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AN ANALYSIS

OF

WILD RICE

AT

HOUGHTON LAKE, MICHIGAN

by

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Edited by

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Restoration

The Author

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INTRODUCTION

Houghton Lake is located in the upper part of Michigan's Lower Peninsula. It is 20,094 acres, or about 32 square miles in size. The lake has a medium depth of 8.5 feet and a maximum depth of 22 feet. It is Michigan's largest inland lake. The shoreline is mostly developed with approximately 8,000 permanent and seasonal residences surrounding the lake. Houghton Lake is an important recreational lake, with many uses such as boating, swimming, fishing, and hunting. Tourism is an important part of the local economy.

The legal lake level was established by Circuit Court January 5, 1926 at 1138.1 feet above mean sea level. At that time the lake level was maintained by an old timber dam with flash boards. The lake level is currently regulated by a stoplog dam constructed in the fall of 1938. At 1138.1 feet, there is a 3.1-feet of stoplog above the sill of the dam and 3.7-feet of structure above the Muskegon River channel (1969 Engineer's Report).

This means that in its original unregulated state, Houghton Lake was probably a lush emergent wetland with large, deep marsh zones subject to natural drawdowns during dry years. During pristine times the lake undoubtedly teemed with fish, fowl, and furbearers of many kinds.

PART ONE

Loss of Wild Rice Growth

Wild rice has been in decline in Houghton Lake since the late 1980's. In 1989 the Muddy Bay rice bed disappeared (see Figure 1). This was followed by the disappearance of the rice bed in North Bay in 1990. The extensive rice bed in the Middle Grounds persisted until 1992. It has been essentially absent in 1993 and 1994.

Some floating leaf stage rice plants were observed from July 14, 1994 until August 26, 1994 in the Middle Grounds by Michigan Department of Natural Resources (MDNR) personnel (G.F. Martz, pers. comm.), and by others at various times and places on the lake. The most abundant plant densities occurred on the Middle Grounds during the 1994 growing season.

While the size and density of the extensive wild rice beds has varied over the years, the rice has consistently been there since anyone can remember. There are some references to seeding as far back as 1918 (Miller, 1943). No one knows whether this was an expansion seeding or establishment seeding. A 1920 publication, Inland Lakes of Michigan, refers to wild rice beds of such density that it would be "difficult to even consider studying other plants and animals". This suggests that the wild rice has been there many years due to its lakewide abundance at that time. Perhaps a study of earlier records could further date its presence on the lake.

Impact on Waterfowl

Wild rice has long been known to be an important plant for waterfowl (McAtee-1917, Chambliss-1922, Stoudt-1944, Bellrose-1976, and Peden-1977). Most previous studies have focused on its food value but less well known are published and unpublished works focusing on its value as brood cover and as a feeding condition modifier for both dabbling and diving ducks.

Its use as spring and fall migrational habitat for waterfowl has been well documented. Much of the waterfowling in Houghton Lake was centered around the wild rice beds, and Houghton Lake is recognized as one of the four most important habitats in Michigan for migrating diving ducks (G. F. Martz, MDNR, pers.comm.).

Impact on Fisheries

Wild rice is beneficial to fishery resources in a number of ways. The detritus from a previous year's abundant wild rice growth forms a dense mat on the bottom of a lake in the spring. It is likely this substrate provides adequate spawning for Northern Pike, a species whose eggs have good adhesion qualities (D.Schupp, Personal Comm.). Several rice lakes in Minnesota are important northern pike spawning areas (J. Fraune, MDNR, Pers. Comm.). The emergent plant community formed by wild rice is also an important nursery habitat for various species of panfish and pike.

In the case of Houghton Lake, the wild rice beds were an effective barrier to boat travel in areas of the lake where it occurred. This helped alleviate any possible effects of heavy boat traffic on fishery resources in these areas.

Emergent plant communities are also a place where much interaction takes place between predator and prey fish because of the physical structure of the plant community. They are important feeding areas for fish. Therefore, much of the sport fishing on Houghton Lake was centered around this habitat.

There is currently great concern on the part of many Houghton Lake fishermen over a possible decline in the fishery there. Reports indicate that three local bait shops have closed in the past year due to a decline in fishing success (D. Polens, Houghton Lake Assoc., Pers. Comm.). However, recent studies of the lake done by MDNR Fisheries indicate that species composition and numbers have remained similar when comparing 1983 and 1993 test netting data.

A 1973 study (Water Quality of Houghton Lake, Pecor et.al.) quantified fishery resources on the lake and provides valuable baseline data. They also refer to a thorough study done in 1955. The researchers compared the results of the 1973 and 1955 studies and found no significant changes in fish populations between the two periods. A comparison of current fish populations to these studies would be most useful, especially if the same methodology were used.

Impact on Water Quality

Emergent plant communities break up the effects of wind fetch. That is, they reduce the amount of suspended solids and turbidity associated with wave action. Emergents, such as wild rice and bulrush, are also settling areas for suspended solids. Without the settling effect, these solids combine with other plant and animal material to make water more turbid. Because of Houghton Lake's shallow depth and large surface area, a total mixing of its water takes place. Without the emergent plant community or any extensive deep water zone, little settling of solids can take place.

This problem has been further exacerbated by extensive marsh filling and bulkheading around the lake. Therefore, gradual runout of wave energy cannot occur, particularly under high water conditions. Wave energy is reflected off the bulkheads and filled shoreline areas, then goes back into the lake. It is a prime reason for Houghton Lake's relatively turbid waters.

Excessive water turbidity works against bass and bluegill populations and northern pike to a lesser extent. This is partly because penetration of sunlight is more restricted, resulting in a loss of submerged plant growth. The loss of submergent and emergent plants can result in more nutrients in the water to be taken up by less desirable plants such as algae, causing increased turbidity problems.

Although Houghton Lake's water turns over at an extremely rapid rate, once every 1.2 years (Pecor, et.al. 1973), it is still classified as a eutrophic lake. Therefore, the water has been generally turbid over the years. It is not known if there has been enough increase in turbidity to adversely affect plant growth on the lake.

PART TWO

A General Discussion of Wild Rice Germination and Growth

As with most annuals, wild rice is not a particularly competitive plant. Its growth and survival is partly based on the early germination of the seeds following an overwinter dormancy period (Oelke, et.al., 1982). Since it germinates at 42 degrees Fahrenheit, it literally grows ahead of other slower growing macrophytes such as water milfoil (Myriophyllum spp.).

Natural wild rice stands generally have dense beds of macrophytes associated with them. The wild rice plant is able to thrive because its growing sequence allows it to be among the earliest germinating and growing plants in its native waters. Part of this may be due to its ability to germinate under an anaerobic condition. Oxygen is, of course, necessary for proper growth of the plant, and is translocated to the root by normal plant metabolism sequences.

Germination occurs in late April or early May in Minnesota. The floating leaf stage begins at 29 days after germination and lasts for about 10 days. The plant then becomes aerial.

Under ideal conditions a plant will tiller, that is, have stems branching off the root node. This does not occur as frequently in deeper waters such as that found on Houghton Lake.

By early to mid-July the plant is in the boot stage from whence the "seedhead" emerges followed by the flowers which produce pollen in late July to early August. This is followed by grain filling and ripening in late August to early September. The grain then shatters or falls into the water as it reaches maturity. This occurs at 106-130 days after germination.

PART THREE

Possible Causes of Wild Rice Loss

Several possible causes for the loss of wild rice growth on Houghton Lake were considered.

Because of swimmer's itch, the lake had until recently been subject to heavy annual applications of copper sulfate. It is possible that this compound could accumulate in the lake bottom and inhibit plant growth. A 1973 study on outboard motor use on Houghton Lake found that lead deposits accumulated more rapidly in the organic muck soils, where wild rice is found, rather than the sandy parts of the lake bottom. Tests are underway to determine if copper sulfate or other chemical compounds have accumulated in a similar fashion and possibly affected wild rice germination and growth.

Water Levels and Wild Rice

Proper water depth is usually the key to maintaining or restoring wild rice in a given area.

The optimum water depth for germination and growth of wild rice is thirteen inches (Oelke et al. 1982). However, wild rice will germinate and grow in much deeper water. The water depths found at Houghton Lake in 1994 were about 2.5 feet to 6.0 feet in North Bay and Muddy Bay and about 3.0 feet - 6.0 feet in the Middle Grounds. This is outside of its optimum growing range, yet the rice has persisted for years. However, it is likely that <u>any</u> increases in water depth over the previous norms would greatly impact the wild rice. Individual plants would be affected in several ways.

Wild rice plants are most sensitive when in the floating leaf state. This period lasts from ten days to two weeks in June depending on water depth and geographic latitude.

Any increase in water depths at this time results in plants uprooting and dying and can cause a virtual loss of crop in natural stands. This "bounce" is more critical in soft bottom stands, such as Houghton Lake, because the plants are tenuously rooted and much easier to pull up than in firmer soils such as found on wild rice stands in most river systems. Using data from the Michigan Weather Service and the 1969 Lake Level Control Study, we find that a 3.5-inch 24-hour rainfall event would cause a six inch rise in lake levels. This would be expected once every 25 years and probably would cause a large reduction in rice acreage.

Natural wave action, wakes, and propeller damage from boat traffic would also impact wild rice growth, especially in a high water/soft bottom situation such as found on Houghton Lake. This would compound the effects of "bounce" or persistent high water.

Little research has been done to quantify the amount of "bounce" it take to wipe out a natural stand. Prior to the poor crops of the last few years at Houghton Lake, "bounce" probably affected the density more than the size of the wild rice crop.

Water Chemistry

Wild rice grows in a wide variety of waters, but generally favors a higher alkalinity exceeding 40 ppm (Moyle, 1964) and a corresponding ph of 7.2 - 8.8 according to water tests done on various rice producing waters in Minnesota. A review of the water chemistries done to date on Houghton Lake by Pecor, et. al. as compared with known wild rice growing parameters in Minnesota, shows good compatibility across the spectrum. This was expected since Houghton Lake's water changes over every 1.2 years and the rice has thrived for so long.

However, there may be some questions as to fertility. Phosphorus and nitrogen are known to be two of the most important nutrients regulating aquatic plant growth. It is further known that one is no good without the other being present in sufficient quantities.

Research previously done on Houghton Lake indicated that phosphorus and nitrogen entered the lake at a ratio of 1 to 35 respectively and that algae requires these nutrients at a rate of 1 to 16 respectively. The same average ratio as found in Houghton Lake's water by Pecor et al. in the early 1970's. The Pecor Report also stated that more than 90 percent of the nutrients entering Houghton Lake came from natural sources in 1971-1973.

However, the EPA found that phosphorus was the limiting factor for algae growth on Houghton Lake during the same time period (Natural Inland Lake Study, 1972).

It must be further noted that the MDNR, Land and Water Management Division, found total phosphorus levels twice as high as those of the 1973 Water Quality Study by Pecor et.al. for March and April during 1967-1974 (see table below).

Phosphorus mg/1

Pecor et.al. 1973	Total PO_4 P	MDNR	Total PO_4 P
4/72	.018	4/11/67	.30
2/72	.027	2/11/70	.30
3/72	.016	3/4/74	.30
3/72	.016	3/4/74	.30

The only other pertinent total phosphorus readings we have come from MDNR files and taken at three stations in April of 1988. These readings averaged .015 mg/1 which is one-half the level found in 1967-1974.

More evaluation needs to be done on the sampling and testing procedures of the MDNR at that time. A discussion of the 1973 Water Quality Study test procedures is found under Methods, page 312.

The whole question of nutrient adequacy is difficult to address because the available results and the methodology used to arrive at them are somewhat contradictory. We do know that wild rice needs a great deal of nitrogen for proper growth. The field reports of many people all agree that the extraordinary height and density of the stands historically found on Houghton Lake suggest adequate levels of nitrogen at least through the mid-1980's.

However, if total phosphorus levels have dropped by one-half in the lake and if these levels of phosphorus have been determined to be a limiting factor in plant growth, before the apparent drop in availability, then it follows that the question of total phosphorus availability merits further research.

The wild rice plants observed on Houghton Lake's Middle Grounds seemed to be germinating somewhat adequately in 1994. It appears they readily grew to floating leaf stage, then growth was stalled at aerial leaf stage. This is, of course, prior to booting, flowering, and seed formation. It is these latter stages of the plant's growth when its nutrient requirements are most critical. That is, 50 percent of the total nitrogen is required in the 10-day period from boot to early flower, in a normal 100 day growing cycle. The phosphorus requirement is similar. (Oelke et al. 1982)

Diseases

There are other factors that could cause the stoppage of growth between floating leaf and the plant becoming aerial. A field check of Houghton Lake on August 5th and 6th of 1994 revealed that virtually all of the rice plants present were in floating-leaf stage as they had been previously on July 14, 1994 when checked by MDNR personnel. This is four to six weeks beyond the stage when the leaves would normally be aerial. Also, many of the floating leaves showed signs of disease.

Samples were taken to the University of Minnesota Plant Pathology Lab and analyzed by Professor James Percich. He found evidence of Bacterial Leaf Streak (BLS) and Anthracnose lesions present on the leafs. The author feels other samples not tested may have had evidence of Bacterial Brown Spot (BBS). BBS and BLS are similar in that they cause a breakdown in leaf tissue thereby stressing the plants. Anthracnose is known to be an important disease on Canadian lakes and can severely limit production there (J. Percich personal communication).

BLS and BBS have not been known to cause the type and frequency of damage such as that found on Houghton Lake. However, all these diseases do occur in natural stands. Also BBS has a wide variety of grasses as host and several lawns surrounding the lake showed blades of grass with similar lesions (Roy Spangler, Extension Service, Pers. Comm.).

There was some speculation during the time of our field check on August 5-6, 1994, that lesions on the rice plants and those on the lawns surrounding the lake were caused by Helminthosporium disease. This disease, also known as fungal brown spot or FBS, was not present on the samples tested.

Insects

There are also several species of insect which can cause damage to rice of the type found on Houghton Lake. However, no larvae or definite sign of insect activity was found. This may have had more to do with the late date of the inspection and should be more closely monitored in 1995.

A common thread among many of the pathogens which affect wild rice is that they overwinter along the shore in vegetation from the previous year. Since Houghton Lake's wild rice seems to be most affected in the areas around the shore and least affected in the Middle Grounds (furthest from shore), it is possible that a pathogen is attacking the rice in the floating leaf stage and preventing it from going to the aerial stage. In natural stands some floating leaf plants appear up until harvest time in mid-August to mid-September.

Floating leaves on Minnesota wild rice plants viewed shortly after the Houghton Lake field check showed some of the same damage that Houghton Lake's rice showed, but not nearly as pervasive. The late season floating leaf stage plants in Minnesota were also found in deeper water, approximately three to four feet deep. This suggests that Houghton Lake's problems may be due to generally deeper water levels over the past few years.

Under this theory, the deeper water makes for slower plant germination and growth. This delayed plant growth allows a pathogen to develop and infect plants which would not otherwise be vulnerable in a normal growth curve. As with many species, wild rice is a plant which depends on achieving a timely level of growth, ahead of other plants which could out compete it; and ahead of various insects and diseases which would otherwise eradicate it.

Indicator Plant Species

There are very few plants which help provide the combination of food and cover for wildlife and fishery resources that wild rice does. As such, wild rice is perhaps the most unique emergent plant in all of nature. There are a wide variety of unique pathogens and environmental circumstances which can affect its germination and growth.

Nevertheless, the rapid and catastrophic loss of growth on Houghton Lake suggests an environmental change which would affect other plant species as well. Two possible indicator species are Hardstem Bulrush (Scirpus acutus) and Robbins' Pondweed (Potomogeton Robbinsii).

The hardstem bulrush beds located away from the immediate shoreline of Houghton Lake are the remains of what were undoubtedly much larger and denser stands. The remaining bulrush away from the immediate shoreline will probably disappear within the next decade at their current levels of distress. For example, many of the remaining plants no longer appear to produce seed. They also show insufficient stem growth above the waterline and may have some brown spotting on the stem tissue similar to that found on the wild rice plants.

Hardstem bulrushes germinate only on dry lakebed or wetland margins under low water conditions such as drought or drawdown. They expand and thicken best under saturated soil conditions and spread by both seed and root stock. When water returns to normal or higher levels, the bulrush beds become partially inundated and can persist for perhaps hundreds of years under suitable conditions.

Bulrushes are normally an important part of a lake's ecology, where they occur in sufficient numbers. The stands on Houghton Lake are of little significance now, but probably played a critical role in the lakes ecology at one time for many of the reasons discussed earlier in the Water Quality section.

Robbins' Pondweed

During the benchmark 1971-1972 Water Quality studies on Houghton Lake, Robbins' Pondweed was one of the five dominant plants in the eight major weedbeds found on Houghton Lake (Evenson and Hopkins, 73-3).

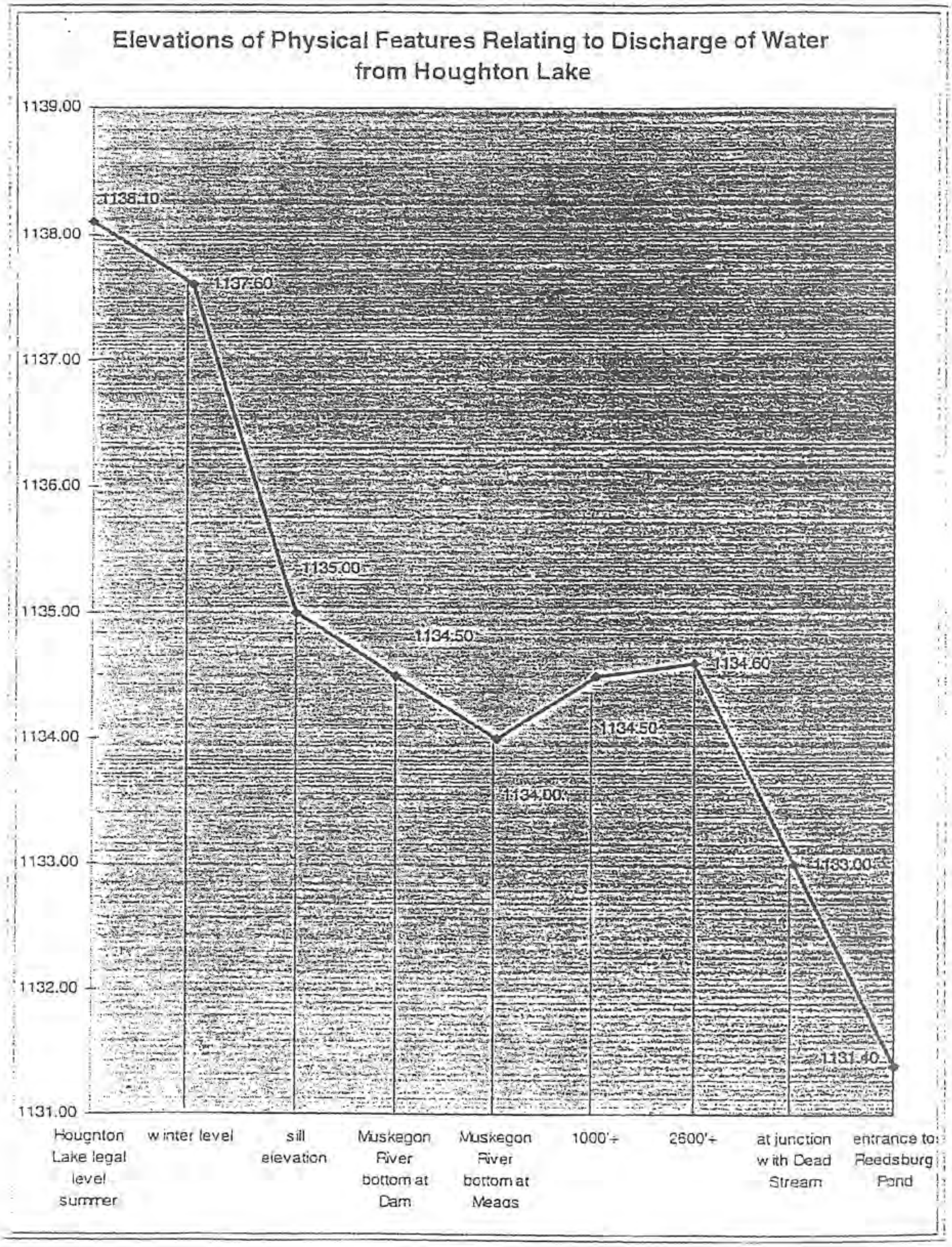
A 1986 Corps of Engineers Reconnaissance Report on Houghton Lake did not find any Robbins' Pondweed and none was found on the August 5-6, 1994, lake inspection.

Robbins' Pondweed was found on Lake St. Helen in lush growth form during the August 1994 inspection however. The water of Lake St. Helen was far more clear than that of Houghton Lake. Sunfish were easily observed using a Robbins' Pondweed bed as escape cover. It is also known to be an important shelter plant and provides feeding habitat for Northern Pike (Fassett, 1940). The large flat leaf clusters of the Robbins' Pondweed make it among the most unique submerged macrophytes and probably a vital part of Houghton Lake's fisheries at one time. Its apparent disappearance may be symptomatic of the ills plaguing Houghton Lake and merits further study and consideration. If there has been a loss or thinning of other submerged aquatic plants, the so-called "cabbage weeds," it would affect the entire lake's ecology. The shading effect and substrate these submerged aquatics provide for all types of small animal life is vital for the well-being of the fish and waterfowl resource at Houghton Lake.

Capacity of Outlet Dam

In reviewing the material provided by the MDNR there are several references to discussion originally contained in the 1969 Engineers Report and subsequently cited by various individuals. The gist of the discussion is that Reedsburg Dam and/or the Muskegon River Channel control the water levels on Houghton Lake and not the Houghton Lake Dam.

The original 1969 report stated that this was true, but the data indicates that this condition exists **only at the upper limits of discharge capacity**, as far as the river channel restrictions are concerned.

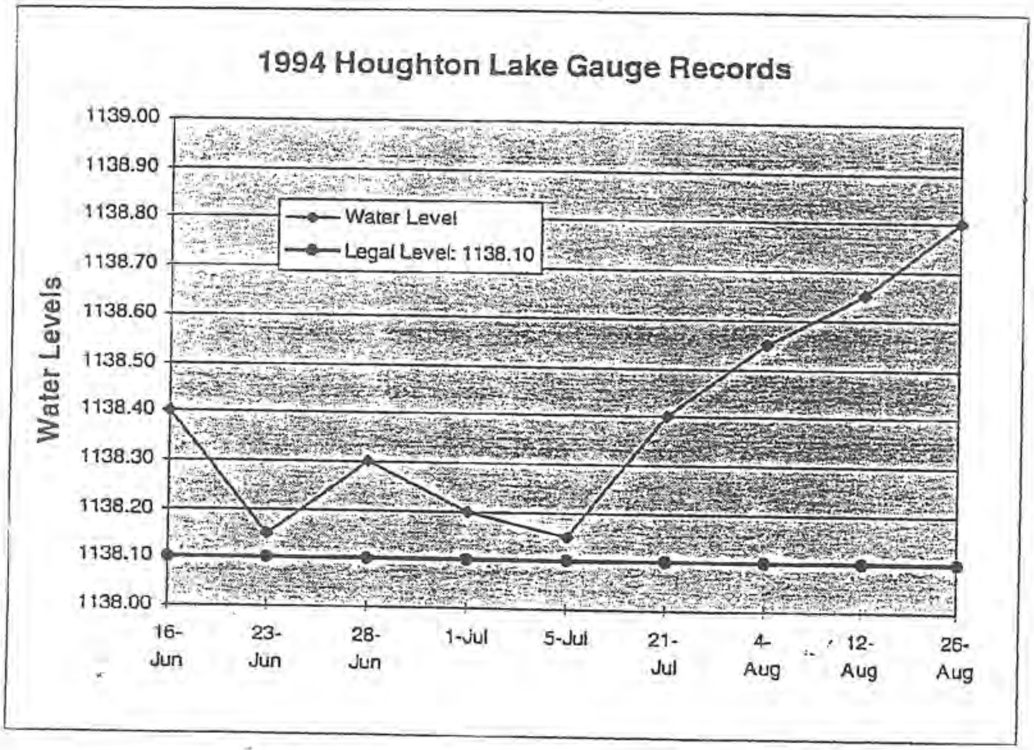

Elevations of Physical Features Relating to Discharge of Water from Houghton Lake
1139.00
1138.00
1137.00
1136.00
1135.00
1134.00
1133.00
1132.00
1131.00
1138.10
1137.60
1135.00
1134.50
1134.00
1134.50
1134.60
1133.00
1131.40
Hougnton Lake legal level summer
winter level
sill elevation
Muskegon River bottom at Dam
Muskegon River bottom at Meads
1000'+
2600'+
at junction with Dead Stream
entrance to Reedsburg Pond

According to the 1969 data, approximately 80 percent of the dam outlet capacity is usable under current conditions (see graph). Approximately five percent of this capacity was used during the summer of 1994. Only one stoplog was removed from one bay while the water rose to a peak of 0.6 foot above the legal level. It seems a program of more aggressive stoplog manipulation is required before costly Muskegon River channel improvements are contemplated. Pecor et al. found that the Houghton Lake area received 28 inches of rainfall in 1972 while evaporation was 23 inches. It is also known that emergent plants increase transpiration over surface waters by a factor of three. Therefore, under normal conditions, Houghton Lake's outlet is probably sufficient to regulate the lake close to the legal level. Past management, as quantified by the water level records also indicates this to be true.

An advantage to aggressively manipulating water levels at Reedsburg, Houghton Lake, and Higgins Lake, as well as the various impoundments, is that the siltation of stream channels above and below these structures may be reduced or eliminated. This will help the channels maintain what capacity they have farther into the future without costly dredging and widening operations.

1994 Gauge Recordings

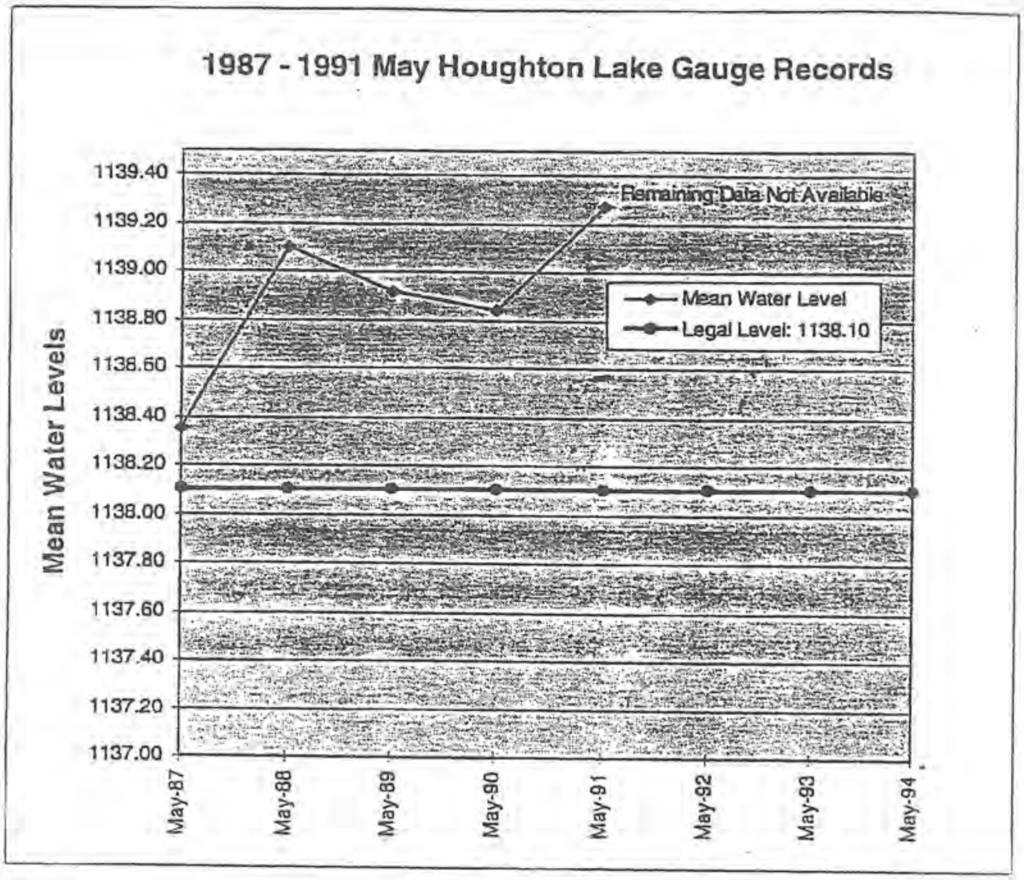
The graph below describes 1994 water level management results on Houghton Lake. We recognize the difficulty of closely regulating water levels on such a large lake with relatively small outlet capacity. However, the fact that water levels were allowed to rise without any significant attempt at management through July and August limited the chance for any of the floating leaf rice plants to become aerial and produce seed in 1994.



Changes in Water Level Management

A water level increase occurred between 1987 when rice was abundant at Houghton Lake, and 1988 and beyond when many changes in the lake's wild rice ecology took place (see graph below). Among these are the loss of the Muddy Bay, North Bay, and Middle Grounds rice beds.

The floating vegetation mat which came out of Muddy Bay and washed up on the Southeast shore of the lake in 1989 was probably due to a combination of thick ice and increased water levels in the spring. This allowed the previous year's vegetation mat to be lifted up and floated out to deeper water. While further study needs to be done to prove or disprove this hypotheses, there is little doubt that Muddy Bay now harbors less aquatic plant life than it did prior to 1988.



1987 - 1991 May Houghton Lake Gauge Records
Mean Water Levels
1139.40
1139.20
1139.00
1138.80
1138.60
1138.40
1138.20
1138.00
1137.80
1137.60
1137.40
1137.20
1137.00
Remaining Data Not Available
Mean Water Level
Legal Level: 1138.10
May-87
May-88
May-89
May-90
May-91
May-92
May-93
May-94

RECOMMENDATIONS

1. The water levels on Houghton Lake need to be managed far more aggressively. In 1994, water levels actually rose during the summer, drowning out whatever chance the rice had to mature. Levels were .4'-.7' above that set by law for summer depth. When the water is high, all the stoplog bays should be open in an attempt to better regulate the lake.

2. Levy a flat per cabin assessment on the 8,000 dwellings surrounding the lake and its channels. A small assessment of $10.00, for example, would provide a net of $70,000.00 or more which could be used for lake management.

3. Place water level management in the hands of paid professionals. The current system whereby the County of Roscommon budgets $3,000 per year to control the water levels on Higgins, Lake St. Helen, and Houghton Lake is antiquated and inefficient.

4. Agree on a Memorandum of Understanding to be signed by the MDNR, Roscommon County, and possibly the lakeshore owners association describing how the assessment money is to be spent. For example, a position description could be developed for an individual to be hired to coordinate future research on lake management of not only Houghton Lake, but the entire watershed from the Higgins Lake outlet to the Reedsburg Dam.

5. Develop a common sense method of modifying the stoplog bays to make water level manipulation more efficient. Appendix VII of the 1969 report on lake level controls listed some alternatives. Beyond this, good old fashioned local ingenuity should be able to devise a low cost way to remove and replace stop logs in a safe, efficient manner. For example, a vehicle with a small boom could be used to remove or replace stoplogs as necessary.

6. Consider dropping the water level at the Reedsburg Dam by up to six inches. This should cause an increase in wild rice growth and density there and improve the waterfowl habitat. Negative impacts on recreational use of this wildlife flooding are not foreseen due to it channel and the structure of the basin itself. This action also has the potential to aid the amount of water which could escape Houghton Lake by increasing the rate of flow. This should help to prevent further streambed siltation between Reedsburg Dam and Houghton Lake.

7. Study the floating leaf rice plants as they develop in the spring of 1995 and have them tested for insect and disease damage.

8. Do follow-up studies on water and bottom sediment chemistry as per the previous discussion.

9. Try to replicate the 1973 Aquatic Plant Survey as closely as possible.

10. Try to replicate the 1973 Fishery Survey as closely as possible.

11. Try to replicate the 1973 Water Quality Secchi Disk Survey as closely as possible.

12. Conduct a small scale wild rice seeding experiment in Muddy Bay or North Bay (see Appendix one).

In all of the above instances, it is fortunate the 1973 studies were done to be able to compare baseline data and find changes in the lake's ecology. This was one of the purposes of the original study.

Houghton Lake is probably one of the nation's most studied inland lakes. It is also one of the most important in terms of its meaning to the people who live, work, and play there.

It is remarkable that a Circuit Court was able to set a level which allowed increased recreational use of the lake and yet preserved many of its fishery and wildlife values. We must be aware that with so many people having so many diverse interests in the lake, it is impossible to satisfy everyone. Therefore, management should be focused on doing what is right by the resource. The entire ecology of Houghton Lake is hanging in the balance and must be addressed before it is lost to this and future generations.

What is needed is a more holistic approach to management of the entire watershed with Houghton Lake as the primary focus of this effort.

Houghton Lake's significance demands nothing less than its management and ecology be brought into the 1990's and beyond for the benefit of all who appreciate its waters.

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APPENDIX

Seeding

In any discussion of disappearing or thinning wild rice stands the subject of seeding invariably comes up. Seeding natural wild rice stands which have produced for years and are suffering from crop loss is generally a waste of resources for several reasons. There are literally millions of pounds of rice seed that accumulates over the years in a rice bed lake bottom despite the best efforts of man and wildlife, primarily birds, to harvest it. That is because when rice is ripe, the slightest jar or movement will dislodge it, causing it to shatter or fall off.

Rice seed remains generally high in germination for at least six years (Oelke et al 1982). The author feels some seed remains viable indefinitely due to its unique waterproof structure and the anaerobic conditions of lake bottoms where wild rice is found.

Therefore, when there is abundant seed already available, the problem in restoring a wild rice stand is not one of establishment seeding but establishing conditions which allow existing seed to grow, thrive and produce new seed. Stated simply, why plant more seed when the conditions are not right for the existing seed to grow?

Another reason lies in plant genetics. Each wild rice lake seems to have adopted a seed morphology that is unique to each lake's physical characteristics. The length of awn and seed size seem to vary from lake to lake to the point it should be considered that each lake or flowage generally has its own subvariety of wild rice plants (Ustipak 1983, unpublished). It is believed this selection process is fairly rapid occurring within perhaps a 20-year period.

The complicated process of mixing gene pools is also a factor to consider. Many establishment seedings in Minnesota have produced rice early but have failed over the years.

Minnesota lake rice sold for 80 cents to $1.00 per green pound in 1994, depending on quality. Seeding rates for paddies is 35 or 40 lbs/acre in first year stands (Oelke et. al. 1984, pg. 16). However, this seed is drilled into a seedbed, then flooded to 13 inches or less of water. In the case of Houghton Lake the marginal conditions would require seeding rates probably three to four times higher, that is, 150 to 200 lbs/acre.

While seeding has been discouraged as a cure for Houghton Lake, a closely controlled experimental seeding of an acre or two would be a reasonable suggestion for this lake in 1995. As suggested by MDNR (J. Martz, pers. comm.), Muddy Bay or North Bay would be good candidates for this type of initiative. A small scale seeding experiment would be quite inexpensive, costing less than $1,000.00 if managed properly.

(WILDRICE)

GAME LAKE SURVEY - HOUGHTON LAKE

I. INTRODUCTION

LAKE NAME, IDENTIFICATION NUMBERS, MEANDER STATUS, AND LOCATION

LAKE NAME Houghton Lake ALTERNATE NAME (S)

LAKE IDENTIFICATION MEANDERED

LEGAL DESCRIPTION: T. ; R. ; S.

WATERSHED TRIBUTARY NUMBER AND NAME Houghton Lake is the headwaters of the Muskegon River

COUNTY (IES) Roscommon

NEAREST INCORPORATED MUNICIPALITY, DISTANCE, AND DIRECTION Houghton Lake Heights, Houghton Lake, Prudenville

ACCESSIBILITY

DESIGNATED PUBLIC ACCESS AREA (S) (LOCATE ON MAP) AND OWNERSHIP
There are several around the lake: At muddy Bay on the east side: Also in the center of the lake on the south side.

OTHER ACCESS AREAS

MANAGEMENT PROBLEM - REASON FOR SURVEY
Dwindling stands of wild rice and possibly other equatic plant species

SURVEY REQUEST BY
Michigan Department of Natural Resources (MDNR)

PREVIOUS INVESTIGATIONS AND SURVEYS AND DATES
Sept. 1969 A Report on Lake Level Controls for Roscommon County.
1973 - comprehensive study was done by cooperative effort and sponsored by the Upper Great Lakes Regional Commission. (Pecor et al)

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

LAKE AREA AND DEPTH:

AREA: MEANDERED ACREAGE 18,950 (Pirnie, 1935) / 20,094

PLAINIMETERED ACREAGE - HIGHWATER EXISTING 31.3 sq miles

DEPTH IN FEET: MAXIMUM 22 MEDIAN 8.5

ABOUT 1 % OF WATER AREA IS LESS THAN 1 FOOT. 21% deeper than 12 feet

ABOUT < 5 % OF WATER AREA IS LESS THAN 4 FEET.

DRAINAGE RATIO: INFORMATION SOURCE

MILES OF SHORELINE: HIGHWATER 72 EXISTING 72

Watershed is 220 sq. miles

Higgins Lake - 9600 acres

LAKE ______________________

COUNTY (IES) ______________________

	INLETS*										OUTLET*	
	1		2		3		4		5		1	
NAME	The Cut/Backus Creek		Spring Brook		Knappen Creek		Denton Creek		All other minor ~~tributaries &~~ drains (28)		Muskegon River	
Watershed Size	95 sq.mi.(51%)		1.2sq.mi.		4.7 sq.mi.		38 sq.mi.(20%)		47.2sq.mi. 25%		accounts for 70% of water leaving lake	
Contribution Percentage	73%		--		--		--		12%			
LOCATION ON LAKE	NE corner		SE corner		SE corner		SE corner				NW corner	
Origin of water input to Houghton Lake: The Cut - 46%; Over water precip-32%; Deep Groundwater - 13%; ~~Adjacent surface~~ runoff & other - 9%	Includes Higgins Lake & Backus Creek Impoundments(3)						Includes one wildlife flooding impoundment		Groundwater Marsh outflow Surface Runoff		TRIBUTARY STATUS AND DISTANCE	
	AT FLOW STATION	WHOLE STREAM	AT FLOW STATION	WHOLE STREAM	AT FLOW STATION	WHOLE STREAM	AT FLOW STATION	WHOLE STREAM	AT FLOW STATION	WHOLE STREAM	AT FLOW STATION	WHOLE STREAM
SHOW ALL FLOW CALCULATION FIGURES ON REVERSE SIDE: AVERAGE WATER WIDTH-FEET											3,100-20,800 ac/ft per mo.	100,400 ac/ft per 1972 study
AVERAGE WATER DEPTH-FEET												
VELOCITY-FEET PER SECOND												
DISTANCE OF FLOW MEASUREMENT-FEET												
FLOW-C.F.S. IF DRY, SO INDICATE												
THIS INFORMATION REQUIRED FOR DRY STREAMS ALSO: & BOTTOM TYPES ESP. SPAWNING AREAS+												
BANK TYPES AND COVER												
BANK TOP HEIGHT-RANGE IN FEET ABOVE WATER SURFACE												
BANK TO BANK TOP DISTANCE, RANGE (FT.)												
BARRIERS TO FISH MOVEMENT												

OUTLET ELEVATION - CRITICAL BOTTOM ELEVATION - INDICATE (SHOW GAUGE READING OR MEASURE IN FEET AND/OR INCHES) ABOVE OR BELOW THE PRESENT LAKE WATER LEVEL:

*ALSO INCLUDE AND INDICATE WHICH ARE DRY OR INTERMITTENT INLETS AND/OR OUTLET.

+SEE PAGE 5 OF GAME LAKE SURVEY MANUAL FOR BOTTOM DESCRIPTIONS.

LAKE ______

COUNTY(IES) ______

LAKE WATER LEVEL FLUCTUATIONS (DESCRIBE IN FEET ABOVE OR BELOW PRESENT LAKE LEVEL)

WITH REFERENCE TO NORMAL:

PRESENT STAGE OF LAKE ______

ANNUAL FLUCTUATION OF LAST FEW YEARS 1140.05 (4-23-85) 1137.60 (8/7/87)

EXTREME (LONG-TERM) FLUCTUATION 2.45' 1129.79-6/4/43 1136.95 9/ 3, 5/58

ORDINARY SPRING HIGHWATER LINE ______

HISTORY OF PAST WATER LEVEL FLUCTUATIONS

In 1984, 1987, 1990 water level was at or below summer level. 1139.08 on 5/25/90

The "summer" or legal level of 1138.10 U.S.G.S. Datum was set in 1926

LAKE WATER LEVEL CONTROLS — DATE OBSERVED see appendix 1

DAMS (SKETCH AND GIVE MEASUREMENTS ON REVERSE SIDE)

GAUGE READING OF LAKE WATER LEVEL ______ FEET, HEAD ______ FEET, ELEVATION OF SILL WITH REFERENCE TO (INDICATE - SHOW GAUGE READING OR MEASURE IN FEET AND/OR INCHES - ABOVE OR BELOW THE PRESENT LAKE WATER LEVEL) 1135' sill elevation

WATER FLOWAGE WIDTH OF DAM ______ FEET, DESCRIPTION OF DAM 6 bays - 7' between piers 42' opening

LOCATION AND APPROXIMATE DISTANCE FROM LAKE ______

OWNERSHIP ______

OTHER STRUCTURES OR BARRIERS (SKETCH AND GIVE MEASUREMENTS ON REVERSE SIDE)

DESCRIPTION Reedsburg Dam

LOCATION AND APPROXIMATE DISTANCE FROM LAKE 5 miles northwest

BENCHMARK AND LAKE WATER LEVEL — DATE OBSERVED ______

WATER LEVEL ______ FEET BELOW BENCHMARK, DESCRIPTION AND LOCATION OF BENCHMARK ______

DESCRIPTION AND LOCATION OF OTHER OR PREVIOUS BENCHMARKS - INDICATE WATER SURFACE ELEVATIONS AND DATES READ ______

ELEVATION OF HIGHWATER LINE WITH REFERENCE TO WATER SURFACE ______

NATURE AND USE OF LAKE'S IMMEDIATE WATERSHED

OTHER WATER AREAS WITHIN ONE MILE (OUTLINE ON MAP)

CLASS(II. III. IV, ETC.)	NUMBER	APPROXIMATE ACREAGE
Pike Rearing Ponds	2	800

TOPOGRAPHY OF SURROUNDING LAND AREA: North side - some marshy and less developed
South Side - residential and developed

ESTIMATED LAND USE (IN PERCENTAGE)

TYPE	IMMEDIATE	VICINITY
Residential		29%
(Undeveloped		~~61%~~
973 (Forested		
Lakes and Ponds		10%
974	95% - estimated	

LAKE ____________

COUNTY (IES) ____________

V. BIOLOGICAL CHARACTERISTICS OF LAKE

OBSERVATION DATE (PLANTS) ____________

AQUATIC PLANTS (SEE PAGES 18 AND 19 - MANUAL OF INSTRUCTIONS FOR GAME LAKE SURVEYS)

SPECIES OF EMERGENT AQUATIC PLANTS

ABOUT 3 PERCENT OF THE PRESENT LAKE WATER AREA IS COVERED BY STANDING EMERGENT VEGETATION.

COMMON NAME	SCIENTIFIC NAME	*RELATIVE ABUNDANCE	DISTRIBUTION	**FOOD V TO WATERF
wild rice	zizania aquatic		see map	.
four beds				
'73-covered 1 sq. mile	.9 lbs per sq.yd. (wet wt.	basis)		
of surface area (estimated)	Hopkins			
Hardstem Bulrush	Scirpus acutus	sparse	very thin stands	—

DESCRIPTION AND LOCATION OF EMERGENT PLANT DISTRIBUTION (OUTLINE EMERGENT PLANT AREAS ON MAP)

*RELATIVE ABUNDANCE OF EACH SPECIES WHEN COMPARED TO TOTAL EMERGENT VEGETATION IN LAKE. USE FOLLOWING DENSITIES: ABUNDANT, COMMON, OCCASIONAL, SCARCE.

SPECIES OF FLOATING-LEAVED AND SUBMERGED AQUATIC PLANTS - DNR 73.3

TOTAL % OCCURRENCE OF SUBMERGED VEGETATION ____________

GREATEST DEPTH TO WHICH ROOTED SUBMERGED PLANTS GROW 12 FEET. (21% of lakebed - 1973)

COMMON NAME	SCIENTIFIC NAME	% OCCUR-RENCE N ___	DENSITY	DISTRIBUTION	**FOOD V TO WATERF
Muskgrass	Chara			throughout lake	
Waterweed	Elodea canadensis				
Water Niad	Najas flexilis			Middle Groun	
Robbins Pondweed	Potomogeton Robbinsii			Muddy Bay	-
Bladderwort	Utricularis vulgaris			North Bay	
Water Milfoil	Myrio phyllum				
Small Pondweed	Potomegeton pusillus				
Mud Plantain	Heteranthera dubia				
Pondweed	Potomogeton praelongus				

**S - SLIGHT: SF - SLIGHT-FAIR: F - FAIR: FG - FAIR-GOOD: FE - FAIR-EXCELLENT: G - GOOD: GE - GOOD-EXCELL

LAKE ____________________

COUNTY(IES) ____________________

DESCRIPTION AND LOCATION OF SUBMERGED PLANT DISTRIBUTION about 1/6 of lake area is eovered with dense weedbeds

see maps

ALGAE: TYPE

TYPE	FREQUENCY OCCURRENCE	DENSITY
benthic algae (Rhizoclonium)	common to 12'	
green		

DISTRIBUTION NOTES

NOTES ON PLANKTON AND INSECTS: 44 species identified - 4 most common in order: Scuds (Hyallela Azteca), Midge (Chironomids), Fingernail Claims (Pisidium), Snails (Bulimus) (Pecor et al 73-3)

WILDLIFE HABITAT AND UTILIZATION

WATERFOWL HABITAT - GENERAL DESCRIPTION

The amount of all types of waterfowl habitat discussed below varies with the frequency and density of occurence of the wild rice. The more area and thicker

WATERFOWL NESTING COVER - TYPE, LOCATION, AND AMOUNT density of wild rice, the better habitat it is for waterfowl.

WATERFOWL BROOD COVER - TYPE, LOCATION, AND AMOUNT see above

WATERFOWL LOAFING SITES - TYPE, LOCATION, AND AMOUNT see above

A few mallards

WATERFOWL UTILIZATION AT TIME OF SURVEY - OFFICIAL COUNT: DATE ____________________

TIME ____________ WEATHER: SKY ____________ WIND ____________

SPECIES	ADULTS OFFICIAL COUNT	ADULTS SURVEY TOTAL	BROODS OFFICIAL COUNT	BROODS SURVEY TOTAL
Lesser scaup				
Greater scaup				
Redheads				
Ringnecks				
Buffleheads				
Wigeon (Pecor et al. 1972-73)				

AQUATIC FURBEARER HABITAT - GENERAL DESCRIPTION

Generally poor at present, with few emergent weedbeds

AQUATIC FURBEARER UTILIZATION

SPECIES	TYPE OBSERVATION (CUTTINGS, HOUSES, ETC.)	EXTENT AND LOCATION

LAKE:
COUNTY(IES)

NATURE AND USE OF SHORELINE

ABOVE WATER SURFACE

SLOPE

COVER

SOIL TYPE

BELOW WATER SURFACE

SLOPE

VEGETATION

SOIL TYPE

LOCATION OF SHORELINE DEVELOPMENT AREAS AROUND LAKE

all around lake, except some on north side

COUNTS OF SHORELINE DEVELOPMENTS

NUMBER OF RESORTS ______, NUMBER CABINS AT RESORTS ______, NUMBER OF HOMES AND/OR COTTAGES 7,000 (1973), NUMBER OF BOATS ______

III. EVIDENCE AND EXTENT OF EROSION AND/OR POLLUTION

Ice damage has frequently occurred since at least 1920. There is little evidence of major pollution. Much of the lakeshore has been bulkheaded.

IV. PHYSICAL AND CHEMICAL CHARACTERISTICS OF WATER (LOCATE STATIONS ON MAP)

1925 - COE - 2' visibility

WATER TURBIDITY: TOTAL NUMBER OF SECCHI DISC READINGS 158 from 1971-1973

MAXIMUM 10 feet AVERAGE 4.5 MIN. 4.5

COLOR OF WATER ______ COLOR CAUSE ______

TURBIDITY CAUSE The water of Houghton Lake is completely mixed from the surface to the bottom. (Pecor 1973 Page 24)

WEATHER ______ SKY ______ WIND ______

BOTTOM SOIL TYPES

sand

organic

TYPE	PERCENTAGE OCCURRENCE
sand	Predominate - 80%
organic	in deeper areas and rice beds or weed bed areas

WATER QUALITY

FIELD TEST

TOTAL ALKALINITY: BURETTE READING

START	END	P.P.M.

Total (mean) PH 8.2

Range 7.5 - 8.9

LABORATORY TEST

	P.P.M.	MG/1
SULPHATE (SO_4) ION		
TOTAL PHOSPHORUS (TOTAL P)		.007
CHLORIDE (CL) ION		6.0
CARBON DIOXIDE (CO_2)		
TOTAL ALKALINITY (TA)		96.1

	P.P.M.	MG/1
AMMONIA NITROGEN (NH_3-N)		.052
NITRITE NITROGEN (NO_2-N)		.002
NITRATE NITROGEN (NO_3-N)		.061
ORGANTIC NITROGEN (ORGANIC N)		.48
TOTAL NITROGEN (TOTAL N)		

SUMMARY Extensively tested 1973 - see Appendix 1

LAKE ______
COUNTY(IES) ______

OTHER WILDLIFE (PHEASANTS, DEER, ETC.)

PRINCIPAL OTHER WILDLIFE SPECIES OF AREA ______

OTHER WILDLIFE HABITAT - GENERAL DESCRIPTION ______

OTHER WILDLIFE UTILIZATION

SPECIES	TYPE OBSERVATION (SIGHTING, TRACKS, ETC.)	EXTENT AND LOCATION

HISTORY OF WILDLIFE UTILIZATION AND HARVESTS

FROM PREVIOUS INVESTIGATIONS
one of the four most important waterfowl areas in Michigan

FROM LOCAL REPORTS OR OTHER SOURCES

SOURCES OF INFORMATION ______

HISTORY OF UTILIZATION (PRODUCTION, MIGRATION, WINTERING, ETC.)

SPECIES OF WATERFOWL AND OTHER WILDLIFE	TYPE UTILIZATION	OTHER INFORMATION - EXTENT AND LOCATION OF UTILIZATION, ETC.
various duck species	spring & fall migration	

HISTORY OF HARVESTS

SPECIES OF WATERFOWL AND OTHER WILDLIFE	Number of blinds PRESSURE*	SUCCESS**	OTHER INFORMATION - AREAS OF LAKE HUNTED - TIME OF SEASON, ETC.
	200 - 1940's		
	50 - 1961		
	80 - 1964		
Waterfowl	1972	1858 ducks taken	(Pecor et.al.1972-3 P:60)

*HEAVY, MODERATE, LIGHT **SUCCESS - GOOD, FAIR, POOR

NON-GAME WILDLIFE UTILIZATION (SHOREBIRDS, HERONS, ETC.) A wide variety of non-game birds use Houghton Lake now. Improved wild rice habitat causes a more diverse set of conditions and cover types on the lake, thereby benefitting a larger number of non-game bird species. Eagles and Ospreys are two species which seem to particularly favor wild rice habitat.

HISTORY OF TRAPPING

PREDOMINANT SPECIES	PRESSURE	SUCCESS

LAKE ______
COUNTY(IES) ______

WILD RICE None

LOCATION OF WILD RICE STANDS IF PRESENT (OUTLINE ON MAP)

DENSITY AND CONDITION OF WILD RICE STANDS IF PRESENT

HISTORY OF WILD RICE HARVESTS
none available

FISHERY 1972 - Panfish 55.8%
Test - gamefish 7.1%
Netting - rough fish 37.1%

SPECIES PRESENT — RELATIVE ABUNDANCE (ABUNDANT, COMMON, ETC.)

20% Pike
Walleye
Largemouth Bass Smallmouth Bass

White Sucker
Carp
Bowfin
Longnose Gar
Brown Bullhead
20%

60% Sunfish, Crappie
Rock Bass Perch
Rough Fish

Highest densities of any fish - 283 tot[al]

METHODS USED TO DETERMINE PRESENT OR ABSENCE (SEINING, SIGHTING, ETC.)

EVIDENCE OF ROUGH FISH ACTION

POSSIBILITIES OF ROUGH FISH CONTROL

VI. HISTORY OF FISHING

FROM PREVIOUS INVESTIGATIONS AND SURVEYS
Early 1900's - mostly Pike - now mostly panfish
300,000 angler days 1970

FROM LOCAL REPORTS AND PRESENT OBSERVATIONS
Fishing success appears to be declining in recent years according to local reports

FISH MOST COMMONLY CAUGHT AND RECENT (THIS YEAR AND LAST SEASON) ANGLING SUCCESS

SPECIES OF FISH	ANGLING SUCCESS*	OTHER INFORMATION (SIZES, TIME OF YEAR, ETC.

Pecor et al. 1973-7 compared the results of the 1955 survey and the 1972 survey. They found very little change in fish populations during this 17-year period. These results should be compared to more recent data.

*GOOD, FAIR, POOR, ETC.

PAST ANGLING HISTORY

LAKE ______
COUNTY(IES) ______

VII. RECORD OF PAST MANAGEMENT

Cutting operations were employed at Houghton Lake to control this plan
Size and density of the rice beds has been greatly reduced. (Miller 19
Cutting was done about 1938-1958 and eliminated the south bay rice
bed (Michigan Conservation Department)

SPECIAL LAKE CONDITIONS OR PROBLEMS

3670 acres "weed infested" - (Corp of Engineer's Report 1985)

VIII. ECOLOGICAL CLASSIFICATION AND STATUS

ECOLOGICAL CLASSIFICATION

Eutrophic - although water turnover is every 1.2 year

MEANDER STATUS

WETLAND CLASSIFICATION

IX. SUMMARY DISCUSSION AND ADDITIONAL NOTES

See 1995 report on wild rice

FIGURE 1. AQUATIC VEGETATION