Report 202

FISHCULTURAL SUGGESTIONS FOR IOWA

By Carl L. Hubbs

In our survey work in Iowa, a number of suggestions regarding fishcultural practices in that state came to mind. These ideas are presented in this report, for consideration by the Fish and Game Commission and the Superintendent of Hatcheries, in connection with the building up of fishcultural policies and practices.

One brief report (No. 175) issued by us, dealing with an Iowa fishcultural problem, was entitled "A danger in the use of golden shiners as forage fish in bass ponds".

Mr. Baur definitely expressed his belief to us that the interior distribution of fish in Iowa is a simple and solved problem, because outside of the trout waters, any Mississippi fish may be dumped to good advantage in any water. While recognizing how comfortable such a point of view may be, we can not subscribe to it. There would be no point to a lake and stream survey if Mr. Baur's view thus expressed were justified.

No effort is made to present a discussion of the fishcultural problems and needs of the state. These are dealt with in a very general way in the fish section of the Iowa Conservation Plan. It was hoped and recommended, when the fish survey was being arranged, that a fishcultural survey of the state by a group of men combining the science and experience would be made. Such a survey should have resulted in a general report of fishcultural problems for Iowa. But the recommendation for this survey was not followed out.

Apparently one reason why this desirable fishcultural survey was not made, was due to the inclusion of men from the Division of Fish Culture of the U. S. Bureau of Fisheries in the proposed party. It soon became evident that much

friction and ill-feeling exists between the federal bureau and Iowa in regard to fishcultural practices. Our first fishcultural recommendation is that Iowa move at least half way toward healing this breach, so that a real cooperation of mutual benefit will replace the present harmful antagonism.

MISSISSIPPI RESCUE OPERATIONS

This is the subject on which perhaps the greatest amount of conflict has taken place between the U. S. Bureau of Fisheries and the Iowa Fish & Game Commission. Naturally this matter has been kept smothering under cover. But in a confidential report of this sort there seems to be no occasion for anything but a frank discussion. I received the following statement on this subject from Mr. C. F. Culler, District Supervisor of the U. S. Bureau of Fisheries, under date of August 12, 1932:

"..... As far as the writer knows, there is no controversy between the Bureau of Fisheries and the State of Iowa. It is true that the State has restricted the Bureau's operations in certain sections as they desired to do the work in those particular sections themselves.

"In 1931, this office was notified by the State Game Warden that by direction of the Commission the State would conduct the operations themselves. This year, the writer was advised by the Chairman of the Commission that if the Bureau asked for a permit that we would be given the right to fish in Iowa. This was done and the State of Iowa imposed certain restrictions which have been forwarded to the Washington Office for their consideration. In the mean time, we are doing the necessary work in Iowa waters that were allotted us and upon receipt of information from the Office, the balance of the territory allotted will be cared for."

An example of the actual stupidity of poor cooperation between the state and federal agencies was apparent when the Sabula operations were inspected. The state as Mr. Culler mentioned, first refused the Bureau seining rights, then gave out a restricted permit. The Sabula station reserved fishing rights on Golden Lake, which lies only 3 miles below the federal rescue station, or about an hour's journey from the base. When I inspected the work, I found that two state crews had been working this lake out of Sabula for about two weeks, and would require several days more to finish it. The men were working about 8 hours a day, but the trip up and down consumed about 5 or 6 hours, leaving only 2 or 3 hours for actual seining. Assuming 20 days for the whole job, and 10 men at work, and 3 1/2 hours more time per man per day for travelling from Sabula than from Bellevue, we figure for this one lake a net loss of 700 man-hours. This seems a high cost to pay for an expression of the right of eminent domain, and incidently a very good example of the incompetent management of the rescue operations by the state. The customary seining grounds of the state, near Sabula, were being neglected when the state took the especially favorable Golden Lake, which had ordinarily been worked by the federal crew.

Our knowledge of fish rescue work along the Mississippi, as conducted by the Iowa Fish & Game Department, was largely gathered by observations of the operations near Lansing, on August 5 and near Sabula on August 18, and from rather extensive discussions with Messrs. Bamr, Albert (Sr. and Jr.), Babcock, Culler and others.

There was some conflict in the testimony as received from these several officials. This was particularly evident in the discussion of the policy of seining open sloughs. The general theory, as expressed by both the federal Bureau and the states, seems to be that the young fish become stranded in cut-off sloughs when the river recedes in the spring, and that these fish must perish unless "rescued". By seining these pools, many millions of fish are saved, either for the river from whence they came, or for interior waters. That is the theory,

and we assume largely the practice. However, the cutoff ponds are usually weedy and excessively muddy, and often so distant from the river as to require long hauls by man power to get the fish out. The open sloughs are much easier to seine, eliminate the long hand hauls and may procure superior fish. There is therefore a natural temptation to seine the open sloughs, where the fish are not in need of rescue. Some state men claim the Bureau does so, that the small-mouth bass reported by the Bureau must have been so caught, etc. The Bureau officer in charge states that only closed sloughs are seined. Mr. Baur reported to both Salyer and me that the present state practice is to seine the fish out of the cutoff sloughs, dumping these into the river so they may be later seined directly out of the open waters for interior distribution, when transportation is easier. William Albert, Jr., in charge of the Lansing Station, admitted that this was a former, blameworthy practice, and claimed emphatically that he has now (1932) for the first time stopped this deceiving practice, and as an innovation in practice is now distributing inland only those fish which have actually been rescued from waters drying up. Either there is deceit or misunderstanding on somebody's part : in either event, evidence of poor management of the rescue operations.

There was fair agreement in the testimony regarding the half-grown channel cats (7 to 11 inches) long obtained at Lansing for interior distribution. It was stated that "all" or "nearly all" of these fish are caught by the fishermen, and purchased from them by the state at 3 cents each. In order to take these catfish (in the open waters of course), the fishermen are allowed to use 1 inch mesh nets, according to Mr. Baur who said that he supplied these catfish in response to application for small-mouth bass! [This is a peculiar expediency, caused by the failure to provide for the propagation of small-mouth bass in Iowa.]

The removal of game fish from the open waters of the Mississippi seems to me to be a rather unwise policy. When this is also a commercial fish, as in the

case of the channel cat, the added drain on the depleted fish resources of the river may be serious.

The taking of really rescued game fish for interior distribution does not seem reprehensible, as these fish would very likely be killed by dessication or by the abundant fish, bird and snake predators if allowed to stay in the small cut-off ponds. The rescued fish in large part are game and pan fish rather than commercial fish anyway. If there are signs of depletion of any species in the main river, however, some of the rescued fish of that species should be replaced in the river. It would be a good policy, involving a margin of safety, to place a moderate percentage of fall-taken fish of each desirable species back in the river. This would help, as a margin of safety, insure a perpetuation of the species there. This is desirable even for those species not takable by commercial fishermen, as there is a considerable sport fishery in the river, and as the continuation of the rescue operations (involving great quantities of fine fish for restocking of inland waters) depends on an adequate reserve spawning stock in the big river.

Evidence of depletion of the species being rescued should be gathered. An accurate record should be insisted upon, giving the yield of each species in terms of some comparable unit of effort, such as a given length of net used or a given area seined over. The rescue operators did not indicate any strong evidence of pressing depletion. In fact Mr. Babcock thought the fish were more numerous this year, and that the hatch seems to be on the increase. He thought there were more bass this year (1932) than in any of the five previous years.

Accumulated experience has developed a fair degree of efficiency in the fish rescue operations. There may well be room for improvement in the efficiency of the operations.

A very commendable move in the line of efficiency was the posting of the detailed chart of the river and sloughs above Lansing, on the wall of the rescue station, and the indication of the seining points by pins. White pins are used for ponds already seined, blue for points not needing immediate attention, and red

pins for those which should be seined out in the near future. This scheme should be very effective in increasing the efficiency of the work, by grouping the seining points to minimize boat movements, etc., and in lessening the chance of allowing some sloughs to dry up unnoticed. An airplane map would be better, and occasional airplane inspections would be very helpful, and would probably be warranted if the work were expanded to the full justified extent. A disconcerting observation regarding the application of this measure of efficiency was made, when I was informed that "a lot of the pins have been brushed off because the map is hung in the passage way". Until some measure of office routine is established, the fish cultural work of the Department will never operate with a very high degree of efficiency.

Mr. Albert reported that he generally uses three crews of largely experienced men, of 5 men for the simple rescue seining in cut-off ponds, and carrying fish thence to the river, and 7 men for transporting the fish back to the rescue station. We presume he uses two boat-loads of men, divided into three parties during the seining operations. It would seem that this is fair distribution of the labor, and that the crews are adequate in size. With carefully chosen men and foremen and close and intelligent supervision, these crews ought to do good work.

We would suggest, however, that consideration be given to expanding the work. We would recommend stationary crews along the river in camps, or quarterboats, to lengthen the hours of effective work now so seriously cut into by the long trek up and down river. This would also allow more of the seining of the muddy pools to be done in the cooler hours, by working the men in two 4 or 5 hour shifts, with a rest midday. A few men would suffice to move down the fish seined by several parties. This practice should increase the output four times with a mere double of the number of men. While we recognize the objections the men raise against being left on the river, there ought not be any great difficulty in getting hard workers to agree to this condition now. Some scheme of rotating the crews to shorten the stay on the river could be worked out.

The equipment (seines, cans, boats, etc.) seems to have been fairly well worked out

for the rescue operations. We believe that well-boats with shallow draft, having partitions and with devices to prevent the water surging through the compartments, would serve to bring the fish to the station better, than the cans now in use, and would eliminate the need of extra labor to pour water into and out of the cans.

A fine labor-saving and fish-saving device would be to make the compartments for the boat in the form of square tanks drilled with holes in the upper part, and provided with a lid and handle. These tanks could be submerged in the seining pond, then carried half full to the well boat, in which the tank would again fill to the top; or the dirty pond water could be poured off by merely tipping the covered tank, before it refills through the perforations after being placed in the well-boat. With proper devices in the boat a gentle circulation of river water in the tanks could be effected. This could save labor now and in dipping water out of the cans and replacing by dippers full of river water: two dippers in, two dippers out. The number of men required to make the long trip from station to seining ground could thus be cut at least in half. On arrival at the rescue station, the tanks would automatically drain half empty to facilitate carrying the load into the house. Then the tanks could be mostly drained of river water by tipping, and put first into a disinfectant bath. The solution would automatically fill the tank by entering through the holes. This practice would greatly reduce losses in the rescue station, in transport and afterwards, by killing most of the fungi and bacteria on the skin of the fish. Then the tanks could be taken from the quarantine bath, drained of the disinfectant, and the fish poured into the retaining tank. This would remove much netting and handling. The fish should be in better shape when planted, and labor would have been saved.

A combination of better handling of the fish on the river, and of better transportation units as discussed elsewhere in this work, would make it possible to continue the work safely during the hotter weather, when it is now largely suspended

(if we were correctly informed). This would be of material advantage in holding the crews together, in keeping the expensive equipment in service and in increasing the output.

Another example of very inefficient use of man power was evident in watching the carrying of fish from seining pond to river. In some places it would remain impracticable to use anything but man power, owing to the roughy muddy, overgrown trails. Elsewhere, as at Golden Lake, it would be simple to widen and smooth off a trail over which one man could draw on a narrow two-wheel hand-truck two or three times as many fish as two men could now draw. The labor saved would be eliminated, or applied to hastening the seining.

The clever practice of pocketing the fish in a bag or "run" made out of one end of the slack seining which has been hauled in, by proping up the lead and float lines, is distinctly commended. We were, however, unable to verify the claim of Mr. Albert Jr., that he devised this practice.

Mr. Babcock seems to have developed some sound practices and ideas in seining muddy "lakes". He usually takes in a boat and leaves the leads off the seines. By these means he decreases the muddying up of the warm water, which must be harmful to the fish. Mr. Babcock even reports that the fish do not carry so well when the river gets muddy.

The rescue operators disagree as to the place where the fish should be sorted. Some, as Mr. Baur, thinks this should all be done at the seining point. Others claims it is impossible to do this accurately there, and we emphatically agree. Furthermore taking time to sort fish in the warm soupy water of the cut-off ponds must be harmful to the fish. We recommend only such sorting be done there as is required to prevent large fish eating or injuring small ones, leaving the sorting to be done at the rescue station, by men specially trained for this purpose (we found a considerable ignorance of the species). In the house the handling may then be done in cooler and cleaner water, and under more sanitary and better working

conditions. The proper sorting of the fish we regard as very important.

There seems to be some variation in instructions or at least in operation, in regard to the handling of different species of fish. The practice of throwing out the predators on the bank to die (the gars and dogfish) seems justified. Mr. Babcock told me that he is ordered to return dogfish to the river, but believes this to be very undesirable (in fact these were thrown out to die when I inspected the operation). He says "The dogfish even eats crappies in a seine"; "two on a carp will pull it in two"; "they pick bass out of a school of minnows", etc. The rough, marketable fish, such as carp, buffalo and sheepshead, should be returned to the river or open sloughs, and the forage fish (minnows and gizzard shad) should be treated likewise, except as some of these may be needed for specified interior waters. Whereas I was definitely told that all such fish were rescued and put in the river, almost simultaneously I observed numbers being thrown on the shore to die, along with the gars. Catfish are useful for interior planting, and those few caught in the ponds could be planted in the interior whether or not it be deemed wise to take larger quantities from the open water for this purpose. Bullheads are useful to some extent, though many interior waters are overcrowded with them now, and great quantities are available from the inland rescue work and from the nursery lakes; probably most of the bullheads should be returned to the river. Northern pike and wall-eyed pike are fine for planting in proper waters; there is not much likehood of too many walleyes being so taken to deplete the commercial supply of the river. White or silver bass are valuable for interior planting. Large-mouth bass and bluegills appear to be the most desirable fish for interior distribution which are taken in the rescue operations. Common or pumpkinseed sunfish, green sunfish and warmouth bass seem worth taking for planting. While not as large or as good as bluegills, they do not occur in sufficient quantities to cause worry in their introduction into interior waters.

The much dwarfed orange spotted sunfish is a problem. On account of its runt size, it is of absolutely no value as a pan fish. It has been claimed to be a good

forage fish for bass, but we believe it much better to use minnows as forage fish, because the orange-sported sunfish must be a competitor to the game fish and fry-dater. We believe that the wholesale spread of this runt fish into interior waters has been a very serious mistake. Not reaching even the low legal size of sunfish for Iowa (4 inches) it is preserved at the expense of the larger species. We believe that this species should be returned to the river, although we realize that completely sorting it out would be impracticable. Nowhere on the river did we find evidence that the seiners or even the superintendents of the rescue stations, either federal or state, had any idea that they had been sending inland a species of sunfish that never reaches a legal or catchable size. Mr. W. E. Albert, Jr., did tell us that he always recognized this species and <u>never</u> sent any out for planting, but Salyer found a considerable number among the bluegills ready for shipment from the station, and informed Albert of its apparent undesirability, and we suppose Mr. Albert's statement was prompted by Salyer's remark. We recommend that the seiners be taught to recognize the orange spotted species and be ordered to return it to the river, to serve what purpose it may as a forage fish. We observed that the young in August were almost uniformly smaller than those of the bluegill and pumpkinseed. Separation of the young by size is thus practicable, perhaps by using a screen of proper mesh. To be true, putting these young orange-spotted sunfish in the river would materially cut down the number of "bluegills" reported planted in the interior.

The rescue operations above Lansing have been seriously interfered with by the Canalization Project, as Mr. Albert rightly claims. A wing dam just above the upper end of the main slough has almost closed off this end, allowing the Upper Iowa River to accumulate silt. Near the Game Farm, the channel in one place was scarcely more than a foot deep, where a depth of several feet normally existed. This caused great inconvenience in reaching the seining grounds, and destroyed much good water. Albert stated that this slough formerly had a firm bottom, and was one of the most productive mussel beds of the region. Now very few mussels other than the non-commercial soft-shelled species occur here. The rescue operations in this fine

slough region will be very seriously hampered, if the War Department does not approve the petition of Iowa to open up the wing dam enough to permit a fair current to pass through the slough.

There is a real need for accuracy in reporting the number of fish rescued, as in any other fishcultural operation. The state workers claimed that the federal Bureau grossly exaggerates their figures. There is also a need for accuracy and care in filling applications. The admitted policy of filling bass applications with catfish (Baur) and of bluegills with sunfish (including orange-spotted sunfish!) and vice versa (Babcock)should be corrected.

We recommend that the rescue operations be very materially extended, so as to cover the rescue needs more thoroughly, and to reach sections of the river not now attended to. With the development of artificial lakes, the added supply of fish for interior distribution should be welcome. We also recommend that serious consideration be given to establishing rescue operations along the Missouri River. A survey party could spend a summer very advantageously, cruising both east and west boundaries of the state, to build up a program for extending the rescue operations.

INLAND RESCUE OPERATIONS

In a general way, the inland rescue operations seem to be very desirable. It must be emphasized, however, that the indiscriminate seining and dumping of fish is not always good management. As an example, the overloading of Crystal Lake, Hancock County, with black bull heads (the smallest species) by seining these in the outlet by the dam, has been the probable cause of these little bullheads becoming deleterious dominants in this lake. Moving these bullheads to above dams in muddy creeks and rivers may do good, but to put as many as 200 solid bushels of bullheads into Crystal Lake each spring is poor management.

TRANSPORTATION OF FISH

The transportation of fish from the hatcheries, rescue operations and rearing stations to the fishing waters is a problem of major importance in the conservation

program for Iowa. In few states does this item attain the relative importance that it does in Iowa.

The definite impression was gained through numerous interviews, that the late Mr. Albert as well as the present superintendent of hatcheries regarded the problem of transporting fish in Iowa to be a simple, solved and closed problem. The use of the railroad fish cars has been abandoned, being replaced by several trucks. Each truck is provided merely with a battery of cubical tanks, without any provision for circulation or aeration, except such as is furnished by the jarring of the truck when in motion, and without any device for removal of dirt or fecal matter, or any provision for insulation or for refrigeration, other than dumping the ice in with the fish. The satisfaction expressed in this inadequate equipment bespoke an unwarranted conservatism.

In justifying the lack of any provision for aerating or circulation of the water, Mr. Baur expressed the opinion that there were not at all necessary. He went farther, stating that aeration or circulation has proved harmful in practice,—an extremely improbable conclusion, which certainly would require real experimental evidence to corroborate. The advantages of eliminating the bulk and weight of water and air pumps is a sounder argument, but modern units have these pumps made very light and compact, not seriously interfering with tank space. When the truck is in motion, there is sufficient aeration, he believes (we doubt this, believing that more fish could safely be carried with more aeration and circulation). If a breakdown occurs, Iowa is so favored with water that, outside the trout region, the load of Mississippi rescued fish (the trucks are chiefly used for rescued fish) may be dumped in the lake or stream at hand or distanteless than 10 miles, so that local transportation will finish the job. We have already criticized this viewpoint.

Railroad Fish Car.—We are not wholly convinced that the elimination of the railroad fish car is an economical step. It is quite likely that the old car on hand can not be as efficiently operated as trucks. And certainly for a large proportion of the planting operations the smaller units, capable of travelling directly

to the waters to be planted, are vastly more practical than the fish car. Whether one or two railroad fish cars with much increased carrying capacity and of modern design would be desirable we are hardly prepared to say. We do not think that the matter should be thrown out of consideration, especially in view of the abundant supply of fish at the main rescue stations, and of a few localities reached by railroad, where vast plantings need be made. It would seem offhand that on long hauls, to the lake regions especially, it would be more economical to send a very large shipment for the important lakes, or for reshipment by trucks from a point on the railroad.

Of course a very large truck, or truck with tank trailer would serve the same purpose as a railroad car, and might be cheaper to build and to operate.

Design of Truck Units.—The truck units now in use in Iowa did not appear to us to warrant the satisfaction locally expressed as to their excellence. For instance, the lack of proper insulation, of aerating or of circulating devices, seem relatively crude. A number of refinements have been devised by some states, making it possible to haul more fish per load, or larger fish, or to haul the same fish safely for a longer distance, especially in hot weather.

The recent planting units devised by the Michigan Department of Conservation have a number of features which would add to the efficiency of planting operations in Iowa. The units were manufactured by the Owosso Boiler and Welding Works, Owosso, Michigan. Specifications could we suppose be obtained from that company or from the the Michigan Department of Conservation.

An important feature of the improved units is good insulation, to hold a rather low and uniform temperature. Two inch cork insulation is used in the new Michigan trucks. A separate ice tank is desirable, through which the circulating water can be drawn at intervals to keep it cooled. The present tanks on the Iowa trucks do not even have a separate ice compartment above the water, to protect the fish from injury by ice. The circulating feature is extremely desirable. With this should be associated a trap to catch any dirt or fecal matter pulled in from the bottom of

the fish tanks, and a spray release device to aerate the water on return to the fish tanks.

The truck should have a hose connection so that the pump may be used to fill or refill the tanks from any convenient source. A large-bore hose should be available, with connections, to permit passing tanks full of fish directly into a lake or stream, without handling.

By such improvements the number of fish carried could be increased and the cost involved correspondingly decreased, and as pointed out above, the operations could be continued more safely during the hotter weather. The fact that the work is largely discontinued in the hot weather is evidence enough that the transportation units are not perfect. It is time that large numbers of fish are now carried (some of the state fish men insisted the fish were being overcrowded) but certainly the improvement recommended would allow either more fish to be carried, or the same number could be carried with less harm to the fish.

Care of Units.—The transporting units should be kept very clean, and scrubbed out with brine between every use. This will work to great advantage in preventing the spread of disease to the fish being planted. The crowding of the fish, the repeated use and the small injuries or slight weakening caused by handling, are all conducive to the spread of disease, which should be carefully guarded against. It is probable that disinfectant substance harmless to fish life may be found, which when added to the water during transportation of the fish will prevent the spread of diseases.

Starving Fish before Shipping.—Mr. Baur told us that he has the fish starved "few days" before being transported. At times it may be inexpedient not to hold certain fish that long, but we do not believe the practice has any particular merit. To deprive the fish of food for a few hours before shipping so as to prevent the accumulation of putrescible fecal matter in the shipping tanks, may be sound policy, but to starve them several days may seriously weaken them. We therefore recommend a careful organization of the rescueing and transporting campaign, to avoid holding the

fish too long. It is of course impracticable to plan on feeding the bulk of the rescued fish, since it usually requires some days to adjust wild-caught fish to artificial feeding, and requires much space to great quantities of fish for feeding.

FOOD FOR FISH IN REARING STATIONS

Attention may be called to the matter of feeding the several million fingerling fish which Iowa should be rearing in ponds. The feed bill would run into money fast if usual meat products along were used. We would suggest that the fishculturists of Iowa carry on some study and experiments along this line. Much can be learned from research work and experience outside the state boundaries, and much of value, from the standpoint of fish and of economy, should come from intelligent experiments in Iowa.

We wish to call attention to two sources of protein-rich food which could be developed very reasonably in Iowa. Of those is clam meats and clam meal. The flesh of the freshwater mussels is an excellent fish food. It should be obtained very reasonably along the Mississippi; according to Bill Albert, for the "mere hauling away". The meats could be used fresh as available, or could be frozen for later use. Furthermore, a cheap method of processing the meats into the clam meal has been developed in Michigan, and this meal has proved to be a good feed for fingerlings. Information as to this process should presumably be obtained from the Michigan Department of Conservation. We recommend that the state plan a processing plant for clam meal. The excess food could probably be traded to other states for trout eggs.

The second source of cheap protein feed for the large rearing stations which Iowa needs is ground fish. The Ohio Division of Fish and Game has been phenomenally successful in rearing bass and maintaining brood bass on ground goldfish from Lake Erie. A large supply is out in when cheap, and frozen for the season use. There is every reason to believe that carp and other rough fishes would serve quite as well. The supply in Iowa could well come from the rough fish removal operations. Especially when as often the market is "shot", a large supply of the fish could be put

in refrigeration for use throughout the growing season. Using the by-product of rough fish operations, the cost of the meat itself would be virtually nothing. By doing the job intelligently, and by operating large rearing units, the cost of refrigeration, storage, grinding and feeding ought to be reducible to a very low level.

POSSIBLE IMPROVEMENT OF BULLHEADS

There are in Iowa three species of bullheads which are not satisfactorily distinguished. These are

(1) The "black bullhead" (Ameiurus melas)

(2) The "brown bullhead" (Ameiurus nebulosus)

(3) The "yellow bullhead" (Ameiurus natalis)

The difficulty in identification is due largely to the great variation in color shown by all species. Thus the common "yellow-belly" of the Okoboji region is nothing but a color phase of the black bullhead; and is not the true yellow bullhead.

The fishcultural importance in distinguishing these species is in the fact that the commonest species (A. melas) is the smallest. The really large bullheads of the Okoboji region are A. nebulosus. The true yellow bullhead (which is not always yellow) is also a large species.

We recommend that the Department make an effort to propagate one or both of the two larger species, so as to have these available for stocking purposes, especially for stocking the new artificial lakes. We would suggest that a suitable bayou be cleared as nearly as possible of the black bullheads (A. melas) and that it be given a heavy brood stock of the larger species. These could be sorted out of the seinings, as at Center Lake, by one who has studied and learned to recognize the species. The spawning of the bullheads could be encouraged by putting partly broken tile into the rearing pond.

In this way, the size and quality of the bullheads in the state, especially in new fishing waters, could be gradually built up.

POSSIBLE REARING OF SUNFISH

It is possible that a material increase in the fish yield of the smaller, non-trout streams of Iowa could be induced by the propagation of sunfish. It is true that sunfish of some species are of general occurrence through Iowa in such waters. But they are generally dwarfed. Many are orange-spotted sunfish, which are everywhere dwarfed. The introduction of these into interior waters from the Lansing and Sabula fisheries should be stopped. But other sunfish in the Iowa streams, are also dwarfed. This applies notably to the green sunfish, which is a minor game fish of considerable importance and high esteem in parts of Missouri, Kansas and Oklahoma. Very likely the dwarfing is due to some water condition, but does not necessarily follow. The species may be of a different race in different localities, some dwarfed, others large. The chance that a non-dwarfed race could be obtained is worth the research which would be required to solve the problem. This would involve studies of growth rates in different regions, and some rearing and planting experiments.