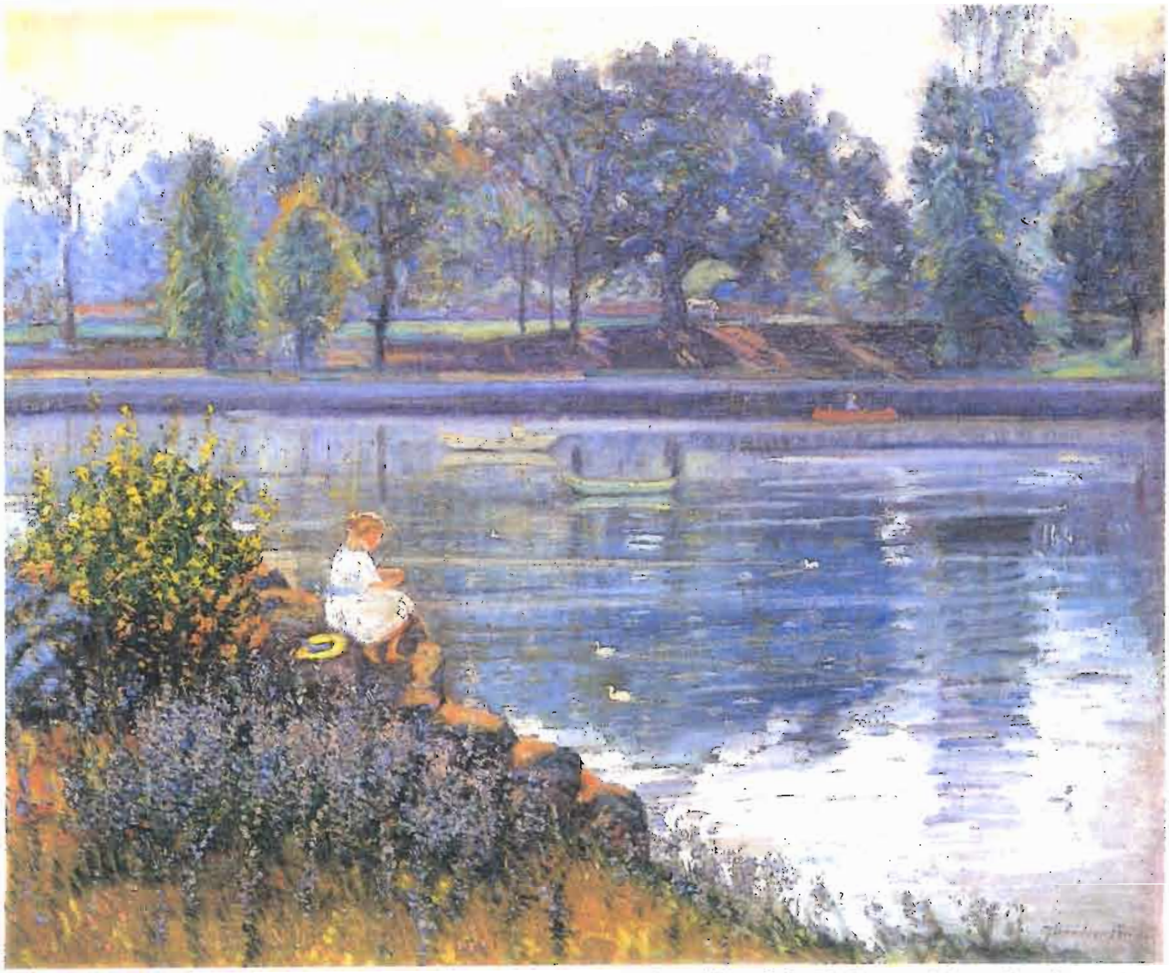


Theodore Wendel, *Girl seated by a Pond,* no date

Little Bearskin Lake, Oneida County, WI
Lake and Watershed Management Report

June 1993

Submitted to:

Bob Young
Wisconsin DNR
Rhinelander, Wisconsin

Prepared by:

Steven R. McComas
Blue Water Science
St. Paul, Minnesota

Submitted by:

Little Bearskin Lake Association
Little Bearskin Lake
Harshaw, Wisconsin

Funded by: Wisconsin Department of Natural Resources and Little Bearskin Lake Association
--A Wisconsin Lake Management Planning Grant Project--

Little Bearskin Lake, Oneida County, WI
Lake and Watershed Management Report

--Contents--

1. INTRODUCTION AND PROJECT SETTLING

Little Bearskin Lake is a glacial seepage lake located in Oneida County, Wisconsin (Figure 1). Little Bearskin Lake is a mesotrophic lake with moderate phosphorus levels and relatively good secchi disc transparency (9 feet average in summer). Wisconsin Department of Natural Resources (or Department of Conservation) has been working on Little Bearskin lake since the 1950's, conducting fish surveys and stocking gamefish and panfish.

The goals of this project were to pull together all data about Little Bearskin Lake, to identify water quality levels, fisheries quality, identify water problems, and to recommended plans of possible actions.

In 1992 a lake survey was conducted on Little Bearskin Lake. The survey was conducted to try to accomplish some of the goals of the project. An aquatic plant survey was also conducted.

Some of the basic lake characteristics are shown in Table 1.

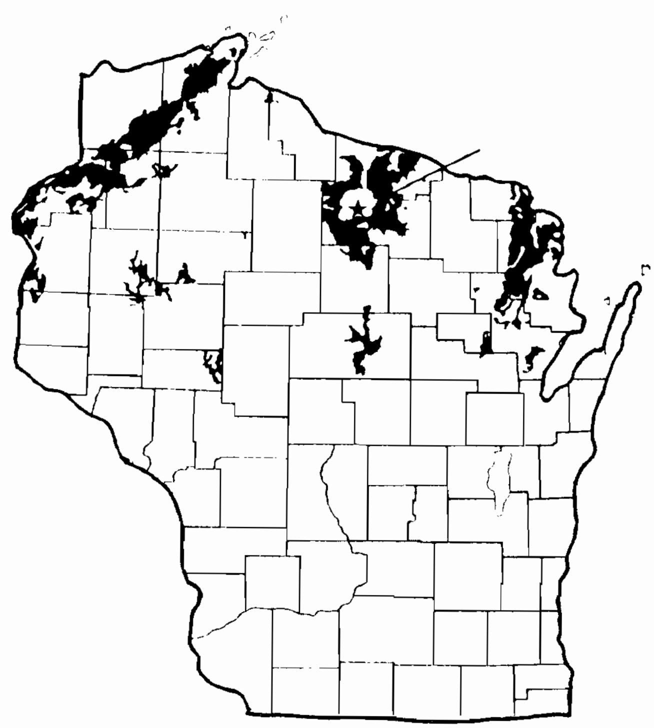


Figure 1. Little Bearskin Lake is in Oneida County (shown by white star) and the setting is in northern sandy soils.

Table 1. Characteristics

Area (Lake): 163.7 acres (66.2 ha)
Mean depth: 8 feet (2.4 m)
Maximum depth: 27 feet (8.2 m)
Volume: 1,279 acre-feet (158.9 Ha-M)
Littoral area: 2 %
Fetch: 0.9 mile (1.5 km)
Direct drainage watershed: 1,032.3 acres (417.8 ha)
Watershed area: 6,080 acres (2,461 ha) Includes Big Bearskin watershed
Watershed: Lake
surface ratio 6:1
Estimated average
water residence time 1.2 years
Fisheries: Ecological Classification:
Management Classification: Gamefish
Public accesses (#):
Inlets: 2 Outlets: 1

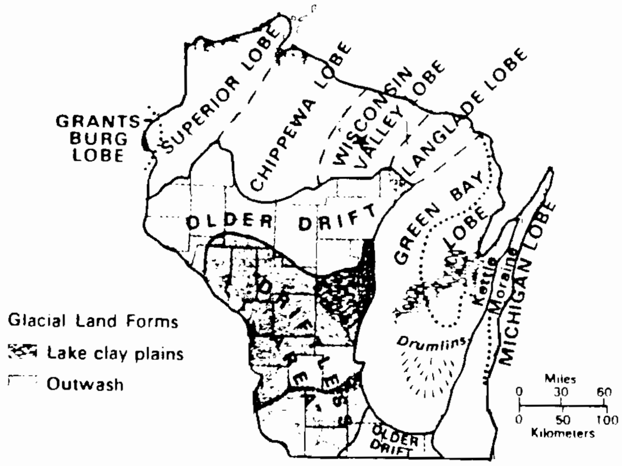
Land Use (percentage/area):

	Forest	Water	Marsh	Urban-Res.
Percentage	52	14	24	10
Acres	618.8	163.7	289.8	123.7

Development (Homes):	Seasonal	Permanent	Total
	29	9	38

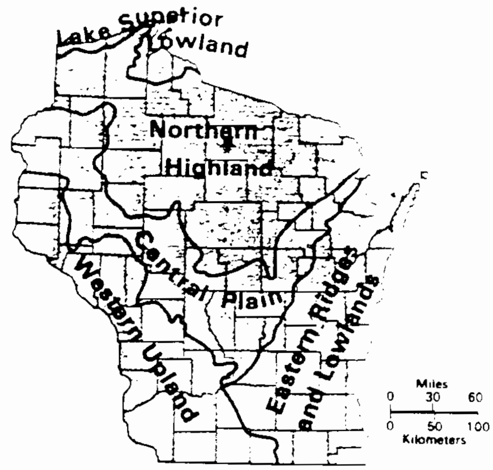
2. GEOLOGIC SETTING

Little Bearskin Lake was formed from a depression made by an ice block that was left behind when the glaciers retreated from this area about 16,000 years ago. Little Bearskin Lake is located in the Wisconsin Valley Lobe (Map 6, Figure 2) which is in the Northern Highland geographic provence (Map 8, Figure 2). Little Bearskin Lake drains to the Wisconsin River which eventually feeds into the Mississippi River. Little Bearskin Lake is very close to the continental divide (Map 9, Figure 2). Most of the land area now is forested (Map 11, Figure 2).



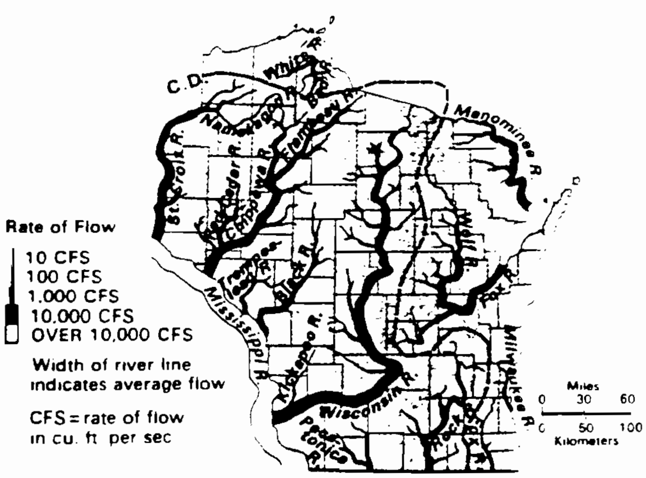
Map 6. GLACIAL GEOLOGY

The last major advance of the ice sheet over Wisconsin was about 16,000 years ago. It covered all but the "driftless" and "older drift" areas. A later ice advanced about 11,000 years ago (dotted boundaries), burying a forest in Manitowoc County. Many land forms were created by the glacial ice and meltwaters: Moraines (solid lines), elongated hills called drumlins, outwash, and lake clay plains. Many peat bogs and lakes occupy glacial pits called kettles.



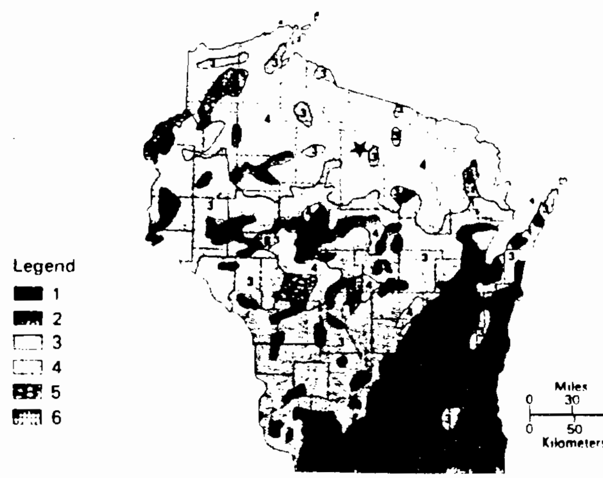
Map 8. GEOGRAPHIC PROVINCES (after Martin, 1932)

The Lake Superior Lowland is an old glacial lake bottom sitting in a much older depression in the bedrock surface. The Northern Highland is a glacial-drift-covered Precambrian "dome," a southern extension of the "Canadian Shield" of igneous and metamorphic rocks. The Central Plain is on an arc of Cambrian sandstones. The drift-covered Eastern Ridges and Lowlands are crossed by dolomite escarpments. The Western Upland is dissected by numerous tributaries to the Mississippi and Wisconsin Rivers.



Map 9. PRINCIPAL RIVERS AND THEIR AVERAGE FLOW

Thirty percent of the state drains to the St. Lawrence River basin, and the remaining 70 percent to the Mississippi River basin. The dashed line represents the continental divide (C.D.) between these two major basins. Peak flows are in March, April and June. The Wisconsin River drains 21 percent of the area of the state; the Chippewa-Flambeau system drains 17 percent; the Fox-Wolf system in northeastern Wisconsin drains 12 percent of the state.



Map 11. AGRICULTURAL AND FORESTRY LAND USE

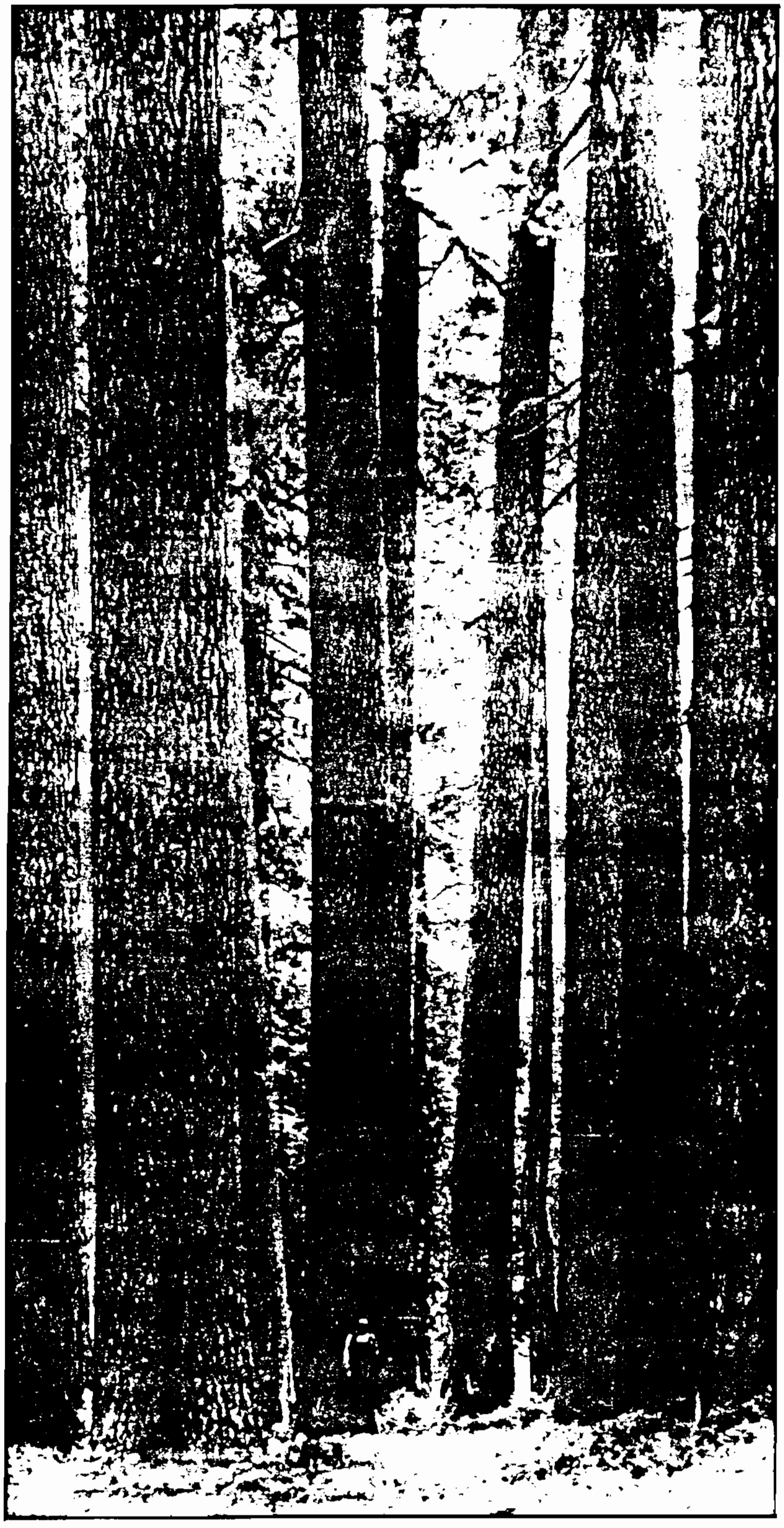
The map shows land use in terms of proportions of land devoted to agriculture and forestry. Highly productive farm land (1), with less than 15 percent of woodland, is in southern counties. Productive farm land (2), with the same extent of woodland, is prominent in the east, but is also widely scattered. Agricultural land with 15 to 50 percent in woodland (3), occupies about half of the area of the state. Forest lands, not sandy (4), are prominent in the north. Jack pine (5), and scrub oak (6) sandy lands are concentrated in the central plain and northern counties.

Figure 2. Glacial geology, geographic provinces, rivers and land use in the Little Bearskin Lake area.
Source: F.D. Hole. 1977. Photo-mosaic soil map of Wisconsin. Univ. Wisconsin Extension-Madison. A2822-1.

3. HISTORY OF LITTLE BEARSKIN LAKE AREA

Little Bearskin Lake is located in a region pock-marked with lakes and lies in Oneida County (Figure 1). About one hundred years ago the area and the watershed of Little Bearskin lake was dominated by pine forests (Figure 3). The original pines that the first loggers saw were well over 400 years old. Most of the pine forest was cut in the late 1800's (Figure 4). Today we are looking at second and third growth forest for the most part.

The fish community in these northern Wisconsin lakes prior to settlement and prior to the onslaught of resorters was very different then found today. Gamefish species were dominated by large members and they probably exerted important control over prey species such as sunfish, minnows, and other slender body fish. Examples of some of the lake monsters are pictured in the early photographs and old newspaper articles of the area. An example is the newspaper article from the Centennial issue of the Cities of Minocqua and Woodruff that describes some of the giant muskies that were caught in the early 1900's (Figure 5). Today much of Little Bearskin Lake and its watershed is still relatively undeveloped except for tier one development around part of the shoreline. Otherwise much of the watershed is a combination of forested land (second and third growth) and wetlands.



"The crowns of great white pine and Norways lifted themselves high above the ground and became intertwined to cast a shade like the dusk of a tunnel. Starved for sunlight, the branches below them had given up trying to live, and as the tree tops swayed in the wind, they jostled each other until they became loosened and fell to the ground, leaving the trunks t[illegible] straight and clear."--Isabel Ebert.

Figure 3. Example of what the virgin pine forests looked like prior to logging. (Source: Minocqua-Woodruff Centennial Edition, 1988)

Vast acres of logged over, burned over land characterized the lakeland area when E.M. Griffith came to the state.
--Department of Natural Resources photo.

Figure 4. Landscape changed drastically after logging. (Source: Minocqua-Woodruff Centennial Edition, 1988).

102-pound muskie

The Loch Ness monster of the North

Fishermen are known for their whoppers. After reading the following article which appeared in the May 2, 1902, issue of "The Minocqua Times," we know how fishermen got their reputations for being long on stories and short on the truth.

As to the validity of the story, Supt. Nevin and E.D. Kennedy took that secret to their grave. The late Jim Kennedy, son of E.D. Kennedy, told "The Lakeland Times" in 1974 that perhaps the story was true, although he added, "the whiskey flowed quite freely in those days."

A lithograph and copy announcing the 1902 catch follows. We hope you enjoy the rest of these fish tales gleaned from the pages of "The Minocqua Times" and "The Lakeland Times."

Supt. Nevin of the State Fish Hatchery Commissioners, who has been taking muskallonge spawn at the Tomahawk and Minocqua lakes the past month, informs us that E.D. Kennedy and himself captured the two largest muskallonge ever taken in these waters.

The largest one was caught in Minocqua lake and weighed 102 pounds, the other being taken in Tomahawk lake and weighed 80 pounds.

After the spawn was taken from these monsters, they were turned back into their native waters, where they await the sportsman to try and land them.

Mr. Nevin has taken muskallonge spawn at this place for the past four years, and says that in seining this season, they have caught more small muskallonge than ever before, which goes to show that they are increasing.

He also informs us that they have about 25,000,000 pike fry ready for distribution and 2,000,000 muskallonge fry, which will be planted in the lakes of Vilas, Oneida and Forest counties. The State Fish Hatchery Commissioners are expected here Saturday to look over the hatchery at this place and to lay out improvements to be done.

Figure 5. Prior to heavy fishing pressure, gamefish communities had their share of big ones. Also it is evident that stocking was underway in the early 1900s. (Source: Minocqua-Woodruff Centennial Edition, 1988)

4. WATERSHED CHARACTERISTICS

General land use in the watershed is shown in Figure 6. The Little Bearskin lake direct watershed encompasses approximately 1,032 acres. Of that 1,032 acres forest lands dominate followed by wetlands area and then lastly 123.7 acres of residential lands. Residential land use is composed of tier one cabins that are predominately seasonal in nature with several homes that serve as permanent residences.

Soils in the watershed are dominated by sandy upland soils with moderate organic content (Figure 7). One striking characteristic of the soils in the watershed is that they have high levels of phosphorus, and in fact are rated as some of the highest available pounds of phosphorus per acre (at 138 lbs/acre) in the State of Wisconsin.

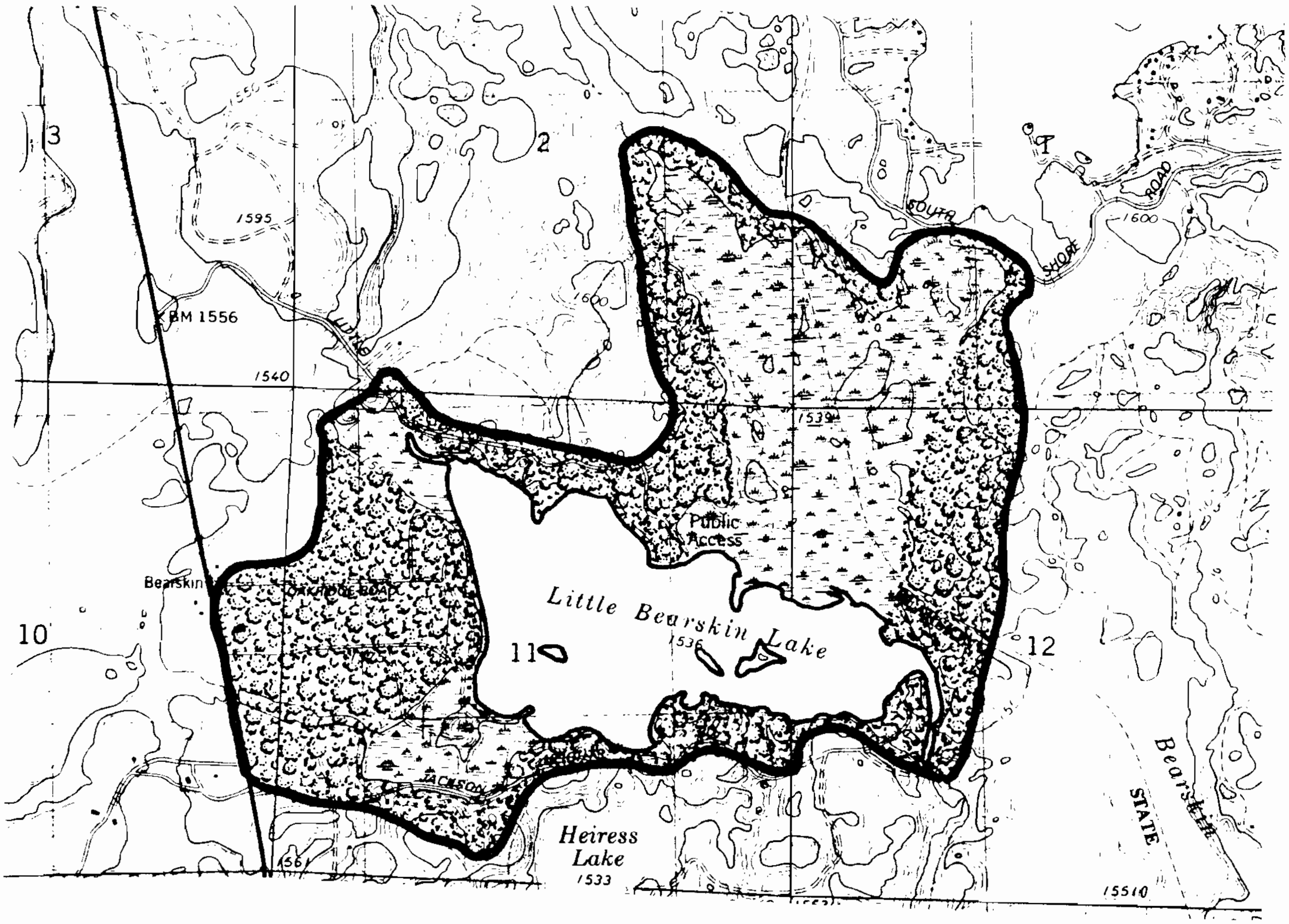
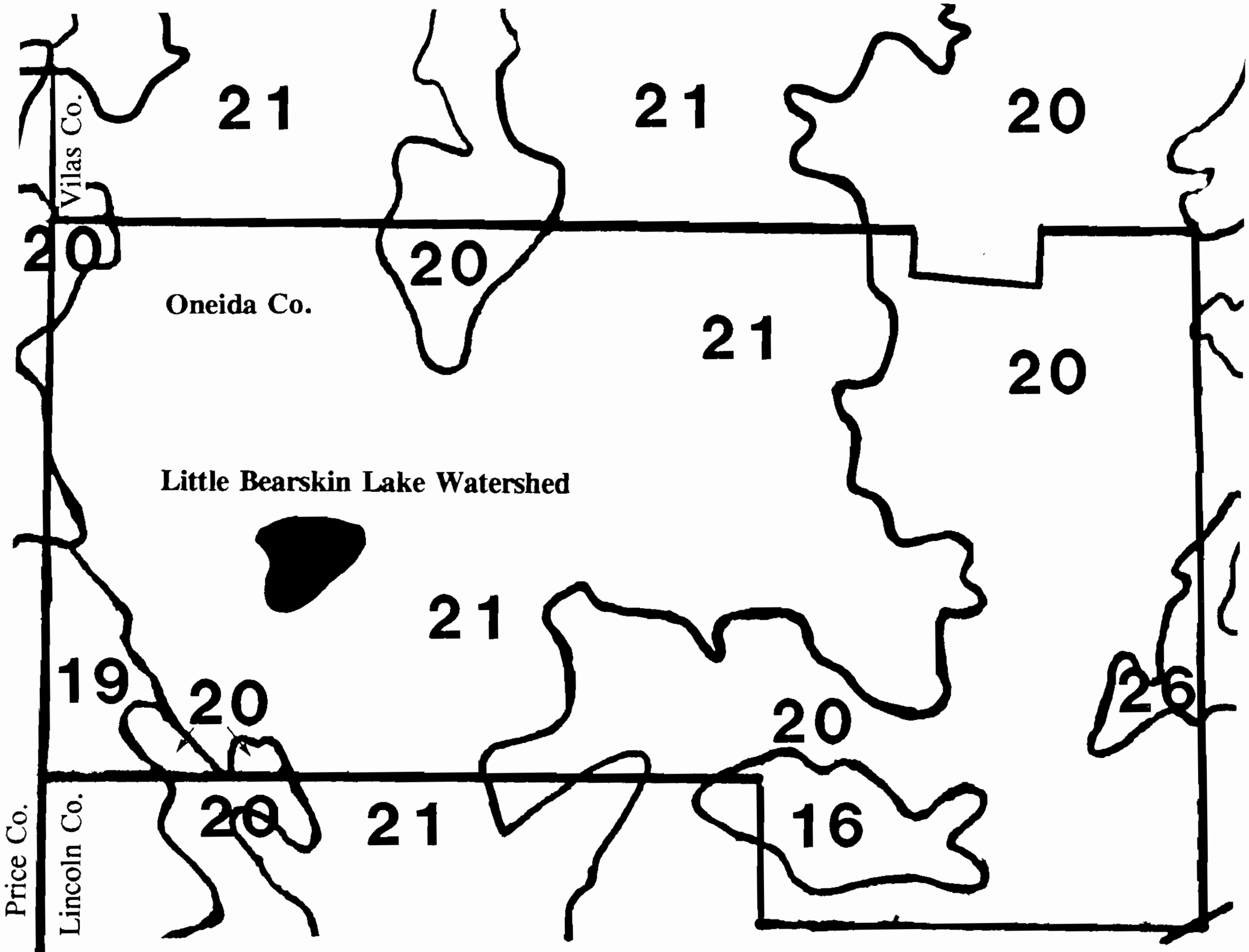


Figure 6. General land use map for Little Bearskin Lake.



Soil Number	Organic matter %	Available phosphorus lbs/A	Available potassium lbs/A	Soil reaction pH	Lime req.
	Low Med High 0-2 2-5 >5 % of soil tests Av.	Low Med High 0- 51- 101- 50 100 200+ % of soil tests Av.	Low Med High 0- 201- 400+ 200 400 % of soil tests Av.	Low Med High 4.5- 6.5- 7.5+ 6.5 7.5 % of soil tests Av.	Av.
16	3 84 13 3.8	65 20 15 54	67 29 4 176	54 45 1 6.3	2.08
19	3 95 2 3.2	64 26 10 52	70 28 2 163	59 46 1 6.3	2.50
20	68 32 0 1.7	35 18 47 114	63 28 9 149	46 46 8 6.0	1.52
21	33 55 12 2.9	29 8 63 138	76 23 1 170	81 19 0 5.5	1.94
26	0 3 97 56.2	51 23 26 96	59 20 21 200	53 39 8 6.4	0.32

■ Approximately where the watershed is located in Oneida County. Not to scale.

Figure 7. General soils map for Oneida County, Wisconsin.

Source: F.D. Hole. 1977. Photo-mosaic soil map of Wisconsin. Univ. Wisconsin Extension-Madison. A2822-1.

5. LAKE CHARACTERISTICS

Lake Water Chemistry

Little Bearskin Lake was sampled in the spring and autumn of 1988 with samples analyzed by University of Wisconsin-Stevens Point and sampled during the summer of 1992 (June, July, and August) by Blue Water Science, with samples analyzed at the Wisconsin State Hygeine Lab in Madison. Samples were analyzed for nitrogen, phosphorus, temperature, dissolved oxygen, secchi disk, chlorophyll a, and conductivity. Monitoring results are shown in Tables 2, 3, and 4. The 1988 sampling results indicate that the lake is phosphorus limited (Total Nitrogen:Total Phosphorus ratio 40:1). The 1992 sampling results show the same trend with a TN:TP ratio of 44:1.

The temperature/dissolved oxygen curve from 1992 show that in the deeper water dissolved oxygen is close to depletion (Figure 8). The temperature in the lake is stratified as well (Figure 8). Depleted oxygen concentrations in the bottom water may explain why elevated phosphorus concentrations are found (Table 2).

Something kind of scary was found in Little Bearskin Lake: very high concentration of phosphorus in the bottom waters (Table 2). The source of phosphorus must be from the bottom sediments. The Bearskin Creek inlet apparently is not the source, it is running at 36 ppb (Table 2).

Table 2. Results of the data analyses for Little Bearskin Lake for 1988 and 1992.

Date Location	SD ft	Chl a ug/l	TP ug/l	TKN ug/l	NH_3 ug/l	NO_3 ug/l	TSS ug/l	TVS ug/l	Cond ug/l
4.24.88									
	-	-	25	0.4	0.02	0.01	-	-	88
11.08.88									
	-	-	20	0.72	0.02	0.04	-	-	86
6.18.92									
Top	11	14	25	0.4	ND	ND	-	-	76
Bottom	-	-	500	-	-	-	-	-	-
Creek	-	-	-	-	-	-	-	-	80
7.23.92									
Top	9.8	7	22	.05	0.13	ND	-	-	73
Bottom	-	-	71	-	-	-	-	-	-
Creek	-	-	-	-	-	-	-	-	79
8.16.92									
Top	6.8	9	20	0.05	ND	ND	-	-	79
Bottom	-	-	650	-	-	-	-	-	-
Inlet	-	-	36	-	-	-	-	-	-

Table 3. Results of the 1988 epilimnetic data (spring and autumn).

Parameter	Units	Mean	n	Min	Max
Total phosphorus	ppb	23	2	20	25
Soluble Reactive P	ppb	9	2	2	15
Total Kjeldahl N	ppm	0.6	2	0.4	0.7
Nitrite + Nitrate-N	ppm	0.03	2	0.01	0.04
Ammonia-N	ppm	0.02	2	0.02	0.02
Alkalinity	ppm	38	2	36	40
Color	Pt-Co Units	44.3	2	8	81
pH	SU	9	2	9	9
Chloride	ppm	1	2	1	1
Conductivity	umhos/cm	87	2	86	88
TN:TP ratio	40:1				
TSIP (TP)	52				
TSIC (Chl-a)	-				
TSIS (Secchi)	-				
TSI (Mean)	52				

Table 4. Results of the 1992 epilimnetic data, Lake was sampled in June, July, and August.

Parameter	Units	Mean	n	Min	Max
Total phosphorus	ppb	22	3	20	25
Chlorophyll a	ppb	10	3	7	14
Secchi disk	m	3	3	2	3
Total Kjeldahl N	ppm	0.5	3	0.4	0.5
Nitrite + Nitrate-N	ppm	ND		ND	ND
Ammonia-N	ppm	0.01	1	0.01	0.01
Conductivity	umhos/cm	72	1	72	72
TN:TP ratio	44:1				
TSIP (TP)	51				
TSIC (Chl-a)	52				
TSIS (Secchi)	45				
TSI (Mean)	49				

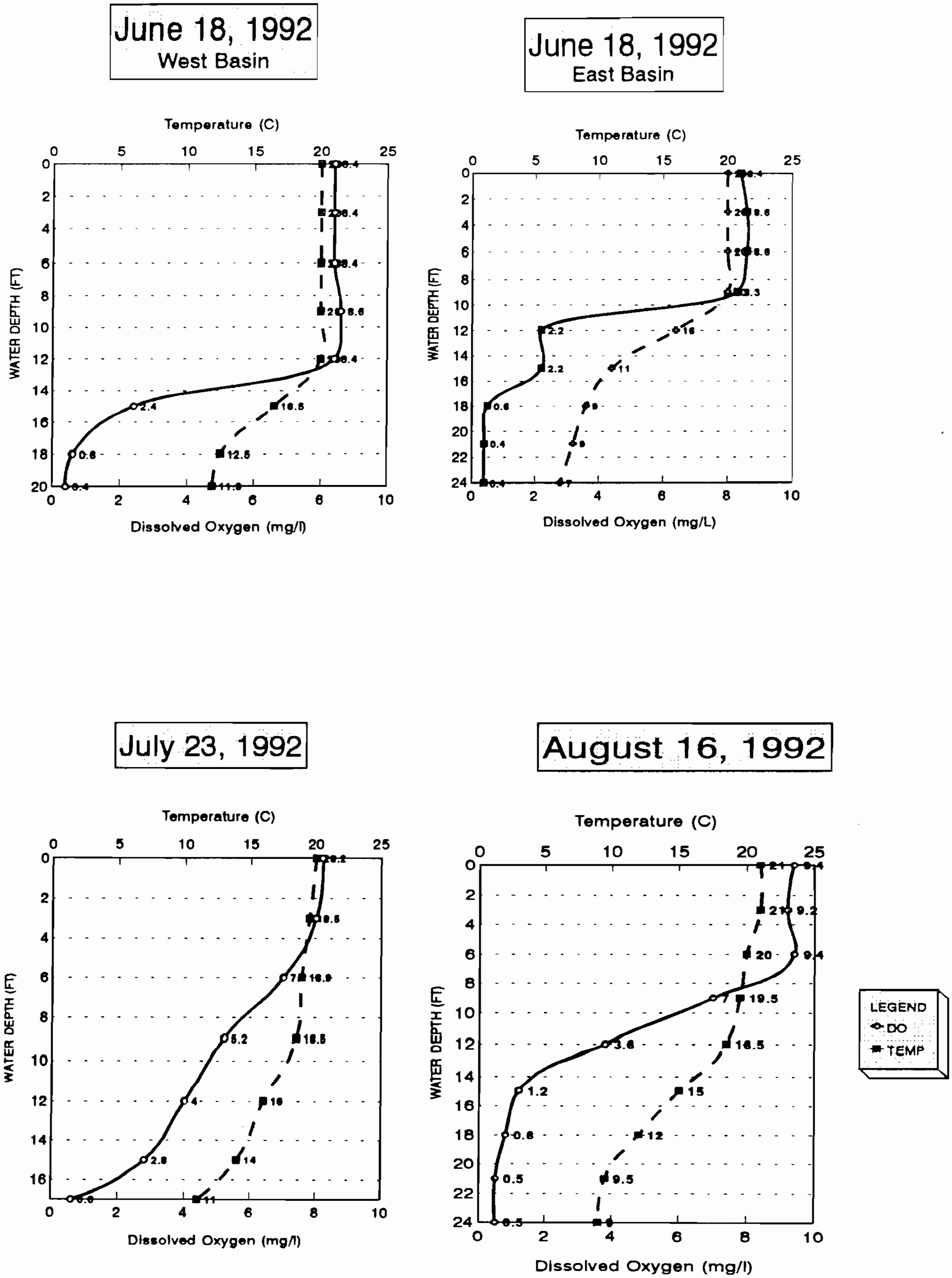


Figure 8. Temperature/oxygen profiles for Little Bearskin Lake.

Macrophytes

In the summer of 1992 an aquatic plant survey was conducted. Fifteen transects of the lake, as well as an excursion up the inlet and down the outlet were conducted using Lowrance X-16 recording Sonar and plant hooks to collect species of plants. Samples of the most common plant samples were brought back to the lab for better identification and were pressed and mounted. The species of plants, the density of plants at each location, and the depth they were found at are listed in Table 5.

The percent occurrence for each species of aquatic plant per transect station is shown in Table 6. The percent of plant coverage was calculated to be 51% of the lake (Table 7). When the percent of plant coverage 40% or more, clear water usually results. Little Bearskin Lake has slightly more than what is considered good. If Little Bearskin Lake ever loses a significant portion of its plant community it could experience nuisance summertime blooms of algae.

The location of the transects is shown in Figure 9 and the distribution of the aquatic plants is shown in Figure 10.

We used scuba diving to aid in the underwater evaluation of the aquatic plant community. One interesting observation was that filamentous algae was abundant in the deeper water. It was found on the bottom as mats and intertwined on coontail. Very little floating filamentous algae was observed.

Table 5. List of transects taken on Little Bearskin Lake and the plants found at each transect. The amount of the plant found at each station and the depth at which the plants were found are also include. The density of the plants were given number ranging from 1-5, with 1 being few plants and 5 being heavily populated.

Transect	Species of plant	Density	Depth of plants
1.a.	Fern pondweed	4	10 feet
	Coontail	1	10 feet
b.	Fern pondweed	4	7 feet
	Amphifolius	2	5-7 feet
	Coontail	1	7 feet
	Emergents	1	
1-2.	Water celery	2	3-4 feet
2.	Water celery	2	4 feet
	Fern pondweed	4	5-10 feet
	Amphifolius	1	5-10 feet
	Water milfoil	1	3 feet
	Elodea	1	5 feet
3.	Amphifolius	4	5-7 feet
	Fern pondweed	4	5-7 feet
3-4.	Water milfoil	2	3 feet
	Water celery	2	3 feet
	Lily patch-Spatterdock	5	4-8 feet
	-White lily	2	4-8 feet
4.	White lilies	4	4 feet
	Coontail	3	3 feet
	Water milfoil	sparse	4-7 feet
	Elodea	sparse	4-7 feet
	Fern pondweed	4	11 feet
	Amphifolius	4	11 feet
	Floatingleaf pondweed		fringed of wetland
5.	Flatstem	5	11 feet to wetland
	Claspingleaf	some	
	Fern pondweed	3	11 feet to wetland
	Amphifolius	3	11 feet to wetland
5-6.	Brassima		
	Spatterdock		
	White lilies	4	
	Water milfoil	2	

Table 5. Continued.

Transect	Species of plant	Density	Depth of plants
6.	Water milfoil	3	4 feet
	Water celery	2	3-4 feet
	Claspingleaf	2	7-11 feet
	Fern pondweed	4	
	Coontail	1	7-11 feet
7.	Amphifolius	2	12-5 feet
	Fern pondweed	3	12-5 feet
	Coontail	1	12-5 feet
	Water celery	2	2-4 feet
	Water milfoil	2	4-7 feet
	Turfgrass		0-2 feet
7-8.	Claspingleaf	2	3-4 feet
	Water milfoil	2	3-4 feet
8.a.	Fern pondweed	5	5-12 feet
	Coontail	1	5-12 feet
b.	Chara	4	0-5 feet
9.	Emergent		up to 5 feet
	Fern pondweed	5	5-10 feet
	Coontail	2	
10.	Fern pondweed	5	9-14 feet
	Water milfoil	1	0-3 feet
	Spatterdock		up to 5 feet
11.a.	Fern pondweed	1	4-10 feet
	Water celery	1	4-10 feet
b.	Fern pondweed	5	8 feet
c.	Fern pondweed	5	
	Coontail	2	
d.	Spatterdock	1	
	Water milfoil	2	
e.	Water celery	2	
	Amphifolius	1	
	Coontail	2	
12.	Fern pondweed	5	4-5 feet
	Elodea	2	4-5 feet
	Coontail	1	4-5 feet
	Water celery		4-5 feet
	Spatterdock		4-5 feet
13.	Amphifolius	3	8-5 feet
	Fern pondweed		8-5 feet
	Water celery	2	3-4 feet

Table 5. Concluded.

Transect	Species of plant	Density	Depth of plants
14.	Fern pondweed	4	
	Amphifolius	2	
	Coontail	2	
15.	Coontail	4	surface to 5 feet
	Amphifolius	3	surface to 5 feet
	Flatstem	2	surface to 5 feet
	Fern pondweed	4	surface to 5 feet
Outlet	Waterlilies		
	Spatterdock		
	Fern pondweed		
	Duckweed		

Table 6. Little Bearskin macrophyte species list and percent occurrence

	Percent occurrence
Potamogeton robbinsii (Fern pondweed)	94
P. amphifolius (cabbage)	56
P. richardsonii (Claspingleaf pondweed)	11
P. tenuifolius (Flatstem pondweed)	6
Ceratophyllum demersum (Coontail)	67
Valisneria americana (water celery)	44
Elodea canadensis (Elodea)	11
Nymphaea odorata (Water lily)	17
Nuphar advena (Spatterdock)	11
Chara sp. (Chara)	6
Myriophyllum exalbescens (Water milfoil)	44
Emergents	6

Table 7. Percent of bottom coverage

Bottom type	Percent of Coverage
No plants	49%
Submergents plants	51%

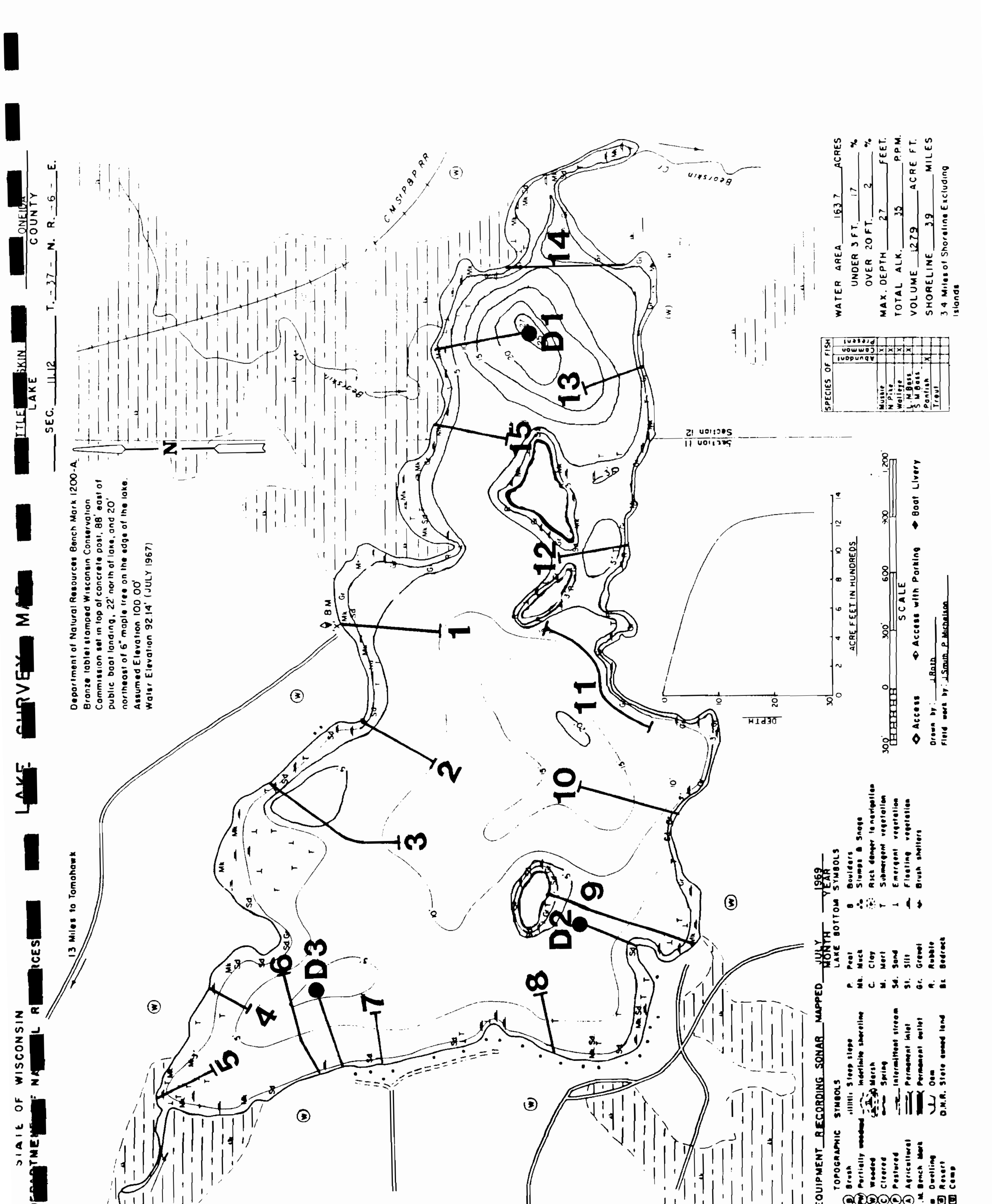


Figure 9. Location of transects taken on Little Bearskin Lake. The dives are indicated by the letter D.

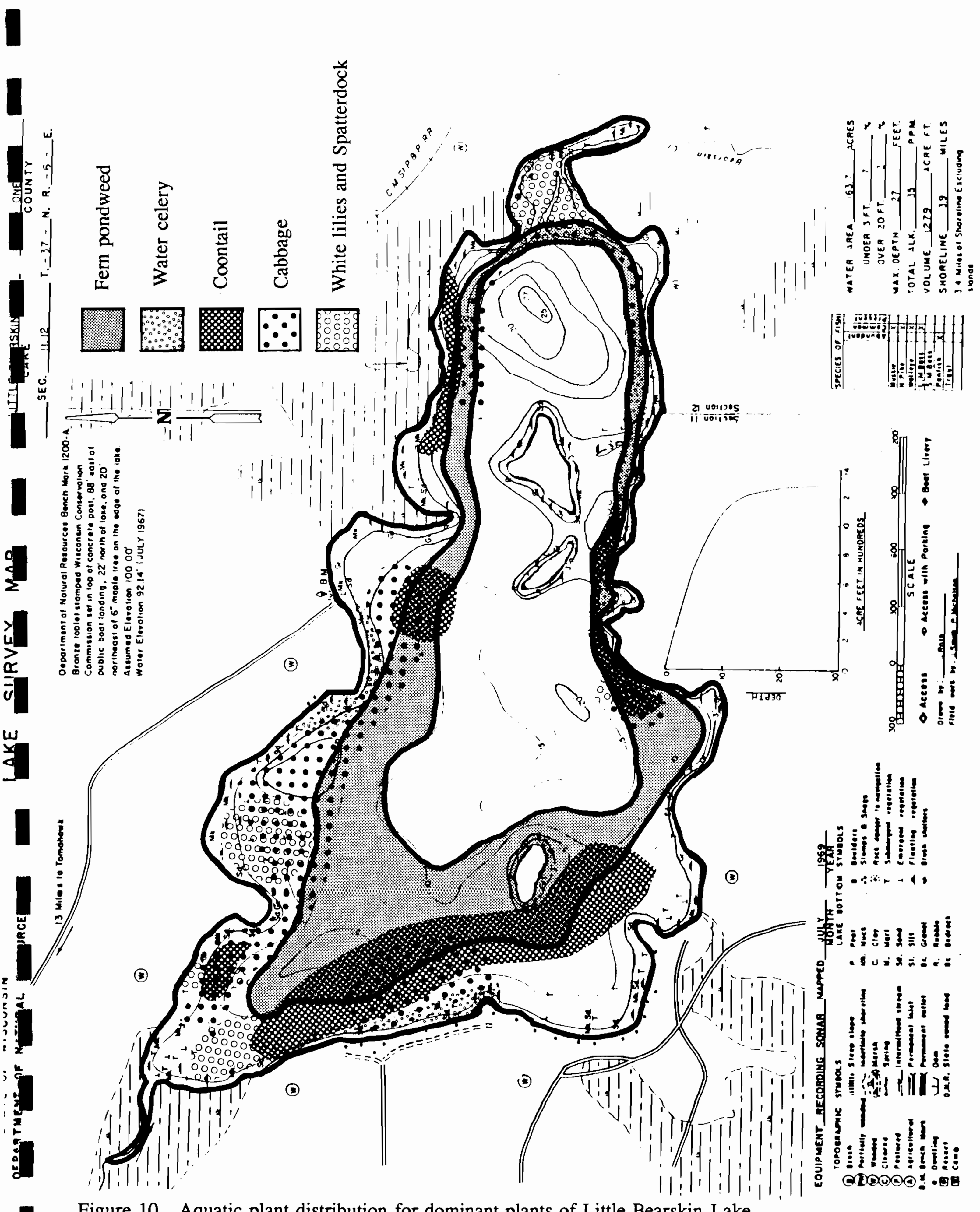


Figure 10. Aquatic plant distribution for dominant plants of Little Bearskin Lake.

Fish

In a fish survey that was conducted by the Wisconsin Department of Natural Resources in June 15-18 1970, a total of 23 Northern pike, 1 walleye, 2,162 bluegill, 118 pumpkinseed, 35 black crappie, 3 yellow perch, 1 rockbass, 61 black bullhead, 6 white suckers, and 5 northern redhorse were observed in 24 trapnets.

It is likely, based on the number of sunfish found and the extensive plant colonization areas that bluegills are stunted. I was a little surprised that largemouth bass did not show up in any of the trapnets. An updated fish survey would be appropriate to check the status of the sunfish and gamefish community. Ron Theis, WDNR-Woodruff should be contacted to see if Little Bearskin is a list of lakes to be surveyed in the mean future.

6. LITTLE BEARSKIN LAKE PHOSPHORUS MODEL

Lake modeling is a tool that aids in predicting what phosphorus concentrations should be in a lake based on the amount of phosphorus that comes into a lake on an annual basis. A lake model is a tool used to check if the estimated phosphorus inputs are close to correct. If lake model phosphorus predictions are similar to actual phosphorus concentrations then the estimated phosphorus inputs are close to correct. The phosphorus model can also be used to predict what future phosphorus concentration might be if changes are made in the watershed that would change (increase or decrease) phosphorus inputs.

The phosphorus model used in this report was the Canfield and Bachmann Model. The model is shown in Table 8. Before the model could be run the phosphorus budget and the water budget had to be determined. By assigning nutrient concentrations with land use delineations and then assuming a certain amount of runoff per year one can then estimate phosphorus inputs from various land uses. These are referred to as export coefficients and a summary of export coefficient with each land use and then the total estimated phosphorus input to Little Bearskin Lake is shown in Table 10. Forest lands and rainfall are the major nutrient contributors to Little Bearskin Lake followed by residential areas, and then the wetlands (Table 10). The unknown variables here are groundwater inputs as well as septic tank inputs. It is estimated that septic tanks and groundwater inputs are low.

The values that were calculated and used in the phosphorus model predictions are shown in Table 9. The model run is shown in Table 11. For Little Bearskin Lake the model prediction was 26 parts per billion (ppb) while the average phosphorus concentration found in Little Bearskin Lake was 23 ppb (epilimnion only). As far as lake phosphorus models go this is pretty close agreement.

Table 8. Phosphorus model used for Little Bearskin Lake was the Canfield and Bachman Lake Model.

Phosphorus Model

Canfield and Bachmann Phosphorus Model (1981)

$$TP = \frac{L}{z(0.162\,(L/z)^{0.458} + p)}$$

where:

TP (mg/m^3) = concentration of total phosphorus in the lake water

L ($mg/m^2/yr$) = annual phosphorus loading per unit of lake surface area

z (m) = mean depth of the lake

p (yr^{-1}) = hydraulic flushing rate

Table 9. Nutrient budget and water budget numbers used for the Canfield and Bachman Lake Model.

	Nutrient load (kg/yr)	Water load (m^3/yr)	L (g/m^2)	P (yr^{-1})	q_s (m)	Z (m)	Model P Prediction (ppb)
Little Bearskin Lake	70.7	1,273,368.5	0.11	0.8	1.9	2.4	26

Table 10. Nutrient input parameters for the Little Bearskin Lake phosphorus model. Phosphorus export coefficients were selected from Reckhow 1979 (Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients, EPA, Washington D.C.)

Land use or nutrient source	Area (ha) volume (m^3) or numbers	Export coefficient (kg/ha/yr)	Estimated phosphorus input (kg/yr)
Forest	250 ha	0.1	25
Wetland	117 ha	0.05	5.9
Urban	50 ha	0.19	9.5
Septic tank systems			
seasonal	29	0.055*	1.6
permanent	9	0.166*	1.5
Rainfall	66 ha	0.40	26
			69.5
Groundwater			1
			70.5

* kg/on-site system/yr was derived from the following assumptions and calculations:

seasonal: 60 gallons/day * 2.5 people/cabin = 150 gallons/day/cabin * 3.785 = 567.75 liters * 120 days = 68,130 liters * 0.8 mg/l* = 54,504 mg/year

permanent: 60 gallons/day * 2.5 people/cabin = 150 gallons/day/cabin * 3.785 = 567.75 liters * 365 days = 207,229 liters * 0.8 mg/l* = 165,783 mg/year

Table 11. Total phosphorus (ppb) Lake Model for Little Bearskin Lake

PHOSPHORUS LOADING			
	Export coeff kg/ha/yr	Area ha	Phos input kg/yr
Forest	0.1	250	25
Wetland	0.05	117	6
Urban	0.19	50	10
Agriculture	1	0	0
Septic Tank Systems			
Seasonal	0.055	29	2
Permanent	0.166	9	1
Rainfall	0.4	66	26
Groundwater	0.04	35	1
Misc Phos Input			0
	TOTAL MASS ==>		71

WATER BUDGET			
Avg Runoff, in	12	0.3048	m
Watershed area, ha	417.8	417.8	ha
Net Precip, rain - evap, inches	0	0	m
Lake surface area, ha	66.2	66.2	ha
Net water input rainfall, m^3	0		
Net water input, watershed, m^3	1,273,454		
Total Water, m^3 ==>	1,273,454		

Canfield Bachmann Lake Phosphorus Model

Description	Units	Eq. Symbol	Value
Lake Area	ha	A	66.2
Mean Depth	m	z	2.4
Lake Volume	m^3	V	1,588,800
Total P mass	kg/yr	M	71.24
Total Water	m^3	Q	1,273,454
Total TP load	mg/m^2/yr	L	108
Flushing rate	1/yr	P	0.80
Nat Sed coeff	1/yr	SIGMA_n	0.92
Art Sed Coeff	1/yr	SIGMA_a	1.07
Natural Lake Total Phosphorus, ppb			26
Artificial Lake Total Phosphorus, ppb			24

7. CONCLUSIONS OF THE LAKE AND WATERSHED ANALYSES

Some conclusions of the 1992 lake study are summarized below:

o Average phosphorus concentrations in the upper water were 23 parts per billion (ppb). This is close to "natural" conditions for lakes in this part of Wisconsin.

o However, there were very high phosphorus concentrations of over 500 ppb in the bottom water of Little Bearskin Lake.

o The inlet creek, Bearskin Creek, is running clear at about 34 ppb. This input cannot account for the elevated phosphorus found in the bottom waters.

o Dissolved oxygen concentrations were low in the bottom water of Little Bearskin. Phosphorus is probably being released from the lake sediments and is probably the source of high phosphorus in the bottom water.

o A rating system for lakes is called the Carlson Trophic State Index (Figure 11). Little Bearskin was rated as being mesotrophic. This means it wasn't overly nutrient enriched (eutrophic) and it wasn't nutrient poor (oligotrophic).

o It appears Little Bearskin has enough nutrients to generate nuisance algae and plant conditions. This condition is expressed in some years, but was not found in 1992.

o Little Bearskin Lake sits in soils that are naturally phosphorus rich. Over the years this may have been a source of phosphorus to the lake.

o Little Bearskin is a lake on the threshold. At some point if phosphorus concentrations reach 40-50 ppb and stay there for a couple of years, nuisance algae blooms could become more persistent. This could cause a decline in the macrophyte community and shift the balance over to an algae dominated system (somewhat like Big Bearskin). It is estimated (based on phosphorus modeling) that only a total of 129 kg (about 280 pounds) of phosphorus are needed to get phosphorus concentrations between 40-50 ppb.

o Projects are outlined in the next section that give inexpensive and expensive approaches for protecting Little Bearskin Lake.

$TSI(Chl\ a) = 36.25 + 15.5 \log_{10} [Chl\ a]$
ppb or ug/l
$TSI(TP) = 60 - 33.2 \log_{10} (40.5/TP)$
ppb or ug/l
$TSI(Secchi) = 60 - (SD \log_{10} \times 33.2)$
meters

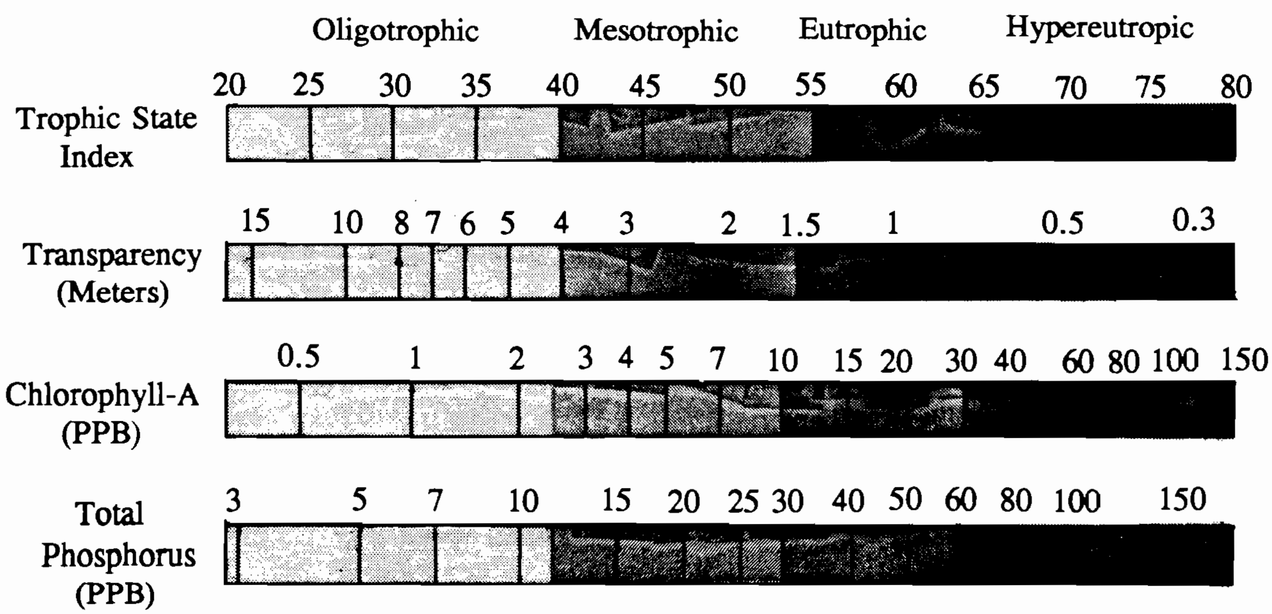


Figure 11. Carlson's Trophic State Index. Taken from NALMS (1988).

8. FUTURE PROJECTS

Little Bearskin Lake is in the enviable position of lake protection and maintenance projects at this time rather than the much more expensive lake restoration. The primary approach is to maintain a healthy lake plant community and a healthy lake. However if plants go away, we have listed potential restoration projects (expensive) projects as well. A summary of recommended projects is shown below:

Inexpensive Projects

1. No wake for boats or reduce speed limits.
2. Small-scale weed harvesting (by hand and net).
3. On-going lake monitoring ($300/yr).
4. Landscaping for wildlife.
5. No action alternatives--let nature take its course

Expensive Projects

6. Aeration ($30,000 + electricity).
7. Alum application ($40,000).
8. Large-scale mechanical weed harvesting ($300/acre).

Inexpensive Projects

1. No wake for boats or reduce speed limits: Driving around in a fast speed boat might be fun but it may be harmful to the clarity of the lake. Fast boats can stir-up the water, disturbing the phosphorus-rich water that is found about 12-14 feet below the surface. The mixing action of boats may allow the phosphorus enriched lower water to get mixed into the upper water. With more phosphorus brought up into the upper water, the algae numbers may increase to the level of nuisance blooms. Enforcing a no wake situation for boats or reducing speed limits would lower the risk of artificial mixing of the water levels.

I think a first step is to inform lake users of the potential problems and ask that when possible, boating speeds be kept down. The intent is not to ban waterskiing, but rather the idea is that cruising speeds when not skiing are better than a wide open throttle.

2. Small scale weed harvesting: Collecting the plants in front of your property helps the lake

by getting rid of the extra plants and it also helps the lake look nicer. The only costs that are involved with this alternative is the cost of equipment you may want to work with, such as: rakes, nets and drags. The idea is to leave some areas "natural" but weeds could be cleaned out for boat landings and swimming areas.

3. Start a monitoring program: It would be very helpful to have an ongoing monitoring program for Little Bearskin. University of Wisconsin-Stevens Point has a very good water chemistry monitoring program that is appropriate for lake associations and at a reasonable cost. Dr. Byron Shaw at UW-Stevens Point is the contact. Sampling is done in spring and fall, and a water sample should be taken at Bearskin Creek inlet as well to monitor what is coming into Little Bearskin Lake. The cost would be around $200.

4. Landscaping for wildlife: The quest for the "perfect" lakeshore property: does it mean wide open spaces with a green lawn ending in a sandy beach? or does it mean a landscape that has a variety of plants and trees both on the land and in the water? or is it something in between? Also another question that goes hand-in-hand is: how much work do you want to put into a place that has been known as a place to relax?

If your idea of the "perfect" property is the big green lawn, this can mean you are in for a lot of work. Not only do you have to take the time for lawn maintenance, which cuts back on fishing time, you have to take the time to keep an eye out for the animals that like the wide open view. Canadian Geese may stop over for some grazing, and leave some nice reminders. Also you will have to keep an eye open for invading plant species, with a battle between the good and bad plants occurring on an annual basis.

Another option is the natural look that starts on your property and extends right into the lake. The natural look also helps protect the reason why you chose this property in the first place, the lake because it can reduce the amount of nutrients that run into the lake. What is a "natural" look? If you own 100 feet of shoreline it may mean naturalizing about 75 feet of shoreline, and lake bottom and clearing about 25 feet for a swimming beach and/or boat landing. You may want to refer to the original vegetation map for your area (check with the Land Conservation Department for details) and reestablish natural vegetation on your whole property.

The original vegetation in the Little Bearskin Lake watershed was the Pine Woods. However Maple, Elm, Oak, and a variety of shrub-like plants are native to the area as well.

When choosing the type of vegetation to use keep in mind what will bring beauty and viewing enjoyment all year round. You may want to talk to other neighbors who have naturalized their property to see what has worked and what has not worked for them. There is no wrong way to customize your property. Just keep in mind some basic ideas:

-study the landscape of your property

-learn the natural shoreline conditions-plants will help stabilize the shoreline

-plant things that will be enjoyable year round

-plant what you enjoy

Why not put out some bird houses, this will add in bringing in different birds and be useful as a form of bug control.

Enjoy your new found wildness!!

5. No action alternatives--Let nature take its course: This alternative calls for letting the lake biology follow the rules of nature. In the future if the decision is made to keep nuisance algae blooms down, it will cost some money. In the years to come, the phosphorus lurking in the bottom waters may create nuisance algae blooms and nuisance macrophyte growth that occur every year. Right now it looks like that nuisance algae blooms occur about 2 out of 5 years with a nuisance plant community appearing occasionally as well.

My interpretation of the data and our modeling indicate to me that the source of the problem is not coming from the watershed, but from the lake sediments. Therefore to treat the source of the problem...the phosphorus in the sediments...will be expensive.

Expensive Projects

6. Aeration ($30,000 + electricity): Aeration may be a way to keep nuisance algae growth down. A successful aeration system will oxygenate bottom waters and this will keep excessive phosphorus from coming out of the lake sediments.

We could probably make an aeration system for Little Bearskin using a prototype made by the WDNR. To purchase an aeration system from a vender would probably be $50,000 or more.

However, you should be cautioned. Even with an aeration system in place, this would not guarantee that nuisance algae blooms and nuisance plant growth would be controlled.

7. Alum Application ($40,000): Alum (aluminum sulfate) is a nontoxic material commonly used in water treatment plants to clarify drinking water. In lakes alum is used to control the growth of algae by reducing the amount of phosphorus upon which algae organisms feed. Alum is used primarily to control this internal phosphorus loading.

On contact with water, alum forms a fluffy aluminum hydroxide precipitate (called a floc). Aluminum hydroxide (the principle ingredient in common antacids such as Maalox) reacts with phosphorus to form an aluminum phosphate compound. This compound is insoluble under most conditions so the phosphorus will no longer be used as food by algae.

As the floc slowly settles, some phosphorus is removed from the water. The floc also tends to collect suspended particles in the water and carry them down to the bottom with it leaving the lake noticeably clearer.

On the bottom of the lake the floc settles into the sediments and acts as a phosphorus barrier by removing phosphorus as it is released from the sediments. It is harmless to water organisms and aquatic plants.

Such a sediment alum treatment can last up to ten years depending on the amount of the initial alum treatment, and lake conditions such as sedimentation rate and external phosphorus loading. Best results are obtained when coupled with steps to control the external sources of phosphorus (Tom Eberhardt, Sweetwater Technology, 1992).

Alum applications currently are in the range of about $300 to $400/acre. To treat 100 acres of Little Bearskin Lake could cost $40,000.

8. Large-scale mechanical weed harvesting: ($300/acre): In years when Little Bearskin Lake experiences nuisance plant growth, mechanical weed harvesting could be considered. Coontail seems to be the problem plant species. Although coontail is not rooted, it is still a difficult plant to remove, and mechanical harvesting is the best approach. I would not recommended using herbicides. Killing coontail in the lake and not removing it, would allow coontail to decompose

and release phosphorus. Algae blooms would probably develop.

Harvesting is not a long-term solution for coontail control either, but it is a management tool. Mechanical harvesting costs range from $70 to $100 per hour, and it takes 3 to 4 hours per acre. Rather than doing whole areas, selective cuts could be made. Cuts could be made to allow boaters to get in and out from their docks. Also cuts could be made parallel to shore which serve as cruising lanes for fish and boating lanes for fishermen.