The Effects Of A Winter Drawdown On Aquatic Vegetation In A Shallow Water Reservoir[1]

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ABSTRACT

Lake Ocklawaha has experienced aquatic weed problems since 1969, 1 year after it was formed. The lake surface elevation was lowered 5 ft from September 1972 to February 1973. The May 1973 sampling indicated that the drawdown gave excellent control for coontail, hydrilla, naiad, and Brazilian elodea, but there was a substantial increase in waterhyacinth, alligatorweed, smartweed, and waterpurslane.

INTRODUCTION

Water level manipulation has been used for controlling aquatic plant growth in fish culture ponds, small lakes, and reservoirs, and recently, in large hydroelectric reservoirs (2, 10). Drawdowns have been used to control many aquatic plants in other states (1, 3, 7, 8) but, the effects of a drawdown on aquatic plants have not been documented in Florida though several predictions were made in 1972 (4) concerning the drawdown of Lake Ocklawaha.

Lake Ocklawaha (Rodman Reservoir) is a shallow reservoir in central Florida that was formed in 1968 by impounding the Ocklawaha River. Aquatic plants have flourished in the reservoir since 1970, at which time the lake level was stabilized at 18 ft msl (mean sea level) producing ideal conditions for maximum plant growth due to central Florida's mild climate (1, 3, 4, 9). The lake surface elevation was lowered 5 ft in August 1972, thus reducing the surface area (6516 surface acres at 18 ft msl to 4060 surface acres at 13 ft msl) and exposing certain plant communities. This surface elevation (13 ft msl) was maintained for 5 months, from September 1972 to February 1973.

A two phase study was initiated on this lake to determine the effects of a fall and winter drawdown on macrophyte communities within the lake basin. The first phase of this study involved the preparation of vegetational maps depicting the entire reservoir as it progressed through its pre-, during, and post-drawdown stages. A general overall view of effects and control of aquatic plants could be observed and compared to the predictions made in 1972 (4). The second phase consisted of documenting the response of selected aquatic macrophytes to water level fluctuations.

METHODS AND MATERIALS

An airboat was used to make vegetation maps depicting the distribution of aquatic plants in August 1971, May 1972, August 1972, November 1972, and May 1973. The reservoir was mapped each time in the following manner. First, the perimeter of the lake was run, followed by the open-water areas being criss-crossed at 50 to 75 yard intervals. In each case the obvious vegetation types were color coded and recorded. Resulting maps were then checked against aerial photographs for accuracy. All vegetation maps were prepared with a scale of 1 inch equal to 800 ft.

Acreage of each plant species or community was computed from the maps using an area calculator. This instrument employs an electrical grid which was placed over the map. The color coded area was traced and the resulting number was converted to acreage (Table 1) for that particular plant. The maps enabled us to pick suitable areas within the reservoir for documenting the responses of certain aquatic plants to water level fluctuation. Recognizing that mapping will reflect only gross changes a detailed study was conducted to reflect subtle changes.

Five sites were chosen and carefully selected so they would be partly or completely dewatered with the 5 ft drawdown. The following eight aquatic plants were selected for a detailed study: hydrilla, coontail, Brazilian elodea, spatterdock, pickerelweed, alligatorweed, southern naiad, and eelgrass. Modified line transects were run through each site with permanent markers placed every 100 ft. A 100 ft steel tape was stretched between each marker and at each 5-ft interval a pole was lowered through the water and plants that touched the pole were recorded, thus showing the multistory. The resulting frequency of occurrence can be more than 100% using this method. At each 20-ft interval a floating square 3.28 ft^2 was lowered to the water or ground and the coverage of each species was sketched on a data sheet. A color photograph was also taken of each plot for further documentation.

From the data three tables were compiled. A list was made of all the plants encountered (Table 1), the frequency of occurrence (percent composition) was calculated (Table 1), and the percent coverage of the plots was determined (Table 1). Since the eight primary aquatic plants were selected in areas which would be partly or completely dewatered, data from all transects were combined and analyzed as if they were one long transect to facilitate data presentation. Due to bias introduced from selecting the sites, the resulting data could not be applied to the lake as a whole.

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RESULTS AND DISCUSSION

Prior to the drawdown (August 1972), those species having the greatest frequencies of occurrence were coontail, Brazilian elodea, southern naiad, and hydrilla, respectively (Table 1). This was also found to be true in percent coverage of plants occurring in the plots (Table 1). The frequency of occurrence of southern naiad is much greater than its coverage (Table 1). This indicates the plant is sparsely scattered and not in dense mats like coontail. It was found from the vegetational map analysis that coontail, waterhyacinth, Brazilian elodea, cattails, and waterlettuce constituted the major plants throughout the reservoir (Table 2).

Most of the sites were dry or had very shallow water during the drawdown, and several changes in dominance occurred. Dominant species during drawdown were sedges, alligatorweed, beak rush, and waterpurslane (Table 1). Coverage in the plots (Table 1) gave similar results, with sedges dominating, followed by waterpurslane and alligatorweed. The lake-wide trend indicated coontail, waterhyacinth, cattails, Brazilian elodea, and spatterdock to be the dominants. Acreage in hydrilla also increased (Table 2). Surface elevation was held at 13 ft msl for 5 months prior to refilling in February 1973. This schedule was similar to the winter drawdown proposed for aquatic plant control (4).

The post drawdown sampling (May 1973) yielded yet another combination of dominant species. Waterpurslane became the new dominant, followed by coontail, beak rush, smartweed, Brazilian elodea, and alligatorweed (Table1). The plots gave a slightly different set of dominants, with waterpurslane dominant, followed by coontail, alligatorweed, Brazilian elodea, and waterhyacinth (Table 1). Percent plant cover increased through the sampling period until after the drawdown (Table 3). By May 1973, the percent coverage had decreased 9.5% over the entire

TABLE 1. AQUATIC PLANTS ENCOUNTERED AND THEIR PERCENT OF OCCURRENCE AND PER CENT COVERAGE IN TRANSECTS ON LAKE OCKLAWAHA DURING AUGUST AND NOVEMBER 1972, AND MAY 1973.

Aquatic plant encountered		August, 1972		November, 1972		May, 1973	
Scientific name	Common name	Frequency (%)	Coverage (%)	Frequency (%)	Coverage (%)	Frequency (%)	Coverage (%)
Alternanthera philoxeroides (Martius) Grisebach	Alligatorweed	6.15	4.76	6.15	5.05	10.00	7.02
Amaranthus australis (Gray) Sauer	Pigweed	—	—	1.54	1.41	4.61	1.37
Axonopus affinis Chase	Carpet Grass	—	—	—	0.06	—	—
Azolla caroliniana Willd.	Mosquito Fern	—	0.03	—	—	—	—
Boehmeria cylindrica (L.) Swartz	False Nettle	—	—	—	0.03	—	—
Caphalanthus occidentalis L.	Button Bush	—	—	—	0.06	—	—
Ceratophyllum demersum L.	Coontail, Hornwort	37.69[a]	35.27[a]	—	—	27.69	23.64
Cynoctonum mitreola (L.) Britt.	Miterwort	—	—	—	0.02	—	—
Cyperus sp.	Sedges	—	—	30.77[a]	17.17[a]	0.38	—
Digiteria serotina (Walter) Michaux.	Crab Grass	—	—	—	0.49	—	—
Diodia virginiana L.	Virginia Buttonweed	—	—	1.92	1.10	—	—
Dyschoriste humistrata (Michauz) Kuntze	—	—	—	—	0.02	—	—
Eclipta alba (L.) Hasskarl	—	—	—	—	0.05	—	—
Echinochloa walteri (Pursh) Heller	Millet	—	—	1.15	0.21	—	—
Egeria densa Planch.	Brazilian Elodea	28.46	19.50	0.38	0.13	10.00	5.30
Eichhornia crassipes (Martius) Solms	Waterhyacinth	2.31	1.08	1.54	1.10	6.54	3.95
Eleocharis acicularis (L.) R. & S.	Spike Rush	—	—	—	0.03	—	—
Eleusine indica (L.) Gaertner	Goose Grass	—	—	0.38	0.41	—	—
Erechtites hieracifolia (L.) RAF	Fireweed	—	—	—	0.08	—	—
Eupatorium capillifolium (Lam.) Small	Dog Fennel	—	—	2.69	1.98	—	—
Hibiscus sp.	Hibiscus	—	—	—	0.13	—	—
Hydrilla verticillata Royle	Hydrilla	10.38	5.77	—	—	1.15	—
Hydrochloa carolniensis Beauvois	Southern Watergrass	—	—	—	—	0.77	0.25
Hydrocotyle bonariensis Lam.	Water Pennywort	—	—	—	0.02	1.15	0.40
Lemna sp.	Duckweed	—	—	—	—	1.15	0.02
Ludwigia palustris (L.) Ell.	Waterpurslane, False Loosestrife	0.38	0.54	4.62	10.05	48.46[a]	39.68[a]
Mikania scandens (L.) Willd.	Climbing Hempweed	—	—	—	0.16	—	—
Najas quadalupensis (Sprengel) Magnus	Southern Naiad	18.85	7.42	—	—	—	—
Nuphar macrophyllum (Small) E. O. Beal	Spatterdock, Cow-Lily	3.08	1.44	1.15	—	2.31	1.25
Panicum sp.	Panic Grass	—	—	—	—	—	0.14
Phytolacca americana L.	Pokeweed	—	—	1.15	0.22	—	—
Pistia stratiotes L.	Waterlettuce	0.77	0.19	—	0.08	—	—
Pleucheae purpurascens (Swartz) D. C.	Marsh Fleabane	—	—	1.54	0.46	—	—
Polygonum punctatum Ell.	Smartweed, Knotweed	—	—	1.92	0.59	10.77	2.70
Pontederia lanceolata Nutt.	Pickerelweed	3.08	5.78	2.69	1.64	4.23	2.43
Potamogetan illinoensis Morong.	Pondweed	0.38	1.09	—	—	—	0.46
Rhyncospora sp.	Beak Rush	—	—	6.15	1.03	12.31	2.89
Rumex verticullatus L.	Swamp Dock	—	—	2.69	0.79	—	—
Sacciolepsis striata (L.) Nash	—	—	—	0.77	0.29	—	—
Sagittaria lancifolia L.	Arrowhead	—	—	—	—	0.38	0.03
Sagittaria subulata Buch	Eelgrass	6.92	5.40	—	—	—	—
Salvinia rotundifolia Willd.	Salvinia	0.38	0.13	—	—	—	—
Typha latifolia L.	Cattail	—	—	—	0.44	—	—

[a]Dominant plant

TABLE 2. COMPARISON OF ACREAGE COVERED IN LAKE OCKLAWAHA BY AQUATIC PLANTS AT EACH SAMPLE DATE.

Plant Species	August 1971	May 1972	August 1972	November[a] 1972	May 1972
Coontail	455	1027	763	531	142
Southern Naiad	341		67	28	3
Waterhyacinth	642	690	622	318	888
Brazilian Elodea	137	390	383	98	110
Cattail	47	202	160	290	115
Spatterdock	51	63	70	93	138
Hydrilla	2	11	25	59	7
Eelgrass	11	22	40	28	11
Bladderwort	11	20	—	—	—
Waterlettuce	—	—	144	91	—
Alligatorweed	1	1	1	1	34
Pickerelweed	67	28	50	—	22
Beak Rush	—	—	—	—	34
Pigweed	—	—	—	—	75
Smartweed	—	—	—	—	110
Waterpurslane	—	—	—	—	177
Total acres	1765	2454	2325	1537	1866

[a]during drawdown

reservoir. There was a complete shift in the dominant plants (Table 2). Waterhyacinth became the new dominant. This was expected because water level fluctuation has been shown to encourage this plant (3). There was a large decrease in coontail, Brazilian elodea, and hydrilla (Figure 1). Southern naiad, which had been decreasing all along, was virtually eleminated. Eelgrass and pickerelweed also exhibited a decrease in coverage (Table 2). Spatterdock increased, and alligatorweed exhibited a dynamic proliferation. Several semiaquatic plants invaded the area exposed during the drawdown and were among the dominants after the drawdown was complete. Beak rush and pigweed were found in all sections of the reservoir in moderation. Smartweed and waterpurslane formed the dominant submerged vegetation (Table 2) in May 1973.

Frequency of occurrence and percent coverage of coontail were reduced by 30% following the drawdown. Control of coontail has been obtained with drawdown in Louisiana (5), Arkansas (6), and Wisconsin (1). The reduction in coontail which occurred in the transects and plots reflects the lake-wide trend, an 81% reduction (Table 2). Southern naiad was not present in the post drawdown samples in the plots or transects and had been reduced 96% (Table 2) over the lake. Spatterdock indicated a slight reduction in the transects and plots, while over the lake there was a 97% increase (Table 2). Beard (1) found, during a Wisconsin winter drawdown, that there was a large reduction in spatterdock. During a spring-summer drawdown on Lake Tohopekaliga in central Florida, acreage of spatterdock remained about the same (5).

TABLE 3. COMPARISON OF PERCENT COVERAGE OF AQUATIC PLANTS AT EACH SAMPLE DATA.

	August 1971	May 1972	August 1972	November[a] 1972	May 1973
Coverage (%)	26.9	37.4	35.4	37.9	28.4
Pool level (msl)	18	18	18	13	18

[a]during drawdown

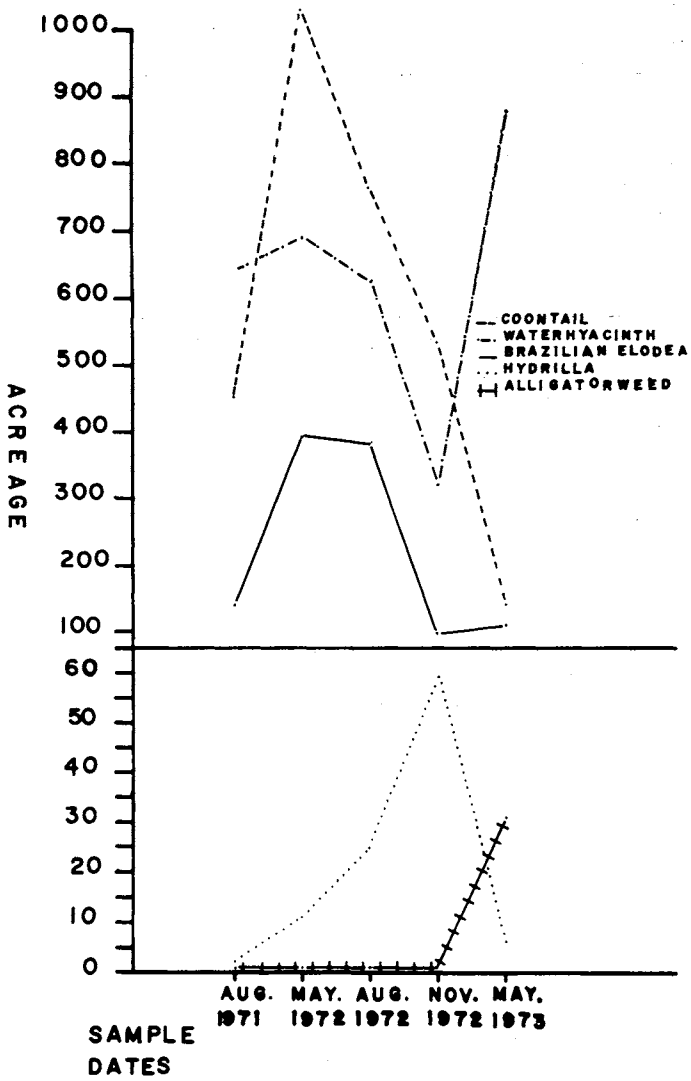

Figure 1. Comparison of selected aquatic plant coverage from August 1971 to May 1973.

Waterhyacinth and alligatorweed had increased in Louisiana during drawdown (3) and the same trends held in Florida. Waterhyacinth increased 183% in frequency (transects) and 266% in coverage (plots). This general increase was also evident over the lake, which experienced a 43% increase. Alligatorweed exhibited a much smaller increase in the transects and plots (62% and 47%, respectively) than over the entire lake (3300%). The large increase in population of alligatorweed was mainly located along the shoreline; thus the transects and plots did not indicate this dynamic proliferation. Waterhyacinth seedlings were abundant on the newly exposed area and were immune to the biological control, "root-rot",[2] that was containing them before the drawdown. The flea beetle (*Agasicles hygrophis* Selman and Vogt) was not

[2]The agent of this disease is unidentified and currently under study by D. R. Charudattan, Dept. of Plant Pathology, Univ. of Fla., Gainesville, Fla.

effective in controlling alligatorweed during the drawdown as shown by its 3300% increase.

The two main plants of concern during the drawdown were hydrilla and Brazilian elodea since these noxious plants are capable of choking the entire water column of a reservoir. The percent frequency of occurrence for hydrilla decreased 89% (Table 1), while the percent coverage decreased 100% (Table 1). This trend held lake-wide, with a 72% total reduction (Table 2). Brazilian elodea decreased 65% in percent frequency of occurrence and 73% in percent coverage at the study sites. Over the lake there was a decrease of 71% (Table 2).

From this information, it is evident that only a few of the predictions made were correct (4). It was thought that coontail, hydrilla, and Brazilian elodea would overgrow the reservoir. They did during the drawdown, but upon refilling they disappeared. It appears that the drawdown gave very good control of these plants, especially in areas that were completely dried.

It was predicted that waterhyacinth may be controlled, depending on the winter. The winter, however, of 1972-73 was mild, letting the waterhyacinth and alligatorweed proliferate and colonize many new areas. This had been expected, but not to the degree to which it occurred.

It appears that the fall and winter drawdown gave excellent control to all plants except waterhyacinth, alligatorweed, spatterdock, smartweed, and waterpurslane. The rapid refill of the lake (8 days) possibly could be the main reason for the control. The severe reduction in light caused the demise of most of the submerged aquatics, while the mild winter (no frost) was the cause of the increase in waterhyacinth, alligatorweed, and spatterdock.

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