Cairo, Illinois, it contributes more to the flow of the lower Mississippi than do the upper Mississippi and Missouri Rivers combined. The Tennessee River, largest among the Ohio's numerous important tributaries, is renowned as the site of the Tennessee Valley Authority (TVA), our nation's earliest project for basinwide development. Below Cairo the principal tributary of concern to us here is the Arkansas, which originates in Colorado, and flows southeasterly, to enter the lower Mississippi about midway between Memphis and Vicksburg.

Much as is true for the Great Lakes, the principal value of the Mississippi River system is that it is an avenue of traffic and a domestic and industrial water source. Almost all sizeable cities in the Region, other than those lying in the Great Lakes basin, are located on the Mississippi or on a tributary. Freight traffic on the Mississippi system now amounts to about 180 million tons per year, and it can be expected to increase. Most of it now moves by barge.

The Mississippi and its tributaries have been and continue to be greatly modified by the installation of navigation dams and locks, the maintenance of minimum-depth channels, and the construction of reservoirs for flood control, navigation, power, and, in the more westerly regions, irrigation. These installations are levelling fluctuations of flow and creating large new areas of water.

The commercial fisheries of the Mississippi system, like those of the Great Lakes, are not vital to the total economy of the valley. They have, nevertheless, maintained a substantial production; and through better research, management, processing, and marketing, their worth could be increased materially.

The comments made previously on the importance of the Great Lakes for sport fishing and other recreational pursuits apply equally well to the waters of the Mississippi system. The principal difference lies in the constantly increasing potential of the Missis-

issippi and its tributaries. Many impoundments have been completed, numbers are under construction, and many more are scheduled or being planned. Together they will add hundreds of thousands--indeed millions--of acres of water in areas in which water resources previously were most scanty. The growing evidence that active commercial operations are essential to the maintenance of good sport fishing in reservoirs gives cause for strong optimism on the development of commercial fishing enterprises.

Relatively few inland lakes of the Region are exploited commercially in the strict sense of the word; principal exceptions are the Red Lakes and the Boundary Lakes of Minnesota. As the result of the "rough-fish-control" programs of various States, however, tens of millions of pounds of fish are caught annually in other inland lakes. These landings can be increased substantially. In fact, almost numberless lakes could be fished commercially to the benefit of sport fisheries and other recreational uses.



Examination and tabulation of the catch in experimental nets fished by the *Musky II*, Lake Erie.

THE REGION AS A MARKET FOR FISH

No other area offers greater opportunities for important increases in the consumption of fish and fishery products than does the Great Lakes and Central Region. As was previously pointed out, the Region contains 36 percent of the total U.S. population; it also encompasses 38 percent of all U.S. cities of 100,000 population and over. The cosmopolitan population of the heavily industrialized areas offers a relatively unexploited and receptive market for fishery products. The agricultural communities of the Region--traditional centers of heavy meat consumption--also offer an inviting challenge to efforts to increase the consumption of fishery products.

Proper exploitation of these opportunities will not only benefit the economy within the Region, but also provide important relief from market gluts of fish and fishery products originating in other areas. The per capita consumption of food fish in this heavily populated area is low. Many persons eat fish and shellfish rarely or not at all; few include fish regularly on their menu.

The failure of so many midwesterners to eat fish can be traced to the not-too-distant past when fish and shellfish were unavailable in many localities, or, when they could be purchased, were of highly undependable quality. Advancements in processing, refrigeration, and distribution have done much to better the situation, but the deep-grained habit of not eating fish has been slow to disappear. Tangible evidence of conditions can be had from the menus of public eating places, many of which offer no fish or, when they do, carry a sharply limited choice. Vast improvements in the consumption of food fish surely can be made through an adequately staffed and vigorous promotional program.

Possibilities for the expansion of markets are by no means limited to increases in the consumption of food fish. Great potentials exist for the broadening of uses of fish meals, fish oils, and raw fish for the manufacture of pet foods and for feeding fur-bearing animals, particularly mink. Feeding livestock and fowls is of major importance in midsouthern and midwestern agriculture. Increases in the use of fish meal can benefit both the fishing industry and agriculture. The midwest--a traditional canning center--also offers a good site for

the manufacture of canned pet foods. Many canning facilities in the Region are now operated only seasonally. Finally, 70 to 75 percent of all mink reared in the United States come from the northerly States of the Great Lakes and Central Region. The percentage of fish in the mink diet is far below the highest possible level and below that actually used in other mink-growing areas.

Uses of fish oils in industry need not be detailed here, but they currently are many. Possibilities for new uses also exist. Recent research, for example, indicates that these oils are valuable in the recovery of iron from taconite, an ore not formerly exploited. An alert program can assure that these possibilities are not overlooked.

THE REGION AS A PRODUCER OF FISH

Production of fish in the Great Lakes and Central Region does not now meet the requirements of the large population, the intensive agriculture, and the expanding industries of the area. Probably it never can be expected to fully meet these needs. The Region does, nevertheless, have fisheries of considerable worth and does produce some fishes of unique value. The Great Lakes, for example, have been the principal or only domestic source of such highly prized fresh-water fish as whitefish, lake trout, walleye, blue pike, yellow perch, and chubs or ciscoes. Possibilities for increased production are great, provided the biological, technological, economic, and marketing problems can be mastered.

The U.S. waters of the Great Lakes now yield fish at an annual rate of 70-80 million pounds. The rate of yield is near that of the last 40 to 50 years but, if allowance is made for the decreased value of the dollar, the present-day income is well below that of former years. Changes in fish stocks have lessened the abundance of the higher priced species while many of the lower priced, sometimes unmarketable, fishes have grown more plentiful--a few even excessively abundant. The true extent to which these underutilized fish are available for exploitation is not known, but the potential output may well run into hundreds of millions of pounds.

A detailing of the changes in fish stocks in the Great Lakes or an exhaustive review of the factors that brought them about is not



A 1,500-pound lift of alewife - Lake Michigan trawl vessel.

possible here. Among the principal factors, however, we may list: selective fishing against the higher priced species; progressive changes in environmental conditions; and the introduction or invasion of such species as carp (in the past century), smelt, alewife, and sea lamprey. Most severe impact came from the sea lamprey, that nationally renowned parasite which destroyed the lake trout stocks in Lakes Huron and Michigan, has almost reduced Lake Superior trout below the level of profitable exploitation, and inflicted severe damage on such other species as whitefish, suckers, walleyes, and the larger species of chubs.

Harmful also to the Great Lakes fisheries have been the ultraconservative attitude of the industry and the equally conservative fishery codes under which the fishermen have operated. Methods of catching, handling, and marketing fish have changed surprisingly little over the past

50 years; the industry has been especially slow in introducing and accepting modern processing, packaging, and distribution. This conservative attitude has been furthered by fishery codes under which it is difficult to produce profitably any but high-priced species. The backwardness of the fisheries is most surprising in a region in which technical development in industry has made such advances.

Biologists hold on good grounds that the abundance of fish in the Great Lakes is probably at a record high. Yet we have a sick industry. An adequate program can save it from total demoralization and further the restoration of economic stability. We shall need the development of fishing gear and methods to reduce production costs and the exploration of new grounds; we must give technical advice to handlers and processors and aid in the development of markets for both food and industrial species; we must inform operators on the economics



Three-ton catch of Lake Erie smelt caught in a 30-minute trawl drag.

of boats, gear, fishing, storage, and distribution; and we must have biological research to follow changes in fish populations and judge better the short- and long-range potential productivities of waters so that commercial operators can economically adjust to changing conditions.

Only a few inland lakes of the Region support bona fide commercial fisheries--principal exceptions, as we have stated, are the Red Lakes and the Boundary Lakes of Minnesota. Substantial quantities of fish (mostly carp, sheepshead, and bullheads) reach the market from the "rough-fish-control" programs executed in various States by State personnel and by contracting individuals and firms. The annual output from the rough-fish fishery amounts to about 20 million pounds. This production is not likely to decrease; in fact, it can be expected to increase substantially.

The Mississippi River and its tributaries have yielded an average of 50 million pounds

of fish per year over the past 2 or 3 decades. (Mussel-shell production, once of great significance, has dwindled to a low level because of competition from plastic buttons and changes of environment that have greatly reduced the abundance of mussels.) Most species are low-priced. The operating units are usually small, fishing methods are relatively primitive, and marketing is to a considerable degree haphazard. These river fisheries, much like those of the Great Lakes, sometimes operate under highly restrictive regulations. States bordering on the Upper Mississippi are cooperating to improve the status of the fisheries, but they have expressed a need for assistance from the Bureau.

Proper modernization of equipment and plants and improvements in processing and distribution doubtless can promote increase of production of existing fisheries on the Mississippi River and its tributaries,



Experimental gill nets being lifted by the fishery research vessel *Cisco* in Lake Michigan.

but the greatest possibilities for expansion in the great central valley lie in the numerous and rapidly expanding reservoirs of the system. Biological studies of TVA reservoirs have demonstrated the existence of huge resources of fishes usable as food or in industry, but public opposition has blocked the development of any substantial commercial operations. Commercial fishing is heavily restricted or prohibited in reservoirs in certain other areas as well. States along the Missouri River, on the other hand, have expressed a strong interest in the possibilities of commercial production of fish in reservoirs within their boundaries, and they can be depended upon to give full cooperation in any investigational and developmental programs.

Development of fisheries on reservoirs will require careful biological studies of fish stocks, the development of economical means of producing commercial species, and assistance and advice in technology, economics, and distribution. The work must

be initially exploratory, and the program must be developed with care, for our present foundation of knowledge is practically nil. Our limited knowledge makes it impossible at present to estimate the potential productivity of the reservoirs with any confidence, but the ultimate capacity of these bodies well may run into so many millions of pounds as to exceed even the most optimistic estimate that might be ventured today.

Still other potential sources of commercial production are the rice-growing areas (notably Arkansas) where promising advances have been made in growing fish in rice ponds. Under the terms of the law as presently written, the Bureau of Sport Fisheries and Wildlife has responsibility for assistance in the development of production methods. We, however, have responsibilities in the fields of processing, handling, and distribution. Here, as in the reservoirs, the attainable level of output may prove staggering.

UNIQUE MANAGEMENT SITUATION

The fisheries of the Great Lakes and Central Region are unusual in that every acre of fishable water, except acreage in privately held ponds, is owned and administered by a State. The Great Lakes States do not merely border on the lakes, they own the entire U.S. share of them. Interstate boundaries within the lakes are closely defined; indeed, boundary disputes that involved productive fishing areas have reached the Supreme Court.

Because the lakes are owned by the States, U.S. fisheries operate under eight separate State fishery codes, as many as four of which may apply within a single lake; the Ontario regulations add still another code on every lake but Michigan. These codes differ--sometimes widely--in such matters as gear specifications, open seasons, size limits, Since the fish are unaware of the political boundaries, the diversity of regulations leads to friction and discontent within the industry--much of it well founded. Numerous attempts, some dating back to the past century, have been made to achieve a greater uniformity of regulations. Some important advances have been made, but much remains to be accomplished.

Conservation officials of the Great Lakes States have traditionally relied heavily on our Bureau for advice in the management of the fisheries in which the fish move freely from jurisdiction to jurisdiction, and our Bureau has long been in the forefront promoting interstate and international cooperation in regulation, management, and research. We have sponsored or participated in many conferences, and all of our important early research programs were in cooperation with and supported by State agencies. In the main, our record has been good. The trust placed in our judgment continues high. Nevertheless, our usefulness could be increased greatly by the establishment of a program broad enough to meet our responsibility in the complicated situation on the lakes.

Many of the important problems cannot be attacked satisfactorily by individual States, and cooperative enterprises have definite limitations unless one of the par-

ticipants, such as our Bureau, is free to operate without the regard for State boundaries that limits so greatly the work of State employees.

Similar conditions face many of the river fisheries. Rivers may flow for some distance entirely within a single State, but commonly they mark the boundary between States. In the latter situation a fisherman may not range beyond the middle of the river and fishermen on opposite sides of the same river may be subject to different laws. Here again a sound Bureau program could aid greatly in easing an annoying situation.

The strictly advisory status of our Bureau in the management of fisheries within the Region relieves us from many pressures that could prove burdensome. On the other hand, we have a great responsibility to provide the States that depend on us for counsel with the kind of advice that can come only from an adequate, well-rounded program.

A particularly delicate point, and one that needs early attention and careful handling, is posed by the constantly growing evidence that many commercial fishery regulations are unduly complicated and unnecessarily restrictive. Much of the backwardness of the fishing industry in the Great Lakes and Central Region can be traced, as we have said, to legal restrictions on gear, seasons, grounds, sizes, Few of them are based on scientifically sound information, and none can be demonstrated to have increased the productivity of the fisheries. Yet overhauling this legal structure to permit efficient, profitable exploitation of fishery resources will be difficult. Liberalization of regulations is commonly viewed by the general public, especially by sportsmen, as anticonservation--and the views of sportsmen inevitably carry great weight with State conservation agencies and State legislatures. If we are to achieve desirable changes of regulations and retain the respect in which we are now held, the basis for our suggestions must be factual and sound. The presentation of our case must be one that convinces State officials and in turn permits them to convince their constituents.

IMMEDIATE AND CRITICAL PROBLEMS

It would be no exaggeration to describe all major fisheries of the Great Lakes and Central Region as economically distressed and seriously in need of aid. Practical considerations forbid a detailing of problems in all of these diverse fisheries, just as they forbid any proposal for simultaneous intensive assistance to all of them. We must develop our program of assistance to the fishing industry in the Great Lakes and Central Region through a coordinated attack on the problems of certain particular fisheries that are now in an extremely perilous state while we learn more of the conditions in other fisheries. Experience gained in all-out aid in a limited number of fisheries can give the background essential to more effective approaches in other waters later.

In this section we shall outline briefly the nature of problems facing the industry and the procedures by which the Bureau is acting or proposes to act to solve them in control of the sea lamprey and in the fisheries of Lake Michigan, Lake Erie, and the rice fields of Arkansas. The sea lamprey work and the three proposed fishery programs are most important in immediate plans for the Region, but they do not constitute by any means the entire program; neither should they be confused with the long-range program set forth later, even though many of the activities will be included in that program. Rather, they are high priority areas in which efforts are to be concentrated immediately and temporarily. The accounts will serve further to illustrate the fashion in which the various disciplines will be brought to bear in a team approach.

We have not included Lake Superior in our "emergency schedule," but conditions there are poor and worsening. We are giving Lake Superior considerable attention now, and we hope gradually to increase our services.

We wish to emphasize that "crash" programs are basically undesirable. The proper solution for industry problems is a program sufficiently broad and well balanced to permit early detection of conditions that could lead to emergencies and to allow time for the development of remedial measures. We have not had such a program, however, and situations have developed that can be treated only as emergencies. Further, it must be admitted that no program could be

devised that would end forever the development of emergencies, even though their frequency and severity surely could be reduced.

Sea lamprey research and experimental control, started as a "crash" program toward the end of 1949, now has become part of a smoothly running, internationally sponsored operation that is rapidly approaching attainment of its goals. An account of it here serves principally to show how an emergency program, unavoidably inefficient as it may be at the start, can, through careful direction, achieve ends that could be gained by no other means.

THE SEA LAMPREY

The potential menace of the sea lamprey in the Great Lakes was realized early by scientists of the area. The actual presence of sea lampreys above Niagara Falls in Lake Erie was detected in 1921. Lampreys did not thrive in Lake Erie, but when they reached Lake Huron in the early 1930's Bureau biologists warned of the havoc they might wreak in the upper Great Lakes. The fiscal stringencies of the depression period and our later preoccupation with World War II delayed any significant allocation of funds for lamprey research until fiscal year 1950. By that time the lake trout fishery had disappeared in the U.S. waters of Lake Huron, trout production had fallen by 95 percent in Lake Michigan, and sea lampreys were gaining a foothold in Lake Superior.

The many accounts that have been written of the sea lamprey--especially the popular ones--have stressed the destruction of lake trout. Yet, almost equally important additional effects were so sure to follow that biologists of the Bureau's Biological Laboratory at Ann Arbor felt free to predict the train of events years before the present conditions developed. As lake trout (the first principal food of the sea lamprey) disappeared, that predator turned to other species. Among the varieties that live in medium shallow water, whitefish and suckers have been the principal victims; in the Saginaw Bay area of Lake Huron the walleye also was greatly reduced. In the deeper waters the sea lamprey turned to chubs, and because of the lamprey's rapid growth the larger individuals and species were first to be destroyed. At the same time the larger chubs were exposed to more intensive



Bureau of Commercial Fisheries Biological Station, Marquette, Michigan.

exploitation by operators who formerly fished for trout, and the bloater--the smallest chub species and once the principal food of lake trout--was free to expand its numbers enormously. Thus, it was possible in the early 1950's to outline--almost to detail--the critical conditions that are described in our later proposed emergency program for Lake Michigan. Similar conditions hold now for much of Lake Huron and may develop soon in Lake Superior.

The "crash" sea lamprey program that started in 1950 had the advantage that considerable knowledge of the lamprey's life history and habits was available from research previously sponsored by the State of Michigan. It was, accordingly, possible to organize the program immediately along two major lines: development of control procedures; and testing of these procedures in a practical field program of experimental control.

Control methods tested initially were based on blocking weirs and other types of mechanical barriers designed to prevent the upstream movement of spawning lampreys. These devices proved too costly, too difficult to keep in operation, or usable

in too few situations to be broadly practical. Research was started almost immediately, therefore, to develop electrical barriers that would give the same blocking action, but that would be little affected by floating debris and sharp changes of water level. Although many improvements and refinements were made subsequently, effective electrical barriers, powered by 110-volt a.c. current, were devised and turned over to the experimental-control group in 1951. Several pilot models were tested in 1952, and 10 barriers were in operation in Lake Superior tributaries in 1953. This network of barriers was rapidly extended in the following years to cover all important spawning streams along the U.S. shore of the lake, and considerable numbers were installed in tributaries of northern Lake Michigan.

As electrical studies were terminating at the Bureau's laboratory at Hammond Bay, the staff at that station was assigned to a search for a selectively toxic chemical which, if added to streams, could destroy sea lamprey larvae without seriously damaging other fish or other organisms. Success in this study would shorten the time needed to attain control since by reason of the long larval life, the young from some

4 to 6 or more spawning years live simultaneously in the same streams. This highly speculative enterprise included many thousands of bioassays that covered more than 4,000 chemicals. Several effective compounds were discovered, one of which is used in our present chemical-control program.

Laboratory tests, development of application equipment and methods, and preliminary stream trials were completed by June 1958 when the chemical operations were turned over to the experimental control group at Marquette. By the end of 1960 all Lake Superior tributaries containing larval lampreys had been treated chemically, and a start had been made on streams of northern Lake Michigan. The take of spawning lampreys at electrical barrier: (now operated as monitoring devices) should provide an indication of the results of the Lake Superior stream treatments in 1961; the 1962 catches will give a positive measure of success.

The foregoing sketchy account covers few of the many problems encountered and does

not even mention many important collateral lines of research, some still in progress. It serves to demonstrate, however, that even a "crash" program, if it makes best use of existing knowledge and if it advances knowledge through carefully planned and executed research, can make continuous and efficient progress toward its goal. Another feature of the program has been the protection of the Government by the patenting of inventions and procedures.

The sea lamprey program has been further a fine example first of Federal-State and later of international cooperation. All of the States affected by sea lamprey depredations have supported the Bureau's program wholeheartedly. Michigan and Wisconsin especially have aided by assigning people to control operations and a variety of special research projects. Even so, most of the early activities were limited to the U.S. side of the Great Lakes. Ontario carried out some surveys and operated some experimental barriers, but the Canadian Federal Government had no program on the Great Lakes.



Direct-current barrier used to block sea lamprey spawning runs at Two Hearted River, May 1957.



Mobile laboratory at Hammond Bay, March 1959.



Examining specimens during bioassay test - mobile laboratory, March 1959.



Feeder mechanism that maintains critical level of selective toxicants in streams that will destroy sea lamprey larvae and not harm fish.

In recognition of the great importance of sea lamprey control to both nations and the necessity of international cooperation to achieve effective control, the United States and Canada in 1955 ratified a treaty establishing the Great Lakes Fishery Commission. The Commission, organized in April 1956 and in operation on July 1 of that year, has responsibility for the development and experimental application of methods of controlling the sea lamprey and for the encouragement and coordination of Great Lakes research by all agencies. The Commission receives funds appropriated by the two Governments and then contracts the sea lamprey work to the Bureau of Commercial Fisheries and the Fisheries Research Board of Canada. This arrangement has given a large measure of stability to a program started as a crash operation by our Bureau and carried on for several years under most difficult conditions.

LAKE MICHIGAN

The population changes that brought the commercial fishery of Lake Michigan to its present critical condition came about rapidly. In 1945 the fishery was in a reasonably healthy state. By 1950 the production of lake trout, the principal money fish, had fallen 95 percent and was soon to end completely. Fishermen who formerly fished for trout turned to chubs and did well for a time, but the larger species and sizes--those in good market demand--dwindled sharply. At the same time two possible alternative species, whitefish and suckers, also fell to low levels of availability. These changes--attributable, as we have seen, to sea lamprey depredations--had placed the fisheries in a desperate situation by the mid-1950's, and conditions have worsened gradually since.

Other population changes, hardly attributable to the sea lamprey have added further to the woes of commercial operators. The smelt, which had suffered a nearly total mortality in the 1942-43 epidemic reestablished itself rapidly during the late 1940's. In the 1950's it maintained what seems to be a record level of abundance. In the latter part of the 1950's the alewife, a newcomer to Lake Michigan, became enormously plentiful in most of the lake. Smelt have been exploited profitably in Green Bay since the 1930's by small-mesh pound nets and to some extent by small-mesh gill nets (about 1 1/2 inches, extension measure). Smelt tangle readily, however, in gill nets of any mesh size, and those taken in the larger meshes (2 1/2 inches and more) are regularly in such poor condition that they must be discarded or sold as animal food. Even when they can be sold, the returns are far too small to cover the cost of removal from the nets. The alewife, too, can be exploited commercially--though at a very small profit margin--by pound nets in a few localities. The only present market for this fish is for animal food. Alewives, like smelt, tangle readily in gill nets and again the cost of removal far exceeds the market value.

The great abundance of small chubs, smelt, and alewives and the growing scarcity of larger chubs have combined to make gill net fishing in the main body of Lake Michigan a marginal or even a losing operation. Yet it is the gill net that traditionally has been the principal production gear. Thus we face a paradoxical situation--a lake containing vast stocks of fish that are not being utilized, and an industry equipped with boats and gear that cannot take them profitably. Obviously, if the industry is to survive it must undergo a broad reorientation in methods of taking, handling, and marketing fish.

The fishing industry is ill-fitted by tradition and by organization to undertake this reorientation. Although a few substantial producing firms have developed in Lake Michigan ports, most fishing enterprises are small, one-boat operations owned within a single family or in a partnership. The principal capital investments are in the boats and nets; shore facilities are limited since these small-scale producers have had to sell the fish as landed. Capital reserve, if it exists, consists of the personal savings of the owners.

The kind of fishing that has been done in Lake Michigan has engendered a fierce independence and a deep-rooted conservatism among the individual fishermen. The conservatism has been furthered also by the detailed and complicated fishery codes under which they have operated for many decades--laws that prescribe in detail gear specifications, seasons, grounds, and size limits, . . . and typically stipulate that any gear not mentioned in the code is automatically illegal. Motivation has been scant for experimenting with new and better ways of taking fish; when effective gear modifications have been developed, they commonly have been suppressed by new restrictive regulations.

Still another factor in the conservatism of the industry is the relatively advanced age of many of the fishermen. A few younger men do enter the fishery, but the average age has been increasing. Men in their late 50's or in their 60's and 70's are little inclined to risk their capital in an entirely new venture which, if it failed, might leave them penniless.

The general situation, then, is this. Many commercial fishermen on Lake Michigan, for financial reasons, simply cannot change to a new kind of fishing requiring substantial capital investment. Others, who have the capital, will be unwilling to take the risk. There remain enough fishermen, nevertheless, to develop a productive fishery for the large supply of underutilized fish if it can be demonstrated to them that the chance for a reasonable return on investment is good. The core of our proposed emergency program for Lake Michigan is an actual demonstration of the availability of these fish and of proper methods of taking, handling, processing, and marketing that will permit their exploitation at a profit.

A limited amount of experimental fishing with bottom trawls, the only gear now known to be effective in taking these small deep-water fish, has been conducted under special State permit in Wisconsin waters since 1955, and in Michigan since mid-1960. Indiana also has issued a small number of trawling permits. The success of these enterprises must honestly be described as indifferent. From the start, fishermen were gravely handicapped by ignorance as to the proper methods of vessel conversion and fitting, the actual operation of trawls, the location of grounds that would give the best

returns, and the handling of the catch once it is landed. The trawling program was small, and total effort constituted little more than token aid. Many trawlers received no assistance at all from our Bureau and our best efforts constituted little more than token aid. If the Bureau had had a more effective program on Lake Michigan, the economic success of the trawl fishery surely would have been much greater. Strong effort at this time can improve greatly the possibility of bringing productivity to a level essential to economic stability.

Major phases of the program are:

1. Exploratory fishing and gear development to locate concentrations and learn seasonal movements of fish, and to devise and test alternative gear that might prove more efficient than gear now in use. Gear experimentation will be vitally important once the scheduled rehabilitation of lake trout is initiated; the public will show little tolerance of any fishing method that is highly destructive of small trout.

2. Technological studies on improved equipment and methods for handling, sorting, processing, packaging, freezing, and storing. Maintenance of quality and the development of new products to direct the greatest possible percentage of the take into the human-food markets will be stressed.

3. Intensification of marketing activities to develop and promote sales of presently underutilized species. Not only will particular emphasis be placed on those species having a potential for human food, but efforts will be continued to increase and develop animal-food and industrial markets for those fish which cannot be used for human consumption.

4. Economic studies of costs of vessel conversion and refitting and postaccount research into phases of the industry from capture to final sale, to provide active and potential operators a better base to judge the possibilities of their enterprise and find points for improvement of efficiency.

Excellent catch and effort statistics have been available for Lake Michigan for many years. We need, however, statistical canvasses of storage facilities, stocks of products, and other phases of the industry to further efficient and orderly movement.

Important in these activities will be direct service to the industry through informational releases, demonstrations, and personal interviews. If a private investor can be found who is interested in establishing freezing, storage, and handling facilities, we shall concentrate much of the advisory and demonstration work in a "pilot" project--located preferably in southeastern Lake Michigan, in the South Haven-Grand Haven area. A clear example of effective procedures in a commercial shore operation is far more convincing than printed material and verbal advice.

Biological research has little part in the direct aid to the industry, but it will play a vital role in determining the effects of large-scale exploitation of the deep-water stocks. Surveys by research vessels in 1930-32 and 1954-55 have given a sound long-term measure of changes in these stocks, and a new survey, started in 1960, is providing information on the present state of affairs. The chance to follow changes in the stocks as large-scale production develops will present the biologists with an almost unparalleled opportunity to study the effects of a rapidly increasing rate of exploitation.

Problems facing the research biologists will become more complicated and more fascinating as control of the sea lamprey is accomplished and rehabilitation of the lake trout is started. Present schedules call for completion of the initial chemical treatment of all Lake Michigan tributaries containing sea lamprey larvae in late 1963 or 1964. The stocking of yearling lake trout can be started safely 2 years earlier. Reduction of sea lampreys and the return of lake trout are sure to bring sweeping ecological changes. A proper study of them will be of immense scientific and practical value. Adequate biological research on Lake Michigan requires full-time assignment of a research vessel and considerable expansion of staff.

LAKE ERIE

The fishermen of Lake Erie, like those of Lake Michigan, are suffering from adverse changes in species composition and from a strong reticence toward making the adjustments needed for a prosperous fishery.

The shifts of species composition in Lake Erie have been long-term and less drastic

than those precipitated by sea lamprey depredations in Lake Michigan. The first debacle was the almost total loss of the cisco, traditionally dominant in the catch, in the middle 1920's. The fishery adjusted to this loss, and for the next 20-25 years it held as steady as was possible in the face of the normally wide fluctuations of the remaining species. Real trouble began in the late 1940's. The major changes of the past 10-15 years have been: decline of the blue pike, mainstay of the fishery of central and eastern Lake Erie, to commercial insignificance; decline of whitefish to an unprecedentedly low level; sharp decrease in the abundance of walleyes; substantial increase in abundance of yellow perch; phenomenal expansion of smelt stocks; intermittent but sharp and high peaks in abundance of gizzard shad and alewife. Factors producing these changes are not clearly understood. Evidence is strong, however, that a pronounced change

of environmental conditions is arising largely from the progressive enrichment of the lake water.

The fishing industry of Lake Erie today has lost much of the production of high-priced species. It must subsist largely on such medium-priced varieties as yellow perch and white bass and on such low-priced, sometimes unmarketable, fish as sheepshead and carp. At the same time pressures from mounting imports from Canada have weakened the market. Gizzard shad, alewife, and smelt, though enormously abundant, are exploited but little in the U.S. waters of the lake.

Methods of taking, handling, processing, and marketing fish from Lake Erie have changed little. The methods are so poorly adjusted to present-day conditions that many fishermen have abandoned operations, and others are in economic distress.



Dead and dying gizzard shad in a small boat harbor on Lake Erie.

A significant difference between Lake Erie and Lake Michigan lies in the presence of a fair number of substantial producing firms along the Erie shore. These firms not only operate several boats, but also buy much of the catch of smaller "independents." The problem of capital for conversion to new types of fishing, handling, and processing is accordingly less severe. Most firms are, nevertheless, conservative and little inclined to invest in new and different operations unless assured of a sound return. A few firms have terminated or greatly reduced operations, and numbers of independents also have quit. Still others fear that continuation of present adverse conditions may require liquidation.

The plight of the industry may not be as grim on Lake Erie as on Lake Michigan, but it is still very bad and the industry is gradually disappearing. If the fishery on this, the most productive of the Great Lakes, is to be saved from total demoralization, an emergency program generally similar to the one described for Lake Michigan will be required.

Economic investigations are needed to determine the effects of imports on the U.S. markets for Lake Erie fishery products.

Exploratory fishing, although conducted on a small scale with an inadequate vessel, has demonstrated that the presently unutilized smelt can be taken in quantity by bottom trawls. This work should be broadened to define more clearly the season and grounds for this potentially productive fishery. Various types of trawl and other gear should be tested for low-cost production in the smelt fishery and also in other fisheries where operations are currently marginal.

Technological services should place emphasis on the need for efficient equipment for handling and processing fish. Labor costs no doubt have contributed much to create the "fish-in-the-round" philosophy that has hampered the Lake Erie fishery. Experiments should be conducted to develop processed products from Lake Erie fish.

The industry needs marketing assistance in disposing of seasonal surpluses of yellow perch and white bass. New and profitable outlets should be found for low-priced fish as human food and in industry.

The orderly movement of fish can be furthered by the use of information obtained with statistical canvasses of freezing facilities, and existing storage stocks and material gathered by Market News Suboffices in Cleveland and Detroit.

The present program of biological-limnological research, aimed basically at an improved understanding of the relation of species to their environment, interactions between species, and reactions to commercial exploitation must be broadened. Particular emphasis should be placed on factors of success of reproduction (year-class failures have caused some of the recent declines) and on the significance of evidence for a progressive enrichment of Lake Erie waters. Sampling and analytical procedures must be improved for the early evaluation of year-class strength as a basis for predicting later availability to the fishermen.

All Bureau activities in Lake Erie will be coordinated to provide the most efficient results, and they will be fitted in with the programs of the States, Ontario, and the Canadian Federal Government to give the soundest possible approach to the lakewide problems of the industry. Furtherance of interagency coordination is a major function of the Lake Erie Fish Management Committee (of which the Bureau is a member) and of the Great Lakes Fishery Commission.

ARKANSAS RICE FIELDS

The rice ponds of Arkansas and the auxiliary water reservoirs and extensive bottom-land areas of the lower Mississippi present an enormous potential for the production of food fish, the true extent of which is difficult to judge at this time. Arkansas now has 100,000 acres in rice ponds and many thousands of acres of water-supply reservoirs and immediately adjacent land that readily could be flooded. In addition, approximately 2 million acres of the Mississippi River "Delta" in Arkansas and neighboring States can be called upon to produce fish as needed. Even if only 500,000 acres were developed for fish production and the yield were only 400 pounds per acre (proper management surely could lead to much higher rates) the annual output would be 200 million pounds. Fish rearing on this or even on a much smaller scale--the planting, harvesting, processing, packaging, and marketing, . . . --would be a

great economic boon in this area where industrial development is limited, employment opportunities few, and the per capita income low.

We cannot say that fish rearing in rice ponds has been a sound economic venture, but experiences to date indicate positively that, given proper technical advice and assistance, the industry can prosper.

The possibilities of fish rearing in rice ponds were first sensed in the early 1950's from observations of the growth of fish introduced inadvertently with the water supplies. Subsequently a number of rice

farmers seriously undertook the rearing of fish. They formed a number of cooperatives, one of which--at Dumas, Arkansas--constructed a fully modern processing and freezing plant. At the peak, some 20 to 25 thousand acres were farmed for fish; economic reverses have since reduced the acreage to 10 to 15 thousand. Morale is low, and even the strongest of the cooperatives faces the possibility of dissolution.

From the start, the rice-fish farmers were handicapped by the lack of information and lack of experience in all phases of the business--pond stocking and management, harvesting, handling and processing, and



Rice-farm-produced-fish harvesting operation.

marketing. As a consequence their errors and poor management detracted greatly from what could have been an entirely sound economic venture. Realization of their plight led them to appeal to Senator Fulbright who sponsored a law (PL 85-342 85th Congress, 72 Stat. 35), which authorized the Secretary of the Interior to carry out research and experimentation to develop methods for: determination of management procedures and species best suited for rice-pond culture; production and handling of fingerling fish for stocking; control of parasites and disease; optimum procedures for bringing fish to marketable size; processing and marketing; and determination of best rotation with other crops.

Immediate help will be given the rice-fish farmers in such matters as: efficient removal of fish from ponds and procedures and equipment for on-the-spot sorting to retain marketable fish and save smaller ones for further rearing; efficient handling of salable fish from the pond through the plant; processing procedures and equipment; development of new products, market research and promotion to increase financial returns; location of markets for scrap and for fish not marketable as human food; economic research covering the business as a whole, including cost accounting of the various phases to locate the "soft spots" where improved efficiency is essential.



Smoking buffalofish products in a controlled smokehouse.

THE LONG-RANGE PROGRAM

The need for a broadened, closely integrated Bureau program in the Great Lakes and Central Region was established in earlier sections, and examples were given of the ways in which various disciplines are brought to bear in a team approach to the problems of particular fisheries. The presentation that follows accordingly is a brief listing, Branch by Branch, of programs that must be activated if we are to attain an effective Regional operation. Introductory comments and explanations of programs are held to the minimum essential for an understanding of the nature of the proposals. Detailed justifications and specifications of methods will be submitted according to the approved administrative procedure as the initiation of individual programs and projects is requested.

It is not intended, nor would it be desirable, that all the listed programs be started immediately. In many situations our knowledge of problems is too sketchy to warrant establishing new programs immediately. Furthermore, it will not be easy to find the technically skilled staff to carry all of them out. We shall have to develop many of our own specialists through in-service experience and special training.

We have omitted also any estimates of cost. For some programs we could make reasonably sound estimates now, but for others we shall need to learn better the character and extent of the problems. Indeed, it is likely that some of our requests for funds for new programs initially will be small--intended to support the preliminary inquiries needed for the establishment of a sound schedule of operations.

We have omitted also estimates of cost of capital investments, but they surely will be substantial if we are to meet our needs for buildings, vessels, and other permanent properties. The need is especially critical for a building in Ann Arbor to house the Biological Laboratory and the Ann Arbor staff members of other Branches.

BIOLOGICAL RESEARCH

Biological research on the Great Lakes, started on a permanent basis in 1927, is the Bureau's oldest continuing operation calling for a resident staff in the Great

Lakes area. For many years the task of the Great Lakes research group was difficult as stated in the following quotation from "U.S. Federal fishery research on the Great Lakes through 1956," (U.S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 226, 1957):

Born in the crisis arising from the disappearance of the Lake Erie cisco, Great Lakes Fishery Investigations has forever since experienced the varying fortunes that inevitably befall an organization whose very life depends on the existence of emergencies that cry for attention. Seldom has money been adequate to the task assigned; commonly it was supplemented by funds from State and private agencies interested in particular problems; never until most recently could long-term researches be set up that would contribute to a fundamental understanding of the fish populations and of the factors that control their level of productivity.

Thus the history of Federal researches on the Great Lakes has been one of loosely related projects

Little improvement to the situation just described has been achieved. Some continuing studies have been started, but few have been underway longer than 3 years and all are on a small scale. We continue to expend much of our effort leaping from crisis to emergency. These "crash" operations do have a place in fishery programs, since as explained previously, emergencies do arise that can be handled in no other way. Yet, the need is urgent for a biological program designed to detect adverse changes that may lead to emergencies. We should have fewer post mortem reports on defunct fisheries.

The biological research program set forth for the Great Lakes is intended to give the broad and continuing coverage that leads to basic understanding of fish stocks--the relation of species to one another, the effects of the environment, and ~~effects~~ ^{effects} of varying rates of exploitation. Past researches, limited as they have been, have proved of inestimable value in solving many practical problems of management. A more adequate program can increase these contributions greatly. We have scheduled, also, programs for other inland waters not now covered. In the development of these programs the adequacy of existing projects should take precedence over a too rapid expansion of projects that would serve only to extend our present weaknesses.

Activities of the Division of Biological Research in the Region are divided into

two major segments: general fishery and oceanographic research, supported by Bureau funds; and experimental sea lamprey control carried out under contract with the Great Lakes Fishery Commission and supported by Commission funds. Details of budgeting and program content and scheduling in the sea lamprey work are stipulated by the Commission.

Fishery and Environmental Research

Each significant water area in Region 4 presents its particular research problems. Deep and shallow waters of the Great Lakes, reservoirs, rivers, inland lakes, and rice ponds individually require original and often unique study methods and analytical procedures. Our biological research, therefore, is divided into five major programs arranged in convenient, though somewhat arbitrary, working units covering the general fishery environments typical of the region.

The general goals of these programs are the same--an understanding of fish stocks in relation to the factors that influence species composition and abundance. In addition to the enormous changes of stock that were caused by sea lamprey depredations in the upper Great Lakes, the fish stocks of all waters--especially of such highly productive areas as Lake Erie, Saginaw Bay in Lake Huron, and Green Bay in Lake Michigan--have exhibited vast and rapid fluctuations of abundance and a long-term trend toward decrease of the high-priced and increase of low-priced species. The resulting variability of supply and declining value of landings have placed the industry under severe economic stress. The extent to which management can remedy the situation is not to be predicted at this time, but certain it is that effective management must be biologically sound and that only discriminating and meticulously planned and executed research can provide the needed information. The landed fish is the end product of a complex biological process.

Oceanography

The term oceanography is more appropriate than limnology for the Great Lakes in the sense that the sizes and characteristics of these immense bodies of fresh water require the use of oceanographic procedures, techniques, and equipment. The major differences from the oceans--fresh-



Reversing thermometer being lowered from the *Musky II* on Lake Erie.

ness of the water and the inconsequential tides--operate in our favor since they simplify research into theoretical aspects of oceanography that often are made complicated by salinity gradients and tidal movements of water.

Oceanographic research on the Great Lakes will proceed along two major lines: Lake-wide surveys that will call for a specially constructed and equipped oceanographic vessel; and more intensive studies of particular problems on the physics, chemistry, and biology of the Great Lakes environment. Our oceanographic vessel and the several fishery research craft will contribute materials and data for most of the more intensively studied problems.

Despite the unique nature of the Great Lakes as the world's greatest area of interconnecting fresh water, their location in a densely populated region of highly advanced culture, and the great significance of the lakes to the economy of that region, oceanographic research on the lakes has been limited and sporadic, and our understanding of their characteristics continues to be sketchy. Continuing operation of an adequately equipped vessel will gradually remedy the deficiencies in our knowledge that have proved so exasperating to scientists of the Great Lakes region and so puzzling to researchers elsewhere in North America and abroad.

The initial work of the oceanographic vessel will stress broad and, to a degree exploratory, physical, chemical, and faunal surveys. Included will be such matters as annual heat budgets, water movements, bottom sediments, chemical characteristics of the water, biochemical cycles of nutrient materials (including trace elements), plankton, and bottom fauna The program will be kept flexible and will be modified as knowledge and experience accumulate. Operating unmanned buoys and developing and testing equipment will be important in the oceanographic vessel's program.

An oceanographic vessel on the Great Lakes will serve further as a badly needed training facility for oceanographers. It is intended to make considerable use of university graduate students as temporary and part-time employees.

Special problems that may require intensive study are many; some we doubtless cannot anticipate at this time. A broad listing is not attempted, but among the more significant studies anticipated are those concerned with: effects of long-term trends and short-term fluctuations of climate on the lake environment; character, extent, sources, and environmental effects of materials added to Great Lakes waters--silt, fertilizer from drainage of cultivated lands, detergents, insecticides, domestic sewage, industrial waste, . . . ; effects of engineering projects--harbor construction, deepening of channels, and sand-sucking, . . . ; effects of use of water for cooling in industrial plants and at atomic reactors under construction or planned; limnology of reservoirs, rivers, commercially exploited inland lakes, and rice ponds;

Cold-water Fisheries

The coregonids (whitefishes, chubs or ciscoes, and lake herring) are the most abundant cold-water fishes in the Great Lakes. They are presently almost the only support of commercial fisheries in the open waters of Lakes Huron and Michigan. The coregonids are becoming increasingly important in Lake Superior as the catch of lake trout continues to decline. Our knowledge of these fishes is limited. In fact, it is impossible to identify species of chubs when they are much less than 8 inches long. Present methods of capturing chubs and herring are destructive to young lake trout. We must investigate the life history, distribution, and ecology of chubs so that fisheries for them can be developed that will damage lake trout stocks the least during and following the period of lake trout rehabilitation that is to follow sea lamprey control. Present studies, which are small-scale and limited to Lakes Michigan and Superior, should be broadened and extended to include the rest of the Great Lakes.

Lake Trout

Although the lake trout is a cold-water species, its past and potential economic value and the importance of its rehabilitation warrant a separate program of research. Experiences to date suggest that control of the sea lamprey in the Great Lakes will be realized within the next few years. The next step is the replacement of the lake trout. They are almost extinct from all lakes except Lake Superior.

The rehabilitation of lake trout offers a unique opportunity to observe, catalog, and analyze the mechanics of population reestablishment as artificially reared lake trout are stocked into the lakes. Information from this study will be invaluable as a guide to future attempts at restoration or establishment of new stocks.

Warm-water Fisheries

Great Lakes.--Research on warm-water fishes is confronted by three major problems: extreme fluctuations in abundance; the almost explosive increase in abundance of such exotic species as the smelt and alewife; and presence of a selective fishery for high-value fish while the more abundant species are not being fully utilized.



Lowering a net for the capture of larval fish, *Musky II*, Lake Erie.

In Lake Erie, Green Bay, and Saginaw Bay we have experienced great fluctuations and serious decline in the abundance of several commercially important fishes. The blue pike and cisco fisheries have collapsed in Lake Erie. Lake herring and walleye stocks in Saginaw Bay have been at an unprecedentedly low level in recent years. Most species have fluctuated widely in Green Bay. An understanding of the factors in these fluctuations requires continuing studies of important species.

Studies of the life history and distribution of the alewife and smelt are badly needed. These species, new to the Great Lakes, are now extremely abundant in many areas where they have become important as com-

mercial species, and as hindrances to fishing for other species as well as through their biological relations to other species.

Rivers, reservoirs, inland lakes, and ponds.--A major feature of this program will be a study of the biological effects of commercial fishing in reservoirs. Millions of acres of water have been impounded above dams in our large rivers. These waters cannot be cropped adequately by sport fishing. Development of commercial fisheries may be necessary to keep the fish populations in balance. Yields from these reservoirs could be an important contribution to the Nation's food supply and to the supply of industrial fishes. We need, therefore, to ascertain how commercial fisheries,

on a large scale, will affect fish populations of reservoirs.

Investigations of rice-fishfarming should be initiated by the Bureau to learn the species composition and stock densities that will yield the most profitable output of fish from rice ponds. Much of the economic distress of the rice-fish farmers stems from the lack of knowledge as to proper species composition and stock density of fish being reared.

Other phases of this program will be research on commercially exploited rivers and continuation of our support of fishery studies in the Red Lakes, Minnesota.

Sea Lamprey Research and
Experimental Control

Details of this program are determined by the Great Lakes Fishery Commission. A brief review of this originally "crash-type" program was given in the descriptions of emergency projects.

ECONOMICS

The economic distress of the Great Lakes fisheries in recent years is due largely to changes in species composition. The higher priced varieties have become more scarce, while the cheaper varieties, some of them with little market value, have increased in abundance or at least have held their own.

New methods of capture, handling, transportation, and marketing must be adopted if the fishery is to operate at a profit with the low-priced varieties now available. These changes in turn call for ventures into fields in which a background of economic experience is lacking. A sound economic program in the region can help avoid many ill-advised undertakings, reduce business failures, and contribute materially to the development of a stable, profitable industry. The economic program will be concerned with the following matters.

Cost of Various Methods of Production

Much fishing in the Great Lakes is conducted by inefficient methods. In many of the present fisheries fishermen cannot produce at a profit with the gear used unless it is modified to make it more effective or ~~savings in the handling of the catch to reduced~~ ^{the catch can be reduced} costs. A particular need is research on the

costs of trawling compared to other fishing methods. Although costs of trawling will change as the fishery develops, a knowledge of current conditions will be of great aid to those who are considering converting to this method of fishing. The costs of operations, labor, and marketing for fish taken by the various gear will be investigated.

Transportation Costs

Producers and wholesalers presently are expending a high portion of the total value of fishery products on transportation. Research will be directed toward a possible reduction in transportation costs through heavy-volume movement and lighter, more economical containers. Possible alternate markets and methods of transportation will be sought.

Effect of Imported Products on Prices of Domestic Products

Large quantities of processed fishery products now being sold in the Great Lakes area originate in foreign fisheries. These items depress the market for domestic fishery products. Research in this field will determine what pressures the imports impose on domestic producers and may suggest possible remedies.

Distribution Efficiency

This study will be directed toward determining what waste, spoilage, or damage occurs to fishery products between the point of landing and the final retail sale. Information will be obtained on the volumes of production, where fish shipments originate, and the destinations of these shipments. Checks will be made to determine whether improvements could be made to eliminate waste and spoilage of fishery products in shipment or through mishandling in distribution plants. Wholesale and retail markets will be checked in detail to determine whether traffic congestion, poor equipment, or other factors cause undue delays and add to marketing costs. The economic evaluation of the data will be of material assistance to the Region's processors in improving their operations.

Development of Cooperative Marketing

At present, few effective cooperatives exist in the Great Lakes area. The development of an industrial fishery will

necessitate cooperative organizations if the producers are to obtain maximum financial returns. Assistance in establishing cooperatives will not require large expenditures.

Economics of the Commercial Fisheries of Rivers, Reservoirs, and Ponds

The river fisheries and rice-pond fisheries are presently neglected in the economic program. Reservoir fisheries are just beginning to develop. Investigations concerning cost of production, prices, transportation, marketing, and employment are necessary.

EXPLORATORY FISHING

The need for exploratory fishing in the Great Lakes and Central Region stems principally from the reluctance, sometimes the financial inability, of fishermen in this area to undertake the exploration and experimentation to meet changing conditions,

even when legal authority is granted. Most Great Lakes fishermen are by nature conservative, partly because of the complicated and restrictive fishery codes under which they have long operated. Many cling tenaciously to traditional fishing methods, even though they become less and less profitable, apparently in the hope that the highly desirable and valuable species will return to their previous abundance. Others who see the need for change will not risk a total transformation of procedure. Still others are leaving the industry altogether rather than attempting to exploit the vast numbers of the less-valuable species now available. In order to assure the utmost utilization of this great natural resource, adequate research is needed to demonstrate the feasibility and means of harvesting the existing fish stocks profitably. This program will show kinds and amounts of fish available to different types of gear in various localities, will measure seasonal variations in availability, will ascertain the best fishing



Exploratory fishing and gear research vessel *Kaho*.

methods and gear, and will help the fisherman adopt methods and equipment that are unfamiliar to him now. Areas which are in greatest need of immediate attention include: Lake Michigan, where extensive bloater-chub and alewife populations are being cropped only superficially by otter trawling; Lake Erie, where large populations of smelt, alewife, and gizzard shad are not being utilized; and Lake Superior, where practically nothing is known about the possibilities for low-cost production of lake herring and other abundant but low-value species. Exploratory fishing and gear research designed to serve commercial fishing needs adequately in Region 4 must include basic exploration, gear development, and technical assistance to industry. The activities outlined in succeeding pages are not necessarily restricted to the fisheries of the Great Lakes, but can be adapted to river, reservoir, inland-lake, and rice-pond fisheries where harvesting methods are also antiquated or new fisheries await development.

Basic Explorations

The explorations involve test fishing with various types of commercial gear to determine the seasonal abundance and distribution of various species, to assess the potential commercial yield of certain underutilized fish stocks, to locate and determine the extent of areas suitable for different kinds of fishing, and to make this information available to the fishing industry soon after it is obtained. Basic explorations will be carried out on all five of the Great Lakes and on certain inland waters as required. Several types of fishing gear and methods will be tested in addition to the otter trawl now being used. New gear will be developed for use under the unique fishing conditions of the Great Lakes and other inland waters. Studies will include research on diurnal variations of catch and on population fluctuations--both seasonal and annual.

Gear Development

Gear development includes the testing of modified existing fishing gear or newly designed gear and electronic fishing aids to develop the most practical and efficient means of catching certain fish. Midwater gear, air curtains, electric and light attraction devices, impounding nets, and seines that are presently not used by Great Lakes

fishermen, will be evaluated for initial and operating expense and efficiency in local situations. Direct and remote methods for observing fishing gear in action will be used to study the performance characteristics of gear and the reactions of fish. In support of technological studies, handling and holding facilities aboard vessels will be investigated to increase operational efficiency and improve the quality of landed fish.

Technical Assistance to Industry

Assistance to industry consists of close cooperation aimed at working out fishing method and gear problems. Information and direct aid will be given to fishing vessel operators in adopting unfamiliar fishing methods and equipment. Lectures, reports, and consultations, including the use of drawings, charts, photographs, slides, and motion pictures depicting various fishing methods and gear, will be made available to individuals or groups of fishermen. The short-term demonstration of unfamiliar and costly equipment aboard a fisherman's own vessel will be continued where it appears necessary to overcome his hesitancy to change from traditional fishing procedures.

MARKETING

Promotion of sales and development of markets for fish and fishery products in the Great Lakes and Central Region started on a small scale in 1955. The staff for this work is sadly inadequate for a region that offers the largest potential outlet for fish and fishery products in the United States. The work done to date by the marketing staff clearly indicates its ability and the capability of the program to increase the per capita consumption of fishery products, to dispose of stocks of products in excess supply, and to find outlets for various types of industrial fish. Success of the marketing program in Region IV will have highly beneficial effects on the industry throughout the United States. Region IV is a major market outlet for products from every segment of the U.S. fishing industry.

The long-range program contemplates no great change in fields or methods of activities. Rather, we need the facilities to place the programs in the following listing on a truly effective basis.

BRANCH OF MARKETING

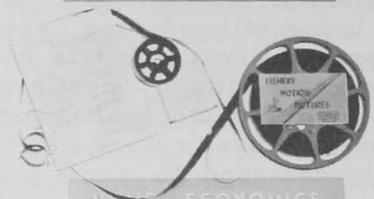
CONSUMER EDUCATION



MARKET RESEARCH



VISUAL EDUCATION



HOME ECONOMICS



Branch of Marketing consumer education services display at the Regional Office open house.

Market Promotion

This program is designed to further immediate sales of food fish, principally at the retail level. To insure greatest effectiveness, much of the market promotion will be coordinated with promotional activity on the part of the industry and State or other agencies. The work will be implemented by public service consumer education programs for National and Regional promotions. Consumer education materials will be distributed through the press, radio and television stations, food-trade associations, consumer groups, State and Federal agencies concerned with food distribution and consumption, through National and Regional fishery trades, and others involved in food promotion. Important also will be special action programs to alleviate supply and demand imbalances that occur in certain U.S. fisheries.

Market Development

Human food. -- If all segments of the public are to be contacted effectively the program must be developed along several lines and

the alert opportunism of the staff will play an important role. The major avenues of approach are nevertheless obvious; they are described briefly in the paragraphs that follow.

Consumer education through mass-information media:-- This approach affords the broadest coverage of any proposed, but it generally lacks the appeal of person-to-person contact. Experience has proven, nevertheless, that factual materials, soundly prepared and cleverly presented, can, through repetition, have profound effects. The materials will include press releases, recipe booklets, radio recordings, television slides and film strips, and motion pictures. The distribution of materials will be supplemented by personal appearances of staff members.

School lunch programs:-- School lunch programs are given special listing since the furtherance of fish consumption in schools serves the dual purpose of increasing the use of fish immediately and of influencing the eating and buying habits of families of the future.



Array of fresh-water and marine products served at Regional Office open house.

Animal foods and industry.--The decline of high-priced and the increase of less desirable species in the Great Lakes are forcing operators to depend more and more on lower priced fish and to look toward presently unmarketable or underutilized species. Proper market development may carry some of these less expensive fish into the human food market, but the success of the fishery for underutilized fish will depend primarily on their use as animal food and in industry. This supply of inexpensive fish may increase even more as production expands in rivers, reservoirs, and rice fields.

The principal potential outlets for low-priced fresh-water fish are in pet food manufacture and as food for fur-bearing

animals--principally mink. Bureau programs have contributed in an important way to expansions of both uses, and a broadened scale of activities can add greatly to the rate of advancement.

It is still questionable whether large-scale production of fish meal and liquid fish from fresh-water species is economically feasible, but the market for these valuable sources of protein for feeding fowl and livestock is great and can be increased through an adequate technological and marketing program. Increased consumption in the agricultural sections of the Region can ease materially the economic difficulties of the fish meal industry in other parts of the country.



Display of Marketing activities for developing markets for underutilized fish. Bob cats used in zoo animal feeding experiments utilizing fishery products.

Fish cookery demonstrations and test kitchen research:--Cooking demonstrations will be conducted for extension service personnel, university home economics classes, women's organizations, and persons responsible for feeding large groups. Much of the demonstration work will be by Bureau home economists, but strong efforts will be made to influence home economists of utility firms and other organizations engaged in cookery demonstration to place greater emphasis on fish and fishery products. The development of new recipes can increase consumption through improvement of variety and palatability; good possibilities exist here for increased use of species now generally held in disdain.

Consultation and advisory services for retailers, restaurant owners, and institutions:--Retail sales often lag because displays are unattractive or because store operators lack sufficient knowledge of sources to offer a consistently

appealing selection. Services here (which will be concentrated on, but not confined to, supermarkets and chain outlets) include supplying market information (sources, prices, seasonally abundant items) and conducting of marketing clinics to help retailers merchandise fishery products more effectively.

Approximately 558 million meals are eaten in restaurants each week. Many restaurants offer no fish or shellfish or a limited, monotonous selection. Market information on availability and suggestions on improved preparation can add greatly to the consumption of fish in restaurants.

Institutions, as used here, cover a broad range of public and private charitable institutions, penal institutions, hospitals, food-serving establishments in industrial plants and others. Here, as with restaurants the supplying of proper information, advice, and

encouragement can greatly widen the use of fish and shellfish.

Possibilities for the use of fish in industry are difficult to assess because so much additional research is needed. New uses of fish and fish oils constantly develop. Unquestioned but unevaluated potentials for fish or fish products occur in such fields as medicinal preparations and dietetic uses and as fish flour, meals and solubles in agricultural fertilizers, and fish oils in ore-beneficiation processes,

Market Research

The development of orderly marketing in the Region requires market research and analysis of a type previously not attempted. The research needed for all types of fish and fishery products includes: accurate determination of distribution patterns, eating habits, and consumer preference; availability, including seasonal variations of different fish and fishery products; and evaluation of existing and potential markets. The issuance of periodical bulletins based on these studies will serve industry members and consumers alike.

MARKET NEWS

Established in 1938, the Chicago Market News Office was one of the earliest Market News Offices set up by the Bureau--only the New York and Boston offices preceded it.



Market News activities.

This service rapidly proved so valuable that circulation of Market News information doubled in a few years, and more than

tripled by 1960. In the same period, services were broadened by the issuance of monthly and annual summaries, and the publication of numerous special reports. So vital has market news reporting become to the orderly movement of fishery products that pressures are increasingly strong for further expansion of service, including the establishment of new reporting centers.

The Chicago Market News Office is the only one in the entire Great Lakes and Central Region. From the standpoint of circulation it is the third largest among the seven maintained by the Bureau. Current services include: "Fishery Products Reports," issued daily, Monday through Friday; comprehensive summaries of receipts, prices, and trends, issued monthly; an annual summary with a complete review and analysis of the trade; special reports on the marketing of individual products such as shrimp and halibut; and other nonregular reports The full coverage of various categories of processed and frozen products makes the reports valuable at many landing, processing, and marketing centers throughout the country and in some foreign localities.

The principal features of the proposed Market News reporting program are: broadening market coverage to include receipts, prices, and market trends for fishery products not now reported; a close following of industry changes--marketing and distribution patterns of new products; dissemination of information concerning the Bureau's regional and national programs and activities; and the extension of coverage to other major market centers.

Market News Suboffices

Detroit, Cleveland, and St. Louis.--The major function of the suboffices is to be the collection of data on markets and prices. Distribution of processed reports will be limited to local circulation. Information from suboffices is to be forwarded to the Chicago office for publication in the report series published there. Suboffices will be established one at a time as funds are provided. Order of priority will be: Detroit, Cleveland, and St. Louis.

Detroit is the principal port of entry for our extensive imports of Canadian fish into

the Middle West. In addition, Detroit receives substantial supplies from the Great Lakes, from coastal areas, and from overseas sources. A survey made in 1956 set the annual volume of receipts at roughly 30 million pounds. The industry needs information on prices and movements covering this important market center.

Cleveland is the principal processing and distribution center for fishery products in the heavily industrialized Lake Erie region and southward to and beyond the Ohio River. The exact annual volume is not known, but it probably equals or exceeds 30 million pounds. Here, too, the industry is wholly without information on prices and movements.

St. Louis is the most important processing and distribution center for fishery products for the central Mississippi Valley and areas to the west. Large quantities of frozen ocean fish are handled in this traditional test-marketing locality. The annual volume is unknown, but it probably exceeds that in either Cleveland or Detroit. Here, again, the industry would benefit materially from detailed marketing information.

STATISTICS

Statistical offices of the Great Lakes and Central Region collect, compile, and disseminate data on: the employment of fishermen, fishing craft, and gear; the volume and value of the catch; the production of manufactured fishery products; and the number of wholesale fishery firms in the fresh-water fisheries of 21 States. Statistics collection is the Bureau's oldest activity in the fresh-water fisheries. The first survey of the Great Lakes was made in 1879. Complete surveys were infrequent for many subsequent years but have been continuous since 1926. The first production statistics for river fisheries were published in 1894. Scattered surveys were made in later years, but coverage has been continuous only since 1954. Currently most of the data needed on river fisheries are being collected, but quality and detail are not adequate to satisfy all users. The proposed statistical program for the Great Lakes and Central Region calls for three operational units which will be able to provide all statistical data necessary for the Branch of Statistics and for the other Branches to carry out their responsibilities in the Regional program.

Data Processing

Located in the Regional Office, this group will collect and tabulate complete data on Great Lakes catch and operating units through the use of data-processing equipment. This unit will provide detailed biological and economic data for biometric studies by the Bureau's Biological Laboratory at Ann Arbor, and for economic studies by the regional economists. It will provide statistical data for monthly landings bulletins, annual landings bulletins, the Statistical Digest, and other purposes as needed.

Great Lakes Statistics

Also located in the Regional Office, this unit will prepare tables of statistics on the Great Lakes fisheries from data supplied by the data-processing unit and make canvasses of the processing industries and the wholesale fishery firms. Materials will be analyzed and prepared for reports on trends and conditions, press releases, marketing-outlook publications, and special projects as required.

Mississippi River and Inland Waters

This unit will operate from two field offices. The field agents will collect statistics for the fresh-water fisheries outside the Great Lakes. In addition to surveys now made, the agents will census the bait fishery, pond-trout production, the rice-fish fishery, and the wholesale fishery firms in inland cities. Monthly landings bulletins will be established for significant fisheries. Reservoir fisheries will be canvassed to provide production records for individual impoundments. Agents will assist States in establishing and operating statistical-collection systems. Reports on trends and conditions will be prepared for all States.

TECHNOLOGY

Technological service to the commercial fishing industry in the Great Lakes and Central Region prior to the establishment of the Regional Office in Ann Arbor in 1958 was infrequent and inconsequential. Mostly it consisted of short visits by technologists from other areas and the proximate analysis of a few fresh-water species. Even when a technologist was added to the Regional staff, stringent limitations of personnel, funds, and facilities restricted sharply the

services that could be offered. Some experimentation with filleting equipment was started, advice in matters of processing and handling was given to the extent possible, and a little progress was made in the analysis of additional fresh-water fish. In connection with the USDI Inspection and Certification Service, an inspection office which offers lot-inspection service to the industry was opened in Chicago in March 1960. Inspection services are financed solely through reimbursements from industry for services rendered. Shortages of staff and funds persist.

The scanty technological program in the Region is peculiarly unfortunate since the fisheries here, perhaps more than in any other area, stand in need of our services. As we explained previously, the modern technological advances of the fishing industry have penetrated only slightly into the Great Lakes and Central Region. Backwardness in handling, processing, packaging, and quality maintenance has indeed made it difficult to take and sell even the choicer fish at a profit. The situation in the Great Lakes is made even more trying by changes of species composition that are forcing a reorientation of the entire fishery. Without technical assistance, that industry surely will find it difficult to make the necessary readjustments. The program proposed here is intended to bring technological services in the Region to an adequate level.

Composition of Fresh-Water Fish and Fishery Products

Mink ranchers, pet-food canners and dietitians have asked for information on the chemical composition and characteristics (proximate analyses; amino-acid, vitamin, and thiaminase contents; and digestibility data) of fresh-water fish and fishery products, both raw and processed. These data are absolutely necessary for safe and efficient utilization, particularly of the industrial fish. Lack of this information limits the success of marketing programs to expand uses of fish as animal food. Physical and chemical analyses are needed to provide background information for developing specifications and quality standards of fresh-water fishery products.

Freezing and Cold Storage of Fresh-Water Fish

Relatively little is known about the frozen-storage characteristics of most fresh-water

species. Data on the cold-storage life would assist the producer greatly in selecting the best handling and packaging procedures and in adjusting to fish-marketing changes. Furthermore, studies of the freezing and cold storage of presently underutilized species may aid in broadening the markets.

Engineering Development of Fish-Processing and Holding Equipment

It is becoming practically impossible to sell whole or partially dressed fish. Yet, larger quantities of smaller fish are being landed. These must be filleted or hand dressed individually. Hand labor is so scarce and costly that processing by machine is vitally necessary. Demonstration equipment that can be employed in various locations will assist greatly in showing the possibilities of machine operations to processors. Technological studies are needed also on basic-design requirements of such equipment as conveyors, sorters, packing tables, and containers, . . . , to insure efficient and sanitary handling.

Refrigeration facilities on vessels and at shore plants are inadequate or obsolete, if present at all. Directions as to the proper design, installation, and operation of icing and handling (mechanical conveying) systems, chill tanks for holding fish in cold-liquid systems on the vessel or at the plant, and cold-storage installations can substantially improve the quality of fishery products. Model systems will be used for demonstration. Thus, the industry will be able to see in operation a complete, well-engineered system for the proper handling, transfer, holding, and processing of various species.

Fresh-Water Fish as Food for Fur-Bearing Animals

The animal-feed industry is continually searching for sources of economical yet well-balanced protein and other nutritional supplements to include in their products. The increasing output of such species as bloaters, smelt, alewife, sculpin, carp, and sheepshead, formerly underutilized or totally unmarketable, provides an opportunity for expanded use of fish that can benefit both the producer of fish and the user of animal foods.

Users of fish as animal food--especially mink farmers--are understandably reluctant to increase fish in the diet even if they



Present industry methods of holding fish in wooden boxes and tubs with minimum icing, resulting in poor quality.

have proximate analyses of the fish. They wish also definite evidence from actual feeding tests that increases of fish in the diet are both economical and safe. Many species of fresh-water fish are known to contain a biological antagonist, thiaminase, that destroys thiamine (vitamin B₁) when the fish are mixed raw with the balance of the rations.

Basic research is proposed, therefore, on processing methods to destroy or modify the antithiamine factor so that thiaminase-containing fish can be fed to mink safely and economically. Feeding studies with mink also are necessary to determine optimum (nutritive and economic) levels of fresh-water fish in the ration with and without treatment to destroy the thiaminase factor.

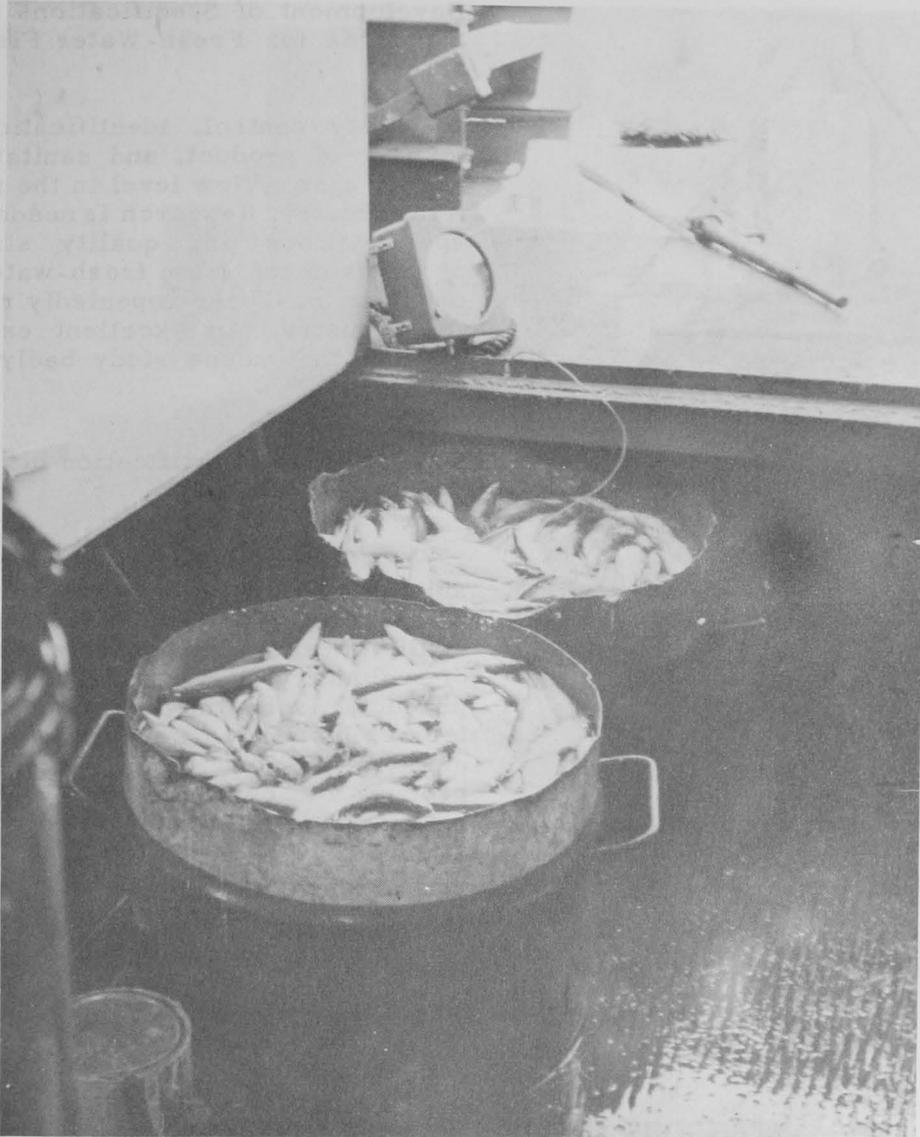
Rice Field, Reservoir, and River Fisheries

The needs of the rice-fish farmers were covered in the earlier account on proposed

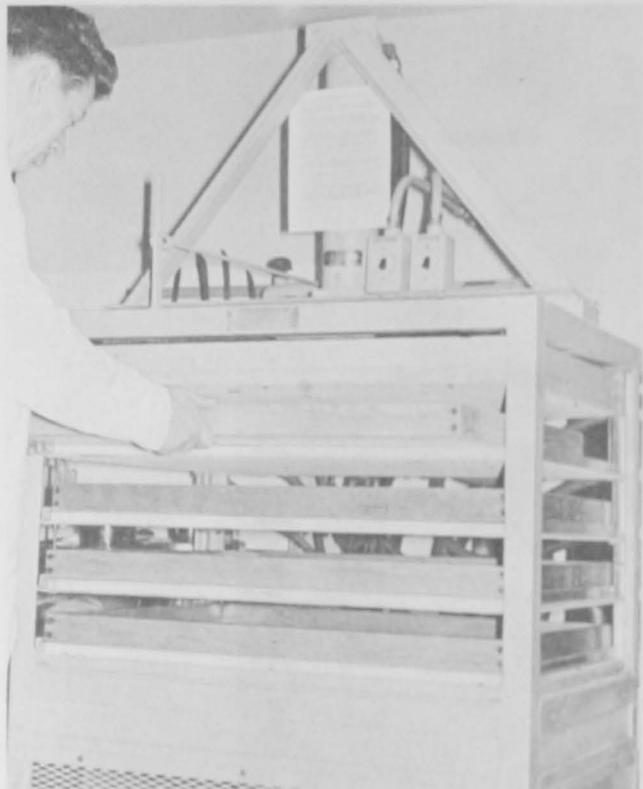
emergency programs for the Arkansas rice-fish industry. Technological services will be required also to assist river fisheries to modernize and to aid the presently limited reservoir fisheries as they expand. Assistance is and will be needed in: the development of new products and uses for the various species; handling, freezing, and packaging; and the development of efficient processing equipment. Especially pressing is the need to find uses for the less valuable fish.

Advisory Service to Industry

Members of the fishing industry and consumers of fishery products often express need for information on specific technological problems. Demonstrations are often required to illustrate the application of available information. The program of service and liaison must be made effective to bring to the attention of the industry up-to-date information on methods of processing, quality control, and sanitation.



Industry demonstration on a fishing vessel of holding fresh-water fish in ice-water mixture to improve quality.



Quick-freezing fresh-water fishery products on laboratory-model plate-freezer to determine cold storage life and quality.

Development of Specifications and Quality Standards for Fresh-Water Fishery Products

Quality control, identification and uniformity of product, and sanitation, . . . are at a very low level in the fresh-water fish industry. Research is needed to develop specifications and quality standards on products made from fresh-water fish; this program has been repeatedly requested by the industry. An excellent example of a product that needs study badly is smoked chub.

Inspection and Certification of Fishery Products

Inspection and grading services are available on a fee basis to processors who meet the existing voluntary Federal standards of quality for fishery products. Promulgation of voluntary U.S. standards for fishery products is by the Department of the Interior. Inspection services are also available to assure wholesomeness of the product and conformity to written specifications not presently covered by established standards.



USDI fishery products plant inspector examining fishery products.

COORDINATION OF BRANCH PROGRAMS

As has been emphasized repeatedly, coordination of the activities of the several Branches in the vast and diversified Great Lakes and Central Region imposes great responsibility on the direction from the Regional Office and on the supervisory staffs of the Branches. Difficulties are accentuated because present programs of most Branches are extremely small. As we approach gradually the broad, long-range program we have laid down, we must exercise great care indeed that the scheduling of new projects is so established as to give us continuously an effective Regional program.

We contemplate broad use of a committee procedure for the evaluation, planning, and coordination of activities that involve several Branches. The initial committee will consist of a small group representing the

disciplines that have the greatest roles in the proposed operation. It will be the responsibility of this committee to assemble, organize, and summarize relevant information and to offer tentative proposals for an integrated approach. The report they submit will then form the basis for higher level consultations of the Regional Director and his Branch Chiefs, and the laying down of the final operational plan. In this way, sensible, effective, integrated planning can be achieved without the need for the Regional Director and other administrative officials of the Regional Office to spend excessive amounts of time in the consideration of details.

We are assisted to a degree by the very fact that most current programs are small. Building new programs soundly should be

Created in 1849, the Department of the Interior—America's Department of Natural Resources—is concerned with the management, conservation, and development of the Nation's water, fish, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States—now and in the future.