CHANGING FISH POPULATIONS AS AN INDEX TO POLLUTION AND SOIL EROSION†

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It is a fact well known to any student of ichthyology that there has been a profound change in the character of the fish populations of our lakes and streams within the last half century. Even the layman knows that the pan and game fishes are not as common, and the rough fishes, notably the carp, have prospered greatly in this span of years. There are numerous references to this trend in the literature, and it is not necessary to cite authors to establish this contention.

It is equally well known, in a general way, that pollution has unfavorable effects on fish life, and many states have laws prohibiting the pollution of waters based on the principle that fish are killed by pollution. Wisconsin has a law which places the penalty for pollution on a "so-much-per-fish" basis and different species are given different values. Most states have some degree of so-called legal control of pollution based on this general principle.

There is at least one brief paper (Trautman, 1939) dealing with the effect of man-made modifications upon a local fish fauna in which factors other than pollution are considered.

In spite of all this there has not, to this writer's knowledge, yet been any attempt to evaluate the degree of pollution, or of soil erosion, by a survey of the changing character of fish populations.

Hubbs (1933) and others have directed attention to the fact that pollution, from the point of view of destruction of fish life, cannot be measured by averages or other arbitrary figures, since one exceptionally unfavorable day is all that is necessary to kill desirable fish in great numbers, and the "once in a lifetime" occurrence may be exactly that so far as the fishes are concerned. It isn't necessary to kill a fish but once to make sure that it is dead.

The point being made here is that statistical averages, tabulations of dissolved oxygen, abundance of plankton, effect of pollution upon invertebrates, and all the other limnological data that have been collected regarding pollution is meaningless until it is translated into information dealing with the effects upon the fish population. The logical place to go for that information is not to limnological surveys of elaborate design, but directly to a consideration of what has actually happened to the fishes. If the other data help in understanding why the changes have taken place, well and good, but the bare fact that the changes in the fish population have occurred and are the result of pol-

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lution is the all-important and significant point which has too frequently been overlooked.

In much of the water of the Mississippi Valley, as elsewhere, there is a "carp problem." It has been this writer's privilege to work on the infamous "carp problem" of the Madison lakes in Wisconsin. The fishermen there have been greatly alarmed over the tremendous increase of the carp in the lower lakes of the Madison chain, an increase which has taken place at the obvious expense of the more desirable species, and there has been much flurry and fuss made over the situation. At the same time the people of this area have been greatly concerned over an "odor nuisance" on the Madison lakes, and this latter problem has created such public demand for some correction that a special governor's committee has studied the problem for several years. Under the capable direction of Clair Sawyer, the scientist in charge of the study, the committee has gathered an impressive mass of valuable data on this problem.

Several facts stand out from all this study in clear relief. Lake Mendota, above Madison, is clear, healthy, and highly productive from the standpoint of pan and game fishes. Although carp are present and relatively common, they have at no time become dominant in the lake, nor have they been the source of any considerable public alarm. There is, however, a sufficiently large and well established carp population in the lake which is capable of exploding into a "carp problem" at some time in the near future if domestic pollution wastes continue to be poured into Lake Mendota in increasing quantities.

Lake Monona, on the other hand, on the downstream side of the city, and for many years the direct recipient of the city's sewage waste, rapidly deteriorated as a fish-producing lake, although at one time it was considered much the better of the two lakes from the fisherman's point of view. Lakes Waubesa and Kegonsa, still farther downstream, have likewise altered in character.

For some years the state of Wisconsin has maintained rough fish removal crews on these lakes to remove the carp in an attempt to alleviate the problem, without any noticable effect. The annual harvest of the carp from the productive waters of these three lakes is actually higher than many men will admit is possible as the total standing crop. The exact figures will soon be released in a report prepared by other workers and cannot be given here.

One of the most significant developments is the observed fact that when the sewage effluent was moved downstream from Lake Monona to Lake Waubesa the carp harvest gradually began to decline in Lake Monona and the game and pan fish population began to recover.

Here, then, is an extreme case where the character and degree of domestic pollution can be measured directly in terms of changing character of the fish population. The complete reports on the Madison lakes when finally published should go far toward providing a yardstick to measure the effects of such pollution. In final analysis, as this author has long insisted, there is no "carp problem" as such, but simply a "pol-

lution problem,'' and when the latter is solved the balance in the fish pollution is quite likely to reestablish itself on a favorable basis.

The same so obviously holds true for the waters of the Illinois River that no comment is needed. Certainly every other factor connected with fish production and favoring the carp is better in the lower reaches of the White River in Arkansas than in the Illinois River, yet in Arkansas there is no carp problem. There are, however, flourishing fisheries for commerically valuable species as well as a considerable sports fishing development. The one thing lacking in Arkansas is sufficient pollution to spoil the water for the other fishes and leave the carp as the only species able to stand the extreme conditions. The fish population of Western Lake Erie is still another classic example of a change in fauna because of pollution.

The excellent early work of Forbes and Richardson offers a fine point of departure for comparative fish fauna studies which could easily be correlated with the degree of pollution in the various Illinois waters. It is a field of study which should be productive of many informative reports and which, if approached from the point of view I have indicated, would go far toward establishing exactly what is and what is not pollution damage.

The same approach should be made to the soil erosion problem. So far as the author is aware this has never been done, and this also in spite of the fact that fisheries, biologists, and systematic ichthyologists year after year have noted such items as ''formerly abundant, now rare'' in their reports about one species after another. Certainly many taxonomists are confident that the depletion of many species is more likely due to erosion and its resultant silting of streams than to any other factor or combination of factors.

The extinction of the hare-lipped sucker, *Lagochila lacera* appears to be directly correlated with the silting of its habitat streams by soil erosion. The near extinction of *Placopharynx carinatus* seems to be based on the same cause. Jordan and Gilbert (1886) reported both these species ''not rare'' in the White River near Eureka Springs, Arkansas. *Placopharynx* in this same report is termed ''abundant'' from the Ouachita and Saline Rivers near Arkadelphia and Benton, Arkansas. Jordan and Evermann (1896) reported *Placopharynx* ''abundant in the larger streams, especially in the French Broad and in the Ozark region.'' Of *Lagochila* they reported ''abundant only in the Ozark Mountains,'' but also listed several streams from which this species was known. No comment was made concerning its rarity in any waters.

Lagochila appears never to have been heard of again in the Ozarks. There was a lapse of some years before serious collecting was attempted in the Ozarks, and when collectors went into the area specifically after *Lagochila* and other rare Ozark fishes they did not return with a single specimen of the hare-lipped sucker. The writer has gone to considerable trouble to find specimens of *Lagochila* and *Placopharynx* in the Arkansas Ozarks but with no success. Certainly these streams have not been fished out, and save from

the damaging effects of sawmills have been noticably free of pollution. One outstanding change has occurred. The timber has been cut from the hillsides, and streams that once flowed evenly and clearly the year round have changed to up-and-down streams, nearly dried up part of the year, and swollen with mud-laden run-off torrents at other times. It seems rather obvious that these two fishes have joined the growing list of "used to be" species that once were common before man improved the countryside. Fifty years ago *Placopharynx* was so common in the Arkansas River near Fort Smith that farm boys frequently would fill a wagon bed with the fish in a short time of spearing and netting and haul them into the city to peddle out on the streets. Over-fishing might have contributed to the relatively sudden disappearance of *Placopharynx* but it seems that this sucker pretty well held its own until the white man went into Oklahoma and Kansas and plowed up the prairie to send it down to the Gulf in a yellow, boiling flood every time it rained.

In summation it is here suggested that some profitable studies could be made on the effects of pollution and soil erosion by a direct study of the changing character of the fish population, and that the fishes themselves serve as the best possible indices to the effects of these adverse conditions upon our fish fauna.

LITERATURE CITED

HUBBS, CARL L. 1933. Sewage treatment and fish life. Sewage Works Journal, Vol. 5 (no. 6): 1033-1040.

JORDAN, DAVID STARR AND BARTON W. EVERMANN. 1896-1900. The fishes of North and Middle America. Bull. U. S. Natl. Museum No. 47, in 4 parts, 3313 pp., 392 pls.

JORDAN, DAVID STARR AND CHARLES H. GILBERT, 1886. List of fishes collected in Arkansas, Indian Territory, and Texas, in September, 1884, with notes and descriptions. Proc. U. S. Nat. Museum, 1886: 1-26.

TRAUTMAN, MILTON B. 1939. The effects of man-made modifications on the fish fauna in Lord and Gordon creeks, Ohio, between 1887-1938. Ohio Jour. Sci., Vol. 39: 275-288.