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**IMPACT OF AN OVERWINTER DRAWDOWN
ON THE AQUATIC VEGETATION
IN MURPHY FLOWAGE, WISCONSIN**

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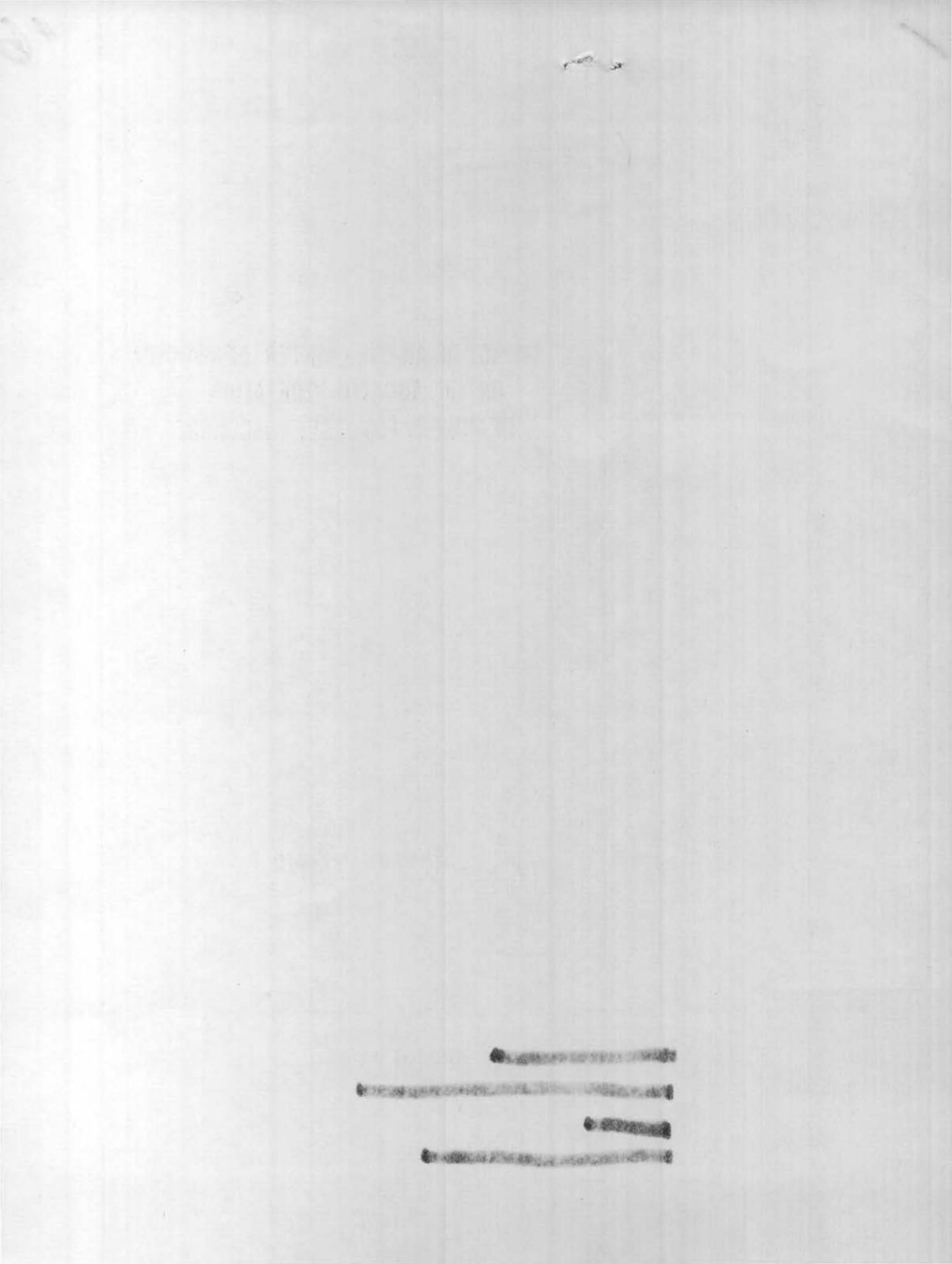
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W A R M W A T E R S T U D I E S

POINTERS ON OVERWINTER DRAWDOWN TO CONTROL AQUATIC VEGETATION

There are a number of questions that were left unanswered concerning the control of aquatic vegetation by an overwinter drawdown when the Murphy Flowage Dam washed out. I have recently had a number of inquiries about this type of vegetation control and I list here some of the factors that personnel should be aware of when using an overwinter drawdown to control vegetation.

Type of Vegetation

An overwinter drawdown does not kill all types of vegetation. Some species seem to be resistant to this type of control. I have made studies on two flowages that were drawdown over the winter and found these results:

Resistant Vegetation

Thin leafed Potamogetons
Floating-leaf pondweeds
Water marigold
Bushy pondweed

Non-Resistant Vegetation

Coontail
Water milfoil
Robbins's pondweed
Yellow water lily
Large-leaf pondweed

Thus, if the dominant species are coontail and water milfoil, you should get a reduction from the drawdown. If the dominant species are water marigold and thin leafed potamogetons, you probably will not get a reduction. It is also possible that you will get a change in the species composition of the flowage, but no reduction in the amount of vegetation.

Invasion of Aquatic Vegetation After the Drawdown

Certain types of vegetation will come back. How long it will take the resistant vegetation to reinvade the flowage is unknown. At Murphy Flowage there were 80 acres choked with vegetation before the drawdown and two summers after the drawdown there were only ten acres with vegetation.

Plankton Bloom

In any flowage you have a source of nutrients coming in and if these nutrients are not used by rooted aquatic plants, they will be utilized by the plankton. One year after the reduction of vegetation in Murphy Flowage there was a pea soup plankton bloom.

Wells

There was one landowner on the flowage with a shallow well (20'). The well went dry approximately one month after the flowage was completely down. Complete drawdown of Murphy Flowage was 5 feet and a water volume reduction of 70 percent.

Should the Pond be Drawn Down Completely?

It is best to draw the pond down to a point where most of the vegetation areas are dry, although at Murphy Flowage we did get reductions in areas which were water covered that froze to the bottom during the winter.

Winterkill

At Murphy Flowage we had no problems with winterkill of fish with a water volume reduction of 70 percent. On the contrary we got a slight increase in the dissolved oxygen during the winter. By reducing the volume of the flowage by 70 percent the water remaining was concentrated around the stream channel causing a faster interchange. Under normal conditions there would not be a rapid interchange because of the dilution factor. (Thomas Beard)

IMPROVED GEAR PERMITS ESTIMATES OF YEARLING GAME FISH

The total northern pike population in Murphy Flowage was estimated at 1250 or 7 fish per acre in April, 1970. Approximately 3 fish per acre were over 14.0 inches and 4 under. Estimates of the smaller group include yearling fish as small as 6.5 inches. More intensive use of fine mesh fyke nets and the boom shocker proved successful in capturing enough yearling fish to estimate their abundance for the first time. Mature males as small as 7.1 inches and females as small as 9.3 inches were handled.

The total population of largemouth bass in Murphy Flowage was estimated at 2,800 or 16 per acre in May, 1970. Of these 4 were over 8.0 inches and 8 under. For the same reasons previously mentioned yearling bass were captured in sufficient numbers to estimate their abundance. This group totaled 11 per acre and included fish from 2.5-5.9 inches. (Howard Snow)

A 22-INCH MINIMUM SIZE LIMIT ON NORTHERN PIKE IN ESCANABA LAKE

Harvest with a 22-inch minimum size limit in effect on northern pike has been determined for seven (1964-70) fishing seasons. A comparison was made (1957-63) of annual catch with liberalized fishing regulations (no size or bag limits and no closed seasons).

During the first 7 years of a size limit the annual catch ranged from 31 fish weighing 83 pounds to 217 northern pike weighing 571 pounds. The annual catch averaged 94 fish that weighed 251 pounds.

With no size limits and after the population was well established (1958-63) an average of 600 fish weighing 948 pounds were caught annually. Under liberalized regulations, the average annual catch was over 6 times as great in number and almost 4 times as high in weight compared to that under the 22-inch minimum size limit.



ABSTRACT

A lowering of the water level on Murphy Flowage during the winter of 1967-68 resulted in a significant reduction in the distribution, relative abundance and acreage of aquatic vegetation.

The five species in greatest dominance before the drawdown were most affected, and collectively showed a reduction of 181.7 acres in the season after the drawdown.

ACKNOWLEDGMENTS

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I also thank Lyle Groth, Donald Stafford, Ronald Masterjohn, and Jon Peterson who assisted with the field work. Lyle Christenson and Gordon Priegel reviewed the manuscript and provided many helpful suggestions.

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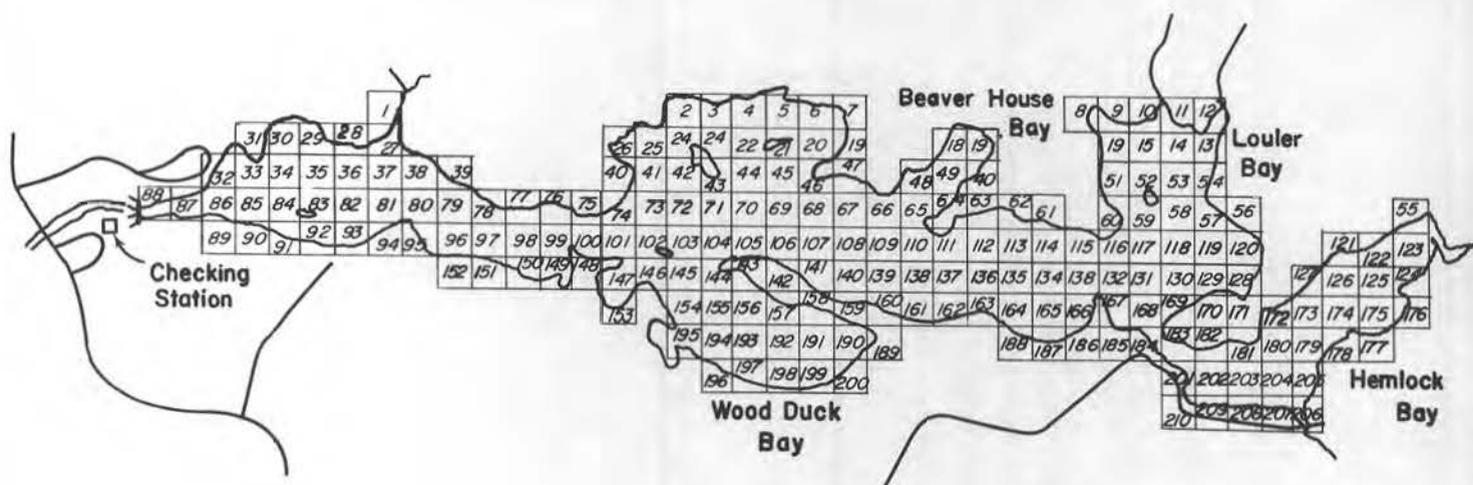
INTRODUCTION

Dense growths of aquatic plants are a problem in many shallow flowages and natural lakes in northern Wisconsin. In some waters the growth of vegetation hinders fishing, swimming, boating and other forms of public recreation.

A number of control methods for aquatic plants are now being practiced throughout the country, the most common being the use of aquatic herbicides. The use of herbicides is an expensive and temporary cure for control of aquatic plants and must be repeated periodically for complete control. Biological control has been proposed by a number of authors: Allsopp (1960) discussed the use of the manatee for weed control; Mathis (1966) made observations on the control of vegetation using Israeli carp; Yeo (1967) used silver dollar fish for biological control of submerged aquatic weeds and Childers and Bennett (1967) studied the effects of largemouth bass-tilapia combination on vegetation control. Most of the biological control methods mentioned above are with species that could not survive in the colder climate of northern Wisconsin. In general, most biological controls for aquatic vegetation have been largely unsuccessful.

A few studies have been made on the effects of fluctuating water levels on aquatic vegetation. McDonald (1955) found that increased water levels in marshes along Lake Erie caused a die-off of the following emergent plants: Typha angustifolia, T. glauca, Scirpus fluviatilis, S. acutus, S. validus var. creber, Carex stricta and Phragmites communis var. Berlandieri. Robel's (1962) study in Utah showed that submerged aquatic vegetation increased by 32 percent in the shallow areas but decreased by 35 percent in the deeper areas when water levels were increased. Mathis (1966) found a complete absence of Elodea spp., Ceratophyllum demersum and Polygonum spp. after a fall and winter drawdown in Lake Catherine, Arkansas. Lantz et al. (1967) reported that a summer drawdown on Anacoco Lake, Louisiana definitely restricted the growth of Potamogeton spp. and Nuphar spp., with a total reduction of 90 percent in vegetation over a three-year period. Of the studies acted, only Robel's (1962) provided any quantitative data to support the findings and his study was concerned with the effects of increased water depths on submerged vegetation. Thus, the objectives of the present study were (1) to determine if an over-winter drawdown would prove to be an effective means of controlling aquatic plants, and (2) to provide a quantitative description of the impact of the drawdown on aquatic vegetation.

The study was conducted at 180-acre Murphy Flowage in Rusk County, Wisconsin. Maximum depth was 14 feet, but 70 percent of the flowage was less than 10 feet deep. The mean annual alkalinity was 38 parts per million. According to Moyle (1945) the natural separation between hard and soft waters seems to be at a total alkalinity of about 40 ppm, with 30 ppm being the lower limit of the hard water species and 50 ppm being the upper tolerance of most soft water species. The vegetation in Murphy Flowage included both hard and soft water plants.



NOTE:

Maximum Depth - 14 Feet

Shoreline - 6.4 Miles

Area - 180 Area



FIGURE 1. The distribution of the 210 quadrats at Murphy Flowage, Wisconsin.

Murphy Flowage was formed at its present level in 1937 and an intensive study of the fish population has been conducted on the flowage by the Wisconsin Department of Natural Resources since 1955. Observations by Department personnel indicated a gradual increase in the total acreage covered by the aquatic vegetation since 1955. The first quantitative and qualitative study made on the aquatic plants was the present study begun in 1967.

METHODS

Murphy Flowage was divided into 210 quadrats (Fig. 1). These quadrats were used originally for determining random net sets for making fish population estimates. Each quadrat was 225 feet square with a total area of 1.16 acres. Since each quadrat did not lie completely within the flowage, the approximate area which was under water was calculated so that the total acreage covered by each species could be determined.

The aquatic plants were identified in each quadrat and a visual ranking as to abundant, common, present and rare was made. If a species covered 75 percent of a quadrat it was ranked abundant; 50 percent, common; 25 percent, present; and below 25 percent, rare.

In deeper areas where visual observations were limited, a garden rake was used to determine the presence of aquatic plants. In no case was any vegetation found below visual observation range. Jessen and Loud (1962) used rake recoveries at selected sample sites to determine density of aquatic vegetation as well as visual observation of density at the same sample sites. They found that no significant differences existed between visual observation and rake determinations.

Between October 24 and November 16, 1967 the level of Murphy Flowage was lowered 5 feet. The low level was maintained until March 11, 1968, after which the water was gradually raised to the former level by April 1. During the entire winter the area of the flowage was reduced by 45 percent and the total volume by 70 percent. Observations on the abundance of vegetation were made in the last two weeks of August, 1967 and during the same period, after the drawdown, in 1968. Aerial photographs of the flowage were taken in the first week of September, 1967 and 1968.

RESULTS

Before the drawdown, in 1967, there were 24 species of aquatic plants present in the flowage. After the drawdown, in 1968, there were 20 species found, including 18 of the pre-drawdown species and two new species. The two new ones were: Vallisneria americana and Scirpus americanus (Table 1). In 1967, 202 quadrats had aquatic vegetation while in 1968 only 163 quadrats had plants.

Before Drawdown

Potamogeton Robbinsii was the most abundant species in the flowage before the drawdown (Table 2). It was found in 84 percent of the quadrats in the flowage and it covered 75 percent or more of the area in 131 quadrats. Nuphar was the next most abundant plant, being found in 69 percent of the quadrats. It was abundant or common in 22 percent. Myriophyllum occurred in 53 percent of the quadrats. Although this species was only abundant and common in 6 percent of the quadrats, it was recorded present and rare in 47 percent. Ceratophyllum demersum and Potamogeton amplifolius were recorded in 40 and 32 percent of the quadrats respectively. C. demersum was abundant in 4 and common in 11 percent, while P. amplifolius was never recorded abundant or common but only as present in 8 and rare in 24 percent of the quadrats.

After Drawdown

There was a drastic change in the abundance of aquatic vegetation noted in August, 1968, after the drawdown. Ceratophyllum demersum and Potamogeton amplifolius showed the greatest change, being absent in the flowage in 1968 (Table 3). Potamogeton Robbinsii was recorded in 42 percent of the quadrats and was not abundant or common in any of these. Nuphar was found in 53 percent of the quadrats but was only abundant or common in less than 2 percent. Myriophyllum, the third most abundant species in 1967, was found in only 5 percent of

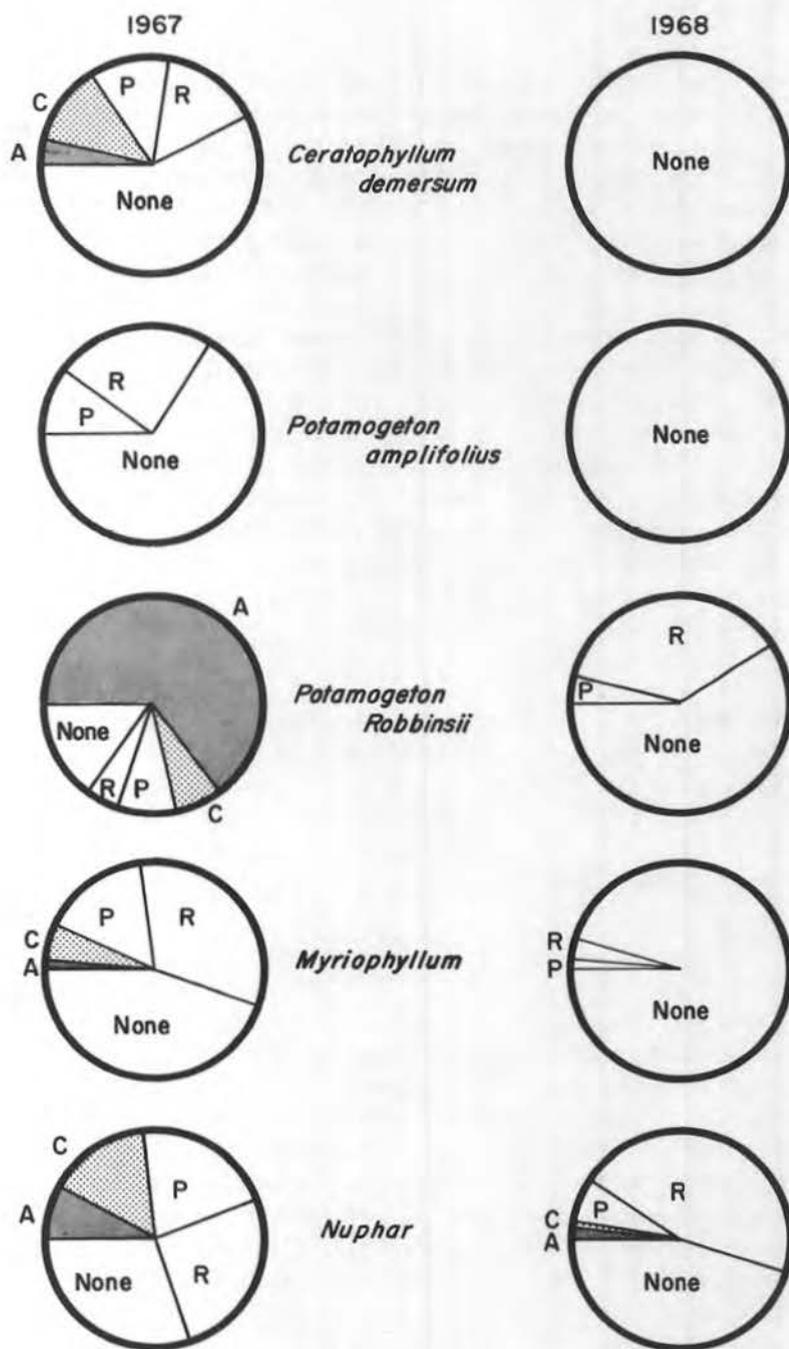


FIGURE 2. Abundance of aquatic plants before and after an overwinter draw-down at Murphy Flowage, Wisconsin. A=abundant; C=common; P=present; R=rare. Ranking was based on the percentage within the 210 quadrats, covering the entire flowage.

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|  A = Abundant |  P = Present |
|  C = Common |  R = Rare |

the quadrats after the drawdown. The five most abundant species before and after the drawdown are shown in Figure 2. The ranking was based on the percent abundant, common, present and rare within the 210 quadrats covering the entire flowage.

A number of species occurred only rarely in the flowage. *Najas flexilis* and *Ranunculus trichophyllus* were found in 2 percent and 3 percent of the quadrats in 1967. After the drawdown there was very

little change in the abundance of these two species, being present in 2 percent and 0.5 percent, respectively. Other species recorded only rarely before and after the drawdown were Sparganium chlorocarpum, Sagittaria latifolia and Potamogeton Richardsonii.

To provide a more quantitative description of the change in vegetation due to the drawdown, the approximate acres covered by each major species was calculated. The aquatic vegetation was divided into three categories, those species showing greatest decrease, slight decrease, and increase.

Species Showing Greatest Decrease

The five most abundant species in 1967 were also the species showing the most drastic decrease in 1968 (Table 4). Potamogeton Robbinsii covered 104.4 acres in 1967; in 1968, it covered only 8.0 acres for a total reduction of 96.4 acres. Myriophyllum covered 19.8 acres before the drawdown; after the drawdown it covered only 0.9 acres which was a decrease of 18.9 acres. Nuphar was reduced 30.1 acres, from a total acreage of 43.1 to 13.0.

The five major species showed a total reduction from 203.6 acres to 21.9 acres after the drawdown which was a decrease in acreage of 181.7 acres. The average acreage covered in each quadrat in which the species was present was reduced from 0.3 to 0.1 acres. The reason for the acreage covered by the major species being more than the total acreage of the flowage was that more than one species could be ranked abundant in the same quadrat.

Species Showing Slight Decrease

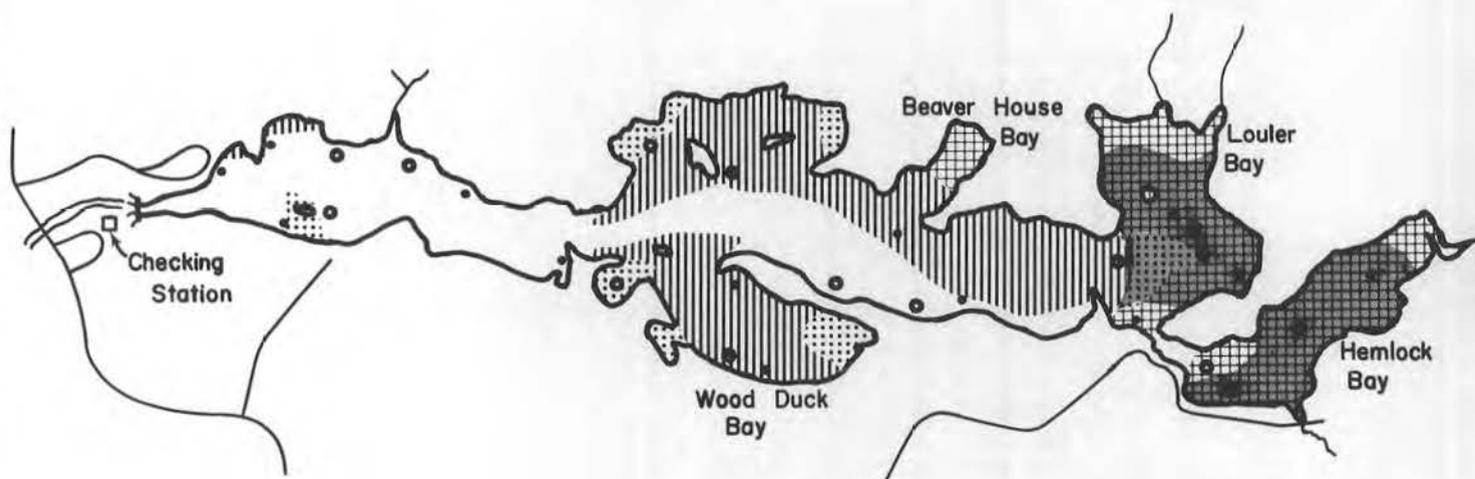
The largest number of species showed a slight decrease, but only one plant of major importance was in this category (Table 4). This species was Potamogeton natans which covered 21.5 acres in 1967 and 18.8 acres in 1968, for a total decrease of 2.7 acres. It was interesting to note that although P. natans decreased in total acreage it increased in the number of quadrats where it was found. The species in this category decreased from 67.3 to 37.5 acres for a total reduction of 29.8 acres. The average acreage covered in each quadrat in which the species was present was reduced by only 0.1 acres.

Species Showing Increase

Three species showed a slight increase after the drawdown (Table 4). Utricularia vulgaris increased from 10.0 to 13.6 acres for a total increase of 3.6 acres. Potamogeton Richardsonii and Sparganium chlorocarpum showed an increase of 0.5 acres and 0.1 acres, respectively. The total increase for the three species was 4.2 acres.

Distribution Changes

The distribution of the major species of aquatic plants before the drawdown is shown in Figure 3. The distribution includes only



NOTE:

Maximum Depth - 14 Feet
 Shoreline - 6.4 Miles
 Area - 180 Area



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| | <i>Potamogeton Robbinsii</i> and <i>Nuphar</i> | | <i>Nuphar</i> |
| | <i>Ceratophyllum demersum</i> | | <i>Myriophyllum</i> |
| | <i>Potamogeton Robbinsii</i> | | |
| | <i>Potamogeton amplifolius</i> | | |

FIGURE 3. Distribution of the Major Species of Aquatic Plants in Murphy Flowage, Wisconsin before an Overwinter Drawdown in August, 1967. The distribution includes only the areas in which the species were abundant, common and present.

FIGURE 4. Distribution of the Major Species of Aquatic Plants in Murphy Flowage, Wisconsin after an Overwinter Drawdown in August, 1968.



NOTE:

Maximum Depth - 14 Feet
 Shoreline - 6.4 Miles
 Area - 180 Area



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| | <i>Potamogeton Robbinsii</i> and <i>Nuphar</i> |
| | <i>Potamogeton Robbinsii</i> |
| | <i>Nuphar</i> |
| | <i>Myriophyllum</i> |

the areas in which the species were abundant, common and present. In 1967 approximately 75 acres were covered by plants to the extent that fishing was almost impossible in this area.

Potamogeton Robbinsii was found mostly in depths of 10 feet or less. The major concentration of Nuphar was in Louler and Hemlock Bays and some of the other shallow areas of the flowage. Ceratophyllum demersum was found exclusively in Louler and Hemlock Bays where the average water depth was less than 3 feet. Myriophyllum and Potamogeton amplifolius were not concentrated at a certain depth or area but were evenly distributed throughout the flowage.

The distribution of the major species after the drawdown is shown in Figure 4. The distribution of Potamogeton Robbinsii was reduced to a few areas around the shore and Nuphar was found in only a few shallow bays. Myriophyllum was eliminated except for a few areas in Louler and Hemlock Bays. The drawdown released approximately 60 additional acres for fishing.

DISCUSSION

Lantz et al. (1967) and Mathis (1966) found that by lowering the water level there was a drastic reduction of Ceratophyllum demersum, such as was recorded in Murphy Flowage. The stress due to the low water level probably destroyed the vegetative reproductive structures. The reduction of Myriophyllum was probably due to the same factor.

Muenschler (1936) found that most potamogeton species reproduce vegetatively by either tubers, winter buds or creeping rootstocks and if any fruiting does occur it is usually in the fall. Potamogeton Robbinsii apparently matures fruit only very rarely but reproduces vegetatively from winter buds. The overwinter drawdown probably destroyed most of the winter buds and the few plants that did survive, survived from seeds produced in the fall or from winter buds in unexposed areas. The elimination of Potamogeton amplifolius could also be due to the reduction of the plant's capacity to reproduce vegetatively.

The main mode of reproduction of Nuphar was by vegetative means from underwater rhizomes. In the shallow area where Nuphar was abundant the rhizomes were exposed over the winter, and in the spring and throughout the summer large numbers of these rhizomes were found floating on the flowage. Also, much of the Nuphar sprouting from the remaining rhizomes in the spring would turn yellow and die after a short period of development. This was probably due to the lack of food reserve in the rhizomes because of the stress during the low water level period.



Shallow area in Hemlock Bay choked with Nuphar before the drawdown, August 1967.

The same area after the drawdown in August, 1968.





Aerial photograph of Wood Duck Bay looking north across the flowage in September, 1967 before the drawdown. The white area at the tip of Arrows 1 and 2 shows the relative abundance of submergent vegetation. Arrow 3 shows the scattered stands of Nuphar.

September, 1968. Notice the complete absence of submergent vegetation and the reduction of Nuphar (Arrow).





Nuphar rhizomes which were found floating on the flowage during the spring and summer of 1968.

Potamogeton natans showed very little change after the drawdown. One reason for this may be that it is one of the few potamogetons that develops mature fruiting bodies consistently (Muenscher, 1936). P. natans could have dispersed its seeds before the drawdown, with most of the reproduction coming from that source. Potamogeton cocconeum did not show a drastic change after the drawdown. Most of these plants produced mature fruiting bodies before the drawdown, and most of the reproduction of this species in 1968 was by seeds produced in the fall of 1967 before the drawdown.

Utricularia vulgaris and Potamogeton Richardsonii showed a slight increase after the overwinter drawdown. Lantz (1967) found that Utricularia also increased after a summer drawdown in Louisiana. P. Richardsonii may be resistant to low water levels as evidenced by its prevalence in the Bayfield and Spooner rearing ponds that are drawn down each fall, year after year (Leon Johnson, pers. comm.).

An erroneous conclusion might be that the reduction of most of the vegetation was caused primarily by the severe winter conditions in northern Wisconsin, but Lantz (1967) obtained a reduction of Ceratophyllum demersum and Potamogeton spp. with a summer drawdown in Louisiana. Mathis (1966) observed a reduction of C. demersum with a winter drawdown in Arkansas, where the winters are not as severe as in northern Wisconsin. Winter freezing conditions were probably one of the factors responsible for the reduction in the vegetation, but it may not have been the primary factor causing the reduction.

The main mode of reproduction for the major plant species in the flowage is by vegetative means. When these species were subjected to low water levels the plants may not have had time to develop mature fruit and most of the vegetative parts were destroyed, causing the reduction observed in 1968. Also, lower water levels may modify various other factors such as temperature, light intensity, rate of photosynthesis and growth, any of which could cause a change in the vegetation.

The overwinter drawdown on Murphy Flowage did result in a marked reduction of aquatic vegetation. It is possible that the overall decline may be temporary until some other species takes over. Further studies will point toward determining if this type of succession does occur. Also, it is possible that in a number of flowages more adaptive species are the dominant plants and a drawdown would not cause a reduction in the aquatic plants.

SUMMARY

1. There was a drastic change in abundance of aquatic vegetation after the drawdown of Murphy Flowage. The five major species before the drawdown were the ones most affected. Ceratophyllum demersum and Potamogeton amplifolius were absent after the drawdown; Potamogeton Robbinsii was reduced from 84 to 42 percent of the quadrats and decreased 96 acres in extent; Nuphar was reduced from 69 to 53 percent and decreased 30 acres; and Myriophyllum, reduced from 53 to 5 percent, and decreased 19 acres.

These five species showed an approximate acreage reduction after the drawdown of 181.7 acres.

2. The drawdown released approximately 60 additional acres for fishing in 1968.
3. The severe winter freezing conditions in northern Wisconsin were probably one of the factors involved in the reduction of the aquatic vegetation, but interference with reproduction due to the low water levels may also have been responsible.

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TABLE 1

Species of Aquatic Plants Identified in Murphy Flowage, Wisconsin
in August, 1967 and 1968*

Species Name	Common Name	Present in 1967	Present in 1968
<u>Potamogeton Robbinsii</u>	Robbins' pondweed	x	x
<u>P. natans</u>	Floating-leaf pondweed	x	x
<u>P. Richardsonii</u>	Clasping-leaf pondweed	x	x
<u>P. epihydrus</u>	Leafy pondweed	x	x
<u>P. zosteriformis</u>	Flat-stemmed pondweed	x	-
<u>P. amplifolius</u>	Large-leaf pondweed	x	-
<u>P. foliosus</u>	Leafy pondweed	x	-
<u>Spirodela polyrhiza</u>	Big duckweed	x	x
<u>Lemna</u> spp.	Duckweed	x	x
<u>Myriophyllum</u> spp.	Water milfoil	x	x
<u>Ceratophyllum demersum</u>	Coontail	x	-
<u>Utricularia vulgaris</u>	Bladderwort	x	x
<u>Megalodonta Beckii</u>	Water marigold	x	x
<u>Najas flexilis</u>	Bushy pondweed	x	x
<u>Ranunculus trichophyllus</u>	Water crowfoot	x	x
<u>Anacharis canadensis</u>	Waterweed	x	-
<u>Vallisneria americana</u>	Wild celery	-	x
<u>Polygonum coccineum</u>	Smartweed	x	x
<u>Nuphar</u> spp.	Yellow water lily	x	x
<u>Sparganium chlorocarpum</u>	Burreed	x	x
<u>Sagittaria latifolia</u>	Arrowhead	x	x
<u>Typha latifolia</u>	Common cattail	x	x
<u>Brasenia Schreberi</u>	Water shield	x	x
<u>Eleocharis acicularis</u>	Needle rush	x	-
<u>Acorus Calamus</u>	Sweet flag	x	x
<u>Scirpus americanus</u>	Three-square bulrush	-	x

* Scientific nomenclature from Fassett (1966).

TABLE 2

Percentage Occurrence and Relative Abundance of Each Species
in 210 Quadrats Before Overwinter Drawdown at Murphy Flowage,
August 1967

Species	Occurrence		Relative Abundance (Percent)			
	No.	Percent	Abundant	Common	Present	Rare
<u>Potamogeton Robbinsii</u>	176	84	62	6	9	6
<u>Nuphar</u> spp.	145	69	7	15	20	27
<u>Myriophyllum</u> spp.	112	53	0.9	5	14	33
<u>Ceratophyllum demersum</u>	85	40	4	11	11	14
<u>Potamogeton amplifolius</u>	67	32			8	24
<u>Potamogeton natans</u>	54	26	5	11	6	3
<u>Megalodonta Beckii</u>	49	23		0.5	4	18
<u>Spirodela polyrhiza</u>	49	23			13	10
<u>Lemna</u> spp.	49	23			13	10
<u>Utricularia vulgaris</u>	32	15	0.9	4	4	7
<u>Polygonum coccineum</u>	29	14			3	10
<u>Potamogeton epihydrus</u>	21	10	0	1	2	7
<u>Potamogeton foliosus</u>	18	8				8
<u>Typha latifolia</u>	16	8		0.5	2	5
<u>Brasenia Schreberi</u>	18	8	0.9			8
<u>Acorus Calamus</u>	17	8	0.5		1	6
<u>Potamogeton zosteriformis</u>	12	6				6
<u>Potamogeton Richardsonii</u>	10	5	0	0.5	1	3
<u>Ranunculus trichophyllus</u>	7	3			0.5	3
<u>Anacharis canadensis</u>	7	3				3
<u>Sagittaria latifolia</u>	6	3			1	1
<u>Najas flexilis</u>	4	2			0.5	12
<u>Sparganium chlorocarpum</u>	3	1				1
<u>Eleocharis acicularis</u>	3	1				1

TABLE 3

Percentage Occurrence and Relative Abundance of Each Species
in 210 Quadrats After Overwinter Drawdown at Murphy Flowage,
August, 1968

Species	Occurrence		Relative Abundance (Percent)			
	No.	Percent	Abundant	Common	Present	Rare
<u>Nuphar</u> spp.	111	53	0.9	0.5	8	43
<u>Potamogeton Robbinsii</u>	89	42			3	40
<u>Potamogeton natans</u>	64	30	2	12	5	11
<u>Utricularia vulgaris</u>	40	19	3	2	10	4
<u>Polygonum coccineum</u>	27	13			0.9	12
<u>Megalodonta Beckii</u>	25	12	0.5	2	3	6
<u>Potamogeton epihydrus</u>	15	7			2	5
<u>Spirodela polyrhiza</u>	16	7			0.5	7
<u>Lemna</u> spp.	16	7			0.5	7
<u>Potamogeton Richardsonii</u>	12	6	0.5	0.5	0.5	4
<u>Typha latifolia</u>	14	6			1	5
<u>Myriophyllum</u> spp.	11	5			0.5	5
<u>Sagittaria latifolia</u>	8	4				4
<u>Najas flexilis</u>	5	2			0.5	2
<u>Sparganium chlorocarpum</u>	5	2				2
<u>Acorus Calamus</u>	5	2				2
<u>Vallisneria americana</u>	2	0.9				0.9
<u>Ranunculus trichophyllus</u>	1	0.5				0.5
<u>Brasenia Schreberi</u>	1	0.5			0.5	
<u>Scirpus americanus</u>	1	0.5				0.5
<u>Potamogeton zosteriformis</u>	0	0				
<u>Potamogeton amplifolius</u>	0	0				
<u>Potamogeton foliosus</u>	0	0				
<u>Ceratophyllum demersum</u>	0	0				
<u>Anacharis canadensis</u>	0	0				
<u>Eleocharis acicularis</u>	0	0				

TABLE 4

Approximate acreage covered by
Vegetation Before and After Over-
winter Drawdown on Murphy Flowage

Species	1967			1968		
	No. Quadrats	Total Acres	Avg. Acres/ Quadrat	No. Quadrats	Total Acres	Avg. Acres/ Quadrat
GREATEST DECREASE						
<u>Ceratophyllum demersum</u>	85	26.1	0.3	0	-	-
<u>Potamogeton amplifolius</u>	67	10.2	0.2	0	-	-
<u>Potamogeton Robbinsii</u>	176	104.4	0.6	89	8.0	0.1
<u>Myriophyllum spp.</u>	112	19.8	0.2	11	0.9	0.1
<u>Nuphar spp.</u>	145	43.1	0.3	111	13.0	0.1
TOTALS	585	203.6	1.6	211	21.9	0.3
AVG.	117	40.7	0.3	42	4.4	0.1
SLIGHT DECREASE						
<u>Potamogeton natans</u>	54	21.5	0.4	64	18.8	0.3
<u>Megalodonta Beckii</u>	49	7.4	0.2	25	6.2	0.3
<u>Spirodela polyrhiza</u>	49	7.5	0.2	16	1.5	0.1
<u>Lemna spp.</u>	49	7.5	0.2	16	1.5	0.1
<u>Polygonum coccineum</u>	29	6.0	0.2	27	3.8	0.1
<u>Potamogeton epihydrus</u>	21	3.4	0.2	15	1.8	0.1
<u>Brasenia Schreberi</u>	18	2.4	0.1	1	0.1	0.1
<u>Potamogeton foliosus</u>	18	1.7	0.1	0	-	-
<u>Acorus Calamus</u>	17	2.7	0.2	5	0.5	0.1
<u>Typha latifolia</u>	16	2.2	0.1	14	1.9	0.1
<u>Potamogeton zosteriformis</u>	12	1.1	0.1	0	-	-
<u>Ranunculus trichophyllus</u>	7	1.0	0.1	1	0.1	0.1
<u>Anacharis canadensis</u>	7	.9	0.1	0	-	-
<u>Sagittaria latifolia</u>	6	1.2	0.2	8	0.7	0.1
<u>Najas flexilis</u>	4	0.6	0.2	5	0.6	0.1
<u>Eleocharis acicular</u>	3	0.2	0.1	0	-	-
TOTALS	359	67.3	2.7	197	37.5	1.6
AVG.	22	4.2	0.2	12	2.3	0.1
INCREASE						
<u>Utricularia vulgaris</u>	32	10.0	0.3	40	13.6	0.3
<u>Potamogeton Richardsonii</u>	10	1.6	0.2	12	2.1	0.2
<u>Sparganium chlorocarpum</u>	3	0.4	0.1	5	0.5	0.1
TOTALS	45	12.0	0.6	57	16.2	0.6
AVG.	15	4.0	0.2	19	5.4	0.2

