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INSTITUTE FOR FISHERIES RESEARCH

REPORT NO. 112

TORCH LAKE

This lake, though not the largest in surface area, contains a greater volume of water than any other of our Michigan inland lakes. It is, in many respects, similar to the finger lakes in New York State. In beauty it rates very high among the inland waters of the world. We are told that on a bronze plaque in Switzerland some of the best known lakes of the world are rated according to beauty and that there Torch Lake ranks third, being surpassed only by two Swiss lakes. Some who have seen the three lakes feel that the Swiss have been over ambitious, that an unprejudiced observer would rate Torch Lake above either of these Alpine waters. Truly, there are no castles to adorn the shore line of our lake but the blue water and the gentle hills across the horizon excel and man made adornments.

At any rate, Torch Lake and its adjoining waters are fast becoming a Mecca for tourists and resorters. Only one obstacle prevents an even faster movement toward this ideal summer play-ground; fishing in Torch Lake is only fair. The fisherman who starts the day full of hope too often returns in the evening with little to show for his efforts.

A survey was made of this lake in the summer of 1931 by this institution, with the moral and financial support of the Michigan Division of the Izaak Walton League. This report presents, in a general way, some of our findings and also our recommendations to improve the fish life in Torch Lake. It is hoped that eventually this lake may be known, for its fishing as well as for its beauty.

Previous investigations Several investigations of Torch Lake have been made prior to this time. A state party made an examination of the lake on August 17 and September 1, 1888, and reported in the manuscript "Examination of Waters" (field No. 17) a depth of 320 feet and the following species taken: lake trout, whitefish, herring, lawyer, perch, suckers, deep water cottus. The most recent was that of John Van Oosten and Walter Koelz in 1923. This research was undertaken primarily for the purpose of collecting data on the distribution and ecology of fishes belonging to the whitefish and herring group. They say of Torch Lake:

"The survey was continued on Torch Lake in Antrim County until August 9. Torch Lake is eighteen miles long with an average width of less than two miles and has the distinction of being the longest, and probably the deepest, lake in the state. It is surrounded by an extensive range of relatively high ridges or terraces, which in several localities are broad and very well-marked. In the best development of the terracing there are two terraces whose faces are so bold as to give an almost cliff-like appearance to the shore-line. Observations on the topography of the lake bottom, which were confirmed by residents of the locality who had knowledge of the old Federal Hydrographic Survey of the lake indicate that most of the lake consists of a deep basin, the cross section of which shows about the same degree of curvature as that of the bowl of a spoon. The maximum depth found by us was about three hundred feet off Camp Mayo-Went-Ha. This depth dropped to two hundred and seventy-five feet off Clam River and to two hundred and fifty feet northeast of Deepwater Point. At the south end of the lake the basin constricts into a narrow channel which runs near the west shore to Torch River. This central basin appears to be surrounded by submerged terraces like those which hem the lake shores. The first is narrow and runs to a depth of about twelve feet. The second is overlain by forty-five to fifty feet of water and in at least two localities broadens into an extensive table land, the one off Clam River and the other between Alden and Torch River Bridge. The transition to the deep water basin is everywhere abrupt, even precipitous (off Deepwater Point a drop of one hundred and seventy-five feet was encountered in the distance of less than a rod). The submerged terraces are sandy and are comparatively free from rocky stretches or even scattered boulders and water-vegetation is rare. The bottom of the deep trough is clay, mixed often with marl. The same species of food-fishes which inhabit Elk Lake occur also in Torch, though the same species are not equally abundant, relatively, in both. Their bathymetric distribution is also about the same. In Elk Lake depths of more than one hundred and fifty feet were not explored but in Torch Lake nothing was ever taken at greater depths, (except herring). Shiners and food fishes of the year were nowhere common but were not so rare as in Elk Lake. From casual examinations of stomachs it appears that the lake herring, the most common of the deep-water forms, provides the main source of food for the mackinaw-trout."

Survey of 1931

Acknowledgments We are indebted to Mr. Roberts of the Bellaire Bank for having provided free, an ideal camping site; to Dan Berg for having furnished a power boat for our work; also to the many resorters and local residents whose interests in the lake and the work kept the survey party continually inspired.

Location and size Torch Lake is located in the western part of Antrim County. At its northern end it is less than a half mile from Grand Traverse Bay, but the two bodies of water are not connected at this point. The lake lies in a north and south direction. It extends into the northwest tip of Kalkaska County.

An accurate survey of the lake indicates that it has a shoreline of slightly over 42 miles. It extends 17.6 miles from north to south, and has a mid-channel length of almost 19 miles. The average width is about 1.65 miles. The lake is narrowest at the north end and widest just north of Alden near the south end. The maximum width is 2.35 miles. The surface area is 18,286 acres or about 28.5 square miles.

Inlets and outlets Aside from a few very small intermittent inlets, Torch Lake has only two streams emptying into it. One of these is Spencer Creek, a small trout stream, which empties into the lake at Alden. By far the most important inlet is Clam River. It enters Torch Lake on the east side, a few miles below the center of the lake. Clam River carries water from the Intermediate chain of lakes, from Lake Bellaire and from Clam Lake. It is undoubtedly one of our shortest streams, being only several hundred feet long, but it drains a rather large area and has a considerable volume of water at all times of the year. The lakes above it tend to keep this flow fairly constant and the level of the

stream fluctuates much less than is common in most streams of similar volume. Any of the boats on Torch and adjoining lakes can pass up or down this river. A road crosses it near its mouth but a swing bridge is in operation here.

The outlet, Torch River, is located at the southwest corner of the lake. This stream, too, is large enough to permit the boats to pass through. It is slightly over two miles long, and empties into Round Lake. The entire system drains, eventually, into Grand Traverse Bay at Elk Rapids.

Pollution No study was made of the discharge of wastes from the summer residences or from the village of Alden, or from any towns or cottages along the lakes draining into Torch Lake through Clam River. However, the water is very clear and appears to be unusually clean. It is doubtful whether any pollution will be found here. Certainly none is present or likely soon to develop which would be injurious to fish life. In fact a considerable amount of sewage or other rich organic pollution would probably increase the fish production, however disadvantageous this might be from other standpoints.

Use of water Torch Lake has an extensive resort development along the south and east sides. A number of stores and summer hotels are found along the shore as well as several small towns. The largest of the villages is Alden, located near the south end of the lake. Eastport lies at the extreme north end of the lake. Other small communities include Torch Lake Village, Torch River, and Clam River (formerly Helena). Torch Lake Village (formerly Brownstown) was once a thriving little community. By 1870 a sawmill was in operation here. Logs from the neighboring region were floated here, cut up, transported across the narrow neck of land and shipped via Grand Traverse Bay. Today a few scattered buildings remain and hundreds of water logged slabs in the lake show where

the mill once operated. Alden, settled in 1870, was also a thriving little town in the logging days. Today it depends entirely upon resort and tourist trade, and to some extent upon the surrounding farms.

A Y.M.C.A. camp, a Boy's camp, and a Girl's camp are found along the eastern shore of the lake. A yacht club has its club house on a prominent point. Each Sunday, during the summer, races are held here and a number of sails can be seen moving along on the blue water.

Boating is carried on extensively. Fishing is also indulged in to a considerable extent.

Camping sites for the tourist are available as well as rooms or cottages, and boats, fishing tackle, and guides can be obtained along the lake. Fishing will be more extensive when the supply of fish in the lake has been increased.

Temperature This may be regarded as a cold water lake. Even in the middle of the summer, those who swim here realize that the temperature is lower than that of most lakes. Readings on August 10th (air temperature 85°) showed the surface temperature to be 68° Fahrenheit. At a depth of 40 feet it was 66° , at 60 feet it was 59° , and at 80 feet it was 49° . The water below 100 feet in depth was quite cold, ranging from 44° to 41° .

On August 8-18, 1888, the old survey party obtained similar temperatures: 67° to 69° at the surface, and $32\frac{1}{2}^{\circ}$ (impossibly low) to 48° at the bottom.

The water near the surface, though slightly colder than in most lakes, is suited to such warm water fishes as small-mouth bass while the deeper water is ideal so far as temperature is concerned, for lake trout, whitefish, herring, and other cold water species.

Oxygen Although oxygen is usually low at or near the bottom of our lakes, Torch Lake is an exception. It has a large amount

of oxygen at all depths, even at the very bottom. Little decay takes place here and wave action is great. These factors are very likely responsible (at least in part) for this condition. Oxygen at all depths is quite desirable. It means that, other conditions permitting, the fish can use the entire lake. Nets set on the bottom in the deepest part, showed that cold water fish are found here at a depth of almost 300 feet.

Other chemical conditions In many ways the water was found to be almost uniform from top to bottom, although the fall turnover had not yet taken place. No carbon-dioxide was found at any depth. The water is a little softer than that of the average lake so far investigated by our institution. It is alkaline at all depths. Analyses of conditions other than those mentioned here were not made. Our results indicate that, so far as oxygen, carbon dioxide, hardness and alkalinity are concerned, the lake is very well suited for fish life.

Depth The lake bottom has several terraces of flat shelves, with a deep trough running thru the center. It is quite uniform in a north and south direction, but gets shallower to the south end. This trough, if it once existed at this end, has probably been filled in gradually, by wave and current action.

The shoal area is generally wide, especially near the south end, but at some points, such as Deep Water Point, the sharp drop is only a few feet from shore. The slope at the dropoff is generally very steep. A maximum depth of 297 feet was found, in the 1931 survey. The 1888 survey reported the maximum depth of the lake as 320 feet, and the 1923 survey reported 330 feet off Camp Hayo-Went-Ha in the northern part of the lake. The trough, for almost its entire length has a depth of over 200 feet, generally between 250 and 297 feet.

Bottom The bottom on the shoal area is chiefly sand. Boulders and gravel are present along most of the east and west shores. The bottom in the deeper areas is of soft, sticky blue clay, often mixed with some marl. Marl is also present in some places on the slope.

Vegetation Unfortunately, very few weed beds are present in the lake.

A small amount of muskgrass is found on the shoal area, but even this bottom weed is generally quite sparse where it does occur. Some pond weeds are found on the slope, especially along the west side. Almost all the fish seen in the lake by our party were found near the few weed beds which do occur. The beds usually provide good fishing for warm water fish, particularly for perch.

One of the resorters, Mr. C. S. Monnier, has been watching one of the weed beds near his summer home for some years. He states that it is gradually growing larger. This bed is located on the west side of the lake about 500 yards below Clam River.

More vegetation is highly desirable. Some aquatic nurseries make a business of providing and planting aquatic weeds but it is doubtful whether the weeds could obtain a foothold before shelter improvements are added. The weed beds will very likely increase of their own accord about the brush and log shelters. But planting of the weeds and addition of muck would accelerate the development of the weed beds (see Recommendations).

Natural Crayfish and aquatic insects are not abundant. Minnows are
food present and are fairly numerous at the south end but in general they are not present in sufficient numbers to provide food for a very large fish population. Microscopic plants and animals and bottom fauna were not examined, in great detail, but it may be assumed that these, too, are not present in very great abundance. There is presumably a relation between the amount of vegetation and the amount of food.

Fertility A basic lack of fertility may be a factor of great importance in limiting the plant growth, food production and fish population of Torch Lake. If this is true, it will be difficult to build up the fish supply. But the fact that both the inlet and outlet waters are rich in plant and fish life points hopefully toward the chances of success in increasing the fish supply in the lake proper.

If weed beds can be built up on the shoals, the food production should increase, and the fertility of the bottom and water should gradually increase. Because of the size of this body of water, the large amount of deep cold water and the amount of drainage out of the large outlet, the practicability of increasing the fertility of the lake by adding commercial fertilizers would seem impractical; at least in the present state of our knowledge of the advantages to be so obtained. Manure is scarce in the region and even though it could be obtained, adding it would meet with the disapproval of many of the resorters and tourists. Nothing should be done to this lake which would mar its reputation as one of our cleanest and most beautiful bodies of water. Under "recommendations" we discuss what in our opinion would be the most economical way of improving the food production of the lake.

Spawning grounds Gravel is present on the shoal in large quantities. The nest building, warm water fishes have excellent conditions for spawning, except that along a large part of the lake strong current and wave action during storms probably interferes seriously with the nests.

Perch generally spread their strings of eggs over vegetation. Since weed beds are limited the perch spawning grounds may also be regarded as inadequate. Increased fertility will probably increase the weed beds and improve conditions for perch spawning. Our knowledge about the breeding habits of lake trout and cisco is very limited, and a definite statement regarding this matter can not be made.

Species of 1. Food and game fishes.

fish present Our net sets and seine hauls indicate that fish are not numerous. Of the various species taken, perch were most abundant. Other food and game fishes found here by the party include: small-mouth bass, lake trout, brown trout, rock bass, cisco and suckers. Some brook trout were seined in the mouth of Spencer Creek and some blue-gills or sunfish were seen at the mouth of Clam River.

Food and game fishes taken by the 1888 survey party (on August 17 and September 4) are: lake trout, whitefish, herring, perch and sucker.

Hollman who accompanied the party reports also large-mouth bass, small-mouth bass, rock bass and brook trout. Koelz and Van Oosten in August 1923, took the same species and also both species of black bass and rock bass.

The lake trout is regarded as the most important fish in the lake. Some resorters and local residents state that these are gradually increasing in number. Those who know the lake well have fairly good luck in fishing for this species.

The perch reach a good size and good catches of perch are often made at the few weed beds in the lake.

Whitefish were not taken by our party but were found by both other parties (1888 and 1923). Very likely they are still present in limited numbers.

Herring were taken. Never more than a half dozen or so were caught in a net at one setting.

Some suckers were seen and a few were taken. These reach a large size but are evidently not very abundant.

A number of bass were seen at the south end of the lake. One of the resorters states that he has seen a few bass nests in Torch Lake. Except at Torch River and near Clam River, the bass appear to be relatively few in number.

An occasional muskellunge is taken. Resorters say that the "musky" was coming back about three years ago. At that time night spearing with jack-lights was carried on very extensively on Torch River. Many resorters feel that this extensive spearing had a direct connection with the almost complete disappearance of muskellunge since that time.

Sturgeon were once found in the lake. One was speared here about seven or eight years ago.

2. Obnoxious fish

Two lawyers were taken by our party, and this predator was also secured by the 1888 and 1923 parties. They fortunately do not appear to be present in very large numbers.

3. Forage fish.

Forage fish are present in some numbers but are not particularly abundant. Straw-colored and rosy-fronted minnows were taken in greater abundance than any of the other species. Other species obtained by our party include common shiners, blunt-nosed minnows, Johnny darters, muddlers, log perch, mud minnows (in inlet), long-nosed dace, black-nosed dace, horned dace, and lake shiners.

Bollman, Aug. 8-18, 1888, reports horned dace, blunt-nosed minnows, log perch, Johnny darters, muddlers (*bairdii*), deep water sculpin and *N. atherinoides* (probably *rubellus*).

Straw-colored minnows, blunt-nosed minnows, trout perch, log perch, Johnny darters, lake shiners, long-nosed dace and muddlers were taken in 1923.

Large numbers of fish, believed by some to be young herring, were reported as having been seen going up Clam River in big schools at some times of year; these were likely lake shiners, the species which pre-eminently shows this habit.

At least three species of deep-water forage fishes are available for lake trout: cisco, trout-perch and deep-water sculpin.

Predators Predators are very few. A few kingfishers and a few lawyers were found here. Neither of these appears to be abundant, although the 1888 party reported lawyers common. It is probably the most destructive predator in the deeper water. Other predatory animals were not found. Kingfishers were found to be rather plentiful on Torch River. No gars or dogfish or carp were found by any of the survey parties in Torch Lake.

Cover Very little protection is afforded the young fish. Weed beds are few and deadheads are scarce. Except for what little cover is provided by the boulders and the slabs at Torch Lake Village, the small fish are practically without protection of any kind.

Water level The water level fluctuates very little. Clam River maintains a fairly even flow and other inlets are too small to influence the level of Torch Lake to any noticeable extent. A stationary level is desirable.

Laws and regulations "By change of provision of Act 165, P. A. 1929, as amended by Act 326 P. A. 1931, Chapt. 3, Sec. 1 - Taking permitted of lake or mackinaw trout by hook and line at any time of year, to number of 2 per day per person or to 5 per day or in possession by party in boat."

The lake is designated as a pike lake although it is well known that members of the pike family are extremely rare here.

In a pike lake "pike, pike-perch, muskellunge, perch, calico bass, rock bass, strawberry bass, crappies, catfish, bullheads, cisco, whitefish, smelt, suckers, mullet, redhorse, carp, gar-fish, dog-fish and sheepshead" can be taken from May 1st to March 31st.

In trout lakes or undesignated lakes these fish can be taken from June 25th to March 31st.

The season for these fish is longer by one month and 24 days (May 1 to June 24) in pike lakes than in other lakes. So far as Torch Lake is concerned, in view of the special amendment (of 1931) on the closed season law to permit taking of lake trout at any time of the year in this lake, and in view of the scarcity of pike, wall-eyes and muskellunge in the lake, the only particular and material advantage remaining in having this lake illogically designated as a pike lake, in definite contradiction to the provision that "A pike lake under the terms of this act shall be deemed to be a lake in which pike or pike-perch are the predominating species of game fish found therein, and commonly known as pike lakes," is the privilege of catching perch and rock bass, and brook, brown, and rainbow trout, from May 1 to June 24. If concentrated efforts are made, as is recommended, to build up the lake for small-mouth bass fishing, there is an added reason for removing the designation of the lake as a pike lake.

RECOMMENDATIONS

In our opinion three important factors must be changed to permit improved fishing in Torch Lake. These are food, vegetation, and cover. All are now present in very limited amounts only. The three factors are all related more or less intimately to each other. Any increase in cover is likely to increase the vegetation, which in turn provides more cover. And any increase in either vegetation or cover will increase the food for the fish, and hence allow of a building up of the fish supply.

In our opinion there is a narrow limit to the returns which may be expected from the heavy stocking of Torch Lake, unless this stocking be accompanied by or preceded by extensive improvement of the living and food conditions for the fish.

Stocking We regard a stocking of 85,000 fall fingerlings of small-mouth bass as desirable at the present time, in order to build up the supply to a point where good bass fishing can be expected around the entire lake. (This result as stated before presupposes rapid progress on improving the shelter in the lake.) This is a large number, but figures out as less than 5 per acre of total lake surface, and as 16 per acre of shoal water, and as about 2000 per mile of shore line. If large bass are available for planting in the lake, from Elk Rapids or elsewhere, the number of fingerlings, these could be taken to supplant the fingerlings in the ratio of 10 fingerlings for each half-grown bass, and 20 fingerlings for each adult bass.

When the bass become more abundant in the lake, natural reproduction may make possible the cutting down of the planting quota without diminishing the supply.

We recommend that the same number (85,000) of fall perch fingerlings (preferably from the Great Lakes) be added annually. A larger planting might tend to overcrowd the lake with perch. The perch planting is recommended with the double end in view of building up perch fishing and of helping to support a good bass population.

We further recommend that 50,000 lake trout fingerlings or 500,000 lake trout fry, preferably the fingerlings, be added annually. This is less than 3 fingerlings per acre of lake surface, and it may develop that the number should be increased later.

In the present state of fish propagation we would not recommend stocking the lake with bluegills, as the surface temperatures of the shoals do not rise high enough to permit successful natural spawning. The lake is the opposite of a large-mouth bass lake, so no planting with that species is recommended. Furthermore, if Torch Lake were suited to these species, they would have established themselves in larger quantity, by moving in from Clam Lake. Planting of whitefish is not recommended, as the species

is already present, probably in numbers as large as the specific food supply for this species will permit. Grass pike and muskellunge are not propagated by the state, and are difficult to handle in fish culture, and the lake is not especially well suited to either species. In the present state of our knowledge of the proper habitat of wall-eyes in our inland lakes, and of their predaceous habits (we could expect them to prey heavily on perch, bass and perhaps also on lake trout in Torch Lake), we believe that the total production of good game fish in Torch Lake will be higher if wall-eyes are not encouraged. The reasons for not expecting landlocked salmon to succeed or be beneficial in Torch Lake are given in a special report (Report 88).

We urge that the question of planting smelt in Torch Lake be held in abeyance for at least another year, giving time for making investigations now under way on the relation between smelt and lake trout and other fish. Smelt may be needed to build up the lake trout population in Torch Lake, but they themselves are so predaceous that it is wise to consider the question carefully before making the irrevocable step of introducing them. It should be borne in mind that at least three species of forage fish are already available to lake trout in Torch Lake (see p. 10).

Rearing The large number of fall fingerlings of small-mouth bass and
Ponds lake trout which are needed for Torch Lake, and the large
 numbers of these and other species needed in other lakes of
the same general region, would appear to render a local rearing station
for lake fish very desirable (see general recommendations for lakes of
county).

Predator In a deep, clear lake, of the type of Torch Lake, fish-eating
control birds cannot be considered a serious menace to fish life,
 and their control would not have any marked effect on the
fish production.

The lawyer, an arch predator occurring in the deep water of the lake, will no doubt have some retarding effect on the upbuilding of the lake trout supply--how much cannot be definitely estimated. We cannot now recommend any means for controlling the numbers of lawyers, however, as by set-lines or gill-nets, that would not also destroy lake trout. It is possible that at certain places at certain times of the year they could be caught in large numbers, without destroying many trout, but it would require a careful investigation that would hardly be warranted unless the lawyers should increase alarmingly while the other fishes are on the increase.

Gravel spawning beds Gravel is sufficiently plentiful for the spawning of small-mouth bass and other fishes. Owing to the strong wave and current action, however, it may be a matter of importance to locate some of large log shelters on gravel beds, so as to give protected spawning sites.

Food increase Reference has already been made to the apparent impracticability (at the present time) of increasing the food production in the lake by adding chemical fertilizers. The introduction of smelt is discouraged until further knowledge of the effects of this species on the game fishes is acquired.

The introduction of other species of forage fishes is not strongly urged, as the lake is not well suited to many of the species (as golden shiner, black-nose shiner, etc.) and as most of the species to be expected are already present. If, however, an extremely abundant supply of lake shiners is located within quick hauling distance, their introduction would provide some additional food for the game fishes at least.

The supply of shore minnows is at present insufficient for a large population of bass in the lake. An effective means of building up the minnow population in our opinion would be to supply flat slabs for the natural spawning of blunt-nosed minnows and Johnny darters and muddlers. These fish all have the habit of depositing and guarding their eggs on the under surface of flat objects. The great pile of slabs by the old mill on the west shore opposite Torch Lake Village would provide ideal material for construction of spawning devices for the reproduction of these forage fish. Some slabs are also left by the old mill at Alden. The slabs could be loaded onto a scow, large boat or even raft and hauled around the shore, and made into the spawning boxes. Sketch 1 shows our recommendation for constructing these devices. These devices would also serve as cover and shelter through the year, and no doubt would produce crayfish and insect larvae as well as forage fish. A special advantage of providing spawning means for these minnows, is that they produce young through the summer, so as to feed the fingerling bass as well as the larger ones. We recommend that these be placed in depths of one to 4 feet, and that as many as can be made from the available slabs be constructed. One thousand would put them more than 200 feet apart on the average, in one row around the lake. It would be best not to put them closer than 50 feet apart, but they could be concentrated to some degree inside the large log-and-brush shelters.

In our opinion, putting in these slab boxes would be worth while for the shelter they would provide, even though they did not serve their primary purpose of increasing the minnow supply.

Any increase in shelter and in weed beds will have a beneficial effect on the production of food in the lake.

Vegetation One of the prime reasons why Torch Lake does not provide
increase rich fishing is the small amount of plant growth present.

The reason for this is the great exposure of the shore to storms. This is shown by the fact that the few weed beds present are in the bays. That the water itself is capable of supporting plant growth is indicated by the weed beds growing in the outlet.

On account of the extreme exposure, ordinary methods of weed planting cannot be expected to produce results. The bottom must be protected in order to allow the beds to obtain a foothold. Musk-grass (chara) is probably the best plant to start with as it is naturally a pioneer on sand bottom.

We recommend providing of protection by means of the log-and-brush shelters recommended below--thus to make the shelters do double duty, starting the weed beds and sheltering the fishes directly.

To facilitate and hasten the establishment of the weed beds, we suggest that at least one shelter out of four, black soil be dumped into the interior of the shelter so as to give a chance for the plants to root, and that chara and other plants be then added, with clay about the roots to insure sinking and increase the chance of rooting, in about one shelter out of eight.

As the amount of soil to use, we would recommend about two cubic yards in a shelter 15 or 20 x 50 feet in size. The plants could be scattered about on the inside of the shelter, so as to form nuclei from which the beds could grow out.

Cover The most woeful deterrent to fish increase in Torch Lake
increase appears to be the lack of cover. In our opinion no amount
 of planting alone will make this lake an outstanding fishing
resort. And that is of course what is needed to realize properly on this otherwise wonderful natural resource. Increasing the cover in a huge lake like Torch will be a big undertaking but one which appears to us abundantly

worth while. Much depends on the way the job is undertaken. Using a small crew of trained men, with a launch and a scow, and good equipment otherwise, and a definite plan, ought to yield large results without an excessive outlay in funds. No doubt a considerable amount of voluntary help could be obtained at Alden for instance.

The chief type of shelter we recommend for Torch Lake is made out of logs one crosswise at either end and enough end to end on either side to make the whole about 50 feet long. Brush is to be stapled or wired to the whole frame, and the finished product sunk so that only a small part of the brush reaches to within two feet of the surface. This will prevent breaking up of the brush by ice, and will allow boats to clear.

When trees instead of logs are used, less brush or none will be needed. They should be set parallel with the shore, and not closer together than about 500 feet, so as to give a good forage range about the shelter. Placed this distance apart, about 450 shelters would be needed to give one file around the lake. Where the shoal is wide, as near the south end, they could be put in two rows parallel with the shore, and alternating in position.

As a suggestion for the construction of the shelter, we would suggest that supplies of logs, dead or useless trees, etc. be found, cut (over the winter is possible) and hauled to the water's edge, so they could be made into rafts and towed to the shore of Torch. We believe there are available sources about Round, Clam, and Bellaire Lakes, to supplement what might be obtained about Torch itself. Any old logs or trees would do, even slender poles where nothing better can be had. The whole will water-log, so that later breaking up will not release the brush. One log can be anchored by a weight (stone or sand bag) in the selected position, in water 5 to 20 feet deep; then other stringers added, fastened end to end by a wire until a length of about 50 ft. (30 to 100 ft.) is attained, allowing the boom to float with the current; then fixing the first cross

stringer at the head, running down the second side, and closing off the end with the second cross member. The oblong hollow raft is then ready for the brush, any kind that is most available--either whole alder or willow or poplar shrubs, or loosely bound bundles of criss-cross brush. These can be attached as appears most convenient by wiring, nailing or stapling. Finally the whole is sunk by boulders, by stones in netting or by sand in tarred bags. The fishes will find and use the shelter we are convinced. The fingerlings will find shelter here. And incidentally the bass and perch will hang around the edges, where good fishing can be predicted.

The importance of the brush shelters in increasing the weed beds and the food has already been stressed. They are the key we believe to the upbuilding of fishing in Torch Lake.

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