

## INCREASING THE FISH SUPPLY OF IOWA:

## A TWENTY-FIVE YEAR PLAN

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The endowment by nature

Iowa was bountifully endowed by nature with fish life. Sturgeon, buffalo, catfish, pike, pickerel, bass, bluegills, and dozens of other species inhabited its boundary waters, two major branches of the greatest river of the North American continent. The many glacial lakes which beautified the prairie of north-central Iowa carried their quota of aquatic life. A score of small to large rivers which contribute their waters to the two great boundary rivers also swarmed with fish life: a major element in the support of the Indian and the white pioneer. <sup>North of</sup> Above the deep loess areas, over at least half the area of the state, these streams provided very satisfactory conditions for their large population of that regal fish, the small-mouth bass. And the brook trout, its rival to the claim of being the leading game fish of American streams, was native to the limpid, spring-fed streams of the northeastern corner of the state.

The destruction of aquatic life

Iowans, like their brothers in other states, have proceeded with reckless abandon in the destruction of this endowment. in aquatic life.

1. Lakes and permanent marshes have been drained in large number, completely destroying their fish life.
2. Hundreds of miles of beautiful creek and river course, well adapted to the feeding and protection of an abundant fish life in their lateral bayous, bends, holes and coverts, have been all but ruined by ditching. The canalization of the Mississippi, on a large scale, appears to be similarly acting, to the detri-

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ment of its important fish resources.

3. All the streams of the state, unditched as well as ditched, have been made over into a less satisfactory fish environment by the excess silt which has been wastefully allowed to drain off the land. Through the loess area the streams have become choked with mud, while in the northeastern part of the state the originally excellent streams have in large part become loaded with sand, which has filled up the deep holes, where the bass or trout had previously resided, and has covered over the rich food-producing bottom with a layer of shifting sand—a real aquatic desert. Such waters are gradually being made unfit for the better kinds of fishes. The Mississippi and Missouri rivers are being especially affected, in a harmful way, by silting. The lakes too are suffering, especially artificial lakes in the stream courses, where by reason of the slackened water, the silt is deposited very fast.

4. The scores of dams which have been built on many of the major and minor rivers, creeks and brooks, unprovided with any really efficient fish passes, have further contributed to the decimation of fish life in the state. The migratory fish have been prevented from reaching their spawning grounds, and their young have been restrained from their natural downstream migration, which may be of equal importance. Keokuk Dam in the Mississippi River is apparently leading to the complete extinction above it of paddlefish, skipjacks and perhaps other species.

5. The flooding of Iowa streams, which appears to be on the increase, has a disastrous effect in the fishes directly and also indirectly, through the destruction of the food organisms.

6. As though not content with the destruction of the feeding grounds and the coverts which sustain the fish life of the streams, man conveniently pours into the streams, within the state and along its boundaries, the waste products

of his life and his industries. Thus the aquatic life is often smothered, for sewage consumes the life-giving oxygen. The waters are filled with dangerous bacteria. The streams in extreme pollution become laden with unsightly trash and foul sludge, so that their visual as well as olfactory charm is lost. Great recreational interests are ruined or endangered. Property values are destroyed or at least greatly lowered, and esthetic values of no less real though not so readily computable human importance are wiped out.

7. Soil erosion and pollution, together or separately, have brought such an increase in the fertility of certain Iowa lakes as to place them in a condition of biological instability. They may for a period be extremely productive of fish life, but are apt to become unbalanced, especially in the production of the obnoxious algae. Overdevelopment of these algae often leads to wholesale fish mortality and to odor nuisance.

8. The depletion of Iowa's fish stock has been aided by unwise and ineffective management of this resource. Violations of the fishing laws have been common. Unwise laws have been enacted. Some undesirable species of fish have been introduced. Fish culture has not been sufficiently and properly developed along certain lines. Politics have too often been allowed to dictate the fish policies and practices of the state. Those intrusted with the administration of the state fisheries have not always been of the ablest sort. In the face of the most serious, difficult and pressing problems standing in the way of real fish development, Iowa has not seen fit to make full or proper use of technical assistance.

These are blunt and hard criticisms, but we are convinced true ones. Every abuse cited has occurred in other states. Blame can not be specifically placed on Iowa. But the fact that these administrative abuses are not peculiar

to Iowa is no argument or excuse for Iowa to avoid their correction within her own borders. Iowa has already taken vigorous, well-meant and often effective steps to reduce or eliminate these abuses. But this circumstance should not be allowed to engender such a feeling of confidence and accomplishment as to prevent much needed further improvements in the management of fish resources of the state.

9. The citizens of Iowa as a whole, excepting an active and relatively large group of conservation-minded individuals, have not been educated as soundly or extensively as they should have been on conservation and natural history matters. For instance I found one group which had been rather effectively bringing pressure to bear on the state for the construction of a local fish hatchery, on the delusion that the hatchery would be a place where they could go to catch fish. Such ignorance is a great hindrance to sound fish conservation and development.

In these abuses of their aquatic resources, Iowans have of course not been sinners alone. To a greater or less degree there has been a destruction of these resources in all states. But correlated with the extensive agricultural development of Iowa, there has been a relatively very large amount of draining, ditching and silting of the original waters. Damming, flooding and polluting of streams have also been extensive in the state. The overshadowing importance of agriculture has until recently retarded the development of conservation ideals and consciousness among the people of the state. The problems involved in the conservation of Iowa's fish supply are not local ones, but they are particularly pressing and difficult in this state.

#### Compatibility of human and fish interests

It does not follow that human life, in its present abundance, activity and complexity, is incompatible with the conservation and development of aquatic life.

If a reasonable share of the very power and energy and wealth and intelligence which has led to the destruction of fish life of Iowa can be diverted into the conserving of the aquatic resources; these may be saved from further depletion. Passing beyond this limited goal of conservation, we may with confidence plan to increase the supply of fish life back to the primeval abundance which pioneers enjoyed, and beyond that to an abundance surpassing anything which the Indian ever saw.

Such an increase in the fish supply of the state can be accomplished even in the face of an increasing human population, with the attendant increase in the utilization of the aquatic resources.

1. Many of those lakes which have been unwisely drained may be restored to something approaching their former levels and richness, leading to a restoration in numbers of fish as well as other wild life.

2. Ditched streams, where compatible with agriculture, may be allowed to return to their original meandering course, and this return may be accelerated by introducing barriers to the stream flow. Thus the mileage and area of habitable water may be increased, and stream side bayous will be reestablished. When reservoirs and lakes are constructed in the stream courses, and the watersheds reforested or otherwise treated to prevent excessive runoff, there will be less flooding in the streams, less need for ditching and a better opportunity for allowing the streams to revert to their former productive condition.

3. The silting nuisance can be alleviated by erosion control, either directly for this end in itself, or indirectly by altering agricultural methods so as to leave the soil on the fields instead of the stream bottoms.

4. The damming of the streams can be turned into benefit instead of harm, primarily because the damming in itself greatly increases the water volume available for fish. Progress is being made in developing really effective fishways.

Ponding streams also advances erosion control, and helps to prevent excessive flooding.

5. This flooding of the streams can be reduced, by treating the land to reduce the runoff, and by damming the streams and intelligently operating the gates of the dams so as to increase storage capacity. The stream flow can be rendered much more uniform than it is at present, to the distinct benefit of the fish life.

6. The pollution evil certainly can be eliminated from Iowa waters. By proper sewage treatment, the oxygen-consuming capacity of the wastes can be so reduced, that none of the streams of the state will be robbed of the life-giving trace of oxygen which is soluble in water. This can be done without removing the nitrogen, phosphorus, potassium, and other elements conducive to plant growth, which occur in the sewage. The fertilizing substances, other conditions being satisfactory, may make a stream far more productive of fish life than it originally was.

7. The excessive fertility of certain Iowa lakes should be regarded as a blessing, because investigation must eventually lead to dependable methods of controlling the algal nuisances which often result. The high fertility can then be directed by proper management methods into fish production, and can be prevented from causing excessive growths of obnoxious algae.

8. Certainly an improvement in the management of Iowa's fish resources is possible, and in order. A larger, better organized and more competent force of wardens can be built up to prevent the depletion of the fish stock by illegal methods. This can be done not only through arrests, but through education, both by the local wardens and by the central office. The fish laws of the state can be recodified and improved, in the light of the best technical advice available, and in full consideration of the sportsman's interests and of the

practicability of enforcement. Those species of fish which have been unwisely introduced, such as the carp in certain lakes, can be held in check if not eliminated. The further spread of undesirable fish, such as the dwarf orange-spotted sunfish taken in the fish rescue work, can be much reduced if not eliminated. Fish cultural practices can be further improved, so as to control diseases in the hatchery stocks, to increase the output of the hatcheries, to increase the number of hatcheries and particularly of rearing stations and to extend fishculture into new fields, such as the large-scale production of small-mouth bass fingerlings. By proper legislation, by the continual vigilance of true conservationists, by education and by the suppression of local and selfish interests when these conflict with the general welfare, politics can be prevented from dictating the fish policies and practices of the state. By increases in salaries; by the careful selection of men; by the tenure in office of those who have demonstrated ~~and~~ fitness and sincerity and by the elimination of the less competent officials; by increases in the staff, and by the elimination of excessive routine from the duties of the higher officials, a more competent and more effective force can be built up, to administer the fishes of the state. Finally, technical help of the best available sort can be engaged and utilized much more extensively than at present, and on a more thorough and continual basis.

To conclude: It is wholly possible to conserve and even to increase the fish supply of Iowa, in the very face of an expanding population and of an increasing drain of this resource. This happy ideal can not be realized through any waving of the magic wand of science; nor through wholesome sentiment or well wishing; nor through the preaching of conservation; not even through diligent surveys and thoughtfully drawn up plans for the future. All these forces are needed and will help. The real task and responsibility must rest on sincere and able fishery

administrators, aided by and utilizing the conclusions of sound technical investigation.

9. The general ignorance of fish conservation, and of the natural history which lies behind the conservation and upbuilding of our fish supply, can be dispelled by education. This can be accomplished in part by employing an able field force and by properly instructing them, and by creating a more active education division in the central office. But the real place where this ignorance and lethargy which block the progress of fish conservation in Iowa must be attacked is on school front. The coming generation must not only keep alive the splendid conservation spirit now engendered in Iowa, but must expand this, with united opinion demanding real conservation. A thorough education of the youth of Iowa in the natural history of fishes, and in the methods and ideals of conserving and upbuilding the fish supply, is absolutely necessary for the fulfillment of this twenty-five year plan, and for the attainment of its objective: the increase of the fish supply of the state to a quantity surpassing that known to the early pioneers. *Thus only can be realized the* ~~Only thus can the~~ bold vision of an enlightened and idealistic group of Iowa conservationists, the modern pioneers who have fathered the twenty-five year plan, be realized.

Fish conservation and increase intimately  
bound up with other conservation plans

It is very obvious that plans for conserving and upbuilding the fish supply of the state are intimately bound up with other items in the conservation plan. Restoration of lakes, decrease in ditching, control of erosion and silting, construction of artificial lakes, flood decrease, pollution control, algal control in lakes, improvement and extension of the conservation administration and conservation education—all are related to game increase, and to the general building up of recreational interests and values. Fish problems and fish conservation plans should never be thought of alone. They are an integral part of the general conservation problems of the state, and of the twenty-five year conservation plan.



Methods for the increase of Iowa's fish supply

The program being proposed for the upbuilding of the fish supply of Iowa, while radical in a way, does not involve the casting aside of any of the existing means of fish conservation and development. It recognizes the need for ~~and involves pro-~~tection <sup>against</sup> of any lawless or uninformed elements which unfairly prey upon the fish supply. It acknowledges the need for protective, restrictive legislation, and calls for the obtaining and coordinating of data which will make such laws sounder and more effective.

As a basis for sound fish laws for Iowa, I recommend that the state sponsor natural history investigations. These should be made and coordinated by a technically competent official trained in the methods of modern fisheries research and by assistants, and by institutes or fellowships at one or more of the colleges or universities of the state. Points in obvious need of investigation include:

- (1) The rate of growth of different game fishes in various waters of the state.
- (2) Their age and size at first spawning.
- (3) The percentage of fish maturing at each given age, weight and length.
- (4) The usual and the extreme limits of the spawning season.
- (5) The relation between catch, carrying capacity and present fish populations in various waters (to be kept under continuous observation).
- (6) The location of natural spawning grounds in the lakes and streams.
- (7) The advantages of closing nursery waters in stream and refuge areas in lakes.
- (8) The relation of the coarse and obnoxious fishes to the game fishes.
- (9) The effect of various predaceous animals on the desired species of fish.

Even though some of these problems may have been thoroughly studied in other states, they should be investigated carefully and at length in Iowa. Answers to these

problems to meet the needs of legislation and regulation in Iowa, should be obtained in Iowa. These answers are need to determine the most desirable size, season and bag limits; the importance and even the desirability of closing refuges in lakes and nursery feeders to trout streams; the exact location of such refuges and nurseries; the removal of obnoxious fish, to the best general value; the degree of protection to be accorded the predators, etc. No hasty survey can provide satisfactory answers to these problems. The best available technical help must be engaged, and held, on these problems.

Experience has taught us one vital lesson in fish conservation: needful as are the erection and enforcement of sound restrictive regulations, these alone are quite insufficient to hold back the flood of depletion. Though the levees are piled high, the floods continue to break disastrously through. Other measures of control must go hand in hand with regulation and enforcement, if we would control the torrential problem of fish depletion.

The chief additional means which has been employed to conserve and develop the fish supply in Iowa as in other states is fish culture. Developing fish culture in Iowa to a state of high efficiency and the greatest economy compatible with an active building up of the fish supply, will also demand extensive and long-continued research. For these investigations, also, the employment of technical help either in the state fisheries office or in the college or university. <sup>is called for</sup> Lines of fish cultural investigation and observation in Iowa should include:

- (1) Diagnosis and control of diseases in hatcheries.
- (2) Effective fish cultural practices—food and feeding; degree of crowding; kind of troughs, raceways, ponds, etc.; kind and amount of water.
- (3) Location of suitable points for the stocking of fish.
- (4) Most satisfactory time and age for planting, based on survival and migration studies.

(5) Methods of transporting fish, and suitable equipment for this purpose (the transporting units in present use do not appear the best).

(6) Methods and location for planting each size of each species of fish propagated.

(7) Effective and economical methods of rescue operations along the Mississippi River.

(8) Possible extantion of rescue operations to other bases along the Mississippi River, and to the *Missouri River*

(9) Improvement in sorting of rescued fish, so as to avoid the interior distribution of undesirable species, including the dwarf orange-spotted sunfish, which has been spread in this way.

(10) Development of a definite stocking policy for the state. This is a matter of fundamental importance. As a basis ~~for this~~ for a stocking budget there must be continued to a reasonable state of completeness a thorough FISH SURVEY of the state. The resulting inventory of the lakes and streams of the state should be kept up to date, all changes in the lakes and streams and in their fish fauna being tabulated. This would give a check on the success of plantings and other management practices. Conducting the state fish operations without lake and stream surveys and inventories, and fish budgets, is equivalent to attempting the conduct of a business without any market analyses, without any inventories and without schedules of production. Lack of competition is the reason why state fish operations have not gone bankrupt.

The fish survey should <sup>determine</sup> answer for each water, the physical and chemical characteristics; the available food supply; the species of fish already present and the abundance of each; the growth rate of the fish, in reference to population, intensity and carrying capacity; the fishing history of the lake or stream and its present fishing status; the species of fish adapted to each body of water;

the number of fish of each species and age which need to be stocked to increase or at least uphold the fish stock. The success obtained in fishing over the state may be determined from an expanded and continued creel census. Another source of improvement in fish cultural activity in Iowa would be a closer cooperation with the work of the U. S. Bureau of Fisheries. In developing and holding this cooperation a technical staff should be of help.

It is obvious, and universally recognized, that protective laws and their enforcement can not alone provide good fishing and uphold the fish supply. Fish culture (including hatching, rearing, rescuing and transplanting fish stocks) greatly aids in conserving the supply of fish in Iowa. But by <sup>all</sup> these means combined, no matter how extensively employed or intelligently administered, Iowa can not expect to attain the twenty-five year goal of producing more fish in its lakes and streams than were produced in the pioneer days. Another weapon must be brought into use to fight against the ever increasing tendencies to the depletion of the fish resource.

This newer means of increasing fish life, as also game life, is the method of environmental control. If the lakes and streams of Iowa are to produce more fish than they did in original condition, they must be made more suitable for fish life. This is the meaning of and the reason for environmental control.

The more fundamental phase of environmental control of Iowa lakes and streams lies in the correcting of the abuses by which the aquatic resources of the state have been destroyed. Thus, as already indicated, involves the restoration of drained lakes; allowing ditch streams to revert to natural meandering, and accelerating this process; lessening the silting of the streams; installing fishways in dams, and making best use of the impounded water; reducing the flood menace; correcting the pollution evil, but retaining as much of the basic fertilizing material as the water receiving the sewage can utilize to the advantage of its fish supply.

Beyond the mere correction of abuses lies the conscious creation in Iowa lakes and streams of conditions more favorable to the protection, growth and

reproduction of fishes. This is the contribution of the present group of fishery workers to the cause of fish increase. It is the hope of the future, the basis for our belief that it is still possible to increase the fish output of the lakes and streams beyond the primeval production.

Means of modifying the lakes and streams of the state so they will carry and produce more fish life are many. In the first place more water can be furnished by damming the streams and by raising lake outlets. The dams may vary from those transforming little brooks into lakes of several hundred acres, down to little dams in trout streams which increase the pool depths only a few inches. In addition to merely supplying more water, other conditions can be altered to add to the fish production. Thus cover can be added where insufficient, to function as better cover on land does in the increase of game. Where spawning grounds are lacking, they may be provided, in the form of gravel, slabs, or whatever material is used for spawning by the species, <sup>whose increase is</sup> desired. The food supply can be increased in a number of ways, for instance by increase of the minnow life in a lake. The length of trout-habitable water in the headwaters of Iowa streams may be increased by planting stream-side shade.

To make full and effective of this new method of increasing fish production, Iowa should

- (1) Employ technical help trained in modern fisheries methods;
- (2) Conduct careful fish surveys and inventories, with the purpose included of learning for each body of water what is lacking or deficient for maximum fish production;
- (3) Determine how these deficiencies can be met;
- (4) Proceed to modify the environment accordingly.

By combining the beneficial effects of sound laws and regulations, adequately enforced, with expanded and improved fish cultural operations, with the correction of the misuses to which the lakes and streams of the state have been

subjected, and the conscious improvement of the lakes and streams to make them better suited to the protection, growth and reproduction of the valued fishes, Iowa can, if it so wills, attain the goal of increasing its fish production beyond anything previously experienced.

#### Inventory of fish yield

Of fundamental importance in the understanding and the management of the fisheries of any state is the keeping of an inventory. This will prove of particular value in Iowa, in determining where and to what degree the drive to build up the fish stock of the state is <sup>succeeding</sup> progressing.

An inventory of yield is of importance for both the commercial and sport catches. The methods of gathering the commercial statistics should be made so thorough, so accurate and so continuous as always to give data on the changes in the fish yield, in terms of both catch per unit of year (intensity of fishery) and of total catch. Cooperation with the Bureau of Fisheries and with boundary states should be obtained, to assure that comparable statistics are available for both sides of the great boundary rivers.

For the sport fishery, however desirable this might be, it is obviously impracticable, except perhaps for certain lakes, to obtain any definite figures on the actual total yield of the fishing. It is possible, however, with the active cooperation of all conservation officers in the state, and of others if this be thought expedient, to obtain records which will indicate the yield of the fishing, in terms of number of fish caught per hour of fishing. This can be accomplished by an extension and a continuation in the use of the so-called creel census system.

With proper explanations, gathering this data will allow officers to inspect catches without engendering ill will, and will even serve to bolster up the good will of the public toward the Fish <sup>and</sup> Game Department.

In applying this system, it is of importance that each officer, or other person trusted with the responsibility of properly gathering the data, interview as many anglers as possible, inspect their catch and make out the creel census card completely.

The instructions should always emphasize, that a card must be made out, whether or not any fish has been caught, even when the angler has only been fishing a short time. The purpose is to get at the real facts.

The primary value of the creel census to Iowa will be to determine (1) for each fishing area of the state, (2) for each county, and (3) for each lake and stream,

(a) The kinds of fish caught, with proportions of each, and with an estimate of number of small (illegal) fish caught and returned.

(b) The success or failure of fish plantings.

(c) The rise or fall of the fish supply.

#### The fishing areas of Iowa

As an aid to fish management in Iowa, it will prove helpful to classify the waters of the state into five fishing districts. Each of these areas has outstanding problems, which call for extra emphasis on one or more of the specific means proposed to build up the fish supply. Each of the areas, however, shares to some degree every one of the problems which confront the whole state.

#### The commercial fishing area

This area involves the Mississippi and Missouri rivers and adjacent bottom lands, along the eastern and western margins of the state, and also such other rivers or portions of rivers, if any, which are utilized for commercial fishing or clamming.

"A survey of conditions affecting fisheries in the Upper Mississippi River" has been made by Dr. M. M. Ellis for the United States Bureau of Fisheries, and published by that bureau as Fishery Circular No. 5, September, 1931. We quote and approve Dr. Ellis' summary and recommendations:

(1) The Keokuk Dam, just as any other permanent obstruction of a moving stream, has produced certain physical and chemical changes in the river in the Lake Keokuk district. Those changes having particular bearing on the fisheries problems are:

(a) Large lateral areas were flooded producing extensive tracts of shallow backwaters. These shallow backwaters, as has been demonstrated by observation in the Lake Keokuk district and elsewhere, supplied large quantities of plankton and other fish food, provided spawning grounds, and were available as refuges for young fish.

Consequently, while these areas were in existence and were properly maintained, game fish of several species increased in Lake Keokuk district. These lateral areas of shallow water were, however, reclaimed from time to time for agricultural purposes and as a result the breeding grounds and refuges for young fish were greatly reduced. At the present time—that is, the 1930 survey—Lake Keokuk proper as the result of the reclamation of these lateral areas and of shore construction is practically without a littoral zone in which game fish can spawn and in which young fish may develop.

(b) The current of the river has been materially slowed following the impounding of a large volume of water behind the Keokuk Dam. This slowing of the current has made possible a rapid and extensive silting-in of the Lake Keokuk Basin which has resulted in completely changing the bottom fauna of the former river bed. As this silt consists of erosion material mixed with incompletely decomposed organic waste, the bottom fauna in Lake Keokuk has been reduced to those forms capable of withstanding low oxygen and tolerant of the various conditions attendant upon the decomposition of organic waste. This silting in has, therefore, limited fish fauna of Lake Keokuk largely to those species capable of utilizing for food those organisms living in such a silt environment. Consequently, carp, buffalo, and catfish were the dominant fish found in Lake Keokuk. This silting in also has eliminated almost completely the commercial mussel population of the Lake Keokuk district. This silting-in with a mixture of erosion silt and organic waste becomes a serious factor since such a mixture has a high oxygen demand. In the 1930 survey distinct differences were found in the dissolved oxygen content of Lake Keokuk and the river both above and below the dam in midsummer, and it has been shown by observations on other bodies of water, notably Lake Pepin, that the dissolved oxygen in water above such a silted-in bottom decreases to a point critical for the maintenance of life during the winter months when the surface of the body of water is frozen over.

(c) The depth of the water has been increased to over 15 feet for 4 or 5 miles above the dam. This volume of deep water produces a more acute oxygen demand and mechanically restricts the purification of the silt which has settled to the bottom.

(2) Wing dams both in the Lake Keokuk district and elsewhere along the river have produced the same general set of conditions as regards the silting-in of the bottom, except that the wing dams occupy relatively shallow water. The silting-in back of wing dams presents, however, a less acute situation to those animals capable of moving about as other portions of the river near by are available and the decomposition products are swept away more readily from behind wing dams by the adjoining river currents. The mussel population has suffered particularly, however, from the construction of wing dams because these animals do not move rapidly and are more or less restricted to particular habitats.

(3) Large numbers of game fish, both young and old, were found in the Wabasha district. This district has ample lateral backwaters producing quantities of plankton and supplying refuges for young fish. Consequently, the detrimental effects of silting-in were not so noticeable in the Wabasha district as in the Lake Keokuk districts. Studies on the mussel population, however, showed that silting-in is a serious factor even in the Wabasha district.

(4) The conditions in Lake Pepin, a natural body of impounded river water, were very similar to those in Lake Keokuk as regards silting-in character of bottom, oxygen, and the physicochemical factors of the environment. In Lake Pepin, however, areas of shallow water containing weeds, producing large quantities of plankton, and supplying suitable spawning grounds and refuges for young fish are to be found, resulting in a more abundant fish fauna, in general richer in game fish in Lake Pepin, than in Lake Keokuk.



(5) Summarizing all of the available data from the survey it is evident that from the standpoint of fisheries problems the fixed-level dams have many advantages over arrangement allowing sudden changes in the water level of the river. As has been demonstrated in the Lake Keokuk district a fixed-level dam will flood sufficient lateral land to provide desirable shallow water areas producing quantities of fish food maintaining large numbers of young fishes. If the water level be suddenly changed these shallow areas will suffer first. Both the forms producing fish food and large numbers of young fishes will be destroyed if the change in water level be made during the summer, losses which can not be replaced during that season. It is recommended, therefore, that in the vicinity of the fixed-level dams suitable portions of these lateral flooded areas be maintained as fish refuges. This procedure will avoid the complications arising from the withdrawal of these areas for other purposes, as has happened in the vicinity of Dallas City, Ill., to the detriment of the fisheries interests. It is recognized, however, that question may be raised at once as to the relative value of these areas for agricultural purposes as against their value for fisheries purposes.

(6) The outstanding factor producing changes in the Mississippi River fauna seems to be that of erosion silt. It must be borne in mind, of course, that with the increasing accessibility of the various parts of the river fishing has increased tremendously and also that with the increasing value placed on the mussel shells, shelling has been greatly stimulated. As a result many more fish and many more shells have been taken from the river during the past few years than formerly, but aside from the factor of overfishing and overshelling, erosion silt becomes a serious matter in the river. Soil experts of the Department of Agriculture have shown recently that the silt now carried by the Mississippi River greatly exceeds in volume that which was carried by this same river only a few years ago, and that the annual increment of increase in erosion is rising rapidly. The Mississippi River is, therefore, so loaded with erosion silt that any obstruction of the current slowing down the movement of the water temporarily will produce a rapid silting-in behind the obstruction. This was conspicuous at all points between Quincy, Ill., and Point Au Sable in Lake Pepin. The silting-in overwhelms the bottom fauna faster than it is able to adjust itself, with a result that many species are being eliminated or greatly reduced in numbers. As a complicating factor the erosion-silt suspension, which is almost colloidal in nature, carries down with it when settling out partly decomposed organic waste which has reached the river through municipal sewage and other sources. The nitrogen values of silt taken from the bottoms of Lake Pepin and Lake Keokuk were surprisingly high, and the decomposition of the organic material after it is carried to the bottom by the erosion silt produces gases and other substances which modify the character of the water and reduce the quantity of dissolved oxygen to the detriment of the bottom animals, as has been noted under the discussion of Lake Keokuk. As the result the silting-in behind wing dams and other permanent obstructions in the river below large cities presents a serious complication of the pollution problem.

(7) Bacteriological and chemical studies of the water of the Mississippi River, both in the vicinity of cities and towns and in the portions of the river less closely bounded by civilization, showed that the pollution of the river by municipal sewage and industrial waste has been accomplished to an alarming extent; this factor of pollution in itself, regardless of other conditions in the river, is rapidly reducing the river fauna to such forms as carp and paper shells, which are tolerant of these conditions. The municipal-sewage problem is greatly complicated by presence of soil-erosion material, since the sewage when incorporated with the erosion silt decomposes more slowly than when moving in clear water and consequently the effects of pollution from municipal sewage are being projected farther and farther downstream from the source of pollution.

(8) In conclusion, the findings of the 1930 survey seem to warrant the statement that the construction of permanent dams maintaining a fixed water level in connection with the requirements of navigation need not be incompatible with fisheries interests. On the contrary, the construction of such dams may be made to increase fish production and to better fisheries conditions in the upper Mississippi River if proper cooperation be given by those interested in fish conservation. This involves the setting aside of suitable fish refuges, elimination of unnecessary erosion silt from the Mississippi River and the removal of various municipal wastes from the stream. These are problems facing the fisheries interests, regardless of the construction work of the War Department.

It is recommended that Iowa, as a part of its twenty-five year conservation plan, take a lead in:

(1) Insisting that all sewage entering the river from Iowa be thoroughly treated to render it relatively free of solid matter, of excess oxygen-demand and of pathogenic bacteria.

(2) Controlling erosion from the Iowa sides, thus lessening the silting nuisance.

(3) Acquiring and designating as fishing refuges the rich overflowed shallows along the west side of the river.

(4) Inducing the neighboring states to cooperate in similar fashion to uphold the great fishing resources of the upper Mississippi.

(5) Extending the fish rescue work in the overflow lakes along the Mississippi, improving on the methods used (both for efficiency and economy), and cooperating better with the Bureau of Fisheries.

(6) Attempting to provide for the passage of fish over the dams, in cooperation with the other states and the federal government.

(7) Development of fish culture for such river fishes as would appear to benefit therefrom, similarly in cooperation with other states and the Bureau of Fisheries.

(8) Cooperating with the Bureau of Fisheries in efforts to rebuild the supply of freshwater mussels.

(9) Processing the mussel meats into meal for fish food in the hatcheries.

(10) Extension to the Missouri River of these actions designed to build up the fish supply; and of rescue operation if surveys and trials prove this practicable.

(11) Cooperating with the adjoining states and the federal government in studying the fisheries problems of the boundary rivers, to increase the understanding of these problems, to recognize and measure depletion in the fish population and to devise means to counteract this depletion.

The southern fishing area

This area may roughly be defined as the Missouri River drainage basin south of Sioux City, and the Mississippi drainage basin south and east of Des Moines. It includes also a number of streams scattered through the small-mouth bass and the trout fishing areas, and more or less of the lower courses of most of the large tributaries of the Mississippi north of Davenport. Some of the streams within this area may through the elimination of pollution and the control of erosion be redeemed for small-mouth bass. The streams of the area now provide little fishing, except for catfish and bullheads.

The limits of this fishing area are not very sharply defined, although they rather closely coincide with the area of the state most deeply buried by loess. Its characters are determined by excessive silting of the streams, and by tremendous variation in stream flow. Ditching has been combined with erosion to turn formerly clear, hard-bottomed streams in this area into muddy runs. Fundamentally the improvement of these streams must rest on erosion control. Some recuperation will follow from allowing the streams, wherever at all compatible with agricultural interests, to revert to an originally meandering course, with the bends and holes and snags and overflow shallows which are conducive to fish increase. An educational campaign pointing out the value of natural streams and more fish will ship.

The return of the streams to natural condition can no doubt be accelerating by placing barriers in the right way to reproduce the meandering course. Means can probably be devised for holding in place, through the floods, other improvement devices, as hole-digging deflectors, coverts of logs and brush, old tiles for cover and for catfish spawning, etc.

The prime possibilities of fishing betterment in the Southern Area is the construction of artificial lakes. These will also serve as means of erosion control, as centers of general recreation, etc. But their main value will probably be their fish resource. Therefore, great care should be taken to so construct these ponds as to make conditions suitable for fish. Important points to consider are:

- (1) Sufficient depth to support fish life in winter--preferably 15 to 30 feet at the dam.
- (2) An accessory drain at the very bottom of the dam, in the old stream bed, to make possible the flushing out of silt from the deepest part of the pond, so as to maintain the desired depth. This drain should be shielded on the upper side by a double screen, to save fish and to permit cleaning of one screen at a time.
- (3) Leaving brush in the lake bed for fish shelter.
- (4) Cutting down trees that would be killed, removing larger logs if desired, but wiring finer branches onto large branches and weighting these <sup>or staking them</sup> so they will lie just under the level where ice <sup>will</sup> not destroy them. These will provide very fine shelter for young fish, and also increase the food.
- (5) Stocking the ponds rather heavily with game and pond fish, particularly (and generally) with large-mouthed black bass, crappies, bluegills and the larger species of bullheads (not the dwarf black bullhead of the region).

Taking these precautions, the Fish and Game Department ought to insure a great increase in the fish supply of the state as these lakes are produced. And this increase will come in a portion of the state where better fishing will be a very valuable asset.

#### The small-mouth bass fishing area

North of the southern (or bullhead) fishing area just discussed, excluding the glacial lakes and the northeastern trout streams, is an area where the streams are in large degree either potentially or actually supplied with game fish other

than catfish and bullheads. The small-mouth bass is the most important of these. The streams involved are portions of all the major Mississippi tributaries, from Upper Iowa to the Raccoon. Prospects are considered good for developing bass fishing in parts at least of the northern tributaries of the Missouri, including the Big Sioux and Rock River, and Mill Creek tributary to the Little Sioux.

Erosion, flood and pollution control are tremendously important, <sup>consideration in</sup> for the up-building of bass fishing in this area, as for the state as a whole. But the specific need of this area, the outstanding fishcultural need for the state, is adequate provision for the hatching and rearing of bass. It is recommended that at least three stations wholly or largely for this purpose be constructed and operated. One of these could be a nursery lake, probably one in Dickinson County. Two at least should be located toward the eastern side of the bass territory, in the "Driftless Area", to obtain pure water and to avoid excessive floods. Certain sites in Winneshiek and Jackson county seem suitable, though other equally good or better sites may be discovered. These three stations should each have a <sup>supplementary</sup> minimum of ten or fifteen acres of pond surface. Smaller, rearing projects, under local control, could be sponsored to advantage.

#### The trout area

A considerable proportion of the streams of the so-called "Driftless Area" in the northeastern corner of the state, arise in clear springs from the limestone bluffs which line the valleys. These are largely in Winneshiek, Allamakee, Fayette, Clayton and Delaware counties. In other counties, more or less close to those named, as Blackhawk, Cedar and Jackson counties, there are <sup>also</sup> some potential or actual trout brooks.

Erosion control is important in this area too, to lessen the amount of sand being washed into the streams where it fills up the holes, levels off the bottom, smothers out the natural trout food.

The outstanding possibilities for increasing the trout supply lie in stream

improvement. In most Iowa streams examined the greatest need is for more adequate cover and protection. This can best be accomplished by propping up limestone slabs, and by constructing log-and-boulder covers, especially in holding basins made by throwing small stone dams across the streams. The impounding of cold brooks by large dams to produce trout pools or lakes is in general not recommended for the area, because the streams warm up all too rapidly as it is. Certain of the streams, flowing into non-trout or quasi-trout waters, may be so dammed to good advantage. To hold down the temperatures of the stream where exposed, ~~the~~ thus to increase trout waters, the planting of willows and other stream side shade plants is urged.

The limited mileage of trout streams in Iowa, and the excessive floods which tear down most of the trout streams after freshets, ~~both~~ call for the planting of a large proportion of the hatchery trout at a legal or almost legal size. This <sup>also</sup> calls for more rearing facilities, including a large rearing station in Winneshiek County or close to it, and for <sup>the</sup> distribution of yearling fish throughout the summer. Planting of the fish solely after the close of the trout season, thus subjecting them to a winter and to spring floods before the opening of the season, seems to be an unsound policy, not to be adopted unless tests prove it advisable.

#### The lake fishing area

This area includes the lakes (but not the streams) of the north-central prairie region, which is mapped as the Wisconsin Drift.

These lakes are among the most productive of any in America. They are ~~mostly~~ <sup>mostly</sup> in fact, so rich in fertility as to be in a condition of biological instability. Small changes in conditions suffice to throw them out of balance, generally in the direction of the excessive growth of obnoxious algae (Microcystis and particularly Aphanizomenon).

The outstanding need of this area is the diligent management of the lakes, to insure good fish crops with a minimum danger of algal nuisance. This can only be done following or in connection with ~~the~~ continued studies of the algal

problems. The use of an alga-eating fish (the gizzard shad) appears particularly promising as a means of holding down the algae, transforming it into food for the larger fish. Experience in Ohio and other states confirms the belief, that this fish may contribute to the solution of the lake problems. Preventing the wading of cattle in the lakes, and the stopping of bank erosion (especially in Storm Lake) should be integral parts of the Iowa conservation plan.

The improvement of the lakes in other ways should be undertaken. These means include:

- (1) Deepening the lakes by raising the dams, where possible.
- (2) Providing brush shelters for the protection of young fish, and for the attraction of larger ones.
- (3) Increasing the food by introducing blunt-nosed and black-head minnows and by providing spawning slabs for their rapid reproduction.
- (4) Increasing the weed beds where deficient, etc.

Attention should also be given to the better and closer management of the nursery lakes. At least one of these should be devoted to small-mouth bass rearing, for stocking the lakes (and also the streams) of the region.

By energetically following out such plans and methods, the goal which we have set can be attained. This goal is the increase of the annual fish crop of the state to a size greater than that enjoyed by the Indian or the pioneer.

#### SPORTSMEN URGED TO AID IN STREAM IMPROVEMENT

According to Carl L. Hubbs and Clarence M. Tarzwell of the Institute Staff of the Michigan Department of Conservation, together with S. P. Baur, Iowa's fish culturist, who have been conducting a survey of the fishing waters of the State of Iowa, we have in this state some of the finest trout waters in the United States. A great many of these waters need improvement, according to the experts. The Fish and Game Commission has been making some improvements on some of the streams, but the financial conditions will not permit any great program of stream improvement work at this time. An appeal to the sportsmen in the vicinity of these streams has gone out from the Commission to assist in this work. Deflectors, dams, digging deep holes, uncovering gravel riffles and establishing weed beds are all very necessary. Fish need food and cover just the same as do game birds and it is the furnishing of these to our streams that will make them worthy of the stocking program as is outlined by the Fish and Game Commission. Farmers living along such streams are asked to work with the sportsmen and fortunately practically all of the material needed for these improvements can be had on the land adjacent to the stream. Sportsmen's groups are urged to organize crews to carry out this plan and information on how and where the work should be done can be had by writing to the Fish and Game Department at Des Moines.

#### HEAVY SNOWS AID TO DUCKS

Indications that the heavy snows of this winter will create better conditions in the duck breeding areas of Canada and the United States, according to the bulletin of the American Game Association. The Association has been conducting an inquiry into the situation by the sending of questionnaires to interested persons throughout the area. Wildfowl suffered the loss of many of their breeding grounds through lack of water and millions of baby ducks died for the want of it. Answers to the questionnaires state that when the heavy snows melt there should be a big improvement in the number and condition of the breeding and rearing areas. Because of the shortage of waterfowl the season for shooting was reduced to two months last fall. Another important phase of the query was that sportsmen as a whole were satisfied with the short seasons and bag limits. Many of those reporting on the questionnaires stated that in their opinion the duck crop of 1932 was larger than that of 1931, but 25% less than that of 1928, the last normal breeding year before the drought began.

#### LUCAS COUNTY FARMER INCREASES QUAIL 400%

A very interesting report from H. A. Holmgren, deputy warden located at Chariton in Lucas County explains how L. E. Callison, a farmer living 5½ miles southeast of Chariton, has been practicing game management for some years. Mr. Callison's farm consists of 400 acres of which all but 40 acres are under cultivation. As the land is rolling, erosion had to be controlled. This was done through the planting of sudan grass in the small washes. Hog feed was provided through the planting of soy beans with the corn which also served the birds. At the time Mr. Callison took over the land some timber had to be cleared and the brush piles remaining were left to stand in odd corners near food. With these practices, the original two coveys of quail of five years ago have now increased to eight larger coveys.

#### AN APPEAL TO DOG OWNERS

Owners of dogs are asked by conservationists to keep the dogs tied up during the nesting season of game birds. While not all dogs will destroy a nest of eggs, the fright that the mother bird will receive when a roaming dog appears on the scene may make her desert the nest to find better protection and more secrecy on another farm. In many states it is a violation of the law to permit a dog to run at large during the spring and summer months. In many sections of the state there are numerous stray dogs which should be put under control. Almost every farm has a dog or two but in most cases it is found that they are usually trained cattle dogs and well behaved. These are not hard to make remain at the farm buildings but there is an equal number who are roamers and in most cases, nest destroyers.