Original: Fish Division
cc: Mr. Ruhl
Mr. Lagler

INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
UNIVERSITY OF MICHIGAN

A. S. HAZZARD
DIRECTOR

ADDRESS
UNIVERSITY MUSEUMS
ANN ARBOR, MICHIGAN

July 12, 1937

REPORT NO. 423

PROGRESS REPORT OF THE FISH MANAGEMENT UNIT OF THE AMERICAN WILDLIFE INSTITUTE, THE FISH DIVISION OF THE MICHIGAN CONSERVATION DEPARTMENT, AND THE UNIVERSITY OF MICHIGAN ON ITS INVESTIGATIONS OF THE NATURE AND EXTENT OF VERTEBRATE PREDATION OF FISHES.

Presented to the American Tackle Manufacturers' Association at its Annual Convention in Chicago on June 22, 1937

by

Karl F. Lagler

The Cooperative Fish Management Unit sponsored jointly by the American Tackle Manufacturers' Association through the American Wildlife Institute, by the University of Michigan, and by the Michigan Department of Conservation, was organized in January 1937. The funds allotted by your Association to the Wildlife Institute were first intended, as you know, for a trial stream project to be carried out under Dr. George C. Embody at Cornell University in New York. Unfortunately, late last fall, Dr. Embody was advised by his physician to retire from all but a minimum of his teaching duties. Dr. Embody was thus forced to withdraw from the supervision of the trial stream project and suggested that a cooperative fish management unit be set up at Michigan with a part of the funds. The remainder of the funds were to go to the support of the investigations on the Striped Bass being carried on in Connecticut by Mr. Donald Merriam.

Seven years ago, when at the University of Michigan, Mr. J. Clark Salyer, now head of the Migratory Waterfowl Division of the Biological Survey of the U. S. Department of Agriculture, began an investigation on the possibilities

of increasing the production of game fishes through the control of harmful predation. Predation is defined as the act of living by preying upon other animals. Before he was called to Washington to his present position, Mr. Salyer had collected extensively and carefully examined the food of many animals which fed upon fishes, he had obtained an excellent perspective on the problem of predation, and had left much material which he himself had collected and which had been collected by others for him yet to be examined. Owing to Salyer's departure and the demands of his new office on his time, active work on the problem ceased some two years ago. This meant that unless means and adequate personnel for continuation were obtained, an investment of over $5000 for equipment and for obtaining specimens and a considerable accumulation of extremely valuable data would be all but wasted.

This time seemed ripe, then, to the Technical Committee of the American Wildlife Institute in charge of cooperative projects, to select this problem for completion with the funds available. It was felt that this work, having progressed so far, would yield the most positive results in the shortest time and for the least investment.

I was brought on from Cornell, where I had received training in Fisheries management under Dr. Embody and valuable general zoological knowledge from that very fine Naturalist, Dr. A. H. Wright, to take over the work.

The arrangement then becomes:

(1) Salyer is to pool all his information and data with that which we obtain and the ultimate results to be tabulated and analyzed by us jointly.

Our close association with Salyer and the efforts of Dr. Carl L. Hubbs, whom you all know, has netted us the complete cooperation of the staff and the use of the accumulated data of the U. S. Biological Survey Food Research Division.

(2) $800 pf the original $2500 grant is to be used for the salary of a graduate student in Fisheries who becomes a laboratory assistant.

The young man selected for this work, Mr. William C. Beckman, is a second year graduate student at the University, has received his Masters Degree in Zoology this year, and has been well trained particularly in regard to Michigan fishes, their needs, and their management.

(3) The Michigan Department of Conservation through Dr. A. S. Hazzard, formerly of the U. S. Bureau of Fisheries, is to match the original grant with $2500 for field expenses which include the purchase of a car, nets, guns, ammunition, and other gear, and defrayal of travelling and incidental expenses.

(4) The University of Michigan at the University Museums to furnish office space, chemicals, glassware, microscope equipment, NYA assistance, and the advice of staff members under the supervision of Dr. Hubbs.

The project as now set up provides for the most intensive study of its kind ever attempted in such an area and will have in its conclusions applications for all northern States and southern Canada. Present arrangements run until July 1, 1938, by which time it is hoped that adequate data will have been obtained to more nearly answer the many perplexing problems which are ours.

Our first task in taking up this investigation was to inventory the materials on hand and ready for immediate study and to take account of the work covered to date. We found sufficient materials to keep us occupied up to and beyond the time when the season for work in the field opened.

Since we are concerned with the food habits of animals, the analyses of stomach contents and droppings consumes much of our time but gives us in return much of the information which we so sorely need. In order to facilitate and make more exact the determination of the bony remains of animals, we immediately proceeded to complete our series of skeletons of

Michigan fishes and to add skeletons of amphibians (frogs, toads and salamanders), and certain reptiles (snakes, and young turtles). These skeletons were prepared either by the use of Pancreatin or beetles of the family Dermistidae, commonly called dermistids.

We also made certain conversion tables by means of which when given the length of the jaw bone of a trout, for example, we are able to tell the length of the whole fish when it was alive. These tables are very useful in determining the per cent of a legal size fishes taken by predators (also in identification of size from remains of illegal fishes in possession of poachers or other violators).

The total number of stomachs examined to date is well over twelve hundred. The bulk of these were worked up by Salyer in his time, but the total here given will probably be doubled before the study is completed. Of the present total: over 200 are Great Blue Herons, over 75 are Green Herons, 100 are Bitterns, 565 are Kingfishers, about 150 are water-snakes, just over 130 are garter-snakes, and only 50 odd are turtles. Over 170 Mergansers have been studied, along with small numbers of other species of ducks. For the correct interpretation of food items present in the stomach, extensive field observations are under way. It is obvious that stomach analyses show merely what an animal will eat. The circumstances under which the food is taken, the manner in which it is obtained, and the condition it is in when taken can only be determined by observing living individuals feeding under experimental and natural conditions.

The objectives of the investigation are:

(1) To enable hatcheries and rearing stations to produce more and larger fishes for stocking purposes at lower costs by reducing losses owing to predator activities.

(2) To find out something about what happens to fishes under natural conditions (both wild fishes and stocked fishes) as a result of the activities

of their natural enemies including man.

(3) To reserve the major portion of the cropping rights to the sport fishes in our lakes, ponds, and streams for fishermen.

Regarding the first objective; then, to enable the production of more and larger fishes at our hatcheries for use in stocking inland waters at lowest cost, where such stocking is desirable, entails more than the mere presence of good physical equipment. Water supply, disease eradication and control, and food and feeding practices must be optimum. In addition, the deleterious activities of the enemies of fishes, which are of course attracted by the abnormally high and unprotected concentrations of fishes at hatcheries, must beremoved or controlled. The preservationist and ideal theory say that no life shall be destroyed in this control. We hope to learn if this is possible and if such control is practical.

Three major groups of animals have representatives which are at least at times obnoxious about hatchery grounds. These are the birds, the reptiles, and the mammals.

It is not news for me to state that the kingfishers and members of the heron family are the most troublesome birds about the majority of our north-central hatcheries. Less common, but at times by far the worst marauders, are the fish ducks (Mergansers), terns and possibly sea gulls.

For many years bird predators about hatcheries have been ruthlessly killed. They were blamed for a large portion of losses in fish. Whether or not these killings are justified, whether some are and others are not, and a determination of the exact extent of losses by birds about hatcheries have never been established. It is very probable that depleted rearing-station populations have frequently been blamed on so-called predators when the actual fault lay with careless handling or lack of knowledge regarding the action of some less obvious agent such as disease or parasites.

From a study of the food and feeding habits of fish-eating birds, we are obtaining data which may well enable us to state rather definitely in numbers of fishes, or dollars and cents, the cost of supporting each predatory species. By comparing the actual, known cost of the support of such forms with their esthetic value, if such comparison be possible, we may learn whether or not their tolerance about hatcheries is warranted, and how large an investment for control is reasonably justified. With such facts at our command, we may proceed to the bird lovers and protectionists with our case and expect a just response.

You know, as well as I do, that Audubon societies and other groups of nature-lovers are well organized. They are much better organized than fishermen as a whole. This is the case because the interests of the former are broader and their attitude less selfish. From this angle, they are in a position to defeat, by bringing about legislation which they desire, any controls which we may recommend which do not meet with their entire approval. For example, it is very probably a consensus of opinion among most bird lovers that the kingfisher is yielding as a species to the pressure brought upon it by its killing under federal permit about fish hatcheries and rearing stations. In Michigan alone, during the last three years, over thirty-five hundred (three thousand and five hundred) birds of this species are known to have been killed. It is obvious how the bird lover, who would spend from one to four hundred dollars for a pair of bird glasses to watch a kingfisher feed and rattle his way down a stream rather than accept as a gift all the fishing tackle he could use for the rest of his days, feels upon hearing such figures.

With preservationists in general, and Audubonites in particular, we are spending some of our time in contacts. In each case we attempt to sell our viewpoints and encourage the individual or group to stand by for our ultimate data and unbiased decisions. We have conferred with Dr. A. A. Allen, eminent bird teacher of the East, Dr. Frank N. Blanchard, ultra-preservationist

and naturalist of the mid-west, Mr. Pough of the National organization of Audubon Societies, and others. Mr. Pough's views are that, since the Audubon Societies can afford no such investigation as we are conducting, he is quite willing to accept our figures and experience in the summation of the score for and against these species which will, you may be sure, govern the legislation regarding their control or protection.

Experiments on practical methods for controlling predatory birds about hatcheries and rearing stations are now under way. These experiments are all in the direction of providing protection for fishes without the extermination of other animal species. At the Oden Trout Hatchery and Rearing Station we are testing methods of screening trout raceways to prohibit entrance to birds. We hope to create an economical, but not unsightly, system of universal application and a system which will permit ready working of raceways for cleaning or removing fishes. We have already found that chicken wire, although 100% effective in excluding birds, is undesirable since food clings to the screen over the middle of the trough and is at once unsightly and malodorous. We are thus going on with our tests to larger meshes of screening, beginning with 8" squares and running up to thirty inch squares. From this series of experiments we will learn which meshes will control which species of birds and which will offer least other complications.

At Bass Rearing Ponds in the southern part of the state, we are testing various methods for keeping birds off ponds. Screens similar to those in operation at the Trout raceways are being contemplated. In addition, revolving lights, flashing squares of metal suspended on rawhide thongs, detonators, and glorified scareerows will come in for their share of experimentation.

Reptiles of two kinds, snakes and turtles, constitute another menace to the well-being of fishes in nursery raceways and rearing ponds. Our information to date seems to establish the water-snake and the common garter snake each as capable of considerable fish consumption under these conditions.

That the garter snake at fish stations is very nearly as detrimental to fishes as the more naturally piscivorous water snake is a fact which has only very recently come to light. The garter snake had for a long time been given a rather clean slate as an offender but will now be controlled like the water snake about fish rearing establishments. Other species of Michigan snakes such as the Green, Ringneck, Brown, Red-bellied, Hog-nosed, Black, Fox, Rattle, and Blue Racer are all at present exonerated by our data from activities which may be harmful to fishes.

Of the ten species of turtles in Michigan, which are, incidentally, the Big Ten in the Fresh Water Turtle World of the North-central and North-eastern United States and Southern Canada where they occur, we have found five which as tramps about hatcheries are capable of sericusly competing with our best interests. These five are the Snapper (Chelydra serpentina), Blandings Turtle (Emys blandingii), the Leatherback (Amyda spinifera), the common Painted Turtle (Chrysemys picta), and the Stinkpot (Sternotherus odoratus). Stomachs of these have shown that under some conditions they consume many fishes or eggs from a raceway or rearing pond and are thus best excluded. This leaves the Spotted Turtle, the Wood Turtle, and the others with a clean slate. We have demonstrated that these may all be successfully withheld from ponds and raceways by the erection of an 18" marginal sheet metal wall. This device will also exclude snakes, and if properly placed, will retard activities of wading birds. Indications are that both snakes and turtles may be locally controlled by a few successive years of intensive campaigning against them.

The extent to which mammals are a menace to fish life about hatcheries and rearing stations in Michigan is largely unknown. Coons, mink, muskrats, otter, shrews and moles are only rarely taken in the control of predatory animals about hatcheries.

In order to learn more of the activities of vertebrate enemies of fishes under natural conditions, 125 Conservation Officers are collecting water snakes and preserving them for this investigation, fifteen members of the staff of the Institute for Fisheries Research are collecting all predatory species which they encounter and are also conducting a census of predator pressure on the lakes which they survey, Game Division employees have been posted as to the cardinal needs of our investigation, and the Regional Office of the U. S. Biological Survey at East Lansing is supplying data on numbers and locations of heronries in the state. Professional turtle trappers and others throughout the state are cooperating in every way possible to guarantee us an adequate sample of stomachs and observations on which to base conclusions.

My personal work for the summer will be to collect specimens and observations as well as to coordinate the efforts of the agencies which are so generously cooperating with us.

The birds which are eating fishes at hatcheries and at rearing stations are the same ones which are frequently at work in the wild:kingfishers, members of the heron family, fish ducks, terns, gulls and even robins and blackbirds--not all to the same extent and none to a known extent. The fish-duck, while only an occasional offender under artificial conditions, causes some of our worst losses on trout streams, particularly in severe winters, insofar as we now know. As the lower reaches of our northern streams freeze, along with a freezing of the shallow lake waters, Mergansers are driven upstream to feed on the open waters above. These waters are frequently the best trout streams of the state. The depredations by these birds under such conditions seem to be extreme. Fortunately, we believe that we are on the right track for a suitable control. Given a cold winter next, we shall complete and test our plans. They are roughly to patrol the vulnerable streams and drive these ducks down to the lowest open waters in each and

thereby protect the more desirable trout above with a minimum of injury to the bird species. An interesting wrinkle to be ironed out concerning the fish-duck is that specimens taken from the Kalamazoo River during this past winter showed a high incidence of Carp in their diet. Do their possible benefits in this direction counterbalance their liability on trout waters? Probably not, but here we have one small illustration of the complex ramification of animal interrelationships and a demonstration of how little we know of them.

We are making special efforts to take large numbers of turtles for laboratory examination. Although we have come only a little ways with them to date our findings have not been dull. For example, present results strongly indicate that surprisingly enough under local conditions the Snapping Turtle is living entirely on a salad diet composed of water lily leaves and stems and pond scum. This is rather an amazing discovery, for all that most of us have ever heard or seen written about the snapper is that he feeds on large fishes, baby ducks and goslings.

Whether or not the garter snake is to be held as a fisherman when he lives away from hatcheries is not to be concluded upon yet. The water snake of course is a fisherman of the first water, but of his actual predilections we know little.

Regarding our second objective, in order to find out what happens to the fishes which are stocked or inhabit our waters naturally, the Fisheries Institute is conducting extensive tagging experiments followed up by Creel censuses... so much for the fishes which the angler takes. How about those which he does not take. Stomach analyses will give some light on the subject, field observations will give more, and the examination of fishes found dead and dying yields still more.

Mr. J. Clark Salyer, who was our predecessor in this work, conducted extensive studies on fishes which the angler did not get. His data becomes

very much a part of our current investigation. Salyer, by gathering large numbers of dead and dying fishes on lakes, streams, and at rearing station head screens, as well as at heron rookeries, kingfisher and other bird nests and mammal dens, was very successful in recognizing and establishing the identity of the marks of the various fish eaters on their prey. Each species has its characteristic method of attack and its equipment for capturing leaves an unmistakeable mark. Much valuable information supplementing the analyses of stomach contents has been derived from this and similar work.

The Game Division of the Conservation Department is investigating the food habits of the otter and mink. Their finding will be available for our use. Our own time is limited to the extent that we are forced to more or less exclude mammals as a group from our current program, except as incidentally encountered.

Also because of restrictions which time places upon us, we must refrain from attacking the host of problems revolving about so-called noxious species of fishes and their control.

Regarding our third objective: in order to reserve the major portion of the cropping of game fishes from our waters for fishermen rather than for lower animals environmental or ecological controls are planned. These controls, if effective, would lead the species which conflict with man's interests to take up their abode in areas where coarser fishes abound rather than in areas where the finer fishes are desired for game. One of the most obvious and best controls of predators on our streams, for example, is a good concentration of fishermen. To keep the fish content of such water up to the point where it could support the number of fishermen for a perfect control is another thing. In proof of the value of fishermen moving up and down-stream as a means of control are the observed high concentrations of predators on nursery streams in the state which are waters

closed to fishing. Observations demonstrating the value of certain types of cover for reducing the possible extent of predation are on hand. Streams well over-grown with alders, although not permitting of the desirable pastime of whipping a fly about over one's head, but rather better suited for plunking with worms, are relatively unexposed to predation by birds. It is possible that well-planned types of bank cover, heretofore thought of solely for the shade which they offer and the erosion which they retard, may be one of our most valuable means for controlling the activities of fisheating birds on some of our most desirable waters. Although no experimental plantings can be made at this time, the possibilities of this type of natural or biological control will be thoroughly investigated and theoretical areas mapped and costs and effectiveness computed.

INSTITUTE FOR FISHERIES RESEARCH