AN INVESTIGATION OF

CERTAIN WATERS IN THE DUCK MOUNTAINS

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BY

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REPORT ON PRELIMINARY BIOLOGICAL INVESTIGATIONS OF LAKES OF THE DUCK MOUNTAIN AREA

PREAMBLE

The importance of the basic ground type in connection with the nature of lakes is widely recognized although in the majority of cases any direct correlation between the two is difficult to demonstrate. Not only does soil serve as anchorage for rooted plants but it influences the turbidity and chemical nature of the water as well as providing building material for burrowing or case forming animals.

Because of the decidedly different nature and origin of the ground, the lakes of the Duck Mountain area are quite different from those of the Whiteshell in many respects. On the other hand they have much in common with other lakes of the prairie steppes, such as Clear Lake in the Riding Mountains.

With the recession of the last glacier, large piles of boulder till were deposited on the western plains and along with the Riding Mountains, Porcupine Mountains etc., the Duck Mountains represent the remains of these piles. This glacial moraine which was very rough when laid down was made up of fairly smooth boulders, gravel, sand, clay, etc. Years of erosion by wind and water have levelled the general terrain considerably and filled in valleys and holes. Decaying vegetation has added a great deal of humus to the soil in many places but even yet only a thin layer covers the original boulders or gravel in many places. At the present time it is heavily wooded with a mixture of conifers and deciduous trees. Although many grassy plains and rolling hills do occur. Ecologically speaking, the higher altitudes represent an outcropping of the northern coniferous forest into what is really aspen parkland.

Lakes of this region represent depressions which were originally filled by melting ice or by springs or in some cases are simply depressions filled by inflowing streams. Quite frequently both springs and sizeable streams contribute to the water supply, but ground springs are very abundant in this area and appear to comprise the main water supply of the larger and better type lakes.

All the lakes investigated in this area lie well back from the eastern slope of the mountain and are situated on rolling terrain at an altitude of about 2200 to 2300 feet above sea level.

LITTLE BLUE LAKE

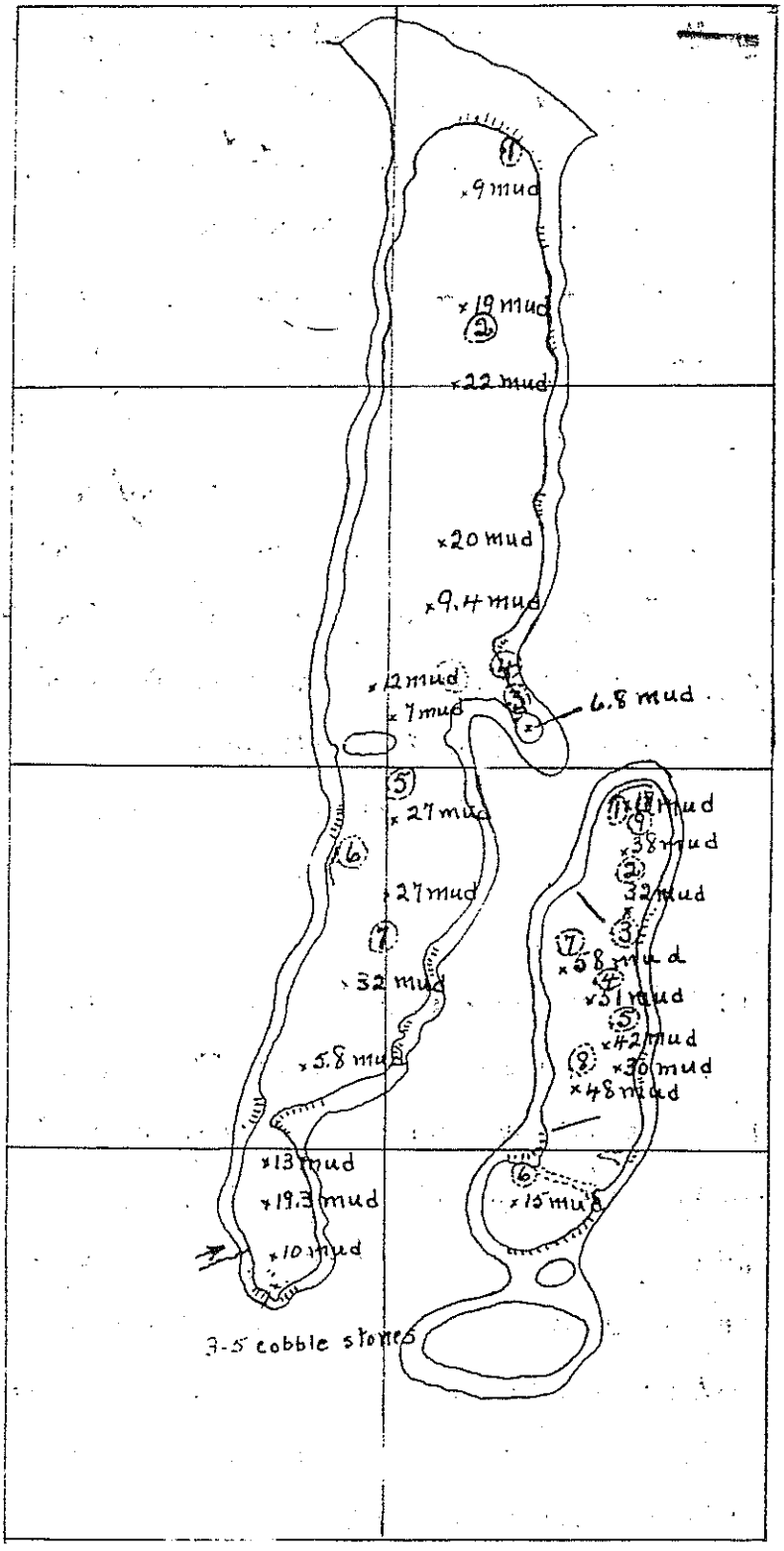
The Blue Lakes are quite accessible by car or truck as a good gravel road connects them with the Dauphin - Swan River highway near the town of Garland. Transportation of equipment and members of the party was very efficiently provided by Mr. V. Norman of Garland acting under the kind direction of the Manitoba Forest Service. A prospector canoe and a second tent also were kindly provided by the Manitoba Forest Service from the Singoosh Camp.

The first night was spent at Singoosh Cabin because of heavy wind and rain but later camp was established at the north end of little Blue Lake between it and a small bay on West Blue Lake. A team and democrat with driver were ordered from the settlement near Garland some 25 to 30 miles away and their arrival timed to coincide with the completion of the work at Blue Lakes.

The territory surrounding Blue Lakes is made up of rolling hills, fairly heavily treed with white spruce, jackpine, poplar and birch with many different shrubs, herbs and grasses. Little or no muskeg occurs close by but a few grassy slopes or valleys are present.

The Blue Lakes present a most unique situation as regards water levels. Practically all lakes in Manitoba have shown a general decline in water level since about 1926 but the past twelve months has witnessed a return to normal level or even in some cases a rise to the all-time high water mark. This apparently is not the case with Blue Lakes. Reports have it that less than twenty years ago the water reached to the tree line near the top of the banks. At present both Blue Lakes possess a steeply inclined beach of from 20 yards to 60 yards in width and rising to a vertical height of about 20 feet.

Blue Lakes



Scale: 2 ins = 1 mile

~~~ Marl outcroppings
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The beach is mainly sand or gravel with occasional boulders and shows 12 to 13 distinct terraces of remarkable uniformity, each terrace is, on the average, 3 to 4 feet, wide and quite level and then there is a sharp drop of slightly over a foot. Each one appears to mark one annual increment in water level drop. Succession taking place in the vegetation on the beach would also bear out this theory as it shows progressive age from top to bottom.

Woody herbs or even shrubs are found to some extent close to the tree line but the vegetation becomes more scanty and of a temporary nature toward the water and the last terrace is quite bare.

Had this lowering of the water level been the result of evaporation it should have stopped within the past twelve months or even returned to some extent to its original level. This apparently has not taken place, in fact the uniform rate of drop appears to be continuing uninterrupted. There is the possiblity of leakage into the subsoil during the drought years but even this should have stopped with the general rise in the water tables. One remaining explanation is that the water is leaking into a subterranean channel although it seems strange that water should run in from bottom springs at one point and then escape through a channel into the ground at another.

Little Blue Lake is roughly rectangular in shape, being rather narrow in proportion to its length. Although available maps show it to be over a mile and a half long its present length scarcely exceeds one mile. This discrepancy arises out of the fact that the maps apparently were made before the drop in water level occurred. The maps correspond very closely to the old shoreline but lowering water has cut off several hundred yards from the south end and left only two potholes separated from the main body of water by ridges.

Should this lowering continue another sizable portion will also be cut off within the next few years.

As pointed out above, much of the shore of Little Blue Lake is of sand or coarse gravel but this appears to form only a superficial coating over extensive marl beds. Outcroppings of this material are numerous along the shore particularly on points. It is somewhat bluish-grey in colour and crumbly when dry but only slightly sticky when wet.

Where sand or gravel are present on shore they extend only a short distance out into the water. From here on until the abysmal region is reached the exposed, very soft bluish-grey marl occurs. The bottom in deeper reaches of the lake is made up of the usual soft, flocculer, organic muck so common in lakes of the Whiteshell area. No clay or sand bottom was found in deep water, except at one point at a depth of 15 M. (See field notes, Station 3) The bottom of the lake in the litteral region shades off very gradually for from 6 to 10 feet from the edge then drops off very suddenly to great depth. Water pressure appears to be the factor which prevents this precipitous wall of marl from sliding down and thus producing a more gradual slope. Because of this peculiar type of bottom close to shore, this lake is a poor bathing place except for expert swimmers.

In spite of its small size Little Blue Lake, next to West Hawk, is one of the deepest lakes in the southern half of Manitoba. Its average depth is around 40 meters (132 ft.) but much of the lake has a depth in excess of this. At one point about midway from the ends and only 100 yards from the west shore a maximum depth of 58 meters (192 ft.) was recorded.

The water of Little Blue Lake was decidedly bluish in color. This appears to be due to something in solution in the water and not to reflection from the marl bottom as it is even more apparent in deep water. It has the same general appearance as a weak solution of copper sulphate but when examined in small quantities no trace of colour can be detected. It is very clear and gave transparency measurements of 5 meters to 5.5 meters.

No surface streams of any sort connect with Little Blue Lake and, as already stated, indications are that it is spring fed. The water is quite cold and there is definite thermal stratification of the water. The Epilimnion show a surface temperature of 14° C (57.2°F). The temperature dropped gradually to 13°C (55.6°F) at 8 meters then there was a drop to 10.8°C (51.5°F) indicating the top of the thermocline. This layer extended down to a depth of 15 meters but showed a variation of only 0.5°C from top to bottom. Below 15 meters the hypolimnion began as indicated by a drop to a temperature of 7.5°C (46.4°F). The lowest temperature recorded from this stratum was 5.5°C (41.8°F).

Chemical Characters

The quantity of oxygen dissolved in the water was relatively high, giving readings of 7.6 to 7.8 cc per litre for bottom samples and 5.6 to 7.8 cc per litre for surface samples. It is interesting to note that in one case tested the bottom water contained more dissolved oxygen than did the surface water.

The water was fairly hard and quite alkaline in nature. Bottom samples gave pH readings of 7.0 and 7.8 while all surface samples were of pH 7.8.

Biota

Emergent vegetation was absent from Little Blue Lake but a very dense growth of heavily encrusted chara was found over the bottom in shallow water and out to a depth of about 20 meters. (Along with this was an abundance of water moss) - plankton was fairly abundant in this lake (see table VII) but was comprised almost exclusively of silicious, case bearing forms such as the diatoms and flagellate Protozoa. A very few green or blue-green algae were present but large numbers of copepods and some Cladocera were found. Larger animals were moderately abundant around Little Blue Lake and included common terns, grebes, loons, goldeneye duck and some muskrats.

Hand picking and drag samples from shallow water showed the presence of Caddis fly nymphs, chironomid larvae, Mayfly nymphs and an abundance of Hyalella and Gammarus. Crayfish remains and Clam shells (Anodonta) were moderately plentiful and there was an abundant snail population both as regards numbers and species. Only chironomid larvae were found in the mud in deep water. Adult Mayflies and chironomids were falling into the water in considerable number.

Two overnight sets of a 4 1/4" gill net, 270 yards in length, resulted in a catch of 5 pickerel and 2 pike. The pickerel were excellent specimens of very uniform size and age and were in good condition. The pike were average in size and condition only. Examination showed that both species had been feeding exclusively on perch (see table I).

Young perch were seen on several occasions in schools in shallow water but none was captured. Johnny darters (Boleosoma)

also were seen around rocks and a few specimens were taken with a drag. Not a single minnow was seen in this lake and repeated attempts with the seine net failed to produce a single specimen of minnow.

Conclusions

Little Blue Lake represents a somewhat simpler type of biological community than the average lake. In summarising the situation two factors appear of major importance:

(1) The chemical nature of the water and

(2) its long isolation and the absence of any connection with other bodies of water. Most of the primary producers of this lake are shelled or encrusted forms and, on the whole, are not the best type of food material. However, an abundant fauna of Cladocera, Copepods and particularly Amphipods is present. No doubt they act as intermediaries in the food chain between the algae, etc., and the perch and other fish. Insect larvae and nymphs are also present in favourable numbers.

It is remarkable that no minnows are present in this lake and it may be that no species can live in water of this chemical composition. However, long isolation may be the cause of their absence and some species might do well if introduced. The plankton of Little Blue Lake is more nearly like that of Mantario Lake than any other examined to date. Here Notropis hudsonius and Notropis heterolepis were well established and it appears that they might also do well in Little Blue Lake.

Two alternatives are available - either a chemical analysis of the water and a series of experiments with different minnow species or simply try the introduction of all possible

species and let the environment do the selecting of the fittest. The latter would perhaps be the less scientific but the more expedient course.

With a good supply of forage types the productive capacity would be greatly increased in spite of the small size of the lake. The enormous depth and low temperature of this lake renders it favourable for a number of game fish species but it is to be borne in mind that the bottom is mostly marl or mud. There is a complete absence of boulder bottom but there is a sizeable expanse of sand bottom in shallower water at the north end which would serve as a spawning ground for some types.

WEST BLUE LAKE

Many of the features of Little Blue Lake are also common to West Blue and need not be repeated here. The two are separated only by a low timbered ridge in some places not more than three hundred yards wide. West Blue Lake is considerably larger, being about three miles in length by slightly less than one-half a mile in maximum width, according to the maps. However, as in the case of Little Blue Lake these dimensions appear to be exaggerated.

West Blue Lake shows the same general recession of the water level and the same terracing of the shore. The only connecting stream was a tiny trickle entering near the south end which apparently had not existed during drought years as no appreciable channel was present. The shore and lake bottom were identical with those of Little Blue Lake excepting that at the southern tip in from three meters to five meters of water the bottom was of cobble stones.

On the whole, the water of West Blue Lake was less intensely blue in colour and considerably more shallow. The maximum depth found was 32 meters (106 ft.) but much of the lake does not exceed 22 meters (73 ft.) in depth. The lake shows three deep portions incompletely separated by broad ridges or mud flats. Transparency of the water measured from 5 to 6 meters, the variations being mainly due to very heavy wind and rain which occurred while the work was in progress. Surface temperatures ranged from 14.8°C to 15°C (58.7°F to 59°F), while bottom readings showed a range from 6.5°C to 8.7°C (43.7°F to 47.5°F).

Chemical Characters

The oxygen concentration of the water was relatively high, being from 4.9 to 7.1 cc per litre in bottom samples and 7.8 to 8.2 cc per litre at the surface. Again, water samples showed some variation in hydrogen ion concentration. Bottom samples gave readings of from pH 6.8 to 7.5 and surface samples a pH of 7.8.

Biota

Some emergent vegetation, mainly in the form of Equisum, occurs around the edge of West Blue Lake mainly because the bottom does not drop off so suddenly in many cases and extensive shallow inshore waters are present. In deeper water there is a dense furry growth of Nitella on the bottom at several points.

Plankton, dredge and drag samples, in general, were very similar to those from Little Blue Lake. Plankton samples contained fewer of the silicious forms but more of the colonial blue-green or green algae. Again rotifers were present in considerable numbers whereas they were relatively scarce in Little Blue Lake. Cloderca were rare but Diaptomus and cyclops occurred in enormous numbers in surface water in the morning and evening. During storms they withdrew to the deeper strata but in bright weather they could be seen swimming about over a good portion of the lake.

Snails and other small molluscs were much fewer than in Little Blue Lake but clams (Anodonta) were found in extensive beds in the mud bottom. Hyalella and particularly Gammarus were superabundant around stones and trash in shallow water. They appeared to have formed breeding aggregations and the writer has never encountered

gammarus in larger numbers. Insects, either as nymphs or adults, were somewhat scarce in West Blue Lake but a good population of chironomid larvae was found in the bottom mud.

Weather conditions did not permit the setting of a net in this lake and a single pike was taken on a hook. It was a good specimen and had been existing on a diet of young perch. One drag of the seine yielded 109 perch of various sizes and one pike fry. The perch were excellent specimens and had been feeding extensively of gammarus and leeches (see table II). No evidence of other fish was seen.

Conclusion

West Blue Lake is a considerably heavier producer of forage animals of a type but its primary producers are fewer than in Little Blue Lake. Its perch population also is much greater but it appears to have nothing in the way of larger fish except a few pike. While the two habitats differ in several details the problem of improving the two Blue Lakes from the point of view of fish culture is essentially the same for both.

CHILDS LAKE

The road connecting Childs Lake with the Blue Lakes is gravelled for about 4 or 5 miles but beyond this it is not graded and has some steep hills. It is well cut out and on dry years is passable for car or truck, but many low places are without ditches or bridges and on wet years can only be travelled by horse drawn vehicles.

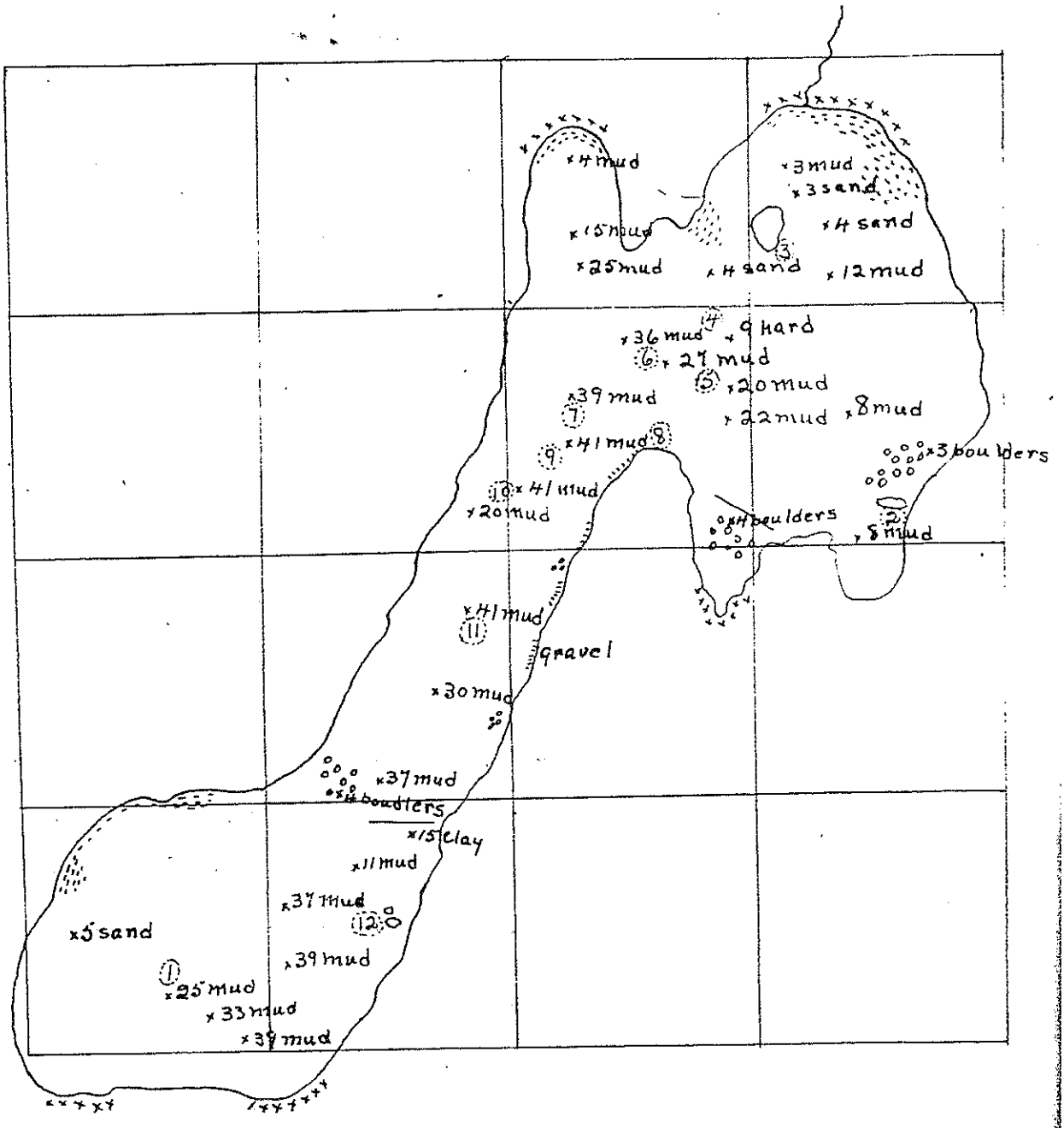
Our equipment was transported by team and democrat with a trailer attached behind on which the canoe was placed. The distance is about 8 to 10 miles, for the most part, through rolling, heavily timbered country. The trail finally emerges on the east shore of Childs Lake about a mile from the south end then follows the beach southward.

Physical characters

The terrain, timber, etc., surrounding Childs Lake are very similar to those of the Blue Lakes and discussion need not be repeated here. The lake itself is situated among rolling hills with stretches of muskeg and comprises a main channel some four miles in length by about 3/4 of a mile in width, with 2 shallower expanded bays, one stretching to the west at the south end and one to the east at the north end. The south bay has an area of about one square mile while the north one is approximately twice this size.

In most places there is a definite shore some 25 to 50 yards from the waters edge and this is followed by a beach that is grown up to some extent with willows, herbs and grasses. Much of the shore and beach is of fine sand but good sized stretches of coarse gravel also occur. No boulder shore or beach is present

Childs Lake



Scale: 1.5 ins. = 1 mile

gravel bottom

Boulder bottom

and in a number of places no shore or beach is present but the lake shades off into muskeg.

A great variation in the bottom types was found in Childs Lake. For the most part the bottom is of sand out to a depth of 4 to 5 meters but several patches of shallow mud were encountered. Again in 3 to 4 meters of water at several points the bottom was made up of large boulders piled one on the other. (See map) Some patches of clay bottom were found in up to 15 meters of water but beyond this depth the bottom was of the usual soft mud.

The bottom of the main channel along the narrower portion drops off from the water line quite suddenly to a considerable depth but in other portions the bottom slope is more gradual. The main channel proper is quite deep and gave a maximum measure of 41 meters (135 ft.). However, in both of the bays extensive portions of medium to shallow water occur.

The water has a fairly distinct greenish colour and is exceedingly clear, giving a transparency measurement of 8 to 9.5 meters. The water was also quite cold as shown by surface readings of 11°C to 13°C (51.8°F to 55.2°F) and bottom readings of 8.3°C to 9.5°C (46.5°F to 49.1°F). The thermocline in Childs Lake is only a few meters in thickness and begins at a depth of about 10 meters.

Chemical characters

The water of Childs Lake appears to contain a much smaller amount of dissolved inorganic material than that of the Blue Lakes and is softer to the touch. It is rather unusual in that some bottom samples were acid in nature, i.e. pH 6.8 while

others were alkaline i.e. pH 7.6. All surface samples tested were fairly alkaline and ranged from pH 7.6 to pH 7.8. Dissolved oxygen was unusually high and showed 7.8 to 8.5 cc per litre for bottom samples and 8.2 to 8.9 cc per litre for surface samples.

Biota

Emergent vegetation is quite common in the shallower bays of Childs Lake particularly at the north end where extensive patches of typha Scirpus and Phragmites occur. In deeper water where the bottom is of clay or mud there occur large beds of submerged ceratophyllum demersum. This gave some trouble as the gill net became fouled with it on one occasion. Loons, terns, herring gulls and scoter ducks were present around the lake in considerable numbers.

Drag samples and hand collections yielded a wide assortment of organisms including caddis fly nymphs, coxixidae and an abundance of Hyalella and gammarus. Molluscs, again, were abundant, particularly the smaller snails and bivalves but both hymnaea stagnolis and Anodonta were found in moderate numbers in localized areas.

The water in Childs Lake showed a slight bloom and plankton samples showed a wide variety of organisms in goodly numbers. With no one of the lower types predominating, Cladocera and Copepods were large and very numerous all through the water. Cold, stormy weather may have been the cause but the organisms of this lake showed the most remarkable uniformity of distribution both horizontally and vertically.

The remains of only a single small perch were found along the shore. Repeated seinings in various localities yielded not a single specimen and only 1 five-spined stickleback was brought in with the drag. No evidence of minnows was seen anywhere.

Two overnight sets and one day set were made with the gill net but the catch was very light. It comprised five pike and one marias. The pike were quite good specimens and had been feeding exclusively on darters and sticklebacks. Numerous suckers were seen swimming about in clear water and the remains of a pickerel and several marias were found on shore.

Conclusions

Childs Lake lying in much the same type of surroundings is remarkably like Clear Lake in the Riding Mountains. It is considerably smaller and somewhat shallower than Clear Lake, of course, and there is less boulder shore and bottom but slightly more clay perhaps. Like Clear Lake it has the channel of an old non-function outflowing stream which is of small consequence and the lake as a whole derives the greater part of its water supply from bottom springs.

It has a moderately broad sand or gravel beach around most of its margin but this beach is not terraced as in the case of that of the Blue Lakes. Again this beach shows a growth in places of woody perennial plants of considerable age so it is assumed on this evidence that there has been no appreciable drop in water level in many years. It is true that low gravel ridges occur where the beach is fairly flat but these appear to have been

thrown up by ice action during heavy storms many years ago.

Childs Lake offers more fine building sites for summer cottages than any lake seen to date in Manitoba. Above the beach proper, the shore, throughout much of its length, rises by two steppes. Both of these are well treed for the most part and the first one is usually quite level and from 25 to 75 yards in width. This should be ample room for the average cottage and at the same time provide good protection with ideal frontage on the lake.

As an angling proposition the present status of Childs Lake is rather low as indicated by the catches mentioned above. In addition to this people who had angled in this lake reported poor catches. Three fishermen were spending a week-end on this lake at the time of our arrival but their entire catch did not exceed a half dozen pike.

In spite of this, Childs Lake offers greater possibilities for success in the introduction of a game species of fish than any lake so far studied with perhaps the exception of Crow Duck Lake. The water is deep, cold and extremely clear. The primary food producers, while not extremely abundant, are present in satisfactory numbers and offer a very wide variety. Small forage types of crustacea are quite abundant and are excellent specimens but the insect fauna was slightly deficient. However, this would undoubtedly improve as the season advances. The molluscan population is both large and varied.

Small plankton feeding fish and fry should find an abundance of available food in this lake and larger fish would

be almost free from the activities of competitors or predators. However, for larger fish there is little available in the way of food except an abundance of amphipods and molluscs. The main food deficiency for larger game fishes lies in the complete absence of minnows and considering the physical, chemical and biological characters of Childs Lake it seems that almost any of the commoner forage types of minnows should flourish here if once introduced.

With this food deficiency corrected, Childs Lake should then be ideally suited for the introduction of some of the smaller, very sporty varieties of trout such as Steel-heads or cut-throat trout. Whether or not they could propagate in this lake is somewhat problematical but the odds appear to be in favour of successful reproduction.

GLAD LAKE

Glad Lake is a relatively small body of water lying due south of Wellman Lake in the Duck Mountain. The survey was conducted to determine the possibilities of Glad Lake as a game fish proposition. This was done at the same time as the Wellman Lake survey as it is most accessible through Wellman Lake.

Glad Lake is located about twenty miles south and east of Minitonas in the north central section of the Duck Mountain. The lake is not readily accessible by automobile although such a trip was made last fall. Previous to our arrival heavy rains had made the trail almost impassable and on the recommendation of the district forester, Mr. Clee, the services of a local farmer with a small tractor were secured in preference to horses. The necessary equipment and the canoe were loaded onto the trailer and towed behind the tractor. Much credit is due to the tractor man, Mr. Eugene Shiel of Minitonas, for the skill and good judgment he displayed in handling the outfit. Although the total distance was not great, owing to a combination of bog holes and windfalls, it required approximately twelve hours to reach Wellman Lake. Glad Lake was reached by crossing Wellman Lake and packing the canoe and necessary equipment over a short, well cut portage on the south shore.

Like the Riding and Porcupine Mountains, the Duck Mountain is the result of glacial deposition and was formed with the recession of the last glacier. At that time the formation was quite rugged but a gradual weathering process has reduced the higher areas and filled the depressions so that the mountain actually consists of an elevated plateau, the top of which is a series of hills and valleys at an elevation of 2,200 to 2,400 feet above sea level.

The vegetation of the Duck Mountain area is classed as mixed woods section of the Boreal forest and consists of both coniferous and deciduous types. As a result of fires there has been a considerable succession of second growth poplar. In certain areas there occur open rolling meadows with a scattered growth of willow and other shrubs, providing an excellent habitat for elk.

Glad Lake is roughly rectangular in shape with the long axis in a north-south direction. It is about one and one-half miles in length and has an average width of one-third mile. The shoreline is irregular with the result that the bays are fairly numerous and apart from the north end which shades off into muskeg, the shore consists of boulders or sand. There are present some excellent sand or gravel beaches which extend well out into the lake. There was no evidence of springs in the vicinity of Glad Lake so that the water supply apart from precipitation is limited to muskeg seepage and intermittent flow from a stream entering the south-west corner from a small lake. The only outflowing stream is a small channel towards the north on the east side which drains into a low lying area. This in turn drains into Wellman Lake. During periods of heavy flow these streams cause the inwash of considerable organic trash. The stream entering the south-west corner and the muskeg seepage from the north are responsible for a marked brown coloration of the water in those areas.

At the time of our visit (July 6th to 8th) the water had reached a normal summer level and both inflowing and outflowing streams were reduced to a trickle. The lake showed considerable variation in depth with a maximum of 121 feet toward the north end

although the bay at this end is rather shallow. The remainder of the lake varies in depth from 40 to 80 feet. The lake bottom in deep water is composed of a blackish organic mud, the nature of which will be discussed in connection with oxygen determinations. In shallow water the bottom consisted of clay, or in many inshore waters of sand. The lake is partially divided in the vicinity of the game line by a bar of sand covered with mud at a depth of 42 feet on either side of which the bottom falls away rapidly.

Thermal stratification was observed in the lake, surface temperatures being 18° C. (64.4° F.) and the bottom readings 9°C. (48.2°F.). Although a fair algal bloom was present in the water, transparency readings of 21 and 27 feet were obtained. The hydrogen ion concentration was constant throughout the lake; all surface waters were fairly alkaline with a pH of 7.5 while the bottom samples were acid with a pH of 6.8. The oxygen content of the surface water was 9 mgms per litre, which is equivalent to 95% saturation at the existing temperature. The bottom samples were found to be devoid of oxygen and the addition of acid to the treated sample produced a marked odour of hydrogen sulphide. This would indicate the presence of reduced sulphides in sufficient concentration to demand much of the available oxygen from the lower strata of the lake. Further reduction in the oxygen content of the water at the bottom would result from the oxidation of the organic muck which covers a good percentage of the lake bottom.

Owing to the depth of the main body of the lake, vegetation is confined to the sandy bays and shallow inshore waters. It consists mainly of Scirpus and Equisetum, although lily pads (Nymphaea) are abundant along the north shore where the lake is confluent with

muskeg. Potamogeton is also found in this area. A wide variety of plankton types were present with an abundance of Crustaceans. The lake is fairly well stocked with minnows of two species, Notropis hudsonius and Hybognathus nuchalis. Young perch (Perca flavescens) were also common in the seine samples. Drag samples and hand collections yielded a wide variety of feed types such as Trichopteran larvae, leeches, Gammarus and mulluscs. One overnight set of 50 yards of 5 1/4" and 100 yards of 4" gill-net caught eight pickerel and one common sucker. The pickerel were in good condition with the exception of two specimens which had cysts in the head region caused by a parasitic infection. Adult tapeworms were present in the guts of most of the pickerel and in four cases the larval form of a tapeworm later identified as Diphyllobothrium sp. was found. This metacestode larva is worthy of some attention although it cannot be identified as to species at the moment. It occurs in the encysted condition and therefore is not D.latum. In all probability its definitive host is some piscivorous bird. If this is the case it will not develop in man but because of the fact that its incidence of infestation in the pickerel of this area is so high it should be fully studied at the earliest opportunity.

At the present time pickerel is the only fish of importance occurring in Glad Lake. Although the lake is sufficiently deep to ensure low temperature during the summer months there are two factors which do not favour the introduction of lake trout. The first is the low oxygen content of the bottom stratum of the lake daused by the presence of reduced sulphides and organic muck demanding the available oxygen. The second is the absence of a deep swimming forage type of fish to sustain the trout when they are forced to deep water through the summer months. Unless the food chain can be

improved by the introduction of a forage type such as the black-backed tullibee, lake trout would experience difficulty in surviving the period spent in deep water. On the other hand Glad Lake appears to be a reasonably good bass lake. The surface waters are quite productive and the sand and gravel bottom of many of the inshore waters would provide excellent spawning grounds for bass. It is recommended that small scale stocking operations with small mouth black bass be undertaken in the near future. Restocking with any type of fish should be limited until the effect of the presence of sulphides under winter conditions has been determined.

Glad Lake is a particularly attractive spot and in combination with Wellman Lake to the north, offers great recreational possibilities following the development of adequate roads in the Duck Mountain. Both lakes are well provided with sandy beaches and excellent building sites. While the pickerel fishing is excellent at the present time, the introduction of a game fish such as bass will add greatly to the value of the lake for angling purposes.

LAURIE LAKE

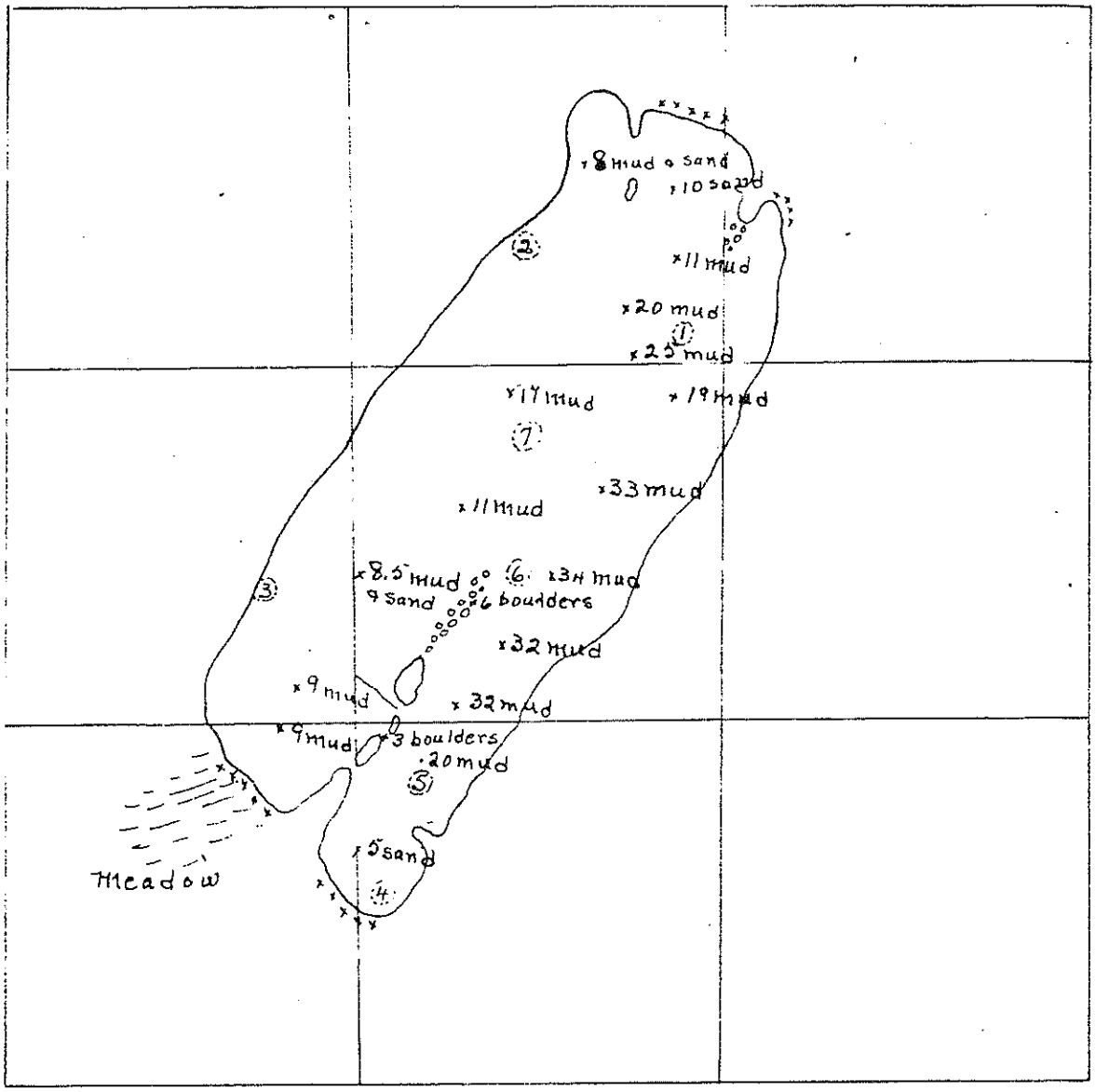
Laurie Lake lies approximately one mile south-east of the southern end of Childs Lake but the two are separated by a stretch of low-lying ground and muskeg. The road to Laurie Lake begins on the east shore of Childs Lake about three hundred yards south of the end of the road connecting with the Blue Lakes and Singoosh. It forms a large U over higher ground to the east for slightly over two miles and finally emerges close to the north-west corner of Laurie Lake. This road also showed signs of automobile travel during dry years but at the present time has several very wet places.

Physical characters

The territory surrounding Laurie Lake is mostly of the usual rolling hills with some low meadows and muskeg. The west side is moderately low and timbered with deciduous trees, mainly poplars, box elder, elm and birch but the east side is somewhat higher. Here the greater portion is heavily timbered with spruce but toward the north end high burned-over hills occur. Both ends of the lake have projecting ridges on each side of which the shore is low and the immediate territory is muskeg. At the south-west corner there is a fairly extensive meadow or grassy swamp.

The lake itself is almost rectangular in outline, being almost two miles in length by slightly less than a mile in width. The beach is well marked and varies from 25 to 75 yards in width depending on the incline. Toward the top it has a growth of herbs and shrubs but in general is very similar to that of Childs Lake

Laurie Lake



Scale: 2 ins. = 1 mile

and does not indicate any pronounced or progressive drop in water level in recent years. Along the sides of the lake, throughout most of the length, the beach is of sand or coarse gravel but at the south-west corner there is a broad, gradually inclined mud flat.

As regards depths, Laurie Lake is divided into two fairly distinct portions. As already stated, moderately high narrow ridges project out from the ends and these are continued out into the lake either as a string of small islands or shoals of large boulders, or both. These imcompletely divide the lake into a narrower, deeper eastern portion and a wider, shallower western portion. The maximum depth of the eastern portion was 34 meters (112 ft.) but it maintained a depth of 20 meters or better throughout most of its length. The western portion gave a maximum depth of 17 meters (56 ft.) but on the average and particularly toward the south end, the depth ran around 9 to 10 meters (29.7 to 33 ft.).

A goodly portion of the inshore water had a bottom of sand or gravel but in a few spots mud bottom was found or a mixture of the two. Such conditions extended out to a depth of about 10 meters beyond which the bottom was of organic mud. Between the islands or out from the projecting ridges, shoals of very large boulders could be seen in from 2 to 6 meters of water. At the north end the bottom was mainly of brownish sand but several outcroppings of clay were detected.

No streams connect up with Laurie Lake and indications are that it is fed by bottom springs. The water is olive green in colour and is exceedingly transparent giving a reading of 9 to 9.5 meters (29.7 to 31.3 ft.). The water temperature was only slightly

higher than that of Childs Lake, being from 12.8°C to 13.5°C (55.4°F to 56.4°F) on the surface and from 8.5°C to 10°C (47.6°F to 50°F) for bottom samples.

Chemical Characters

Chemically the water of Laurie Lake differs from that of Childs and most of the other lakes so far examined in that it is alkaline at both the bottom and the top. All readings taken here from both levels gave a pH of 7.7.

Oxygen concentration was unusually high and ranged from 8.5 to 8.9 cc per litre in bottom samples to 8.2 to 8.5 cc per litre in surface samples. It is notable here that a higher concentration of dissolved oxygen was obtained from lower strata than from the surface layers.

Flora and Fauna

Emergent vegetation was moderately abundant in shallow water at the south end of Laurie Lake. It consisted almost entirely of Equisetum but farther out where mud bottom existed dense patches of potamogetons were present.

Macroscopic organisms collected included moderate numbers of Anodonta, U. trivolvis, Stagnicola colustris, Lymnaea, Stagnalis, Physella sp., crayfish, caddis fly nymphs and a few adult dragonflies. Drag samples indicated that Gammarus, Hyalella and a number of smaller snails and bivalves were quite numerous (see Table X). Strangely enough, chironomid larvae failed to turn up in several dredge samples of soft bottom mud.

Plankton is less abundant in Laurie Lake than in Childs and shows a narrower range of species of blue-green and green algae and also fewer species of rotifers. Apart from these minor points, samples from the two lakes are almost indistinguishable.

A gill net 270 yards in length was set for about five hours in from 3 to 9 meters of water. Four pike were taken, three of which were quite good specimens but a fourth was in poor condition and was infested with Proteus hydrophilus, a bacterium which produces skin ulcers. Examination of the gut contents of these specimens showed that they had been feeding on young perch, sticklebacks and caddis fly nymphs.

Pike apparently are quite abundant in Laurie Lake as three fishermen encountered had taken 16 excellent specimens in a single forenoon. No indications of the presence of other large fish were seen.

The lake was examined quite thoroughly for minnows but none were seen. Again several drags with the seine at different points failed to produce a single specimen. Other small fish were confined to localized areas apparently as only one seine drag was successful. The catch contained a total of 31 sticklebacks (Eucalia inconstans) and one Johnny darter (Boleosoma nigrum). These specimens were in good condition and many of the sticklebacks were nearing the time of reproduction.

Conclusions

Laurie Lake is a pretty little lake with excellent water and is worthy of some consideration as an angling proposition. On account of the apparent abundance of pike present, its status at

the moment from the anglers point of view is a little better than that of Childs Lake. However, for this reason and because of its smaller size and shallower nature, it does not offer quite such good possibilities for the introduction of game fish.

Much of the same treatment required to bring Childs Lake to the greatest possible production could also be applied to Laurie Lake as well. It produces less algae in general, but its planktonic fauna and flora are quite rich. In respect to both small and large crustacea, no complaint can be raised. The same applies to molluscs but there is a slight deficiency in the aquatic insect fauna and a decided absence of the more valuable types of forage fish.

The logical procedure would seem to be as in the case of the other three lakes of the Duck Mountain area already considered, to introduce one or more suitable species of forage minnows. If these can be successfully established, which is highly probable, then the larger game species could be introduced.

Laurie Lake is physically and chemically well adapted for the support of a number of game species that require cold clear water of considerable depths. Some trouble might be experienced as a result of competition or depredations by the pike, already present in the lake but a species might be selected to which the pike is incapable of antagonism.

WELLMAN LAKE

Wellman Lake is a moderately large lake located in the north central region of the Duck Mountain. This lake was surveyed during the period July 5th to 8th, 1944, with a view to determining its present fish population and its possibilities for stocking with game fish.

The lake is located about eighteen miles south and east of Minitonas and is reached by a wagon trail having its origin three miles east and eight miles south of the town. In dry seasons the road will allow automobile travel but heavy rains previous to our arrival eliminated this mode of transportation. On the recommendation of the local forester, Mr. Clee, the services of a farmer with a light rubber-tired tractor were secured. The necessary equipment and canoe were carried on the trailer towed behind the tractor. The first portion of the road from the town to the beginning of the wagon trail presented no difficulty, but the latter portion consisting of a series of steep grades, bog holes and windfalls, reduced the rate of travel so that approximately twelve hours were required to reach Wellman Lake.

Like the Riding and Porcupine Mountains, the Duck Mountain is the result of glacial deposition and was formed with the recession of the last glacier. At that time the formation was quite rugged but a gradual weathering process has reduced the higher areas and partially filled the depressions so that the mountain actually

consists of an elevated plateau, the top of which is a series of hills and valleys at an elevation of 2,200 to 2,400 feet above sea level.

The vegetation of the Duck Mountain area is classed as mixed woods section of the Boreal forest and consists of both coniferous and deciduous types. As a result of fires there has been a considerable succession of second growth poplar. In certain areas there occur open rolling meadows with a scattered growth of willow and other shrubs, providing an excellent habitat for elk.

Wellman Lake is roughly crescentic in shape, the concave side being fairly regular in outline while the convex side gives rise to several long arms or bays varying considerably in size. The area of the lake is in the neighborhood of three square miles. The lake was found to differ considerably in outline from that shown on the map and although the modified map included with this report is probably inaccurate in some respects, it is an improvement on the general outline of the lake and its geographical relationship to Glad Lake to the south. Boulder formation is common along the shoreline, particularly along the inner edge of the crescent. In other areas the vegetation extends down to the shoreline, while the tips of several bays are confluent with muskeg. The remainder of shoreline is made up of excellent sand beach. Only one well defined stream enters Wellman Lake, flowing through a low-lying area below the south-east corner. This stream is joined by another flowing from Glad Lake through a small un-named body of water. During the spring run-off the lake is

also fed by two poorly defined streams entering the forked arm at the north-west corner of the lake. Considerable seepage enters the lake from several patches of muskeg bordering the shoreline. The only outflowing stream is the Roaring River which has origin on the north side of the north-west arm of the lake. This river is joined by many tributaries and follows an indirect northerly route to drain into the Swan River. Although the Roaring River was carrying a fair volume of water at the time of the survey, local reports indicate that it is not unusual for it to cease flow entirely by the beginning of July. Owing to recent heavy rains, the water was slightly above the normal summer level. The maximum depth of water was 54 feet, although the average depth for the main body of the lake was approximately 25 feet. A depth of 45 feet was found in two other locations but the deep area was very limited and in all cases the bottom consisted of flocculent organic muck. This type of bottom was quite general throughout the lake, with the exception of small areas of clay, sand or boulders. The shallower inshore waters possessed a bottom varying in type from sand, mud, boulders, clay to organic muck. In many places the bottom in shallow water consisted of a mixture of sand, pebbles and small boulders providing excellent spawning grounds for bass.

As the result of fluctuating aerial temperatures during the period July 5th to 8th, a variation in the water temperature was also observed. Surface and bottom temperatures varied from 15°C. (59°F.) to 18.5°C. (64.8°F.). No thermal stratification of the water

was observed. Transparency readings of 10 to 11 feet were obtained. Hydrogen ion concentration throughout the lake ranged from 7.6 to 6.8 for surface samples and from 7.0 to 7.6 for the bottom samples. The oxygen concentration of all surface samples was close to saturation while the bottom samples showed considerable variation. In one case the same reaction as that occurring with bottom samples from Glad Lake was seen. No oxygen was present in this sample and its depletion is believed due to the combined presence of reduced sulphides and organic muck, both of which make heavy demands on dissolved oxygen. In other cases the bottom samples showed oxygen contents varying from 40% to 85% saturation.

Almost the entire shore of Wellman Lake is lined with emergent vegetation consisting mainly of Scirpus and Equisetum. In shallow lagoons where the bottom is trashy there is a considerable growth of Potamogeton, Nymphaea and Myriophyllum. Chara was observed in several locations over a sandy bottom. Dense mats of sedges occur at the tips of shallow bays shading off into muskeg.

A fairly heavy algal bloom was present in the water consisting largely of diatoms and colonial algae. Protozoa and Rotifers were well represented while Crustaceans were particularly abundant. A detailed analysis of the plankton samples is provided elsewhere in this report. The lake is well stocked with forage material, particularly small perch and minnows of the species Notropis hudsonius, along with Trichopteran larvae, crayfish, leeches and Gammarus in the shallows. Hexagenia were found in limited numbers.

To determine the abundance and condition of the larger fishes, an overnight set of 100 yards of 4 1/4" mesh and 50 yards of 5 1/4" mesh gill net was made towards the north end. This set yielded

24 pickerel and five common suckers. All fish were taken in the 4 1/4" mesh net. The pickerel were in excellent condition, and judging from the number netted and reports of local anglers, the present population is very large. Owing to its inaccessibility Wellman Lake has been fished very little and until such time as the road is improved no thought need be given to artificial propagation of the species present. Although no pike were taken in the gill-net, they doubtless occur here. From such a lake as this the pike should be in excellent condition and provide a valuable supplement to the pickerel fishing.

Adult tapeworms were found in the gut of several pickerel, and in each specimen the larvae form of a tapeworm later identified as Diphyllobothrium sp. was found in the body muscle. This metacestode larva is worthy of some attention although it cannot be identified as to species at the present time. It occurs in the encysted condition and therefore is not D. latum. In all probability its definitive host is some piscivorous bird. If this is the case it will not develop in man but because of the fact that its incidence of infestation in the pickerel of this area is so high it should be fully studied at the earliest opportunity. The same tapeworm occurs in the pickerel of Glad Lake to the south.

Conclusions

It is the considered opinion of the writers that the combined features of Wellman Lake and Glad Lake offer great possibilities as a tourist attraction as well as serving the residents of the Swan River Valley with recreational facilities. While the limiting factor at the present time is an adequate road into Wellman Lake, the present

road could be made serviceable with a reasonable expenditure. Both lakes are well stocked with pickerel and pike providing excellent angling at present. Wellman Lake is considered to be an excellent habitat for largemouth black bass and the introduction of this species would supplement the pickerel and pike fishing. In the case of Glad Lake, adult lake trout were recently introduced as an experiment. It is also considered a good bass proposition preferably for the smallmouth variety. Adequate spawning grounds for both species of bass are present along with an abundance of forage material. It is considered advisable to introduce the bass as adults rather than fry or fingerlings, as the former method has been more successful in other localities. Apart from their excellent angling possibilities, Wellman and Glad Lakes are very picturesque. The shoreline is high and well treed, providing an infinite number of excellent camping grounds or building sites. Wellman Lake in particular possesses several miles of excellent sand beach ideal for bathing purposes.

In conclusion the writers suggest that these two lakes be stocked with adult bass at the earliest opportunity, and in the near future a check be made on the bass planting in Glad Lake to determine whether or not the new species have become established.