

Temperature
and chemical
condition

Temperature is fairly high at the top (in summer) but is cold near the bottom. The change in temperature takes place between 15 and 25 feet. The cold spring feeders tend to keep the lake temperature slightly below that of similar lakes which are not spring fed.

When examined (July 13, 1931) no carbon dioxide was found at any depth. Oxygen was present from top to bottom and was high except at lower depths. The lake has a slightly greenish color, is moderately hard and is decidedly alkaline.

Chemical conditions appear to be quite favorable for fish life.

Depth

The length of the shore line is more than 4000 feet. The shoal area is moderately wide to narrow (average about 40 feet). It is shallow to the drop off, where the depth is about 5 or 6 feet. The slope is quite steep, generally over 45 degrees. Maximum depth is almost 40 feet while the average depth below the shelf is about 33 feet.

Bottom

The bottom below the shelf is entirely of pulpy peat. The shoal area and slope are of marl with a margin of fibrous peat on some sides, Sand is found only at the mouths of the inlets, where the streams have formed small deltas. No gravel was found. The sand apparently cannot be used to good advantage by the bass for nesting, because of the cold water flowing over it and because it is shifting and "filling in".

Vegetation

Vegetation is not especially abundant on parts of the shelf but is plentiful on the slope. Some is also found in

the deeper water. The common plants in the lake include, pond weeds, water lilies, musk-grass, algae, coontail, water crowfoot, milfoil, and rushes.

In general the vegetation is ample, although a slight increase might be desirable.

Natural
food

Minnows and aquatic insects are abundant. Some crayfish are present. The food should be capable of supporting a rather large fish population.

Spawning
grounds

Spawning grounds are very inadequate. The beds are located on marl. Nests are made on root tips. If this lake is to be used for breeding bass, good spawning facilities are highly desirable.

The marl is only fairly firm but should support gravel. Because of the spring feeders, the lake probably never freezes over sufficiently to permit the placing of gravel on the ice, but it can probably be supplied on the shoal area in some other way (see recommendations).

Species of
fish present

*(3 Brown Trout - 1-6[#]
Jury Marks - 11-13-31
H. M. J.*

Perch, large-mouth bass, bluegills, and brook trout were taken by the party. Rock bass, pike (probably both northern pike and mud pickerel), sunfish, suckers, and dogfish are reported to be present. A number of species of minnows and darters are also found here. Although fish are present in considerable numbers the lake is not heavily stocked and should support more fish than appear to be present.

Designation

This lake naturally needs no special designation now because of the particular use which is being made of it, and

because it is not open to fishing at any time. If the lake should be opened to fishing, consideration might well be given to its designation as a trout lake.

Predators

Dogfish are reported to be present. Pike, whether northern pike or mud pickerel, may be regarded as predators and as very undesirable in this lake. Some fish-eating birds are found here at certain seasons. Some snapping turtles and water snakes, though not seen by the party, are probably also present here.

Cover

Because of the cannibalistic tendencies of bass, good cover would be desirable even though the predators mentioned above could be and were removed. Cover also tends to increase the amount of insect life present. Cover now is unsatisfactory (see recommendations).

Fertility

The lake is of moderately productive category. Food is plentiful. The inlets, especially those from the fertilized hatchery ponds, no doubt add fertility to the lake. Such fertilizer as might be added would in time largely be carried away down the outlet, and would therefore be expensive. The lake seems sufficiently productive unless a very large fish population is desired here.

AN ESTIMATE OF THE FISH-CULTURAL VALUE OF WOLF LAKE, WITH
SUGGESTION FOR ITS IMPROVEMENT TO SERVE AS AN ADJUNCT TO
THE WOLF LAKE HATCHERY

When we first heard of plans to use Wolf Lake as an accessory pond to the associated rearing station, we were, frankly, of the opinion that the decision was ill-advised. We still think that the egg, fingerling, yearling or adult production of fish in the lake would be so decidedly disappointing as to hardly warrant the cost of operating the lake for fish-cultural purposes, or to warrant its being taken off the list of lakes open to public fishing, provided, the lake be used in its natural uncontrolled condition.

But we have lately come to so appreciate the benefits which may accrue from intelligent environmental control of lakes, that we now regard the possibilities of making over the lake into an accessory unit to the hatchery as holding a moderately high expectation of satisfactory success, provided, the lake be extensively improved for the particular uses to which it is desired to put it. Consequently we do not feel warranted now in holding that the Department's plans to use Wolf Lake for hatchery purposes are unwise.

We do not feel, however, that the evidence anticipating satisfying success in the fish cultural use of Wolf Lake is sufficiently strong or certain, as to make it desirable to go ahead without keeping a close record of the cost of operation in relation to the yield.

The primary bases for our scepticism as to the probable success of using Wolf Lake for propagation purposes are:

1. The lake is undrainable.
2. The predators will be difficult to control.
3. The lake will receive disease germs from the hatchery and ponds.

4. The bed can not be exposed to sun, frost or chemical treatment for parasite control.
5. The amount of water flowing out of the lake will cause great waste in its fertilization to increase food production.
- 6. The inflow of spring water and the narrow shoals hold down the temperature below the optimum for lake-fish growth.
- 7. The narrow shoals will hold down the production of food for the fish.
- 8. The lake presents great difficulties in the way of recovering fish from it..

Tending to offset these disadvantages, Wolf Lake has certain features which would favor its utilization for fish-cultural purposes. These are:

1. The situation on the hatchery grounds would facilitate the patrol of the lake to prevent poaching.
2. Also the improvement of the lake by hatchery employees, to supply some of the deficiencies in natural features to high fish production.
3. Also the securing of the fish for planting or propagation purposes.
4. Also the control of predators.
5. Also the fertilizing of the lake. The fact that the lake receives the drainage from all the hatchery ponds, troughs, etc., will doubtless step up the food production, and the fertilizing can readily be supplemented as indicated below.

We consider that the improvement of the lake, with a view to its use in connection with the hatchery project, is desirable for three reasons:

1. The chances of at least moderate success in the venture appear to us to be fairly good.
2. The experience gained would be valuable in connection with more or less similar improvements in lakes open to fishing.
3. Almost all the improvements which appear to us as important in making the lake serviceable in a fish-cultural way, would tend to make the lake a better one for

public fishing, even should its fish-cultural use turn out to be wholly impractical.

Species suitable for rearing in the lake

Trout probably not suitable.--Although the lake is proved capable of growing trout, we would not expect that it could be used to efficiency as a trout rearing body, because of:

- (1) The presence in rather large numbers of more predatory fishes.
- (2) The difficulty or impossibility of suitably controlling these predators.
- (3) The extreme difficulty of seining out fingerlings.
- (4) The adaptability of trout to pond-culture.

Warm-water fishes more suitable.-- Wolf Lake would in our opinion be better suited to the production of warm-water species. Conditions favorable to their production would be:

- (1) The greater ease in increasing the food supply for these fishes.
- (2) The greater ease in protecting the fingerlings from the adults and other predators.
- (3) The greater ease in seining out fingerlings.
- (4) The less perfect adaptability of these fishes to pond-culture.

Removal of trout from lake and inlet

Inasmuch as we consider the lake more suitable to lake-fish than to trout-rearing, we would think it advisable to make any use possible of the trout now found there -- more because they could serve the hatchery purposes than because they would interfere with the lake-fish rearing. Even unavoidable escapee from the hatchery will probably maintain some trout in the lake for years.

We would suggest that a V-shaped wier, of heavy frame and covered with 1/4" heavy galvanized screening, be installed in the main inlet, near the lake, and that the wier be provided with an opening about 8" wide in its pointed upstream end. This would allow the passage of trout into the creek but would retard their dropping into the lake. The trout in the creek could then be seined out - the small ones to be put with others of like size in the rearing ponds, the adults to be stripped.

To facilitate the cleaning of the screen wier, it might be practical to construct the wier in the form of two swinging gates, which could be independently swung downstream by untying a line, and then shaken free of reverse, then swung upstream against a fixed wooden or concrete base, and fastened again in position to a post on shore - all without having to get into the water. Without specially examining the creek for this point, we can not say whether such a scheme would work.

The other and smaller inlets, if they are large enough to contain any trout either in the spawning run or otherwise, could be closed to trout very easily by building a brush-and-gravel dam at their lower ends.

Some trout might also be caught in the fyke nets which we are suggesting, especially in the spring of the year.

Stocking recommendations

Provided concentrated efforts be made to build up the fertility of the lake, we would expect it to be capable of receiving and growing a large quantity of fish. We would urge that the number to be introduced should be determined by experiment, starting with a high number. We might suggest for a beginning ^{that} fry or very small fingerlings be added to the following amount:

Small-mouth black bass: 10000

Large-mouth black bass: 10000

Bluegills.....: 100000

Continued observations (1) on the growth, (2) on the survival through the season, (3) on the increase in the wild population of each species and (4) on the natural reproduction, in the lake should be made, and the number introduced accordingly modified in subsequent years.

The total plant of 120000 suggested as a trial would of course be excessive for a natural lake, and we warn, would be certainly excessive for Wolf Lake if it is not extensively improved, in the line of food and shelter increase and predator control, prior to the introduction of the fish. The number does not appear excessive when we recall the great productivity of the better rearing ponds, the increased protection and food suggested for Wolf Lake, or the fact that 6491 well-fed fish were seined by us in a somewhat similar natural lake about a single brush heap, similar to at least fifty being recommended for Wolf Lake.

The object of suggested heavy stocking

The objects in view in suggesting a heavy stocking of the lake are:

1. Unless its productivity can be made large, the lake might better be forgotten as a hatchery adjunct, and thrown open to fishing.
2. The late fingerlings and the yearlings and half-grown obtainable by seining about the brush heaps would be available for planting in public waters, so the lake would act as a rearing pond.
3. The resulting drain in yearlings and even two-year-olds would likely be heavy enough to warrant some excess stocking to insure an abundance of spawners, which would be used to very good advantage at the hatchery.

Improvement of spawning beds

Wolf Lake, as explained in the description given above, does not possess satisfactory spawning grounds for lake fishes. Furthermore, the rather soft marl

will probably cause added gravel to sink rather rapidly.

To improve the spawning beds, we would recommend that material be added to the shoals of the lake to give a better base for the eggs. On account of the softness of the marl, we would suggest that waterlogged sticks (broken up brush would be satisfactory) be used as well as gravel. Doing this would yield information of high value not only in connection with the work on this lake, but also in connection with the improvement of spawning conditions in lakes in general.

We suggest that 400 feet of the shoal (about one-tenth of the shore line) be improved for natural spawning of centrarchid fishes, in 8 marked off stretches of 50 feet each. Two of these areas we suggest be covered at proper depths with gravel to a depth of one inch (where the shoal is 30 feet wide, 5 yards will be required for each section). On two of the areas we suggest that 2 yards of gravel be used, and that the gravel be put in piles about 1 yard in diameter and about 4 inches deep. All gravel should be put in water 1 1/2 to 6 feet deep, on the basis of the level to be maintained by the dam in the outlet. The other four 50 foot sections of shoal we urge be covered with waterlogged sticks, two thickly and two thinly.

Careful watch should of course be made to determine which type of introduced spawning material is most permanent and which is most conducive to increased natural reproduction.

Improvement of cover

We consider the introduction of good cover to be absolutely essential to the development of Wolf Lake to any fish cultural use. The survival ratio of fingerlings we could not expect to be high with the amount of cover now available.

To provide the needed cover we recommend the introduction of 20 brush covers, roughly 5'x15' to 10'x20' in size, to be spaced at approximately 200 foot intervals around the entire shore, but the distances apart to be modified so the brush can be put in seinable places.

The last point is important, because we believe that the seining out of fingerlings would be impractical, unless they were concentrated. That fingerling and half-grown fish will congregate about brush, is proved by the fact that 6491 were recently seined about a single brush heap in Crystal Lake, Oceana County (see separate report).

The brush should be so installed that it can be pulled to shore in a body after a seine has been thrown around it. We believe a depth of 2 to 5 feet is best, but would suggest that for the first year at least a considerable variation in location, as well as in construction, should be suggested, in order to provide experience on which to profit.

In order to facilitate seining in the fish after the brush piles are pulled out, we suggest that the snags now in the lake be removed from the contemplated seining areas.

We do not recommend any specific attempt to increase the vegetation in the lake, for three reasons: (1) The vegetation is now fairly ample; (2) it will increase with the increased fertilizing of the lake; (3) too much vegetation would afford enough shelter to cut down the desired concentration of fingerlings about the brush shelters.

Predator Control

The control of predators is likewise essential, in our judgement, to the attainment of any marked success in the intensive use of Wolf Lake. We recommend:

1. The shooting of fish-eating birds and other predators.
2. The pole-trapping of kingfishers.
3. The closing of the lake to migrating pike and other predaceous fishes, by a dam in the outlet (discussed below).
4. The night spearing of predaceous fishes and turtles, especially in the spring.
5. The trap-netting of predaceous fishes, turtles, etc. For this purpose, we recommend the construction of four special fyke-nets, to be set at four points in

the lake and lifted at appropriate intervals. We would set these from the shore outward and have the trap lie along and just outside the drop-off (which lies at the depth of 5 or 6 feet). The inner wing should have the proper length and depth to reach to or almost to the shore line. The net proper could be of the commercial type with largest ring about 6 feet in diameter, and with 1/2 inch mesh at the end. Beneath the net and the outer wing should be made fast a triangular piece of 1 inch square-measure seining, 32'x32'x45.25'. This will enable the 45.25 foot length to lie against the bottom of the slope.

Such a net we believe would catch more fish than the big trap-net which was made for Metzelaar's use, and would be vastly cheaper and easier to set and lift. Though we think this the ideal net for trapping fish alive in such a lake, we would suggest that only one be purchased and installed at first, to try it out. If there was reason to believe the fish swam out around the net, a piece of one or two inch seining could be fastened on the outer end, this to have through the same depth as the outer end of the net as described above (32' + the depth of the net proper).

This net should serve to catch:

- (1) Perch, pike, dogfish, rock bass, sunfish and suckers. These we would recommend to be destroyed, and ground into food for the hatchery fish.
- (2) Turtles, to be destroyed.
- (3) Perhaps some trout, to be transferred to hatchery ponds.
- (4) Bluegill and bass spawners.

Regulation of water level and fish movements

We regard as important the close regulation of the water level to a rather high level (near upper edge of beach), in order to control best the conditions about the spawning beds, brush shelters, etc. This will be easy to accomplish by

placing a dam in the outlet.

A much more important function of an outlet dam would be the prevention of fish movements into and out of the lake. The control of predators would be furthered, and the tendency of lake fish, especially bluegills, to drop down outlets in the fall would be prevented. There should be slash boards and fine-mesh screening in the outlet dam.

The outlet dam in our opinion is a vital necessity.

Increase of fish food in lake

Although Wolf Lake is not particularly poor in food production, the development of a much enlarged fish population will demand an increase in the amount of available food. This can be brought about in several ways.

1. Introduction of minnows.—Although blunt-nose minnows are present in the lake, we recommend that about 5000 more be introduced at the present time, which can easily be done from the experimental ponds (Schuil's). Whether the planting should be continued, should be determined by keeping the lake under observation.

We also recommend the introduction of 5000 golden shiners - a species we did not take in the lake. Whether plantings of this species should be continued should also be determined later.

We further recommend the thorough seeding of the lake with large "shrimp" (amphipods or scuds) from some weedy trout stream in the vicinity. These can best be obtained in the very early spring, when they particularly abound.

2. Improving spawning facilities for blunt-nose minnows.— To insure a heavy crop of blunt-nose minnows, to provide food for both fingerling and adult fish, we recommend the addition of 500 waterlogged slabs, boards, pieces of metal or other smooth and flat objects, on the underside of which this species will deposit its spawn. These should be placed around ^{the} entire lake (at intervals along shore of about 8 to 10 feet), and at various depths from 1 to 20 inches. Where the bottom is so soft that

the spawning slabs might sink, they should be placed on a little brush, gravel or other material, but should rest at least in part on the bottom.

3. Fertilizing.— The lake will no doubt receive a considerable amount of fertilizing material from the overflowing or draining of the extensive pond system, and from the troughs and raceways. An effort should be maintained to see that material rich in organic matter goes into the lake inlet.

A considerable amount of basic nutrition can be added to the lake by the rotting of an excess vegetation grown in the ponds. The weeds can be rotted in piles, placed in the ponds themselves, in the inlet, or around the shoal of the lake opposite the outlet.

To further the food production we also recommend a heavy sprinkling of black muck over the bottom of the shoal and the slope just beyond the drop-off, along all parts of the shoal except where the spawning material is added and except near the outlet. This would not be an excessively difficult task, because the muck is available close to the lake, and could probably be scraped to the lake where it could be loaded on a boat, or preferably a raft or small barge. It would be easy to figure out a device which would automatically wash off or out the muck as the craft was being piloted over proper depths by an outboard motor.

Discussion

If ~~the~~ Wolf Lake is to be utilized as an adjunct to the fish cultural establishment, we would recommend that the suggested improvements be started this fall, or at least well in advance of attempting to use the lake for fingerling or adult rearing.

The lake staff of the Institute would be glad to give some assistance in planning the details of cover and spawning improvement, and of other suggestions made in this report.

We do not feel in a position, at least now, to make a definite estimate of the cost of the improvement work.

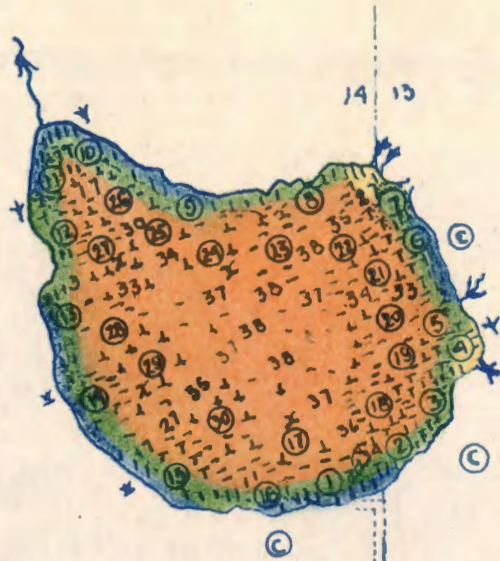
This ^{work} would be done, we assume, largely by the regular hatchery force, at times when other work was not more pressing.

This report was prepared by Carl L. Hubbs and R. W. Eschmeyer. It is accompanied by a colored map of the lake, worked out according to our usual lake survey methods. Also attached hereto is a sketch of our suggestion for the fyke nets, with specifications. Further details, giving the results of the survey, will be forwarded soon on the standard forms for the lake surveys.

INSTITUTE FOR FISHERIES RESEARCH

Carl L. Hubbs.

Carl L. Hubbs
Director



WOLFE LAKE

M-43

Kalamazoo - 9 mi →

VEGETATION BOTTOM & DEPTH CHART

COUNTY: VAN BUREN

RANGE: 13 W

TWP: ALMENA - 2 S

SECTIONS: 13 & 14

LEGEND

- MARL
- FIBROUS PEAT
- PULPY PEAT
- SAND
- INTERGRADATION

- Y BRUSHY SHORE
- X MARSHY SHORE
- o SNAGS
- x TRASH

- | EMERGENT VEG.
- FLOATING VEG.
- SUBMERGED VEG.
- ⊥ BOTTOM VEG.
- ⑦ VEGETATION BED
- ⊙ SPAWNING BEDS
- ⊙ CLEARED LAND
- SECTION LINE

SCALE: 8 INCHES = 1 MILE

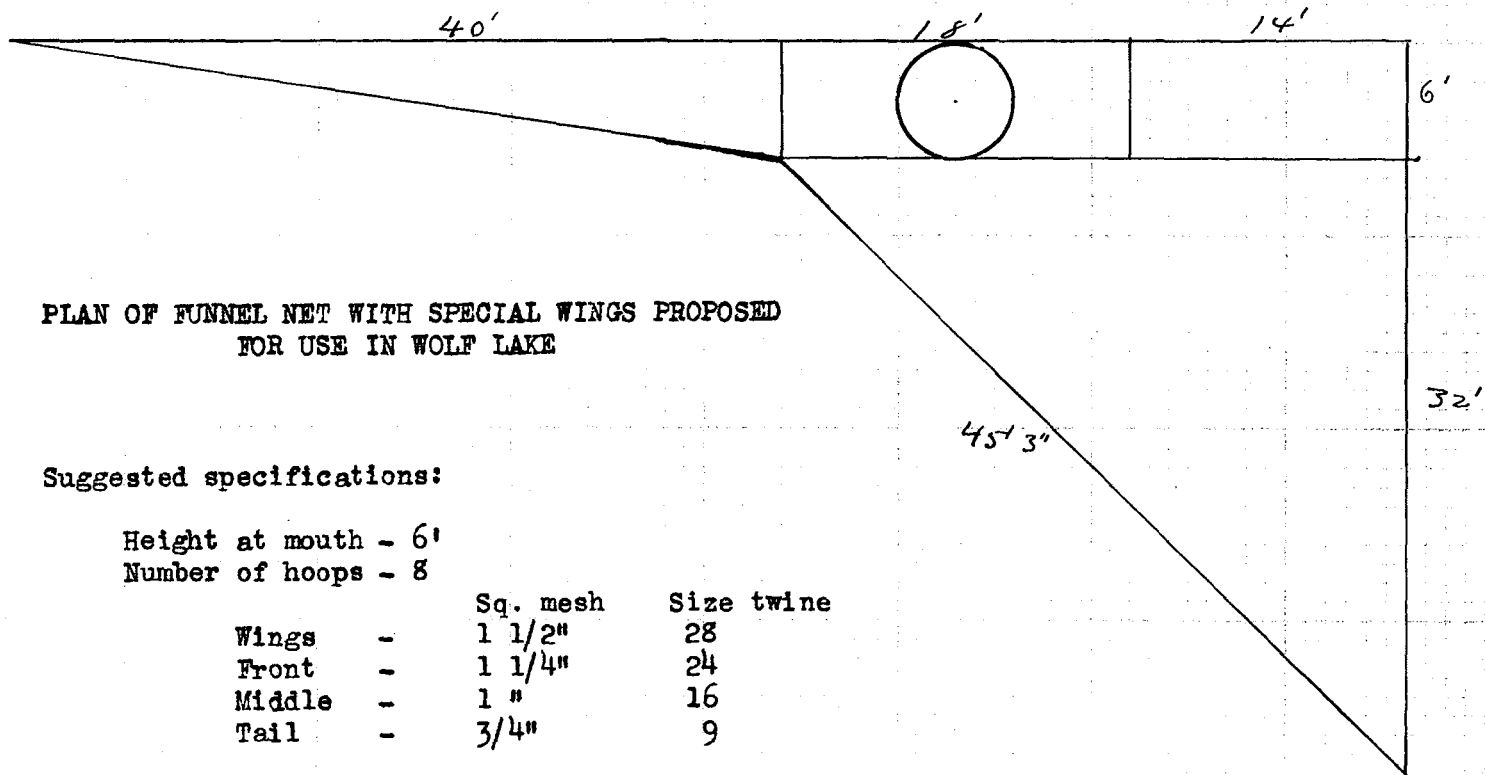
— ALL DEPTHS IN FEET

AREA 26.1 ACRES

INSTITUTE FOR FISHERIES RESEARCH

7-16-31-D —

— ANN ARBOR



PLAN OF FUNNEL NET WITH SPECIAL WINGS PROPOSED
FOR USE IN WOLF LAKE

Suggested specifications:

Height at mouth - 6'
Number of hoops - 8

	Sq. mesh	Size twine
Wings -	1 1/2"	28
Front -	1 1/4"	24
Middle -	1 "	16
Tail -	3/4"	9

To be tarred