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Report 151

REPORT ON GROUSEHAVEN LAKES

Seven lakes and ponds located on Grousehaven, Harry H. Jewett's estate, in Cumming Twp., Ogemaw County, were examined by members of the lake investigation party during the latter part of July 1931. This report covers the findings of the party and contains recommendations for improvement of the lakes.

Since conditions differ greatly in the several lakes, each body of water will be considered separately. Certain general discussions can be made, however, which concern all of the lakes.

Need of Examination

The need of making a careful inventory of the lakes before a definite program of improvement can be formulated is apparent. Since our northern lakes present an unusual variety of conditions, a careful survey of lakes such as those discussed in this report is especially important. Findings of the investigation party will be taken up under the discussions of the individual lakes.

Improvements

To provide optimum conditions for fishing, it is necessary to make certain adjustments. Nature has not made all of her waters ideal for fish production and in many lakes certain important factors have not been provided. The object in making improvements, is to provide those things which Nature has failed to place in the lakes.

Certain factors, vital to fish life are recognized. The fish must have ample food, young fish must have protection, conditions must be satisfactory for reproduction, or, if this is impossible, young fish must be placed in the lakes from year to year, chemical conditions and temperature must be satisfactory and species well adapted for the particular water must be planted. The several items will be given separate consideration.

Stocking

Food, spawning and temperature requirements of our common fishes are fairly well known. The study of a lake gives some idea of which species should

do best in it. Generally, conditions, if suitable for one species, are also satisfactory for certain other fishes. For this reason, the desires of those who own or fish the lakes should be known and efforts should be made to stick with those species which are most desirable, provided the conditions are favorable for these fishes.

Stocking with both trout and warmwater species is generally regarded as unsatisfactory in our smaller lakes unless fish of fairly large size are planted. Of the seven lakes here discussed four are warmwater lakes and should be stocked only with warmwater species. Loon Lake, though quite shallow and appearing on casual inspection to be suited only to the warmwater species has a low enough temperature to support brown trout. Some excellent browns were taken from this lake. The other two lakes, North and Devoe, are suitable for either trout or bass.

The following list indicates which fish (grass pike excepted) should be suited to conditions present in the several lakes.

87.6	1.	North Lake: Trout (brook or brown), smallmouth bass.
125.	2.	Devoe Lake: Trout (brown), smallmouth bass, walleye.
20.	3.	Loon Lake: Largemouth bass, bluegills, brown trout, perch, walleye.
58.	4.	Spring Lake: Largemouth bass, bluegills, perch.
13.	5.	Dollar Lake: Largemouth bass, bluegills, perch.
6.	6.	Teal Lake: Largemouth bass, bluegills.
1.5	7.	Devil's Wash Basin: Largemouth bass, bluegills.
<u>311.1</u>		

The following species are recommended:

1. North: Brook trout or smallmouth bass or both (see discussion).
2. Devoe Lake: Brown trout or smallmouth bass or both (see discussion).
3. Loon Lake: Largemouth bass and bluegills. Walleyes might do well in this lake.
4. Spring Lake: Largemouth bass, bluegills.
5. Dollar Lake: Largemouth bass, bluegills.
6. Teal Lake: Largemouth bass, bluegills.
7. Devil's Wash Basin: No stocking needed.

Discussion regarding amount of stocking will be made in the reports on individual lakes. Generally it is desirable to plant large fingerlings or yearlings since their chances of survival are much greater than are the chances for smaller fish.

Shelter

Shelter for young fish is very essential and the matter of providing adequate protection for them is too often overlooked. Planting fish and then

exposing them to hungry predators is a costly matter and too often it is an unsuccessful venture so far as the planted fish are concerned. In certain Northern Michigan lakes here discussed, abundant vegetation provides considerable protection, in others there is practically no shelter. Most of our northern lakes had dead tree trunks and snags on the shoals at one time but, for various reasons these have been removed in many cases and the resulting unprotected shores have rendered conditions more hazardous for the young fish which generally frequent the shallow waters.

The important problem of providing shelter is, fortunately, one of the easiest to solve. Brush shelters have been found not only to provide excellent protection for young fish but, in furnishing conditions favorable to certain desirable aquatic insects, also to increase the food supply. The small fish finds those two great essentials to all animal life, food and protection, in these structures. The shelters also have a tendency to improve fishing in lakes where food is limited since large fish are concentrated, more or less, near the shelters.

The construction of the brush heaps is not of prime importance so long as the brush is loosely placed together and submerged at proper depths. The design as illustrated in this report is considered one of the best. The open space in the center is more or less protected from wave action, has a tendency to collect some rich soil, and therefore, is conducive to the growth of vegetation. This design calls for shelters of considerable size spread over a relatively large area.

The shelters can be "hung" on the slope where this is found to be desirable. When placed in this manner protection is afforded at various depths by each heap. This is especially important when the protection is meant for trout. A large brush shelter thus hung should give protection down to depths of 20 to 25 feet, thus into the cool water levels.

Since the young fish tend to remain in fairly shallow water a portion of the heaps should be fairly near the surface--just deep enough so that they will not interfere with boating or with the beauty of the lake.

The number of shelters desired depends on the amount of protection already present in the lake.

Food Increase

The abundance of food depends on a number of conditions. Vegetation tends to provide more insect life. It also tends to enrich the lake chemically to some extent. The amount of fish food present depends, to large extent on the microscopic organisms. These in turn depend on the basic fertility of the water. Food in hatchery ponds is increased greatly by adding fertilizer to the water. In large lakes, or in lakes with outlets the use of commercial fertilizer is not recommended, because of the cost involved. Manure is often considered objectionable in the water, especially in lakes where bathing is carried on. It is also quite limited in amount in much of northern Michigan.

Planting vegetation without changing the conditions very often proves unsuccessful. Nature generally provides vegetation of some sort wherever conditions are satisfactory for plant life.

The increase of microscopic food, especially in lakes such as North Lake, is more or less difficult. An analysis was not made of the microscopic life in the lakes but it is assumed that lakes such as North Lake are not rich in these small forms of life.

Increase in large food, aquatic insects and minnows can be made. The brush shelters make increased insect life possible and also tend to increase the supply of minnows.

Where little vegetation occurs and where lakes are generally poor in food, fertilizing locally can be carried on. This is best accomplished by placing rich soil (muck) in the opening inside the type of brush heap illustrated in this report. Several cubic yards in each heap should enrich the lakes locally to some extent. If little or no vegetation is present muskgrass or some other desirable aquatic plant can be placed in the muck. Some of the soil will undoubtedly be washed out in the course of time. A new supply could be added every few years. This should have a desirable affect on both the course plants and the microscopic organisms. The soil is easily obtained and the muskgrass can be obtained with a rake from some lake(on the estate) containing it.

Minnows can be aided considerably by providing suitable spawning areas for them. One of the most desirable species, the blunt-nosed minnow, spawns on the underside of flat objects. Slabs or old boards should be used. The arrangement shown in the accompanying diagram is recommended. If the slabs or boards are placed together in this fashion portions will always be slightly above the bottom even though the structure sinks into the bottom soil to some extent. The structure could easily be raised and moved a few feet once every several years should it be found to sink too deeply into the soil. These should be placed in water 10" to 30" deep and should be located fairly near the brush shelters. When blunt-nosed minnows are not present their introduction is desirable. This will be discussed under the reports on individual lakes.

Spawning Conditions

Conditions needed for spawning vary with the different species of fish. Perch hang their ribbons of spawn on the vegetation or on branches or roots of trees submerged in the water. No special efforts to improve their spawning conditions need be made. The brush shelters will probably be utilized to some degree.

Largemouth bass and bluegills will make their beds on roots of plants or on chips of wood. Smallmouth bass almost invariably use gravel for nests. Brook and brown trout require running water with a gravel bottom.

Where the bottom is quite soft spawning for largemouth bass and bluegills is difficult. A structure made of old planks loosely covered with a layer of small sticks, and gravel should prove satisfactory in these cases. Even on very soft bottom this would sink very slowly. On moderately firm bottom the planks may be eliminated. Each spawning bed should support a number of bluegill nests. Since largemouth bass prefer to be somewhat removed from each other in nesting, spawning areas about 3 feet square should be more desirable. These devices should be placed in water from 1-1/2 to 4' deep.

Trout must be planted or must have access to running water. Since Devoe Lake is intended for brown trout and since Gamble Creek which enters it is a brook trout stream, it may prove undesirable to have the fish in the lake spawn in the stream or to have the trout from the stream enter the lake. In this case a screen in the creek near its mouth would prove desirable. This screen should be constructed so it can be cleaned easily, if not automatically. Fish for Devoe Lake as well as North Lake would have to be transferred from rearing ponds located elsewhere, if the inlet to Devoe is screened. For plans for such a screen see p. .

Devoe Lake

Size, inlets and outlets This is the largest lake of the group. It has an area of about 125 acres.

Several inlets enter the lake, the chief one being Gamble Creek. This stream has a considerable flow of clear, cold trout water. It enters the lake on the northwest side. An intermittent inlet from Loon Lake is also present.

The outlet, leaving the lake at the extreme west end, is the Rifle River, Devoe Lake being the headwater of this stream. A dam is present in this outlet near the foot of the lake. This dam serves to regulate the water level of Devoe Lake and also prevents fish from the river from passing into the lake.

Pollution The water is exceptionally clear and clean. The water was found to be slightly dark, due very likely, to the color of the water in Gamble Creek. Such color is characteristic of some trout streams. No sewage or other substances which might contaminate the water were found. Although no special tests for pollution were made it is safe to assume that no injurious substances are present, and that there is no danger of pollution for some time to come.

Use of water This lake is on a private estate and is used very little except for boating and fishing. Fishing here is carried on only by the owners and their guests.

Temperature Surface temperature was found to be fairly warm. The water cools more or less gradually from top to bottom. A difference of 30 degrees Farenheit was found between surface and bottom. Water below 15 feet is relatively cold.

Oxygen Oxygen is fairly high to a depth of 30 feet. None was found at the bottom. Tests showed, however, that a considerable portion of the cold water layer contains oxygen in midsummer. This fact, and the finding of cisco in the lake, indicate that the water, so far as oxygen and temperature are concerned, is well suited for colwater species of fish.

Other chemical conditions The water was found to be alkaline at all depths. It is relatively hard water. Carbon dioxide was found only in the lower half and was present in fairly large amount only at the bottom.

Depth Less than half the lake has a depth of over 30 feet. A small area is over 45 feet deep. The dropoff is generally fairly near shore and the slope is steep. Maximum depth found was slightly over 52 feet.

Bottom The bottom soils on the shelf are almost entirely marl. Below the shelf the bottom is chiefly a mixture of pulpy peat and marl except in some portions where the bottom is entirely of pulpy peat. The marl on the shoal is not nearly so pure as that on North Lake and a considerable amount of vegetation has been able to maintain itself at the edge of the shelf.

Vegetation Weeds are abundant on the slope and also below the slope in some places. An abundance of foods is found in this vegetation. Although some shallower portions of the shoal are more or less bare, the vegetation in this lake can be considered adequate.

Natural food Natural food is fairly abundant. Minnows were found to be very numerous. The weed beds also harbor many aquatic insects. From all indications this is a relatively productive lake.

Fertility Much of the shoal area is of marl but enough organic matter is present to render the lake fairly rich. This body of water is quite fertile compared with North Lake.

Spawning grounds

Much of the marl present is in the form of concretions which greatly resemble gravel. No suitable gravel areas were found. A certain species of minnows which normally uses gravel for spawning was found to use the marl.

Whether or not this is also used by bass, has not been decided. The weed beds provide suitable locations for perch spawning while Gamble Creek can be used by the trout.

Species of fish present

Game fish. Northern pike, brown trout, perch, rock bass, cisco and largemouth bass were found. Of these the trout, perch, and pike appeared to be most abundant. Several pumpkinseed sunfish were found in the outlet.

Coarse fish. Common suckers are present in considerable numbers. No other coarse fish were taken.

Obnoxious fish. None found.

Forage fishes. Most of the forage fishes were found in the weeds on the slope. Attempts to seine these were unsuccessful. The minnows were quite numerous. Most of them were apparently common shiners. Log perch, river chubs, black-striped shiners and Johnny darters are also present. Common shiners, blunt-nosed minnows, log perch, least darters, hog suckers, river chubs and creek chubs were found at the dam in the outlet.

Predators

Except for a few fish-eating birds and a few watersnakes, no predators were seen other than the adult food and game fish which are predatory to some extent. One of the water snakes had several perch in its stomach. Neither the snakes or the birds are numerous enough to seriously affect the fish population.

Cover

Considerable cover is provided on the slope by weed beds. Very little protection, however, is afforded on the shallow shoal area near shore. Shelter for young fishes is inadequate especially if the fish population is increased.

Water level

Water level can be kept constant by adjustment of the dam in the outlet. Evidently very little fluctuation occurs. A constant level is desirable. Keeping the lake at a lower level to speed up the current in the lower Gamble will not in our judgment be seriously detrimental to the lake, since the shoals are not very productive. But if the lower level is decided upon, it should be maintained constant during the spawning season of the lake fish (May to July inclusive). A beneficial policy for maintaining the water level in Devoe would be to keep the level about two feet

higher during the winter than during the open-water season. The level should be dropped just as soon as the ice goes out, but not before. This would make it possible to put brush shelter where most needed (on the shallow shoals) and protecting these from ice action by keeping the water higher in the winter.

Recommendations

We believe Devoe Lake to be suited to brown trout, smallmouth bass and walleyes. What species should be encouraged is of course a matter for the owner to decide. There is most doubt about the suitability of the lake for walleyes, and this species is a dangerous predator. If the lake were a public lake we would probably recommend either brown trout or smallmouth bass, not both. They will undoubtedly compete and prey on one another to some degree. Both species, however, can, we believe, be maintained. The fairly warm surface water and the rapidly cooling lower layers will keep the two species largely apart during the summer. Until all the water becomes cold in the fall there should be little intermingling.

One consideration making possible the maintenance of both species in the lake would be the planting of large fingerlings or preferably yearlings of both species. If the lake is to be used for both bass and trout, adequate protection for young fish should by all means be provided.

Stocking

If the lake should be stocked with both smallmouth bass and brown trout the planting of large fingerlings or better yearlings is virtually required. An annual stocking with 5,000 bass or of 5,000 brown trout or of both if the owner so chooses, is considered most desirable. This estimate assumes that considerable added shelter will be provided before these fish are placed in the lake.

Shelter increase

Although some protection is afforded by the vegetation, an increase of shelter is considered desirable, especially on the shoals. Some shelters should be placed so as to reach the surface during the summer water level, while others, primarily for trout, should be located in the water level from 8 to 20 feet. If long shelters, such as the one illustrated in this report, are used one end can be placed in shallow water while the other will extend down into the colder area, by hanging the shelter just over the edge of the slope. The construction of 50 shelters is recommended. These should be placed in the lake at more or less regular intervals. Since trout will be found fairly near the surface at the outlet of Gamble Creek, and since pike were also found to be fairly numerous here, several shelters should be placed in the lake near this point.

Food increase

The brush shelters provide a considerable increase in food in furnishing proper conditions for algae and aquatic insects. Should the fish population be found to increase very notice-

ably the introduction of more blunt-nosed minnows will be desirable. These can often be obtained from some nearby lake. At present the introduction of more forage fishes is unnecessary and not recommended.

Except for the natural increase brought about by the brush heaps, special efforts to increase food are not recommended for the present.

Improvement of spawning grounds The trout will evidently not spawn in the lake, but will continue to use Gamble Creek. Stocking will be needed if any considerable amount of lake fishing for brown trout is anticipated. Since Gamble Creek is naturally chiefly a brook trout stream, and since the owner desires to maintain it as such, planting of the brown trout in the creek is not recommended.

The suggestion that the trout be planted in Bass Bay is not regarded as especially desirable or practicable. The seining of this bay is regarded as virtually impossible. The removal of predaceous fish is therefore not possible. We have no reason to assume that this bay will offer a habitat as favorable as the lake proper. We consider it a better plan to distribute the 5,000 trout around the entire lake, about 100 at each of the 50 brush shelters.

If the natural reproduction of bass is to be depended on to any degree, the placing of gravel on the shoal is considered necessary. Since the shoal is fairly soft the use of supporting frames is recommended. For smallmouth bass gravel alone should be used. An alternative, for this and other lakes, would be the construction of a bass pond. Once the stock is available breeders can be taken from the lakes in the spring and placed in the pond and can be returned to the lakes after the young have hatched. The construction of a bass pond calls for a rather small financial outlay and would render the building of proper breeding beds in the lake less important.

Vegetation increase No special effort to increase the vegetation in this lake need be made. Considerable is now present. Additional protection on the shallow areas near shore is much needed but this can be better provided by the building of brush shelters. The shelters will probably stimulate the growth of vegetation by accumulating organic soil.

Channels to connecting waters Some suitable screen should be placed in the inlet from Loon Lake to prevent trout from entering the latter. A loose brush and gravel obstruction would suffice.

A screen in Gamble Creek, near its mouth, is recommended, to separate the brook trout in the stream from the lake fish, preventing loss in both directions. This screen, we recommend, should be located between the lower parallel ends of a V-barrier. It would best be made of pipe bars supporting a

1/2" screen, and hung above so that when it becomes loaded with trash, it will be lifted by the current and automatically cleaned, and then drop back into place. It would need to be weighted or counterweighted so as to work right.

Three plans for the operation of this screen during the brown trout run are proposed. It should be kept in place at all other seasons.

- Plan 1. Remove the screen (or hook it up out of the water) during the whole run, so as to allow the brown trout opportunity to reach the beds, spawn and return to the lake. In our opinion this would probably not very seriously harm the stream though it would mean the loss of some brook trout and would certainly encourage the establishment of brown trout in the stream, especially about the deeper holes.
- Plan 2. Maintain the screen at all seasons, and trust almost entirely to new plantings to stock the lake.
- Plan 3. Set up a weir below the screen. Two rows of stakes about 1-1/2" apart, running upstream to a three foot clear opening in between, would make it possible to trap the brown trout, between the weir and the screen. They could then be seined out, stripped, and returned to the lake. The fertilized eggs could be delivered to a hatchery for hatching on a share basis.

We recommend Plan 3 as by far the best management plan for the lake and stream. The cost of operation is its outstanding objection, but need not be very high. Advantages are:

- 1. Keeping brown trout out of stream, but saving their spawn.
- 2. Keeping record of the number of trout in the lake.
- 3. Removing the largest brown trout (most predaceous) if desired and if permissible.
- 4. Removing pike in spring.

North Lake

Size, inlets and outlets

This lake has an area of 87.6 acres. The only inlet found was a small spring (used for drinking water) located near the east end of the lake. An intermittent outlet, Lone Star Creek, leaves the lake at its extreme west end and enters Gamble Creek a short distance away. The outlet has a small dam near its source, which prevents flow except in very high water, when it may serve as an inlet from Gamble Creek.

- Pollution The lake is exceptionally clean and is quite clear except when roiled. On windy days considerable marl is carried in suspension. The water is decidedly blue in color. It is evident that no pollution injurious to fish life is present. Very few lakes have the very clean appearance which this lake presents. It is used for bathing and should serve this purpose exceptionally well.
- Dam in outlet The small dam, mentioned above, keeps the water level constant and keeps it considerably higher than it would be if the dam were not present. Such a dam appears to be quite desirable.
- Use of water The lake is on a private estate and is not used by the public. The owner and guests use it for swimming, fishing, and boating. Quite a few ducks are generally found on the water.
- Temperature The summer temperature corresponds with that of Devoe Lake in most ways. Warm water, however, is found to reach a somewhat lower depth in North Lake. The chemical cards show the temperature for each meter in depth. Definite warm and cold water layers are present.
- Oxygen Oxygen is fairly high in the upper half. Some oxygen is present almost all the way to the bottom. Conditions appear favorable, chemically, for cold water fishes as well as for the warm water species.
- Other chemical conditions Carbon dioxide was found in small amounts near the bottom. The water is alkaline at all depths. It is fairly hard but is somewhat softer than the water in Devoe Lake.
- Depth The lake has a fairly wide shoal area at the west end. Generally the shelf is narrow. A long underwater bar extends into the lake from the north. Other smaller bars are also present. More than half the lake is more than 30 feet deep and a considerable area is deeper than 45 feet. Maximum depth found was 16.7 meters or about 55 feet.
- Bottom The bottom on the shoal and slope is of almost pure marl. The bottom below the slope is a mixture of marl and pulpy peat. The marl on the shelf is unusually pure.

Vegetation Almost no vegetation is present. Some is present at the extreme west end and a little is found on the slope at various places. The pure marl apparently does not contain the amount of nutriment needed for plant growth. Few lakes have been found, by our party, to contain so few weeds.

Natural food Food is present in very limited amounts only. Few minnows or aquatic insects were seen. Fish were found to be present in very limited numbers. This is probably due to the small amount of food available.

Fertility This lake is evidently not very productive in its present state. The marl present is too pure to permit the growth of vegetation to any great extent and food is relatively sparse.

Spawning grounds Some spawning beds, chiefly those of sunfishes (pumpkin-seed and longeared) were found along the north side and at the west end near and in the outlet. These were on marl, some marl concretions, sticks and root tips being exposed in the nests. The beds were not abundant except locally in very small areas.

Species of fish present Game fish. Northern pike, largemouth bass, brook trout, rock bass, perch, cisco, longeared sunfish, pumpkinseed sunfish, and hybrids between the two sunfishes were taken. Cisco were found to be fairly numerous. Longeared sunfish were abundant at the outlet but very few were seen elsewhere in the lake. They are greatly dwarfed in this lake, and never reach the legal size. Northern pike are fairly common. Nets generally contained very few fish indicating that only a limited population is present.

Coarse fish. Of the coarse fish only suckers were taken. These were fairly common.

Obnoxious fish. None.

Forage fishes. The soft marl shoals rendered seining almost impossible in most places. Very few minnows were seen in motoring around the lake. One common shiner was taken in a small mesh gill net. One bluntnosed minnow and four creek chubs were seined and one Iowa darter was seen. Forage fishes are therefore not common.

Predators No predators were found in the lake.

Cover Cover is poor. Almost no protection is afforded the young fish. Since food is not abundant, good cover is especially desirable.

Water level The water level is kept fairly constant by a dam in the outlet. This dam keeps the water somewhat above its former level.

Recommendations

This lake should lend itself well to certain improvements. The construction of shelters should improve fishing because the fish will very likely be concentrated around the heaps. It is possible that the larger fish now present may be largely caught out in a rather short period of time and that fishing may gradually decline until the young fish in the heaps have grown larger. Such a decline would be purely temporary and permanently improved fishing conditions should result. Since the fish will probably always tend to remain in the vicinity of the shelters and are apt to be hungry, a lake such as this should provide good fishing.

Stocking Stocking should be carried out only after a certain amount of improvement has been made and, preferably, after some of the brush shelters have been in the water for a few months. The brush shelters will be particularly needed by the trout. The fish should be planted in or near the shelters. Annual stocking with 3,000 brook trout or 3,000 smallmouth bass or of both if desired, is recommended. These fish to be planted should be either large fingerlings or yearlings. Regarding the question of mixing the two species, see discussion under stocking for Devoe Lake. In North Lake, considering the conditions, there is a good chance that the bass (and pike) will keep the brook trout down. After several years trying to build up the trout, it may be necessary to abandon the trout idea. If good trout fishing is really desired, with clear expectation of success, we would recommend that no bass be planted unless after several years the trout should not take hold satisfactorily.

Shelter increase This is very important in North Lake. The construction of about 60 shelters such as the one illustrated in this report, and of the same size, is recommended. These should all be "hung" on the slope so that the top is near the surface. This will bring the lower festoon of brush in cold water with high oxygen. Fifty to one hundred small bundles of loosely bound brush on the shoals would be very beneficial to young bass and to minnows. These would probably be destroyed by ice unless pulled out before ice forms.

Food increase

Increased food is needed. The brush shelters will provide suitable conditions for some increase in insect life. Food will also be increased to a considerable extent by increasing fertility and vegetation as discussed below. Ten to thirty thousand blunt-nosed minnows should be placed in North Lake near the brush shelters. This could be done over a period of two or three years. Some can probably be obtained from the Bureau of Fisheries Station at Northville. Our records do not indicate where they could be satisfactorily seined in Ogemaw County. Any species of minnow will not do, as only this kind will use the spawning devices, and many species would not be suited to the lake conditions.

Better spawning conditions for certain species will also eventually increase the food supply. A hundred slab or old board devices, similar to the one illustrated in this report, should be constructed and placed on the shoal in water from one to two feet deep.

Improvement of spawning grounds

The brook trout will evidently have to be planted from year to year unless connections between the lake and Gamble Creek can be made which will permit the fish to run up the creek and spawn.

What is true of bass spawning conditions in Devoe Lake also holds for North Lake. Either the bass must be planted each year or gravel must be introduced. Thirty boxes about 3 feet square with sides about 3 inches high containing coarse gravel, would be used by the smallmouth bass if placed in water from 1 to 5 feet deep. Gravel, if placed directly on the marl, would probably sink too fast. The flat box made of old boards and filled with gravel would be satisfactory for a much longer period of time. When (or if) a good bass population develops, the number of such spawning boxes should be increased to 200.

Vegetation increase

It is true in a general way that wherever conditions are favorable for plant life nature provides plants of some sort or other. Increased vegetation is highly desirable, but changed conditions are usually needed before planting may be expected to be successful. This is discussed under the following paragraph.

Fertility increase

Enriching a lake, other than locally, is not recommended because of the amount of expense involved and because wave action will probably wash most of the fertility below the shelf where considerable organic substance is already present but where the water is too deep for plant growth. The placing of several cubic yards of rich soil in the center of each brush heap and the planting in this soil of muskgrass (Chara) taken from some nearby lake is recommended. The outlet end of Devoe Lake would be a satisfactory source. There is also some in Spring Lake. Muskgrass can be told by its rank odor when crushed in the hand.

If necessary the soil can be further enriched by adding manure. We would recommend that this be done, if not too vigorous a violation of the owner's feelings. In protected bays, and in the extreme west portion of the lake the "dumping" of rich soil should also have desirable effects.

Dollar Lake

Size, inlets
and outlets

Dollar Lake is completely landlocked having neither inlet or outlet. It has an area of slightly over 13 acres. This lake is more or less round and evidently received its name from its shape.

Pollution

Fish in the lake were found to be in good condition. No signs of pollution were found. No sewage or other possibly injurious substances enter the water and it is safe to assume that the lake is unpolluted even though special tests to determine this were not made.

Use of water

So far as known this lake is used only for fishing. A dock is maintained on the north side and a boat is generally kept here.

Temperature

This is a warmwater lake. The water was found to be quite warm with temperature varying only a few degrees from top to bottom.

Oxygen

Considerable oxygen was found at and near the surface but none could be found present near the bottom. The lake has a rich organic bottom and limited wave action. Considerable decay takes place. This evidently accounts for the lack of oxygen near the bottom.

Other chemical
conditions

The chemical condition was found to vary considerably between surface and bottom. No carbon dioxide was found at the surface but a considerable amount was present at the bottom. The water was quite soft. It was quite alkaline at the surface and very slightly alkaline at the bottom.

Depth

This is a shallow lake. Maximum depth found was 19 feet. Average depth is less than 10 feet. This shallowness accounts, in part, for the lakes productiveness.

- Bottom The entire bottom is of peat. In some places along the shore sand, gravel and stones are found on the peat. The bottom, except in a few places very near shore, is quite soft.
- Vegetation Weeds are abundant. Excellent beds of pond lilies and pond weeds are present.
- Natural food Minnows were found to be relatively scarce but aquatic insects are abundant. The lake is quite "rich" and should be capable of supporting a fairly large fish population.
- Fertility This lake is shallow and has a rich organic bottom. It is one of the most fertile of the lakes here discussed.
- Spawning grounds A considerable number of spawning beds were found along the shore at various places. These were placed in the peat or in the sand and gravel found on the peat in certain locations. The nests were made chiefly on roots of the aquatic plants. Most of the nests seen were bluegill or sunfish nests.
- Species of fish present Game fish. Pike, bluegills, pumpkinseed sunfish, hybrids between bluegill and sunfish and black crappies were taken. The bluegills and crappies were probably not native, but were introduced by the owner (Bureau of Fisheries shipment). Perch and largemouth bass may be present in limited numbers but none were taken in our nets and seines. Bluegills and sunfish are the most abundant.
- Coarse fish. None taken.
- Obnoxious fish. None taken.
- Forage Fish. Only Iowa darters were taken in the seine. The bottom was very soft and could be seined only on a small area. It is very likely that certain other forage fishes are also present.
- Predators No predators were found. It is possible that a few water snakes and a few turtles are present. A great blue heron was found to visit lake occasionally. Predators are not abundant in the lake and their control is not called for.
- Cover The weed beds provide considerable cover. A little more protection for the young fish is desirable.

Recommendations

This lake can be used only for warmwater fishes. It should support either bluegills or largemouth bass. By providing a little more protection and slightly better spawning conditions, and removal of the pike as much as possible, natural reproduction should keep up the fish supply, at least for the present. No planting is needed unless it is desirable to build up the bass supply. If bass are preferred to bluegills the annual planting of 500 largemouth bass fingerlings is recommended. The best use of this lake, considering the estate as a whole, would be for bluegills only. One good bluegill lake can be assured if no bass are planted.

Shelter
increase

The construction of 4 brush shelters is recommended. Although weed beds provide considerable protection, brush shelters are considered more desirable.

Improvement of
spawning grounds

Some improvement of spawning grounds is desirable. Ten large spawning boxes (10' x 10') with sand, sticks and gravel should be placed at various locations in water from 1 to 2 feet deep.

Loon Lake (Black Lake)

Size, inlets
and outlets

This lake has an area of about 20 acres. An intermittent inlet enters from Spring Lake and an intermittent outlet flows into Devoe Lake.

Pollution

No evidences of pollution, which would injure fish life, were found.

Use of water

The water is used for fishing and boating. So far as known, no other use is made of it. The lodge is located a short distance from the east shore of the lake.

Temperature

When examined July 25, 1931 (air temperature 88^o), the surface temperature was 80^o and the bottom 62^o. Although the water at the bottom is fairly cold, this lake must be regarded as essentially a warmwater lake. The cold area is only a few feet thick (from top to bottom) and this area contains silty water. It is evident that trout can live in the lake but conditions seem more favorable for bass and bluegills.

- Oxygen Oxygen was found to be slightly lower than in the average lake, but high enough to support fish life. Nearly as much oxygen was found in the cold lower water as at the surface. The lake is fairly well protected from the wind. Considerable decay of dead weeds takes place. These two factors evidently account for the limited oxygen supply.
- Other chemical conditions The water is quite alkaline. It is fairly soft. No free carbon dioxide was found at any depth. Chemically the lake is satisfactory for fish life.
- Depth This is another shallow lake. Maximum depth found was slightly less than 20 feet in a pocket near the northwest end. The average depth is less than 10 feet. The lowest depths are really soft mud.
- Bottom The east side has a margin of sand. The greater part of the lake has a soft peat bottom.
- Vegetation Here, as in the other shallow lakes, vegetation is abundant. Some excellent weed beds are present.
- Natural food Natural food is abundant. Seining was impossible on most of the lake because of the soft sand bottom and the minnows are more abundant than seinings indicate. Aquatic insects are abundant.
- Fertility The lake has a rich organic bottom. It is much more fertile than the average lake.
- Spawning ground The east side has a fairly firm bottom. Aside from this, there is no suitable spawning ground for bass and bluegills.
- Species of fish present Game fish. Net sets indicated that a fair number of brown trout are present. Four trout of fair size (about 2 lb. each) were taken. Perch, 8 to 10 inches long, are fairly abundant. Pumpkinseed sunfishes are also present. No bass or bluegills were taken but they are very likely found in the lake in limited numbers.
- Coarse fish. Large suckers were found to be abundant. A number of schools of small bullheads were also seen.

Obnoxious fish. None found.

Forage fish. Seining could be carried on only along part of one shore and here seining was impossible beyond the ten or fifteen feet nearest the margin. Evidently forage fishes are present which were not found. Only Iowa darters were found. The young suckers also provide excellent food for the fishes.

Predators

Predators are very few. The few fish eating birds, turtles and water snakes found on the estate should have no noticeable effect on the fish population.

Cover

Some excellent weed beds are found in the lake. A considerable number of old tree trunks are also found. Cover is good.

Recommendations

Stocking

Stocking with largemouth bass and bluegills is recommended. Planting of two thousand fingerlings of each species annually appears desirable. Brown trout may do fairly well in the lake, but conditions appear more satisfactory for the warmwater species. Further, the trout are said not to be of good taste.

Shelter
increase

Shelter is good and little improvement is needed. The construction of six shelters should increase the protection of young fishes to a point where their chances of survival will be good.

Improvements of
spawning grounds

Better spawning conditions for bass and bluegills are desirable. The construction of 15 large spawning boxes is recommended. Improvement of fertility, vegetation, etc., is not considered necessary.

Spring Lake

Size, inlets
and outlets

This lake has a size of slightly over 58 acres. No permanent inlets were found. An intermittent outlet empties into Loon Lake.

Pollution

No signs of pollution were found. The lakes are removed from centers of population and the chances of pollution are very few.

<u>Use of water</u>	The lodge is built near this lake and a miniature golf course is located on the west shore. The lake is used only for boating and fishing. Fishing, except for perch, is poor.
<u>Temperature</u>	This is a shallow warmwater lake. The temperature is high in summer.
<u>Oxygen</u>	Oxygen content is high at all depths. Considerable wave action occurs. This, together with the vegetation, evidently accounts for the oxygen present.
<u>Other chemical conditions</u>	No carbon dioxide was found. The water is fairly soft. It is quite alkaline. Chemically the water appears to be quite satisfactory for fish life.
<u>Depth</u>	The lake is shallow. The average depth is not over 10 feet. A small portion of the lake near the east end has a depth of from 15 to 19 feet. Maximum depth found was slightly over 19 feet.
<u>Bottom</u>	Most of the bottom is of peat. Some sand is found along the northeast shore and along the margin in several other locations. A small swampy area is found at the southwest end of the lake.
<u>Vegetation</u>	Some excellent beds of pondweed are found in the lake. Considerable vegetation is present in most portions.
<u>Natural food</u>	Food is abundant. Quite a few minnows were seen and aquatic insects were found to be abundant.
<u>Fertility</u>	This lake has a rich organic bottom. The abundance of vegetation also indicates that this is a productive body of water.
<u>Spawning grounds</u>	Considerable area near the margin and around the islands is firm enough to support spawning beds. No beds were found but this was probably due to the fact that very few nest building fishes are present.

Species of fish present

Game fish. Nets and seines indicated that the fish population was limited to a very few species. Perch are fairly abundant. A number of adult perch were planted in this lake in 1927. Conditions appear to be good for perch

spawning.

A few pumpkinseed sunfish were also found. No other game fish were taken.

Coarse fish. Small brown bullheads were taken. They appear to be fairly abundant.

Obnoxious fish. None found.

Forage fish. Golden shiners are quite numerous. Some black-nosed shiners and Iowa darters are also found here. Only three species were taken. The golden shiner is a fine forage fish and should thrive in the lake.

Predators

A number of bittern were seen near the islands. Other predators appeared to be very few. Unless the bittern becomes decidedly more abundant their presence on the lake will probably do relatively little harm.

Cover

The weed beds provide considerable cover. The pond weeds are not considered as suitable as brush shelters for protecting young fish but they do considerable good in this respect.

Water level

Water level is kept constant by regulation of the outlet. This has been closed and has kept the water level higher than it was formerly.

Recommendations

Stocking

This lake appears to be well suited to largemouth bass and bluegills. Neither species was found here. Food is abundant and the lake should support a fairly large population. Stocking with 1,500 largemouth bass fingerlings and 1,500 bluegill fingerlings is recommended.

Cover increase

Cover is good but could be improved slightly to good advantage. The construction of six large brush shelters is recommended.

Improvement of spawning grounds

The placing of 50 cu. yards of fine gravel on the bottom where it is fairly firm is recommended. This should be put in piles about 3 feet in diameter and 3 inches high in the center.

Other improvements are considered unnecessary.

Teal Lake

Size, inlets and outlets

The lake has an area of slightly over 6 acres. An outlet empties into Skunk Creek. No permanent inlets were found. The lake has two basins, the larger being located east of the other.

Pollution

The water was found to be silty when examined. This condition may have been due to previous rains. No signs of pollution were found.

Use of water

The water appears to be used only for fishing, outside of duck hunting in the fall.

Temperature

This is a warmwater lake. The bottom temperature was found to be 64°. All other readings were 70° or above.

Oxygen and other chemical conditions

Oxygen was found to be fairly low. A small amount of free carbon dioxide was present at all depths. The water is fairly soft. It is slightly alkaline.

Depth

A maximum depth of 18 feet was found. Much of the lake has a depth of from 10 to 15 feet.

Bottom

The bottom is of very soft peat. Even at shore an oar can be pushed out of sight. No seining could be done on it.

Vegetation

Weed beds are quite abundant. A thick growth occurs along the margin and considerable submerged vegetation is found.

Natural food

A considerable number of minnows are present. Aquatic insects are numerous. The lake is fairly rich in food.

<u>Fertility</u>	An unusually rich peat bottom is present. The lake may be considered quite productive.
<u>Spawning grounds</u>	Spawning conditions appear quite unfavorable for nest building fish. No beds were found.
<u>Species of fish present</u>	<u>Game fish.</u> Northern pike are common. They appeared to be in poorer condition than those found in the other lakes. One was diseased. One pumpkinseed sunfish was taken. No bass or bluegills were found. <u>Coarse fish.</u> Many schools of small bullheads were seen. No other coarse fish were seen. <u>Obnoxious fish.</u> None found. <u>Forage fish.</u> Seining was impossible because of the soft bottom. The only species taken from the boat was the black-nosed shiner. This minnow was found to be quite abundant. It is possible that a few other species were also present in limited numbers.
<u>Predators</u>	No predators were found. A few turtles and fish-eating birds are probably present, but they are evidently not abundant enough to seriously injure the fish supply.
<u>Cover</u>	Cover is good. The thick beds of weeds along the margin provide good protection for the young fish.

Recommendations

The oxygen supply is fairly low in summer and may be very low in winter when ice prevents wave action. The fish removed also were in poor condition. Annual stocking with 500 largemouth bass fingerlings and 500 bluegill fingerlings is recommended. Unless these fishes are found to do well within a few years, it is advised that the lake be disregarded so far as fish are concerned.

Except for this experimental stocking, no efforts to improve the lake are now recommended.

Devil's Wash Basin

This 1-1/2 acre pond was found to contain largemouth bass, rock bass, bluegills, pumpkinseed sunfish and long-eared sunfish. Black crappies are reported to occur as the result of planting. Some of the other species were probably also introduced. Hybrids between bluegills and pumpkinseed, and between long-eared and pumpkinseed sunfish were also found. No minnows were seen but considerable food is present.

The pond contains good protection for young fish.

Attempts with hook and line proved quite successful. Evidently the pond now contains all the fish it can support. The fish bit as fast as bait could be provided for them.

The occasional seining of minnows from Spring Lake or some other lake where they are plentiful and the placing of these minnows in the pond for food would be desirable.

Since the pond now contains an abundance of fish no other recommendations need be made.

General Results

Fish planted

According to the owner's records the following fish were planted in the lakes between May 15 and November 6, 1927. These were mature fish taken from Lake Huron.

	Perch	Pickrel (Walleye)	S.M. Bass	Rock Bass	Sunfish	Calico Bass	Pike
Spring L.	1299			2	2	5	
Loon L.	442						
Teal L.	281						
Devoe L.	210						
North L.	427	146	40	11	1	1	2
Dollar L. (Mud L.)			72				

"Pickrel" and smallmouth bass were not taken by our party. They may be present in very limited numbers. It cannot be stated whether or not some of the fishes taken in this survey resulted from this planting since we do not know what fish were present previous to the planting.

The owner reported that a rather large plant of bluegills ("roach"), crappies, and other pan fish were placed in certain of the lakes, the shipment having come from the Bureau of Fisheries, and having originated from some more southern locality. The stock of fish in Dollar Lake and Devil's Wash Basin is said to be largely the result of this introduction.

Predators and
pollution

It will be noted that two factors which present serious problems in some other parts of the state are absent here. Pollution, which is often a serious factor in densely populated areas, is not a problem in these lakes.

Predators are so few that they may be disregarded. However, since pike are quite predatory in their habits and since pike fishing is not held in high esteem by the owner, the reduction of pike by fairly heavy fishing might well be encouraged.

Classification

The lakes fall into two very distinct groups. Two are deep water lakes suitable for cold water species. The others are shallow warmwater lakes fit chiefly for largemouth bass and bluegills.

Stocking

Stocking has been recommended for the five principal lakes. Since fishing is much more limited here than on many public lakes, it is hoped that stocking may become unnecessary after a number of years. The improvements, however, may well be continued. Except for the planting of trout in the two lakes, natural reproduction should take care of the other species once the waters have been well stocked and the improvements in spawning conditions and shelter have been made.

Improvement
procedure

It is advised that attention be given first to North and Devoe lakes since these are the most important and since they are most in need of improvement.

Shelters should be constructed here before the fish are planted. If fingerlings bass are planted, the improvement of spawning grounds would not be of vital importance for two years--until these fish are ready to spawn.

The other three lakes, Dollar, Loon, and Spring, are not so much in need of improvement as are Devoe and North. They should be given second consideration. If most convenient, stocking in the three lakes might precede shelter increase, although the reverse is somewhat the more desirable.

Of the seven lakes only one, Teal Lake, is looked upon as a lake in which the chances of producing good fish in large numbers are not good. The undesirable factors in Teal Lake cannot well be remedied.

Esthetic
consideration

Nothing has been said of the esthetic side of the matter. Views from the lodge can be equalled in few localities in Michigan. Any improvements which might in any way mar the beauty of the scenery have not been suggested. Practically all the changes suggested are made below the surface of the water where they

will not interfere with boating or with the general appearance of the lake. Brush shelters in North Lake can be somewhat bunched on shore lines not visible from the Lodge.

Rearing ponds

The construction of one to three ponds for rearing bass and bluegills should prove interesting and, eventually, profitable. The breeding stock could be taken from the lakes.

If one or two ponds are used, largemouth bass, smallmouth bass, and bluegills could be raised in alternate years. They should not be mixed. A program such as this would aid natural reproduction and the chances of survival would be greatly increased. The costs and red tape connected with obtaining fingerlings elsewhere would be eliminated. The bass ponds can be constructed with little expense.

The ponds should be of not less than one-half acre. Depth should grade down to 3 to 15 feet at the outlet end, where a seining basin should be located. Unless a good supply of intake water is available, the maximum depth should exceed 5 feet. The ponds should be completely drainable. This is of vital importance from the standpoint of seining the fish in the fall and of controlling diseases. There are no natural ponds or lakes on the estate which in our opinion are suitable for rearing purposes. A dry pond would be far less suitable than a diked one.

We would recommend that two ponds be constructed just below the Devoe Dam. The stream would be confined by a dike, protected by piling, to a width of about 25 feet. The banks should be then cut back enough so as to fill the pond and marsh below the dam to a few inches above the summer stream level. We believe that two ponds approaching an acre in area could thus be made quite cheaply. The lake water above the dam would give a good supply of water by gravity feed. The two ponds should have independent intake and outlet.

The advantages of this location and scheme are:

1. Proximity to game farm, to facilitate care of fish.
2. Drainable ponds.
3. Easily seined ponds.
4. Perfect access to Devoe and quick access to other lakes for stocking.

We would suggest that smallmouth bass fry be obtained from the Northville Hatchery for rearing here and that bluegill and largemouth bass fry be obtained from the natural beds in the lakes, just before they rise. For the first few years it might be necessary to get the largemouth bass elsewhere, and after some years it is probable that the smallmouth bass fry could be taken from the beds in the lakes.

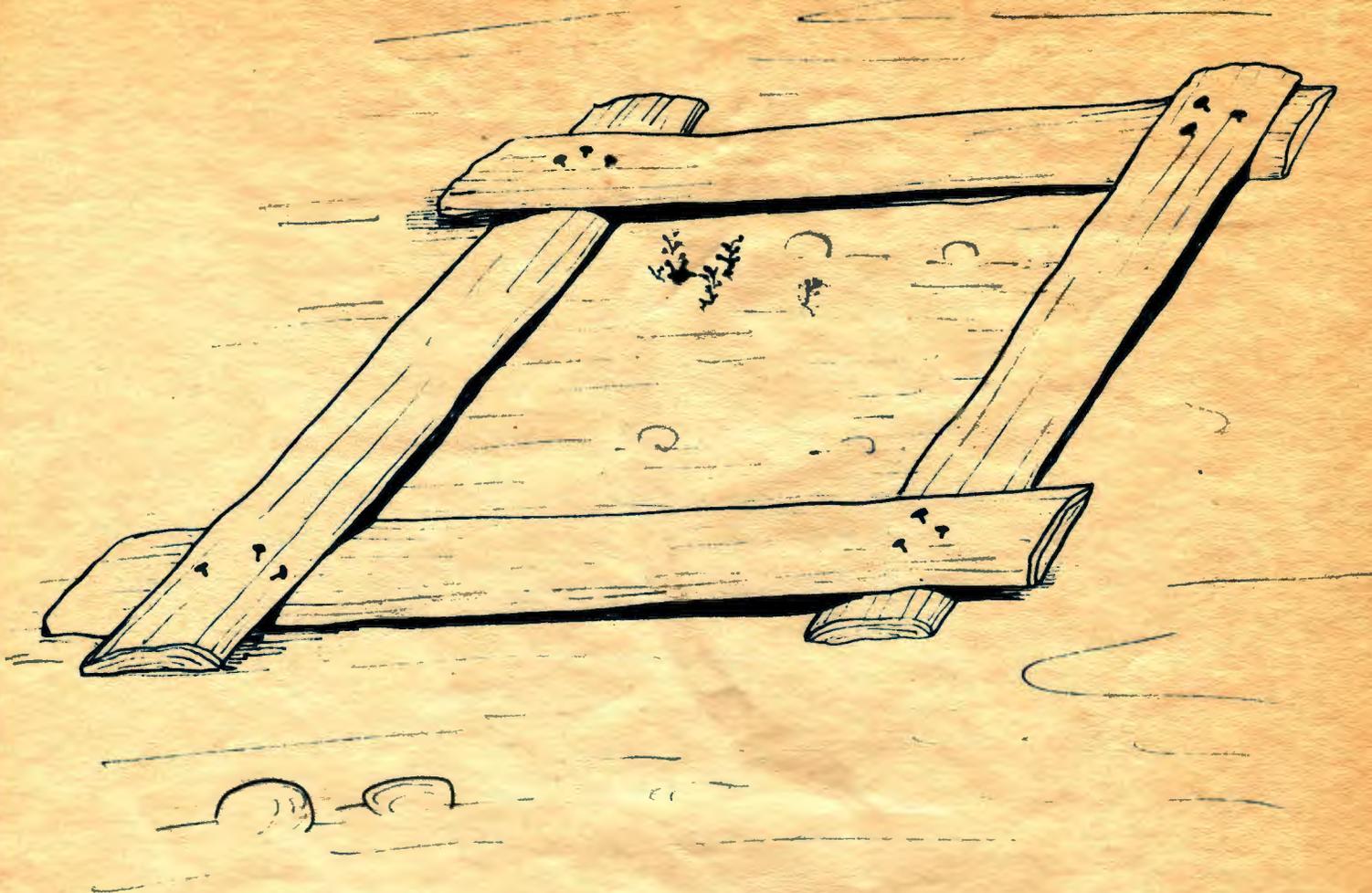


Figure 1

Slab device for increasing the spawning of blunt-nosed minnows, and for providing shelter especially for bass fingerlings.

To be installed in the shoal waters in depths of 1 to 4 feet.

The minnows spawn on the under surface of flat objects. The slabs are ideal for this purpose. Being put together as illustrated, the slabs will not tend to be buried quickly.

Small fish, especially small-mouth black bass fingerlings, use such crevices for shelter; so the device serves the double purpose of increasing food and providing shelter.

In some places weed beds will no doubt obtain a foothold within such shelters.

The size and shape of the slab constructions will depend on size of material available.

(Print)



50'
Figure 2

Showing method of construction of larger rectangular type of brush shelter. This shows how log frame is made in position, and how brush is attached,— either whole bushes, snags or fagots of small brush.