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FISHES AND THE UNIVERSITY

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It will surprise some of you to hear that fishes have anything to do with the University of Michigan. I want to point out not only that, but also that the University has quite a bit to do with fishes, and with fishing. You may have heard or read something about the fish work being carried on at the University, or may have seen some of the lake or stream improvements installed under the direction of the fishery workers of the University, to improve fishing in our state. While various items in the fish work of the University have been given some degree of publicity, the story as a whole has never been given out to the public.

Fish stories are supposed to grow. It is therefore natural to tell of the growth of fish work at the University. Searching the records of the early history of the University, now growing dim, we find evidence of some fish work being done even then, and the University Museum still possesses specimens which represent some of these early studies. These include a gar which was described as a new species from Michigan in 1864, by Alexander Winchell, one of the most illustrious of the University's early naturalists; also other specimens collected by or for Professor Winchell. There are also some Chinese and South American fishe specimens collected by the now venerable Joseph Beal Steere in 1870 to 1875, during the earliest of the expeditions sent out by the University to explore the faunas of foreign lands. But all this early work on fishes was incidental to general natural history studies and expeditions.

During what we may call the Middle Ages of the University's fish history, special studies of these finny animals were first conducted at Ann Arbor. Professor Jacob E. Reighard, head of the Zoology Department from 1896 to 1927,

and still active though retired from official duties, conducted many detailed investigations in ichthyology is the science of fish life. Alone or with students he made and published anumber of notable studies on the anatomy, embryology and life histories of Michigan fishes.

Foreshadowing the work of the present time, Professor Reighard did not restrict his interests to technical problems, but also actively engaged in work of a distinctly practical nature. Since this was done 25 to 43 years ago, it stands as pioneer work in economic ichthyology. Nevertheless these studies were finished products, still standing as authoritative. Among the practical accomplishments of Prof. Reighard we may mention as outstanding, his development, in cooperation with Dwight Lydell, of the methods still employed in the artificial propagation of the small-mouth bass; also his careful studies of the development and artificial propagation of the pike-perch or walleye. These two studies, which were of great importance in the development of fishcultural methods, were conducted for the old state Fish Commission, the precursor of the present Fish Division in our Department of Conservation. Thus as long ago as 1890, the University was giving technical service to the state's fish department, anticipating the work of the Institute for Fisheries Research of the present time. Similarly, Prof. Reighard long anticipated the current work of the Great Lakes Division of the United States Bureau of Fisheries, when he with a staff of workers conducted extensive investigations into the fish life and fish conditions of the Great Lakes. This early Great Lakes survey was carried out from 1898 to 1901 for the old U. S. Fish Commission, now known as the Bureau of Fisheries.

This early fish work at the University was done during the summer vacations, or during the scanty spare time, of Prof. Reighard and a few students and associates who were otherwise busied with teaching work. It was not until 1919 that anyone was appointed to carry on full-time fish work at the University. This first appointee was Dr. Walter Koelz, now a well-known Asiatic explorer, who was

employed by the United States Bureau of Fisheries to investigate, under Prof. Reighard's direction, the species of the whitefish and lake herring family in the Great Lakes waters. Not long afterward, Dr. John Van Oosten received a similar appointment, to investigate the life-history of the same fishes. After Dr. Koelz retired from this position, a staff of aquatic biologists and assistant's was gradually built up under Dr. Van Oosten to form the Great Lakes unit of the Division of Scientific Inquiry of the United States Bureau of Fisheries. This group of federal fisheries investigators maintains its headquarters in the Fish Division of the University Museum of Zoology, and actively cooperates in the fish work being carried on by the University.

The interesting work of this Great Lakes scientific staff of the United States Bureau of Fisheries may be mentioned, since it is being done at the University. A very thorough study has been made of the catching effectiveness of different kinds of fishing gear, and of the harm done by each type of gear in destroying immature fish. The information obtained is of great value for state fishery officials and legislators, in designing laws which will regulate the kinds of nets and the sizes of mesh which may be expected to maintain instead of to destroy the fish supply. While experimental nets were being set in Lake Michigan from the government fishery vessel, numerous drift bottles were set loose, to determine the course of the currents, from the point where the bottle was released to the point where it was rediscovered, the latter data being furnished by whoever found the bottle. Studies are also being made of the life history of the important food fishes of the Great Lakes. This is done chiefly by studying the scales, for these show winter rings, much like those seen on the stump of a tree. Knowing the age of hundreds of individuals, it is possible to compute the maximum age, the age usually attained, the age at first maturity, and the average amount of growth in each year of life and other information regarding the life of the fish. All this information is valuable for the fixing of size limits on the fish, to

insure an opportunity for natural reproduction. The local staff of the Bureau of Fisheries has also conducted some extensive studies on the chemical conditions and the basic food supply for fish life in the Great Lakes. In Lake Erie very thorough studies of this sort were made to determine whether pollution was an important factor in the depletion of the fish supply in that lake. And to determine scientifically whether the fish supply is being depleted, this government staff at the University is carefully analysing the commercial fishery statistics of the Great Lakes. Dr. Van Oosten also cooperates with the fishery officials of the Great Lakes states in drawing up legislation designed to save the great fish supply of our inland seas from destruction.

Shortly after the Bureau of Fisheries assigned Dr. Koelz to carry on fishery work in Ann Arbor, the University employed its own first full-time ichthyologist, when in 1920 the speaker was appointed Curator of Fishes in the Museum of Zoology. At first two small unit rooms in the Science Building served comfortably to house the whole Fish Division. With added growth, new quarters over the campus were occupied, until the commodious new University Museums building was completed in 1928. Since that time the growing fish staff has had available seven offices and private laboratories, one student laboratory, a fish and fisheries library, an excellent aquarium and large rooms for the rapidly expanding fish collection. For the storage of the fish specimens approximately two miles of shelf-space is available, but this is none too much, for the collection has now grown to become one of the largest in the country. In these quarters about a score of fish and fishery workers, including the federal staff already mentioned, keeps busy carrying on scientific and economic investigations into fish life. Such as been the growth of our fish story, from the beginning made early in 1920, when the combined federal and University fish workers at Ann Arbor numbered two, and occupied three small rooms.

The fish work of the University has several angles. First we may mention the

the training of students to become investigators and administrators in fish and fishery investigations. Such students are now scattered far and wide, applying the training they received at the University toward the solution of fish and fishery problems in various states and countries. Among our alumni we may proudly mention the leading fishery researchers of the well-known California State Fisheries Laboratory; the biologist of the New York Conservation Department; the chief of the Fish Culture branch of the Ohio State Division of Fish and Game; the Professor of Ichthyology in the Department of Fisheries of the State University of Washington; an investigator in the Philippine Bureau of Science; professors of zoology in the College of the City of Detroit and in St. John's University of Shanghai, China; the chief and several others members of the Great Lakes staff of the United States Bureau of Fisheries, already discussed, and of the Institute for Fisheries Research which will be mentioned later.

Visiting investigators have been drawn to this internationally known though newly developed center of ichthyological research, not only from various states and Canadian provinces, but also from Argentina and Japan, while more casual visitors have come from many other lands to inspect the various lines of fish work being carried on at the University of Michigan.

A second phase of the fish work being carried on in the Museum of Zoology at the University is research in ichthyology. Mention has already been made and will again be made to researches in fisheries biology. Now a very brief statement will be made regarding the work in ichthyology proper--the science of fishes. Especial emphasis has been given here to what is called the systematic study of fishes: that is, determining and describing the different species of fishes. Unlike some Museums, our institution does not think it necessary to travel to distant lands to discover unknown species, or to discover new facts regarding the species already described. We have discovered many new species of fishes in the freshwaters of our own country, some even in our own state of Michigan.

Best known of these discoveries was that of the spotted or Kentucky bass. Complacently believing that all was known regarding the species of black bass, neither anglers nor scientists thought that there could be more than two species of these famous, "inch for inch and pound for pound, the gamest fish that swim". Yet careful study showed that throughout most of the Mississippi Valley there lives a third species of black bass, which now that it is known, is highly regarded for its game qualities. Other new American freshwater species described by the University's fish scientists include the blue pike of Lake Erie; the largest of the redhorses; several Great Lakes species of the whitefish family, and a number of smaller fishes such as shiners and darters. A considerable number of new kinds of fishes have been discovered in studying collections from Middle America, the West Coast of North America, Argentina; Japan; the East Indies, and other lands. Knowing the different species accurately is of fundamental importance in both scientific and practical ichthyology.

Since it is also important, however, to learn where and how each kind of fish lives, the University fish men (as they are called) investigate into the private lives of each of our finny friends, seeking to learn what regions it inhabits; what sort of habitat it prefers (whether sand or mud, weeds or open water, etc.), by night and by day, by summer and by winter; where or whether the fish rests in its open-eyed sleep; how it finds shelter to escape its enemies; what it feeds upon and what feeds upon it; how fast it grows in each year of its life, and when, where and how it breeds. While these problems are largely investigated in order to contribute to the sum of scientific knowledge, a little thought will show that this is just the sort of information we need to obtain for the state fishery officials, in order that they may have a sound basis on which to build up fishing regulations--size, season and creel limits.

To collect fish specimens and to study the lives of fishes in their natural waters, the University frequently sends out expeditions. Many of these are

short trips to the almost innumerable lakes and streams which so bounteously enrich our own state of Michigan. Being a state institution, the University naturally gives first attention to these Michigan waters. Almost every summer during the years of this century, and often during other seasons, one or more men from or for the University have been exploring our lakes and streams to determine their fish fauna. The expeditions, however, have not been restricted to our own state. The University has conducted or cooperated in the fish surveys of several other states, especially Wisconsin, New York and Oklahoma. Fish collecting expeditions from the University have during the last ten years traversed almost every state in the Union, several Canadian provinces, about half of the Mexican states and a number of Central American countries. For over fifty years the University Museum has also been engaged in the world field of biological exploration, sending our expeditions, on which fishes have been collected, into other continents. The most extensive of these expeditions, so far as fish collecting is concerned, was that of 1929. In that year I journeyed to eastern Asia, collecting fish specimens in the East Indies, China and especially in Japan. During several months almost the entire main coast of Japan was combed over for specimens of the abundant fish life of the island empire of the East. Remote fishing villages which had never seen a white man in the memory of the present residents were visited. Everywhere samples of the fish fauna were preserved, until in the end a collection weighing in the gross five tons was obtained, giving our Museum perhaps the finest collection of Japanese fishes. A Japanese professor and a Japanese student have already come half way round the world to Ann Arbor, in order to help study these specimens.

Not all of the studies on living fishes are made in the streams and lakes of Michigan, other states and foreign lands. Hundreds of fishes are kept in aquaria at the University, especially in the Museum of Zoology. Here many secrets of fish life have been learned. Some of the results of these studies have aroused the interest not only of biologists, but of the public in general.

It was found that fish which ordinarily cease to grow in the winter can be made to continue their growth actively over that season, when kept in warm aquaria and when well-fed; also that fishes keep healthy and grow finely when subjected for long periods to 24 hours of light. It was proved that hybrids between different species of sunfish grow faster than either parent species, that they are mostly males and that they are always infertile. More surprising results have been obtained in the breeding experiments still being continued, using certain tropical fishes which give birth to live young, ready to swim, to seek shelter, to feed and to grow. A certain kind of these live-bearers has been proved to exist only as females. These females may be mated with various species of live-bearers to produce young, but these young in turn are always females and are always exactly like their mothers, never deriving even a trace of their characteristics from their father. This phenomenon is something very close to if not actually classifiable as parthenogenesis, and is quite novel and unique among all vertebrate animals. These aquarium experiments have therefore led us into a contribution to general biology.

That, of course, is a contribution to pure science, being without any obvious practical application to ordinary human interests other than the purely intellectual. However, we have no right to say that any scientific work is impractical, for one never knows when any bit of apparently pure science will be found applicable to human affairs. Experiments with electricity were once carried on solely to satisfy man's intellectual craving for explaining all natural phenomena. Almost every electrical and mechanical marvel of our age had its basis in the experiments of researchers who looked for no practical application of their work. So it has been in ichthyology. A few years ago most practical fish culturists would have branded as mere academic play, any study of the food habits or breeding habits of our minnows and shiners. But now the advantages of rearing forage fish to feed the bass and other fish in the hatcheries and rearing stations, and also in the fishing

lakes, is coming to be generally realized. Questions at once arise: what species of minnow is most suitable for this purpose; how can it be fed; will it in turn feed on the bass fry; how can it be bred in large quantity? Answers to these intensely practical questions are in part already available, as the results of the supposedly unpractical researches of only five or ten years ago. Any increase in our knowledge of any aspect of the natural history of any species of fish may some day assume practical importance.

While hit and miss scientific investigations would eventually be pieced together to make a full story applicable to the practical fishery problems, it would obviously be inefficient to wait for this slow process to take its course while these problems are crying for early solution. Realizing this, the state authorities have supported definite fish and fishery researches of a practical nature at the University, with a few interruptions, for 33 years. The early work of Prof. Reighard on the methods for the artificial propagation of walleyed pike and smallmouth bass has already been referred to. Following that work, which was done for the Michigan Fish Commission, the State Geological and Natural History Commission, the State Geological and Natural History Survey sponsored biological investigations of Michigan lakes and streams, until 1921.

In 1922 the newly created Department of Conservation requested the aid of the few ichthyologists then in the University service in making fish surveys of certain lakes and streams, in making examinations of proposed hatchery sites and in studying the smelt, which had recently established itself in great abundance in Crystal Lake. But in that year and through the summer of 1923, such work was done piece-meal, without any definite organization.

In the fall of 1923, realizing the need for more extensive and more regular technical help along the lines of fish and fishery investigation, the Department of Conservation added to its staff a Fishery Expert, Dr. Jan Metzelaar, and assigned him headquarters at the University, so that he might carry on his work

there under the advantages of library and laboratory facilities, and so that he could keep in close contact with other fish and fishery investigators. Dr. Metzelaar, with the aid of the University staff, energetically set about investigating fish diseases in the hatcheries, studying propagation methods, surveying trout streams and fishing lakes all over the state and in other ways attacking numerous problems for which the Department of Conservation needed answers. T. H. Langlois became Dr. Metzelaar's assistant, and later took over the fish hatchery investigations under the title of State Fish Pathologist. This cooperative arrangement, whereby the State maintained fish investigators at the University, came to a tragic end on October 4, 1929, when Dr. Metzelaar was drowned while carrying on his investigations in Grand Lake near Alpena, thus joining the heroic band of martyrs to science.

Early in 1930 the Department of Conservation requested the University to take over the investigation of the practical fish problems which need solution. An agreement was reached, and the Regents of the University created the Institute for Fisheries Research to carry on work of this nature. The Institute devotes most of its efforts to investigations for the Fish Division of the Department of Conservation, and derives most of its income from a Trust Fund established and maintained for this work by that Department. For three years (1930 to 1932) a considerable proportion of the work and staff of this Institute was supported by the Michigan Division of the Isaak Walton League of America, through the generosity and vision of its President, Mr. Harry P. Harper of Lansing. The work for the League consisted in the survey of more than a hundred Michigan lakes, including some of the largest of the inland waters, the idea being to obtain data on the size, form, depth, bottom, weeds, food conditions and fish life of each lake, and to base on this information a fish management policy for the lake. On a more limited scale, technical help has been given other states, and private waters are often surveyed and improved for fishing on a fee basis. The Institute

therefore, as one of the University's several public service departments, makes generally available, on a cost basis, the facilities of its laboratory and field equipment, and the technical training of its staff.

The University has developed in this Institute for Fisheries Research a small staff of trained fisheries workers, who have had drilled into them the idea that their work must be of a practical nature, designed in one way or another to build up and conserve the game fish supply of the state.

The sort of work being done by the Institute for Fisheries Research may be passed over briefly, as it has already been discussed several times:

(1) Creel census: The Institute is analysing the many thousands of records of game fishing obtained by the Department of Conservation, in order to learn definitely what kinds of fishes are caught in each section of the state, and in what proportions; how many are caught per hour, and whether this index of goodness of fishing is going up or down from year to year, and numerous other facts regarding the game fish yield of the state. A general report on this creel census is being prepared this month.

(2) Lake and stream surveys: These surveys are an inventory of the interior waters of the state: a building up of information regarding the present fish life of the various inland waters, and regarding the suitability of these waters for various species. The end is to build up a fish management policy for each water, budgeting the fish to be stocked and outlining methods for improving the conditions for fish life.

(3) Predator and disease studies are carried out to determine how these factors deplete the supply of fish in the hatcheries and in the natural waters, and to determine whether control measures may be expected to produce beneficial results and how what sort of controls may be practicable.

(4) Life history investigations cover studies of nursery waters, migrations, breeding habits and seasons, rate of growth, age at maturity, and various other items in the fish's life which have an obvious practical significance.

(5) Pollution experiments are carried out from time to time in the aquaria at the University, to determine the effects on fish life of various polluting substances and various effluents of industrial plants. These experiments are run for the state Stream Control Commission, and have been helpful in the efforts of that Commission to purify our streams and to prevent the killing of fish life.

(6) Forage fish studies have already been referred to as one phase of ichthyology which has recently passed from the purely scientific into the practical field. The object of these investigations is to develop means of increasing the minnow production in rearing ponds and in lakes, in order that more and larger fish can be reared for stocking our waters, and in order that the lakes may be made more productive for game fish.

(7) Beaver-trout investigation: Disagreements as to whether beaver improve or ruin trout fishing have become so violent, and the problem is one of such major importance, that the Department of Conservation has asked the Institute for Fisheries Research to employ a full-time naturalist to solve this problem. Mr. J. Clark Salyer is now making fine progress in this very practical field of research.

(8) Lake and stream improvement: Realizing that neither protective laws nor artificial propagation and stocking of fish has been really adequate in stemming the tide of depletion of our game fish, the Institute staff from the time of its organization in 1930 has sought additional means of conserving and upbuilding the game fish supply. The means grasped upon was the improvement of conditions for fish life in the natural waters. The procedure is to survey the lake or stream to determine what condition is lacking or so poorly developed as to hold down the natural tendency of any ~~form of life~~ kind of fish to increase; then to correct this faulty condition so as to give nature a real chance. The factor limiting the increase may be lack of shelter, which when added is readily adopted by the young fish; it may lack of spawning beds, which also may be added; it may be a deficiency in food, which in one way or another can often be increased.

When the plans for the Civilian Conservation Corps were announced, the Institute for Fisheries Research naturally thought of the opportunity which would thus be afforded for carrying into execution on a large scale, these lake and stream improvement methods which the Institute had been developing and fostering. Such work, involving chiefly manual labor and being of obvious public benefit, fit the requirements of projects for the C.C.C. The public benefits lie not only in the health and happiness which is bound to result from more and better fishing, but also from the actual economic values. Much of our northland has as its chief economic assets its pure air, clean water, and its fish and game and other recreational interests. The increase of these recreational assets is of paramount significance to the economic well being of a large part of our state. Water improvements which increase fishing naturally enhance the value of the riparian properties.

The Institute therefore joined hands with others in urging that lake and stream improvement work be included in the activities of the C.C.C., and helped lay out projects for such work in various parts of Michigan. Finally some of these projects were approved, then the lake improvement work was formally accepted as a regular function of the C.C.C., and after trying delays the work got under way. The Institute furnished a number of men to help supervise the work. Despite a late start, the stream and lake improvements installed by the C.C.C. in Michigan during the summer of 1933 include over 1300 current deflectors, covers and dams in streams, all designed to increase the carrying capacity of these streams for trout; 4000 linear feet of bank erosion control, to keep out of the stream the sand and silt which covers the spawning grounds and smothers out the food on which the trout live. And in lakes there were installed, with the same idea of increasing the fishing, 1084 covers and shelters, 248 spawning beds; 233 minnow spawning devices; 60 vegetation plantings and a number of minnow and bass plantings.

Plans are underway for increasing this lake and stream improvement work next year. Two members of the Institute staff are remaining in the field during the winter, making surveys for the future projects and supervising such work as may be done in the winter. It is hoped that material for the stream work next summer may be cut and hauled to the stream bank over the winter, and that the installation of brush shelters in the lakes may be continued in the winter. These shelters, designed to protect small fish and to attract large ones, would be built on shore, skidded over the ice and sunk at the desired spot.

In such ways does the University have something to do with fishes and with fishing. More fish for more people is the responsibility which the University is helping to bear. Success in these endeavors is I am sure a common wish.