

History of Hydrilla Control in Orange and Lochloosa Lakes

by
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Introduction

Orange and Lochloosa lakes have long been noted as top fishing locations in this country, supporting a wide variety of common wildlife and endangered species. Both Orange and Lochloosa lakes are designated as Class III Outstanding Florida Waters by the Department of Environmental Protection and as Fish Management Lakes by the Florida Game and Fresh Water Fish Commission.

Overgrowth of hydrilla in Orange and Lochloosa lakes has been a threat to the economic and environmental health of the area since 1976.

Milon et al. (1986) indicated that regional economic activity attributed to Orange and Lochloosa lakes was over 10 million dollars. Colle et al. (1987) found that an 80-percent coverage of hydrilla on Orange Lake resulted in an 85-percent reduction in angler utilization and a 90-percent loss in revenue.

Milon's study also concluded that aquatic plant management was a significant contribution to the local economy of the community associated with these lakes. Aquatic plant management is an effective tool to improve fish and wildlife habit and also provides recreational and economic benefits to the region.

Orange Lake

Orange Lake is located southeast of Gainesville, FL, in Alachua County with a drainage area of 110 square miles. The lake

has a shoreline perimeter of approximately 25 miles.

The lake receives water flow from Lochloosa Lake by way of Cross Creek and from Newnans Lake through the River Styx. The only surface drainage from Orange Lake is Orange Creek, a tributary of the Oklawaha River. Principal water losses are the result of evapotranspiration and downward drainage through the sediments and solution cavities in the lake.

The bottom of Orange Lake is predominantly unconsolidated organic matter over a clay layer covering limestone.

The water level in Orange Lake has a maximum range of 11.4 ft, ranging from a high of 61.2 FASL to a low of 49.8 FASL. This variation in stage results in lake coverage range of approximately 3,500 to 16,000 acres and volume range of 5,000 to 100,000 acre ft. The average stage for the last 30 years was 57.5 FASL, which would result in an acreage of 12,500 and 68,000 acre-ft of water.

Digitized aerial photographs indicate that emergent vegetation in Orange Lake has increased from a 34-percent coverage in 1964 to a 58-percent coverage in 1991. Major vegetation changes occurred in 1976-77 when spatterdock increased in the West Arm, in 1978 when a 4-ft increase in water levels redistributed floating islands on Orange Lake, and in 1991 when extremely low waters provided for a 700-acre increase in cattails.

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Algae blooms and influx of dark tannin-stained water have resulted in Secchi variations in the lake from 2 to 8 ft.

Lochloosa Lake

Lochloosa Lake is located southeast of Gainesville, FL, in Alachua County with a drainage area of 1,100 square miles and a shoreline perimeter of approximately 12.5 miles.

The lake receives water inflow from Lochloosa Creek and several minor creeks that feed into the marsh on the north end of the lake. The largest portion of the surface outflow is through Cross Creek into Orange Lake, with a small amount of outflow through Lochloosa Slough on the southeast side of the lake. During large storm events, water will occasionally switch directions and flow from Orange Lake to Lochloosa Lake through Cross Creek.

The bottom of Lochloosa Lake is predominantly unconsolidated organic matter over a clay layer covering limestone.

With the exception of extreme lows, Orange and Lochloosa lakes are usually at or near the same stage. Lake levels can vary approximately 7.5 ft from a low of approximately 54.0 FASL to a high of 61.5 FASL. This has resulted in a acreage variation of 5,700 to 10,500 and volume variation of 30,000 to 80,000 acre ft. The average stage for Lochloosa for the last 30 years is also approximately at 57.5 FASL, which would result in an average of 8,300 surface acres and 55,000 acre ft of water.

The shoreline gradient of Lochloosa Lake (1:65) is approximately three times steeper than Orange Lake (1:170), which is a primary factor limiting the growth of emergent plants in Lochloosa Lake, resulting in cypress surrounding the lake instead of large areas of emergent plants. Digitized aerial photographs indicated emergent vegetation occupied only 3.5 percent of the main lake in 1964, increasing to a 6.5-percent coverage by 1991. During this period, there was a slight decline in spat-

terdock coverage, with the increase in coverage the result of other emergent species such as cattails, pickerelweed, and primrose.

Algae blooms and influx of dark tannin-stained water have resulted in Secchi variations in the lake from 0.6 to 7.0 ft.

Orange Lake Hydrilla Management

Hydrilla was first reported in January of 1974 in the Cross Creek vicinity. It was probably introduced at the Marjorie Rawlings boat ramp 1 or 2 years previously. Insufficient funding limited hydrilla control operations to 10 acres of treatment at the mouth of Cross Creek and Marjorie Rawlings boat ramp. By the end of 1974, hydrilla increased to approximately 50 acres.

Hydrilla levels increased to 270 acres in 1975, but few people were concerned about its presence or the five-fold increase in coverage. Control measures were limited to 50 acres of boat trails and 8 acres of test plots, using endothall products and Cardi.

The hydrilla population exploded in 1976, covering 90 percent of open water, including most of the spatterdock areas, with a total coverage of 8,000 acres by the end of the summer. The first funds specifically for hydrilla control were provided by Alachua County, Marion County, and the Department of Natural Resources. A total of 150 acres of hydrilla were treated in the form of boat trails. An additional 49 test plots were tested for hydrilla control using Cardi, Karmex, Diuron, 2,4-D, Diquat, Hydrothol 191, Aquathol, Asulox, Komeen, Cutrine, and System L.

A harvesting program was conducted in the fall of 1976 through the fall of 1977 by the U.S. Army Corps of Engineers. A total of 160 acres of hydrilla were harvested in the form of boat trails and small fishing areas.

An additional 95 acres of herbicide control was conducted to assist in keeping boat trails open. Seven additional test plots were

conducted on hydrilla to determine if there was any difference in efficacy between existing approved products under the particular water quality conditions of Orange Lake. The conventional herbicides containing diquat, endothall, and copper resulted in a minimum of 95-percent control. Since Hydrothol 191 provided equivalent control to other products and was more economical, it was selected for treatment of boat trails.

In 1978, a tremendous decline in hydrilla occurred in Orange Lake as the result of a sharp rise in water level of over 4 ft and persistent, blue-green algae blooms. Hydrilla coverage was reduced to approximately 500 acres, allowing the hydrilla control program to be suspended for the year.

Low levels of hydrilla in 1979 limited the demand for control measures to providing access around the shoreline at fish camps and boat ramps.

Although funding increased substantially in 1981, hydrilla acreage increased to 6,000 acres in 1982. At that time, neither the funding nor the technology was available to control the large acreage of hydrilla with herbicides or mechanical harvesting.

In January of 1982, the first testing of the experimental herbicide fluridone was conducted in Orange Lake. Several small applications over the next 6 months, combined with a gradual 3-ft increase of water level from January to June, reduced hydrilla levels to 1,150 acres.

Even with limited funding, the hydrilla coverage was steadily reduced during the period of 1982-90, with coverage exceeding 30 percent for only a 2-month period in 1988.

A 45-percent increase in treatment area in 1990 reduced hydrilla coverage to 6 percent of the lake in June of 1991. With no funding for fluridone treatments in 1991, hydrilla levels increased to 14-percent coverage of the lake by October.

In 1992, hydrilla coverage increased to 4,100 acres or 67 percent of open water. A 500-acre fluridone application reduced hydrilla coverage by 800 acres.

Hydrilla coverage increased in 1993 to a maximum of 5,100 acres in August, but declined by 1,500 acres by January of 1994 as a result of a 920-acre fluridone application.

An 850-acre fluridone application was conducted in March of 1994 to further reduce hydrilla populations in the lake.

Improvements in the hydrilla management program are obvious when conditions and hydrilla populations in 1991 are compared with those in 1976. Since the lake was 2 ft lower in 1991, it would be expected that hydrilla's potential would equal or surpass 1976 levels. However, 1991 hydrilla coverage was only 6 percent of the lake as compared with 63 percent in 1976.

Lochloosa Lake Hydrilla Management

Hydrilla was first detected in Little Lochloosa in May of 1975 originating from fragments scattered up Cross Creek by boat traffic.

From 1975-1977, the hydrilla management consisted of treating all known areas of hydrilla with contact herbicides such as granular endothall and diquat invert application.

In 1978, hydrilla coverage had increased by 700 percent over the previous year, making it necessary to redirect the management program to provide navigation trails, boat ramp access, fish camp access, and homeowner access along the eastern shoreline. Management programs for 1979 and 1980 were directed at providing access as in the previous year.

In 1982, 7 years after hydrilla's introduction, the population covered 65 percent of open water of Lochloosa Lake. In comparison, 90 percent of open water of Orange Lake was

covered by hydrilla in only 2 years. Early management programs and the steeper gradient of the shoreline were principal factors in the slower rate of hydrilla domination in Lochloosa Lake.

The first use of fluridone for hydrilla control in Lochloosa Lake was conducted in 1982. Unknown at the time, the application was conducted under ideal lake conditions, a 3-ft increase in water levels from January to June. This program resulted in the control of 2,000 acres of hydrilla. Additional control measures in 1983 reduced hydrilla coverage by 1,300 acres. As in 1982, water levels were high at time of application (58 FASL) and rose to over 59 FASL from April to June.

In 1984 and 1985, water levels gradually decreased to a low of 55.8 FASL in June of 1985, allowing hydrilla to dominate 79 percent of the lake. Fluridone was available to treat only 25 acres for 1984 and 1985 under the experimental use permit. With declining water levels and no technique available to control large areas of hydrilla, the problem became serious.

In the spring of 1986, fluridone received full registration. Fortunately, water levels in 1986 had increased 2 ft over the previous June, increasing the potential for hydrilla control with the May fluridone program. From May to November, the hydrilla population was reduced by 3,700 acres or 82 percent.

Water levels rose again in the spring of 1987 to a high of 60 FASL in April, which again improved the effectiveness of the fluridone management program. The treatment resulted in the control of over 2,700 acres of hydrilla, of which the majority was composed of newly germinated plants.

Since hydrilla control funding was limited and there were less than 700 acres of hydrilla present in the lake, management was reduced to the control of 60 acres with fluridone and 110 acres with contact herbicide in 1988. In conjunction with declining water levels, the hydrilla population expanded to cover 85 per-

cent of Lochloosa Lake from May to October. Management with fluridone at that time of year would have resulted in severe and unnecessary destruction of beneficial native vegetation in the lake.

Since the 300-acre fluridone treatment of 1986 was so successful in controlling hydrilla, the involved agency representatives and Center for Aquatic Plants surmised that good control of hydrilla would be obtained with a 250-acre application in 1989, while reducing expenditures. Unfortunately, it could not be predicted that water levels were going to drop 1.7 ft from March to August nor was it known at this time that treatment acreage required for large-scale management increases with dropping water levels and topped out vegetation. The unexpected result was the control of only 410 acres of hydrilla.

With water levels in 1990 continuing to drop, hydrilla topped out and covered 88 percent of the lake. The management program was increased by over 200 percent, which resulted in control of 2,000 acres of hydrilla.

In 1991, management operations were reduced 20 percent because of the previous year's results, and most of the hydrilla was not to the surface as in the previous year, making it more susceptible to the fluridone. A total of 2,600 acres of hydrilla were controlled by October.

In 1992, a total of 400 acres of hydrilla were treated with Sonar. This program was the least effective fluridone management program in Lochloosa. This was probably due to the combined factors of low water at time of treatment, dropping water levels after application, and a strip application that was spread out over a 55-day period. Only approximately 100 acres was controlled, with a double in total hydrilla coverage during the remainder of 1992.

The 1,200 acre 1993 application was the largest fluridone application ever applied to the lake. The program was conducted over a 2-week period, and the applications were not

spread out or strip treated as in 1992. The treatment provided excellent control, reducing hydrilla to a 12-percent coverage of the lake. With fluridone concentrations exceeding 5 PPB for over 5 months, nontarget damage was observed on native species, mainly spatterdock.

In the spring of 1994, hydrilla had regrown to cover 40 percent of the lake, with the majority of the plants less than 1 ft tall at time of herbicide application. A 900-acre fluridone application reduced hydrilla to 3.5-percent coverage by May.

From 1989 to 1994, total acreage of emergent plants have remained constant at 7.5 percent of the lake. Although this figure has not changed, there was a change in species composition. During this period, approximately 60 acres of bonnets were killed indirectly by the hydrilla control program; at the same time, there was a 65-acre increase in pickerelweed, cattail, knotgrass, and primrose willow in other areas of the lake.

The following graphs provide annual acreage estimates for hydrilla remaining after each growing season and the total number of acres of control during each year for Orange and Lochloosa lakes, respectively.

Summary

Management with mechanical harvesting

Harvesting with the Aqua-Trio system was expensive, costing \$460 per acre (\$1,078 in 1992 dollars) in Orange Lake. It was also slow, taking approximately 8 hr to harvest 5 acres of hydrilla. Frequency of harvesting required to keep boat trails open for the year varied from one to three cuttings per year, depending on the specific trail location. To achieve the same control as the 1993 Lochloosa fluridone treatment, a mechanical harvesting program would have required the use of six harvesters for a period of 4.5 months at a cost of approximately \$4.47 million.

Harvesting in Orange Lake (Haller et al. 1980) resulted in a 32-percent loss of fish by numbers and 18-percent loss of fish biomass. This would translate to a monetary replacement value of fish harvested at over \$2,400 per acre.

Management with contact herbicides

Since 1974, the contact herbicides diquat dibromide, endothall, and copper complexes were used in Orange and Lochloosa lakes for hydrilla control. These products were used during the first few years to slow down the spread of hydrilla in these lakes and have continued to be used to the present to provide boat trails, access area around ramps, and small fishing areas of less than 5 acres. Most contact applications resulted in 1 acre of control per acre of treatment, with occasional treatments providing an additional 25-percent control over the treated acreage. The frequency of control to keep any one area open varied from one to three applications per year. A total of 3,187 acres of hydrilla in Orange Lake and 1,170 acres in Lochloosa Lake were controlled with contact herbicides in the last 30 years.

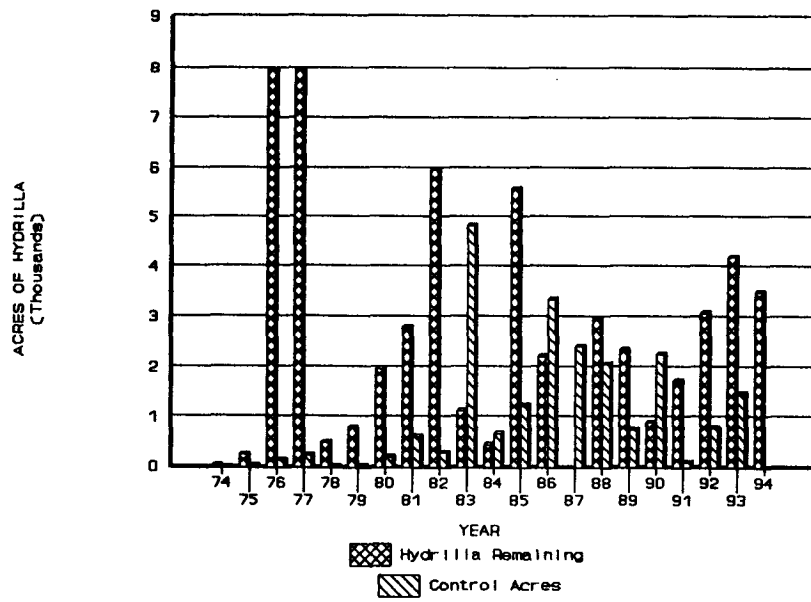
Management with fluridone

Since 1982, fluridone (Sonar) was utilized for control of large areas of hydrilla infestation. Fluridone was the first aquatic herbicide available that could provide large areas of hydrilla control and, in many cases, at a considerable savings over previously used contact herbicides and mechanical harvesting. With proper timing of herbicide application, the product could remove large areas of hydrilla from a lake with only minor damage to native aquatic plant species. Lower toxicity to fish and other nontarget organisms were additional benefits from using fluridone as a management tool.

Although most fluridone applications provided excellent control of hydrilla, the actual

GRAPH A. ORANGE LAKE HYDRILLA

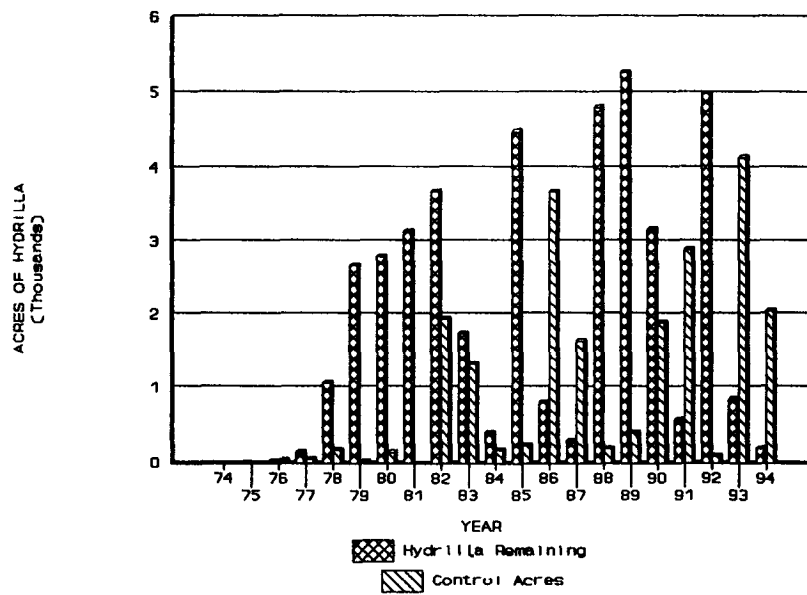
1974-1994



Orange Lake Hydrilla

GRAPH B LOCHLOOSA LAKE HYDRILLA

1974-1994



Lochloosa Lake Hydrilla

areas of control were many times located in areas other than the application sites.

As seen in the following table, the amount of control achieved per acre of treated hydrilla in Orange and Lochloosa lakes varied considerably from one year to the next.

Hydrilla Control with Fluridone, 1982-93		
	Orange	Lochloosa
Total Acres of Control	20,454	20,547
Total Acres Treated	3,572	3,606
Ave. (Acres Control/ Treated Acre)	5.7	5.7
Range (Acres Control/ Treated Acre)	1-24	0.25-30
Average Cost Per Acre	\$114	\$114
Range in Cost Per Acre	\$27-\$650	\$22-2,600

Since the amount of hydrilla control was not directly related to the amount of herbicide applied, it was apparent that physical and/or biological factors were affecting the degree of hydrilla control.

Preliminary results using multilinear regression indicate that the following factors can contribute to increased efficacy of fluridone applications for hydrilla control on these lakes:

- a. Calm weather conditions during and after herbicide application.
- b. Herbicide treatments conducted over a short period of time, no split applications.
- c. Normal- to high-water levels (>57 FASL) at time of herbicide application.
- d. Increase in water level after herbicide application.
- e. Hydrilla plants actively growing and not to the surface.
- f. Low water clarity.

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