May 19, 1934

Report 152

REPORT ON SURVEY OF SILVER LAKE AND BUSH OR DOLLAR LAKE, ON THE BLACK RIVER RANCH

The two lakes included in the Black River Ranch property were examined by members of the lake survey party of the Institute for Fisheries Research in early August, 1931. This party consisted of R. W. Eschmeyer in charge, Lawrence M. Ashley, specialist in aquatic vegetation and Charles M. Davis, geographer. The lake had also been studied earlier in the same year by Dr. Carl L. Hubbs, Director of the Institute.

Upbuilding of the fish supply in northern lakes is apparently entirely practicable. First of all a survey of the lake is called for, to determine the conditions for fish life which are present and especially those which are lacking or too poorly developed. This survey should yield definite recommendations for the improvement of those conditions which appear to be inhibiting the abundant development of desired species of fish life. Then of course these recommendations, need be carried out. The results should be checked at intervals, and the improvement procedure modified when this seems, in the light of actual experience, to be called for.

SILVER LAKE

Description of Conditions

Size The area as mapped by our party was 151 acres. This survey was made at a dry period, when the connecting swales were dry. When these lagoons are connected with the lake at higher stages, the area must approach 160 acres.

Inlets and Outlets — The lake is entirely without outlet or inlet. Since the Ranch property completely surrounds the lake, access by the public is prevented, and the lake is definitely "private" and therefore subject to development by the Ranch for and in its own interest.

Character of Water — The waters of Silver Lake are exceptionally clean, and of course free from pollution. This is splendid from the standpoint of appearances, swimming, etc., but is not conducive to an abundant production and turnover in the fish. Fertility in the water is a necessary condition for a rapid turnover in the fish population.

Temperature — The water temperatures are moderately high at the surface, and do not become cold in the depths. There is no thermocline. The conditions are therefore unsuited to any of the salmonoid fishes.

Oxygen — Dissolved oxygen is fairly high at all depths, though it becomes partially exhausted in the deeper waters in the summer. All of the water is therefore inhabitable by fishes,—a rather uncommon condition for lakes of this size most of which have a deep layer of stagnant water.

Other Chemical Conditions — This lake as would be expected was found to be decidedly alkaline. No free carbon dioxide was found at any depth. The water is fairly soft. These chemical conditions (detailed on one of the accompanying cards) are distinctly favorable for fish life.

Depth — The entire lake is relatively shallow. The maximum depth found was 9.6 meters (about 31 1/2 feet). This depth lies in the south arm of the lake near the mouth of this arm, slightly nearer the west than the east shore. From this point the lake becomes gradually shallower toward the north. For depth readings see map.

Shoals and Dropoff — In general the shoals are wide, though rather narrow off the high ground along the west side of the south arm of the lake. The wide shoals would be especially favorable to fish production, if they were less open, less wavewashed and less deficient in weed beds and other shelter. The

dropoff where developed lies in about 8 feet of water, and the slope beyond it is fairly steep.

Bottom — The bottom along a fairly wide margin is of rather clean sand, except behind the hook point of the west bay, where pulpy peat reaches the shore. At the head of the bay fibrous peat occurs. The main, deeper portion of the lake is covered with pulpy peat, which grades inward into the sand.

Cover — Shelter for fish, especially young fish, is extremely scanty. Very few deadheads are left. The scanty vegetation provides little summer and virtually no winter shelter. This lack of shelter is an outstanding factor limiting fish production in this lake. Young game fish whether naturally hatched or artificially planted are exposed to predators (pike, bass, etc.) with little opportunity to find saving shelter.

Vegetation — In general the shoal vegetation is scarce, consisting of thin to rather thick patches of sedges and bullrushes, some muskgrass here and there, a few beds of pondweeds. The western bay is the only part of the lake adequately supplied with vegetation—pondweeds, sedges, bullrushes and muskgrass. It is here that most of the fish life of the lake,—adults as well as young,—is concentrated. Much of the lake is relatively deserted by fish. Around parts of the lake there are pondweed beds on the slopes beyond the dropoff. The details of the vegetation,—kinds and abundance,—are given on the green card, in columns numbered to correspond with the numbers given in circles on the map. The symbols on this card are explained on an attached white card.

Natural Food — Natural food for game fishes is decidedly insufficient in Silver Lake. This is a prime factor limiting the fish production. Insect larvae, crayfish, clams and other invertebrates are present in moderate numbers around the shoals. Forage fish are extremely scarce. Food is not present in sufficient numbers to support a large fish production.

Fertility — The shoal areas, except in the west bay, are of too clean sand to indicate much productivity. The clarity of the water also indicated a low basic productivity. The pulpy peat bottom in deep water must contribute elements

of fertility to the overlying water, but not enough to make the lake a really productive one.

Spawning Conditions — No spawning beds were located, but this was likely due to the late date when the examination was made. Very little in the way of gravel, which is required for the spawning of smallmouth bass, was found. There is some on the rather narrow shoal off the bluff on the west side of the south bay. This deficiency in gravel is a main reason why smallmouth bass do not inhabit the lake. Largemouth bass are less restricted in spawning conditions, exposing bulrush roots or trash or shells as well as gravel. The same is true of bluegills. The paucity of brush in the lake provides poor spawning conditions for perch.

Predators — Relatively few predators were found. A small number of kingfishers and blue herons occur, but not enough to seriously deplete the fish supply if this can be put on a productive basis. Snapping and pond turtles probably do some damage though their food is by no means entirely fish. Probably the foremost predators in the lake are the game fishes themselves. Of these the northern pike is most predacious. The largemouth bass and perch follow. The sucker may be thought of as an egg predator, but the damage to bass eggs in this lake must be relatively small because the bass are seldom disturbed from guarding their nests and therefore are able to keep off the egg-eaters. What damage the suckers may do must be far more than offset by the food they furnish the game fish, in this lake which is very deficient in forage fish.

Game fish — This lake has a very deficient game fish fauna. Northern pike and largemouth bass are fairly common, and perch, mostly 7 to 8 inches long, are moderately abundant. No other species were found.

Northern pike are among the most predacious of our fishes, and a really large production is only attained in waters rich in food. Bass are somewhat less predacious. Conditions in the lake seem excellent for smallmouth bass, with the exception of the deficiencies in spawning grounds and in forage fish supply. In fact conditions except in the west bay are much more suitable for smallmouth than for largemouth bass.

The very large size attained by some of the largemouth bass is attributable to their attaining a venerable age in a lake relatively little fished. Conditions also seem favorable for bluegills.

Fishing Reputation and History — As usual we heard stories of wagon loads of fish being taken from this lake in the good old days. These stories probably need some discounting. Furthermore a large fish supply in a virgin lake does not indicate that the supply may be maintained under fishing.

Coarse and Obnoxious Fish — Fortunately no gars or dogfish occur. The only "coarse fish" present is the sucker, which as stated above we regard as beneficial in this lake. The northern pike is regarded as obnoxious by most of the Ranch members.

Forage Fish — A most notable deficiency in Silver Lake is the lack of forage fish. This is undoubtedly a prime factor inhibiting the production of game fish. A few Iowa darters were found, but these minute retiring fish are not of much forage importance. A few Menona killifish were found, but these for some reason do not seem to have built up a large population. Spawning conditions for the bluntnose minnow, one of the most important forage species in our lakes, are almost absent. This fish uses the under surface of flat objects for spawning. The young suckers and perch must furnish some food for the pike and bass, but certainly the supply of forage fish is insufficient to permit the good growth of any large number of game fish.

Fish Management Proposals for Silver Lake

Silver Lake is to be classed among the moderately unproductive lakes of northern Michigan. Interrelated causes for this condition were found in

(1) The relatively pure (infertile) water.

(2) The wave-washed sandy shores.

(3) The poor development of water weeds.

(4) The small amount of gravel for spawning, especially by smallmouth bass.

(5) Almost complete lack of forage fish.

(6) Lakk of spawning facilities for bluntnose minnows.

(7) Very poor shelter for young fish.

(8) Inadequate stocking.

Deficiencies therefore exist in each of the fundamental needs of fish life, which consist in good facilities for (1) spawning (gravel, etc.); (2) survival (shelter), and (3) growth (food).

These deficiencies are all subject to alleviation, by such means as are outlined below. There is no evidence of unfavorable conditions which are not capable of being remedied. The physical and chemical conditions, the relatively shallow depth, the rather wide shoals and the limited fishing are all favorable factors. This is the type of lake which should respond well to improvement.

Local Regulations — Even with improvements, Silver Lake can not be expected to furnish an unlimited amount of fishing. We suggest that, irrespective of the question of whether the state fishing laws legally apply to this lake, that these laws be accepted as the minimum regulations for fishing by members of the Ranch and their guests. Until the bass become considerably more abundant, a limit of 3 per day might help.

Fish Refuges — The west bay inside of a line between the east side of the hook point and some prominent or marked point on the south shore, should be set aside as a spawning refuge until July 1, or until such time as the bass have completed their spawning if the season is late. If bluegills become established, some will spawn later than July 1, but it is impracticable to protect all spawning bluegills in northern lakes.

After smallmouth bass become established and make extensive use of the gravel beds, the south bay should also be made a fish refuge.

It is important not only to refrain from fishing in the refuges, but also to stay out of these areas as far as possible because frightening bass or bluegill from their beds even temporarily allows the egg predators to get in their destructive work.

Stocking Suggestions

Since Silver Lake is unsuited to salmonoid fishes, it would be useless to plant any trout. Walleyes are almost as predaceous as northern pike, and are not recommended. We suggest that efforts be concentrated on establishing smallmouth bass and bluegills. Smallmouth bass and bluegill fingerlings would not be furnished by the state, but are both obtainable from the U. S. Fish Hatchery at Northville, Michigan. A matter for possible consideration in this connection is the interpretation made by some that all fishing shall be prohibited in "private" waters unless the public is given the right to fish therein, provided fish have been planted at public expense. Some have interpreted this to include fish received from a federal hatchery. The law in full on this point is as follows:

"UNLAWFUL TO TAKE FISH FROM CERTAIN INLAND WATERS—

EXCEPTIONS

Act 14, P. A. 1923

An Act to prohibit the taking of fish from the inland waters of this state where the public is excluded from taking fish therefrom and fish have been planted therein at public expense and to provide a penalty for violation of the provisions of this act.

The People of the State of Michigan enact:

6442 Inland lakes; prohibited fishing. Section 1. No person shall take any fish from any of the inland lakes of this state, within which fish shall be planted at the expense of the people of this state, after the passage of this act, from which waters the public is excluded from taking fish: Provided, however, That this act shall not apply to any small inland lakes covering less than two hundred and fifty acres in which fish may be so planted without the written consent of the persons who together own in fee simple the submerged acreage.

Am. 1933, Act 247.

6443 Penalty. Sec. 2. Any person violating the provisions of this act shall be guilty of a middemeanor and upon conviction thereof subject to a fine of not less than ten dollars or more than one hundred dollars or imprisonment in the county jail for a term of not more than thirty days or both said fine and imprisonment in the discretion of the court."

Entirely unofficially we suggest that applying for and planting fish from Northville would not provide any tenable cause for action to restrain the Ranch

members or guests from fishing in Silver Lake.

Very few private hatcheries supply bass or bluegills. According to our latest information smallmouth bass are not purchasable in Michigan. Eastern hatcheries listed as furnishing this species are:

Waramaug Bass Hatchery (H. W. Beeman), New Preston, Connecticut.

Fred Tresselt, Thurmount, Maryland.

No one is listed as furnishing bluegills.

There is little danger of overstocking the lake with any number of smallmouth bass or bluegills obtainable. The fingerlings would probably be shipped when small, toward the latter part of the summer. Arrangements for securing the fish and for their transportation should be made as soon as possible, well in advance of planting time. Until or unless a rearing pond is built, the fingerlings should be planted in extensive brush shelters in shallow water, the bluegills in the west bay and smallmouth bass in the south bay. These shelters should cover a considerable area of bottom in water not over 5 feet deep, and should be prepared well in advance of planting time—preferably several weeks ahead so as to allow a growth of insect larvae, etc., on the twigs.

Largemouth bass fingerlings could probably be planted to advantage also, but chief emphasis should be placed on the smallmouths. A total of 8000 summer fingerlings or 5000 fall fingerling bass would seem in order for the first year or two. Later fewer (or possibly none) would need be planted. Of bluegills fingerlings, 2000 to 10000 annually or biennially would seem about the proper planting.

Stocking with bluegills is recommended, not only to provide still fishing (for the ladies and children at least), but also to furnish more food for the bass. It has been found that bass production in ponds can actually be increased if bluegills are reared with the bass.

Rearing Pond It would be much better to hold the fingerlings until late fall, so they may be planted at a larger size when they are more capable of escaping destruction. Probably the most feasible place for a rearing pond would be

the small swale near the south end of the lake. The bottom soil seems firm and productive, and probably would require little puddling with clay. It would be simple to scrape out the bottom enough to smooth it and make it deep in a pocket into which the fish would be drawn for seining out. The dirt scraped out would form the bank separating the pond from the lake. This would require some pumping from the shallowest (and warmest) waters of the lake. When the fish are ready to be planted, the pump could be reversed so as to nearly empty the pond, permitting easy seining from the deep pocket. A small gasoline or electric pump ought to suffice. The lift would not exceed 2 feet. Whether feeding would be required would depend on the number of fingerlings being held, and on the production of natural food in the pond after fertilizing it with, preferably with some such mixture as superphosphate plus soybean meal. Ordinarily little or no feeding would be called for. The pond should be run on a two-year cycle, rearing smallmouth bass one year and bluegills the next year.

After smallmouth bass and bluegills have become established in the lake, the fry could be obtained from the lake rather than from the federal hatchery to stock the rearing pond. Or a few adult brood fish could be put in the pond to spawn in boxes of gravel.

Should it later appear that natural reproduction of the game fish is maintaining the stock at the desired level, the rearing pond could be used for rearing minnows not only to stock the lake with forage fish but also to supply live bait for fishing.

Predator Control

Predators apparently are not a serious problem in Silver Lake. With the expected increase in forage fish and fingerling game fish, predators, especially bird predators, may become more numerous. The brush shelters, however, should make is easier for the fish to escape these enemies. The advantages of maintaining the bird life should also be considered, on account of their contribution to the natural beauty and interest of the Ranch. We see no real call for the killing off of the bird predators on the lake.

When a rearing pond is built, it will likely be found desirable to hold down

the predators on this pond, or to keep them frightened off by some means. Some overhead shelter for the schools of fingerlings to rest beneath would be a big help in holding down losses from bird predators in the pond.

Since most members of the Ranch regard the northern pike with little favor, the control of its numbers seems desirable. It is an arch predator, and as such can not be expected to provide the numbers that bluegills or even bass will. There are never as many wolves as deer.

Spawning Grounds — In order to better the spawning conditions for the largemouth bass and bluegills, and to provide spawning situations acceptable to the smallmouth bass, a large amount of gravel should be provided. The gravel should be placed in low heaps, about a bushel per heap, on firm sand in depths of 1 to 4 feet. When the bottom is soft, a low box or platform is called for, to prevent sinking. These gravel heaps should be placed about 50 feet apart in and near the bays and about 100 feet apart elsewhere. Along the more exposed shores the gravel should be placed in the shelter of bulrush patches or of brush heaps. There is a total of about two miles of shore line, of which half a mile is in the more shelters bays. By placing the gravel patches in a zigzag line, about 4 per 100 feet of shoreline would be appropriate for the half mile which is sheltered, and 2 per 100 feet for the other mile and a half. This gives a total of 260 bushel heaps, which could be installed over a period of several years as the bass stock builds up.

Spawning devices for the minnows are discussed below under the heading of Forage Fishes.

Food Increase — A marked increase in the production of game fish in Silver Lake will be dependent upon increasing the food supply. This can be accomplished by three means:

(1) Introducing forage fish, since these are now virtually absent. Good growth in smallmouth bass seems to depend largely on minnow food. From our surveys of lakes in the vicinity we find that a supply of desirable minnows, especially of the bluntnose minnow, may be obtained in any one of several small lakes in Montmorency County,

north of Atlanta, namely:

Brush Lake (bluntnose minnow numerous)

Valentine Lake

Twin Lake (at edge of Atlanta)

Rush Lake

South Tomahawk Lake (golden shiner especially common)

North Tomahawk Lake (bluntnose common)

S Lake (bluntnose very numerous)

Long Lake (bluntnose numerous).

Long Lake and S Lake, in Secs. 29, 31 and 32 of T. 32 N., R. 4 E., would seem in some ways the best bet. Care should be exercised to make sure that only minnows and shiners are taken, since rock bass or other inferior species might otherwise be introduced. It would be well also to make sure that no complaint or ill-feeling arise as a result of seining out minnows to stock Silver Lake, even though the minnows abound in the other lakes.

The laws state that "it shall be unlawful for any person to use minnows except for bait used in hook and line fishing". Permission from the Conservation Department may be needed before these minnows are taken. The laws also state that seines used in inland lakes shall not exceed thirty feet ~~and~~ in length and eight feet in width.

A total planting of 1000 to 5000 minnows a year for several years would not be excessive, if the whole plan here suggested is followed out. Later natural propagation of the minnows ought to suffice to build up the stock.

(2) Providing minute food for the minnows and for the fingerlings of game fish. This will be in part accomplished by the brush shelters and increased weed beds, since insect larvae, snails, etc., find necessary attachment space on these objects.

The general fertility of the water needs to be increased, however, so that microscopic life will flourish. The very small animals which nourish the minnows

and fingerlings must also have their food. Studies over many years in Wisconsin indicate that phosphorus is generally a prime factor limiting this basic food production. A few hundred pounds of superphosphate a year will often double the phosphorus content of a small inland lake. This phosphorus, though present in such minute quantities, is absolutely necessary to the growth of microscopic life. Lakes like Silver Lake which lack an outlet are especially suited to fertilization, since the material added is not washed away. Such clear lakes are usually very low in fertility, and to insure good fish production need to be fertilized just as poor soil must be fertilized to yield a good farm crop.

Manure will serve well to fertilize the water, but may be objected to from the viewpoint of appearances, or as just "the idea". An early spring application of manure around the shoals, especially near plant beds and brush shelters, should be a helpful and cheap method of increasing the food production and hence the fish production of the lake. If this were done before the summer season, no ill effects or injured sentiments would result.

Even if the application of manure be approved, further fertilizing would be desirable, especially to increase the phosphorus content. The use of one ton of superphosphate per year is recommended. To avoid the labor of spraying this over the lake at frequent intervals, the device adopted in Wisconsin is recommended. This is to put the fertilizer in a perforated wooden box floated near the surface in deep water. The superphosphate gradually dissolves out through the holes in the box, and is carried by the superficial currents to all parts of the lake. The box could be fastened to the under side of two cedar logs held apart by cleats at the ends. A door in the top of the box would provide means for adding new fertilizer when the supply has washed out. The size of the box and the number of holes should be regulated or changed so that one filling a month would just about suffice.

(3) Providing spawning facilities for the forage fish. This is of prime importance, for the growth and numbers of the bass will vary with the minnow supply. The bluntnose minnow is the species which can be increased most feasibly, according

to present evidence. It spawns on the smooth ~~near~~ under surface of any available object (wood, crockery or metal). Slabs or old boards weighted or staked down in water 6" to 24" deep serve well. These may be made up as shown in Figures 18 and 19 of the accompanying diagram. Putting the slabs or boards together in such a fashion keeps some of the surfaces a little off the bottom when the structure partially sinks into the bottom. The structures can easily be raised or moved a few feet when necessary to maintain them at the proper depths and just off the bottom. The bluntnose minnows introduced in Silver Lake will spawn under such slabs, producing broods of little fish through the summer. Approximately 200 of these minnow spawning devices are recommended. These could be installed over a period of years, but some should go in before the minnows are introduced, preferably in one of the bays. And the minnows should be released near the spawning devices.

Increase of Vegetation

An increase in the weeds beds is desirable, because the weeds increase the food production and furnish shelter. The concentration of fish in the west bay of Silver Lake is an example of the beneficial effects of weed beds. We were told that these weed beds in the west bay were largely the result of plantings in the past by Terrell's Aquatic Nursery. These beds in this sheltered bay looked like natural products, to be expedted in such a position, but may have been increased by the artificial planting. However, that may be, the lake is still distinctly deficient in vegetation.

Planting weeds without changing the conditions usually results in failures, for the weed seeds are naturally distributed over the lake and establish weed beds when conditions are right. Excessive wave action not only retards the weed growth by current action, but also washes the sand of the shoals clean of fertility. Increased shelter on the shaols will be conducive to the natural increase in weed beds. This increase can be accelerated by planting muskgrass and pondweeds in the lee of wave-breaking shelters. Sufficient weeds can be obtained from the west bay of Silver Lake and from Bush Lake. Planting these weeds themselves rather than seeds is advised. Some tubers of lilies may also be planted in the lee of shelters, to add to fish

shelter and also the attractiveness of the lake. Where the shelters are placed on sand, it is advised to carry out a scow load of black soil to dump into the shelter and in the lee of the shelter, to aid and in establishing the weed beds. A ball of clay about the routes of the plants will help hold them down until they gain a foothold.

A number of days each year could be spent to advantage in this weed transplanting. There is very little danger of producing any excess growth of weeds in Silver Lake.

Fertilizing the lake as suggested above would doubtless help increase the weed growths.

Cover Increase — Probably the most feasible means of increasing the fish production and the fish catch in Silver Lake is to increase the shelter. The new weed beds will help, but log-and-brush shelters will provide better cover, permanent through the winter when the weeds thin out or die down. And the log and brush shelters are needed to help the weed beds become established.

A considerable amount of cover should be added before restocking the lake, to provide a reasonably safe place for planting the fingerlings. Exposing the fingerlings to the hungry predators is an invitation to costly failure.

Some may object to the idea of putting brush into a lake, but if this be done correctly no unsightliness need result, and the brush will remain secured in place beneath the surface. It can be pointed out that fish can not be produced in a clean basin of pure water. The fish need shelter, and must have food on which to grow.

The shelters should be placed in various depths, from 2 to 15 feet, but should be kept below 1 1/2 feet from the surface to prevent destruction by ice, to maintain appearances and to prevent interference with boating. Those in shallow water will serve chiefly to shelter young fish; those in deeper water will attract large fish. Such shelters along the east shore would provide fishing close to the lodge, and would spread the fishing around the lake. A few large shelters should be hung on the slopes beyond the dropoff to furnish shelter down into water 10 to 20 feet deep.

Various types of shelters are illustrated and described on the accompanying

leaflet. Large rectangular shelters such as shown in Fig. 9 would be good for Silver Lake, especially in 6 to 15 feet of water. The hollow center provides protection for the establishment of weed beds. Protection can also be afforded by paralleling the shore with the "ladder shelter" shown in Fig. 4. If these are built loosely so the brush stands up three or four feet off the bottom, an effective wave breaker results, giving protection in the lee for the establishment of weeds. The smaller fish will find shelter in and toward shore from these shelters, while larger fish will hang around outside. Sets of about three of the ladder shelters set end to end will provide good cover and protection. The size will depend on the length of logs, preferably deadheads, available. An average length of about 20 feet is indicated.

Eventually between 50 and 100 shelters averaging 20 feet in length are recommended, to be set around the entire shoreline, including the bays. These may of course be built over a period of years, as the fish supply builds up. The first shelters to be constructed should be in the shallow waters of the bays, to provide a place for planting the bass and bluegill fingerlings, which should be planted this summer.

Channels to Connecting Waters — When the lake level is high enough to flood adjacent swales, connectings at least ten feet wide should be maintained, for these swales would then provide fine feeding and nursery waters.

BUSH OR DOLLAR LAKE

The other lake on the Ranch property is relatively insignificant, whether judged by its size, scenic attractiveness or fish possibilities.

Description of Conditions

Size — The area determined by our survey is 10.5 acres, approximately 1/15 that of Silver Lake.

Inlets and Outlets — This lake lies in a depression, and has no inlet nor outlet.

Character of Water — The slightly brownish water of this lake contrasts with the clearer water of Silver Lake. Its natural~~ly~~ fertility is probably higher.

Temperature — This lake, like Silver Lake, has no thermocline: that is, its waters are all rather warm in the summer. Actual figures are given on the accompanying gray card.

Oxygen — Dissolved oxygen is fairly high at the surface (8.3 parts per million), considerably reduced at midlevels (5.2 p.p.m) and very low near the bottom (1.1 p.p.m.). Coupled with the rather warm temperatures, it is clear that this lake furnishes no fit conditions for salmonoid fishes in the summer.

Other Chemical Conditions — The water is decidedly alkaline, has no free carbon dioxide except near the bottom and is moderately soft.

Except for the lowest 4 meters, the water in summer seems suitable for fish life.

Depth — The shoals are fairly wide. About half of the lake has a depth of less than 15 feet. The maximum depth, found at the center, is 9.2 meters (about 30 feet).

Bottom — A fairly wide sandy margin surrounds the pulpy peat which floors the deeper parts of the lake. There is some gravel along the east shore.

Cover — A little cover is provided by sticks and deadheads along the sand margin, but most of the shelter is furnished by the vegetation. The cover factor is of no great importance, because few predators occur in the lake.

Vegetation — A considerable amount of vegetation occurs. Rushes, sedges and muskgrass line much of the margin. Muskgrass is mostly outside the rushes. Pondweeds also occur, but are not especially abundant.

Natural Food — Natural food as a whole is relatively scarce. Aquatic insects are moderately common. Green frogs abound. No minnows were found. Iowa darters were the only forage fish.

Spawning Condition — A few cleared patches, apparently sunfish nests were found on the west side. Some gravel was found on the east side. Spawning conditions for largemouth bass and bluegills seem fair.

Predators — None found.

Game Fish — Fish must be very scarce in this lake. None were caught in the net sets. One small perch was found dead on the shore, indicating that dwarfed perch probably occur. The few apparent nests suggest that some kind of sunfish also inhabits the lake in small numbers.

Coarse and Obnoxious Fish — None found.

Forage Fish — Only Iowa darters were found, and these fish, of mediocre forage value, were not abundant.

Fishing Reputations and History — The lake is not fished, and no reports on former fishing were heard.

Fish Management Proposals for Bush Lake

There is no apparent reason why this little lake should not support a moderate number of game and pan fish. We recommend that an attempt be made to establish largemouth bass and bluegills. The conditions do not appear favorable for any kind of trout.

Local Regulations — Applying the state laws to this lake should be adequate.

Stocking — Bush Lake should be stocked with largemouth bass and bluegills. The bass may be obtained from Silver Lake. Two or three dozen breeders or 200 or 300 fingerlings should serve to indicate whether the bass will do well. A few annual plantings of about 500 bluegill fingerlings would give this species a test.

Improvements — Since spawning conditions are fair for these species, and since predators are almost absent, cover rather good, any extensive "improvement" work in this little lake would hardly seem worthwhile. A moderate amount of brush in shallow water might help in getting the bluegills established. One large brush shelter in water about 10 feet deep would provide some cover, and would concentrate the larger fish to make it easier to determine if stocking has been successful. If fish become well established, further improvements may seem desirable in the future.

Forage Fish A few hundred minnows could be planted in the lake to provide food for the largemouth bass. Golden shiners would be good.(These are abundant in South Tomahawk Lake, Montmorency County.)

INSTITUTE FOR FISHERIES RESEARCH

LAKE IMPROVEMENT DEVICES


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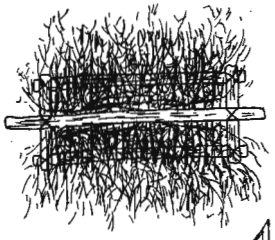
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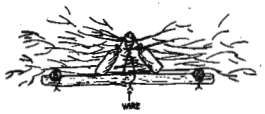

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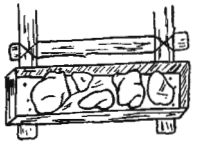
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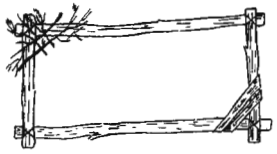
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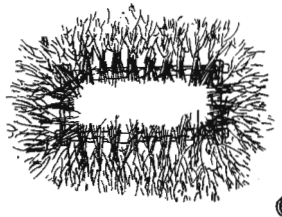
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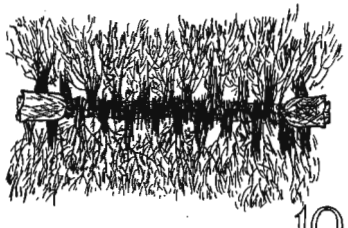
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For Explanation

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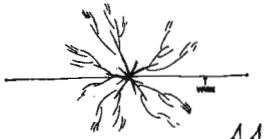

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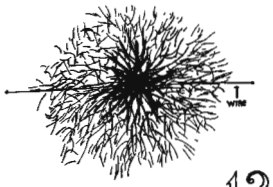

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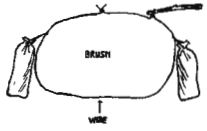

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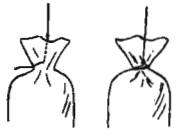
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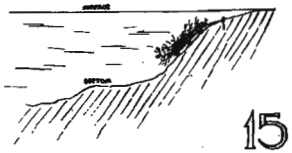

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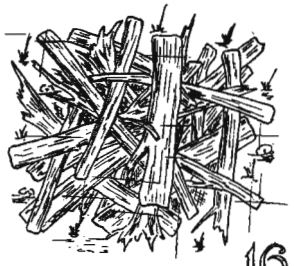
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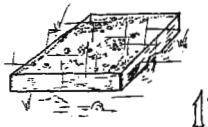
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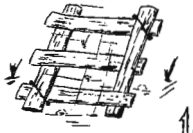
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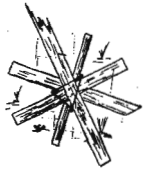
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See Other Side

Fig. 1. Frame for ladder shelter.
A cross-member in the middle is desirable if the frame is over 10 or 12 feet long. Frames can be made any length. A width equal to about one half the average length of the brush is desirable. If built too narrow the shelter is apt to turn over when being submerged.

Fig. 2. A method of fastening the several pieces of the frame.
By notching and wiring as shown, spikes or nails are not needed.

Fig. 3. Shelter practically completed.
Brush is more loosely packed by placing some brush lengthwise to the frame as shown.

Fig. 4. Shelter completed.
The pole is wired to the two cross-members at the ends of the frame and holds the brush in place. Size of shelter depends upon the size of material available and on the particular taste of the individual making them as well as on means of moving the shelter if not built where it is to be submerged. Brush is generally piled to a height of 3 to 5 or 6 feet. The wire holding down the upper timber should be stapled to the timber.

Fig. 5. Method of weighting shelter.
Bag of sand (or rocks) placed in shelter after a supporting layer of brush has been put on the frame. This method serves where shelters are built on rafts or on the ice where they will not submerge prematurely by adding the weight.

Fig. 6. Method of weighting shelter.
This is considered superior to placing the weight on top since the shelter has no tendency to be top-heavy or to turn over while being submerged. One bag at each end may be sufficient, the number depending on the size of the shelter.

Fig. 7. Method of weighting shelter.
Suitable especially where rocks are used. An extension of the two members of the frame at each end of the shelter, covered by a box-like structure as shown, serves the purpose well. Rocks must be placed at both ends simultaneously. This method, by using boards or a layer of brush, also works well where bags of sand are used.

Fig. 8. Frame for square type shelter.
This shows two ways of building up ends to support sandbags or rocks.

Fig. 9. Square type completed.
Ready to be submerged.

Fig. 10. I-type.
Weighted. Ready to be submerged.

Fig. 11. Circular shelter, starting construction.
Wire is temporarily fastened down to prevent its being moved.

Fig. 12. Circular shelter, partially completed.
Showing method of placing brush.

Fig. 13. Circular shelter. Method of wiring, drawing wire tight, and attaching weights.

Fig. 14. Wiring bag.
If wire is placed through bag and then twisted around bag there will be less tendency of the sack slipping out of the wire.

Fig. 15. Method of placing shelter on slope.
If the water is too shallow above the drop-off and if the slope is sharp and extends into deep water, the shelter can be held on the slope by use of a stake and wire as shown. Once it has settled down the shelter will stay on a slope of considerable angle if currents are not strong.

Fig. 16. Water-logged shelter.
Water-logged material placed in heap at proper depth.

Fig. 17. Small-mouth bass spawning box.
Made of boards and filled with gravel and sand.

Fig. 18. Slab device.
Staked to bottom in water ½ to 1½ feet deep. Used by minnows for spawning.

Fig. 19. Board device.
Used in place of slabs.

Fig. 20. One method of arranging improvements.