



Control of Milfoil in Bashan Lake

2003

**Gregory J. Bugbee
Jason C. White**

Connecticut Agricultural Experiment Station

Department of Soil and Water

P.O. Box 1106

New Haven, CT 06504



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Work in Progress

Table of GPS Coordinates

CTDEP Permit Application

CTDEP Approved Permit

Public Notification

Report to CTDEP on Well Tests

Navigate Label and Material Safety Data Sheet



Collaborators

Mr. Gregory J. Bugbee, Assistant Scientist
Dr. Jason C. White, Associate Scientist
Department of Soil and Water
The Connecticut Agricultural Experiment Station

The Honorable Susan Merrow, First Selectwoman
Mr. James Ventris, Land Use Administrator
Town of East Haddam

Mr. Chuck Lee
CT DEP
Bureau of Water Management
Division of Planning and Standards

Mr. Bruce Fletcher, President
Mr. John Hoban, Vice President
Bashan Lake Association
East Haddam, CT

Funding

Funding for this research was provided by grants from the Bashan Lake Association (BLA), East Haddam, CT and the United States Department of Agriculture/Agricultural Research Service.

Acknowledgments

Assistance with permitting by Brad Robinson, Judy Singer and Peter Aarrastad of CTDEP is gratefully acknowledged. Technical assistance by Mark Hood, Mark Reynolds, Dave Richardson, and Lydia Wagner of CAES is greatly appreciated.



Introduction

Beginning in 1999, the Connecticut Agricultural Experiment Station (CAES) has studied the use of granular 2,4-D for controlling variable milfoil (*Myriophyllum heterophyllum*) in Bashan Lake. In 1999, Aquacide (2,4-D sodium salt, 18% active ingredient) was applied to 10 acres of milfoil with marginal success. After CAES obtained clearance from the United States Environmental Protection Agency in 2000, Navigate/AquaKlean (2,4-D butoxyethyl ester, 19% active ingredient) has been used yearly. Control has generally been excellent and rates have been reduced from 200 lbs/A to 75-100 lbs/A. Tests on the use of Navigate/AquaKlean in September have been very successful and this has allowed treatment during a time period when lake use is minimal. Native aquatic plants such as pondweeds (*Potamogeton sp.*) and bladderwort (*Utricularia sp.*) have not been seriously affected by the 2,4-D treatments and often repopulate the areas where milfoil has been eliminated. Although control of variable milfoil tends to be good in treated areas, new areas of milfoil requiring treatment have been located each year and occasionally regrowth has occurred in treated areas. For instance, large areas of milfoil were found in the spring of 2002 in the outer portions of Brooks Cove, the boat launch cove and some previously treated sections of Sunset Acres. In 2003, large areas of milfoil were located along the shore running in an easterly direction from the Sunset Acres beach. Dense patches of milfoil were also found at the entrance to Brooks Cove. This study details the work at controlling this milfoil using spring and late summer treatments with reduced rates of granular 2,4-D ester.

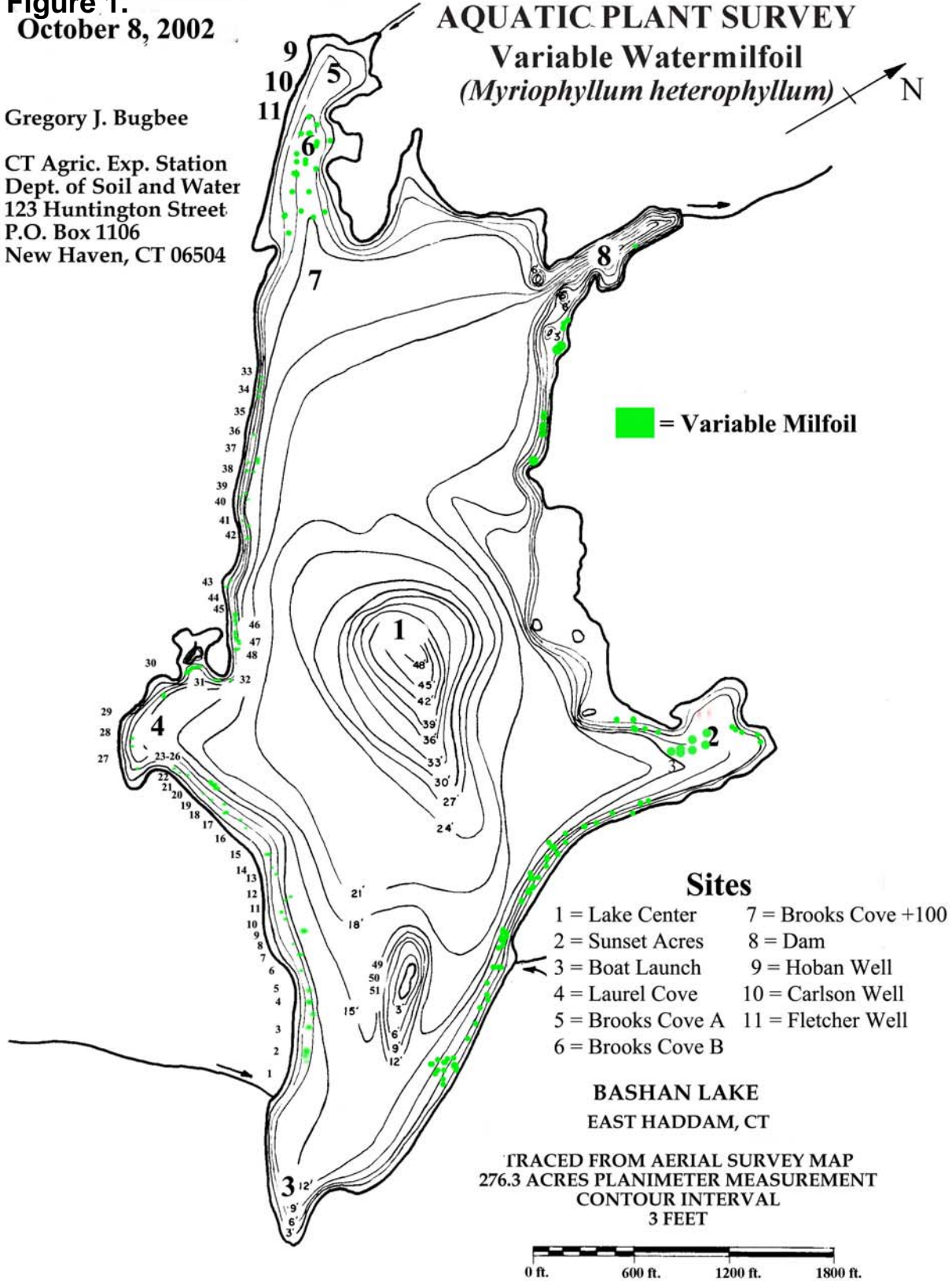


Figure 1.
October 8, 2002

Gregory J. Bugbee

CT Agric. Exp. Station
 Dept. of Soil and Water
 123 Huntington Street
 P.O. Box 1106
 New Haven, CT 06504

AQUATIC PLANT SURVEY
Variable Watermilfoil
(Myriophyllum heterophyllum)



Pretreatment Weed Surveys

The aquatic vegetation survey performed on October 8, 2002 (Figure 1) was the primary source of information used to determine the areas to be treated on June 25, 2003. Surveys performed throughout the summer served as the basis for the September 24, 2003 treatment. These summer surveys usually occurred on the dates when water sampling was performed. Areas chosen for surveillance were based on where wind conditions allowed the best viewing. Locations of milfoil were determined using global positioning system technology (GPS) with an accuracy of between 10 and 20 feet. Details on these surveys can be found in the appendix of this report under in the section entitled "Table of GPS Coordinates." Areas of particular concern were large dense patches at the entrance to Brooks Cove, patches from the Sunset Acres beach along the shore towards the state boat launch and isolated regrowth inside Brooks Cove and between the boat launch and the offshore island (Figure 2). Further details on this mapping are found later in this document under the heading "Milfoil Control and Mapping".

Permitting

CAES prepared and filed a CTDEP permit application for Navigate on February 20, 2003. On May 23, 2003 the permit was approved by CTDEP. The permit allowed for an application of 2000 pounds of Navigate. The applications could be performed in spring, summer or fall. A requirement of the permit was that five ground water wells, close to the treatment areas, be tested for 2,4-D. Further details regarding the applications and permits are in the appendix of this report.

Notification

The public was notified of the herbicide applications during the week preceding the treatments. Newspaper notification occurred in the Hartford Courant and the BLA newsletter. Signs were posted at public entrances around the lake. Notification protocol was pursuant to Section 22a-66a(g) of the CT General Statutes. A copy of the newspaper notifications and sign are in the appendix of this report.

Application of Navigate

Navigate was applied at a rate of 100 lbs/acre on June 25 to the areas shaded in purple in Figure 2. Areas in Brooks Cove, Sunset Acres Cove and along the south shore were the primary targets. A total of 600 pounds of Navigate was applied to approximately six acres. On September 24, 2003 Navigate was applied at a rate of 100 lbs./acre to the 14 acres of milfoil shade in blue on Figure 2. A 12-volt Truckster-mount spreader, attached to the back of a motorized boat, was used to



Table 1. 2,4-D in lake and wells (ppb)

Site	Depth (m)	Date		
		20-Jun	27-Jun	2-Jul
Treatment	0.5	0.0	3.9	10.8
	3.0	0.0	28.0	27.6
Treatment + 100	0.5	0.0	3.7	7.5
	3.0	0.0	5.3	0.0
Center	0.5	0.0	0.0	3.5
	9.0	0.0	0.0	0.0
Hoban Well	Shallow	0.0	0.0	0.0
Fletcher Well	Deep	0.0	0.0	0.0
Carlson Well	Deep	0.0	0.0	0.0
Sabo Well	Shallow	0.0	0.0	0.0
DePasquale Well	Shallow	0.0	0.0	0.0

distribute the granules for both treatments. To minimize inconsistencies in coverage treatment areas were crisscrossed in multiple directions. The weather on days of treatment was partly cloudy and mild (65°- 85 °F) with light to moderate winds.

Sampling of Lake Water for 2,4-D

Lake water samples, for 2,4-D analysis, were obtained from the center of the Brooks Cove treatment site (Figure 1). To determine movement of the herbicide, analysis was also performed on water taken 100 feet away from the edge of the Brooks Cove site and near the center of the lake over 3000 feet away from the treatment site (Figures 1). Samples were obtained from the surface (one foot deep) and near the bottom. Samples were collected before treatment on June 20, two days after treatment (DAT) on June 27 and 8 DAT on July 2. Testing for 2,4-D was done by CAES using solid phase extraction and liquid chromatography with a detection limit of 2 ppb. The levels of 2,4-D (Table 1) in the treatment site peaked, in the bottom water, at 28 ppb on June 27 (2 DAT) and July 2 (8 DAT). Surface water in the treatment site contained considerably less 2,4-D with only 4 ppb found 2 DAT and 11 ppb found 8 DAT. Detectable levels of 2,4-D moved rapidly from the treatment site with 4-5 ppb being found in the treatment + 100 feet site 2 DAT and 4 ppb being found at the surface in the treatment + 3000 feet site 8 DAT. Apparently, water currents at the surface were towards the treatment + 100 feet site while bottoms currents were not. Because, 2,4-D concentrations never approached either the USEPA maximum concentration level (MCL) for drinking water of 70 ppb or irrigation MCL of 100 ppb, testing for 2,4-D was discontinued for



the remainder of the year. Levels of 2,4-D never approached the 1000 ppb concentration thought necessary to achieve milfoil control.

Resumption of Irrigation with Lake Water

Use of water from Bashan Lake for irrigating plants could not occur until 2,4-D levels fell below 100 ppb in all samples. Levels were never above 100 ppb. The Bashan Lake association was informed that its members could resume irrigating with lake water in mid July.

Sampling Groundwater Wells for 2,4-D

Five groundwater wells near treatment sites were sampled for 2,4-D. The owners and locations of these wells are shown on the aquatic plant survey maps (Figure 1 and 2). Samples were obtained from the homeowners' kitchen faucets or outdoor outlets on the same days as the lake water samples. These samples were tested by CAES using solid phase extraction and liquid chromatography with a detection limit of 2 ppb. No 2,4-D was found in any well. Copies of all water tests were sent to CTDEP Pesticide Unit as soon as received.

Milfoil Control

Milfoil control occurred rapidly after treatment even though 2,4-D concentrations never approached the 1000 ppb levels thought to be necessary. This indicates either variable milfoil is either more sensitive to 2,4-D ester than the Eurasian milfoil (*Myriophyllum spicatum*), used in the sensitivity studies, or the water chemistry in Bashan Lake (very low alkalinity etc.) makes 2,4-D ester more effective. The portion of Brooks Cove treated on June 25, was snorkeled in late July and no milfoil was observed in the treatment area. Outside the treatment area, where the cove meets the lake and along the north shore, some dense areas of milfoil were present.

Visual inspections throughout the summer in conjunction with reports from lakefront resident found large areas of variable milfoil in other parts of the lake that had not yet received treatment. These included the areas from outside the boat launch



Figure 2.

Gregory J. Bugbee

CT Agric. Exp. Station
 Dept. of Soil and Water
 123 Huntington Street
 P.O. Box 1106
 New Haven, CT 06504

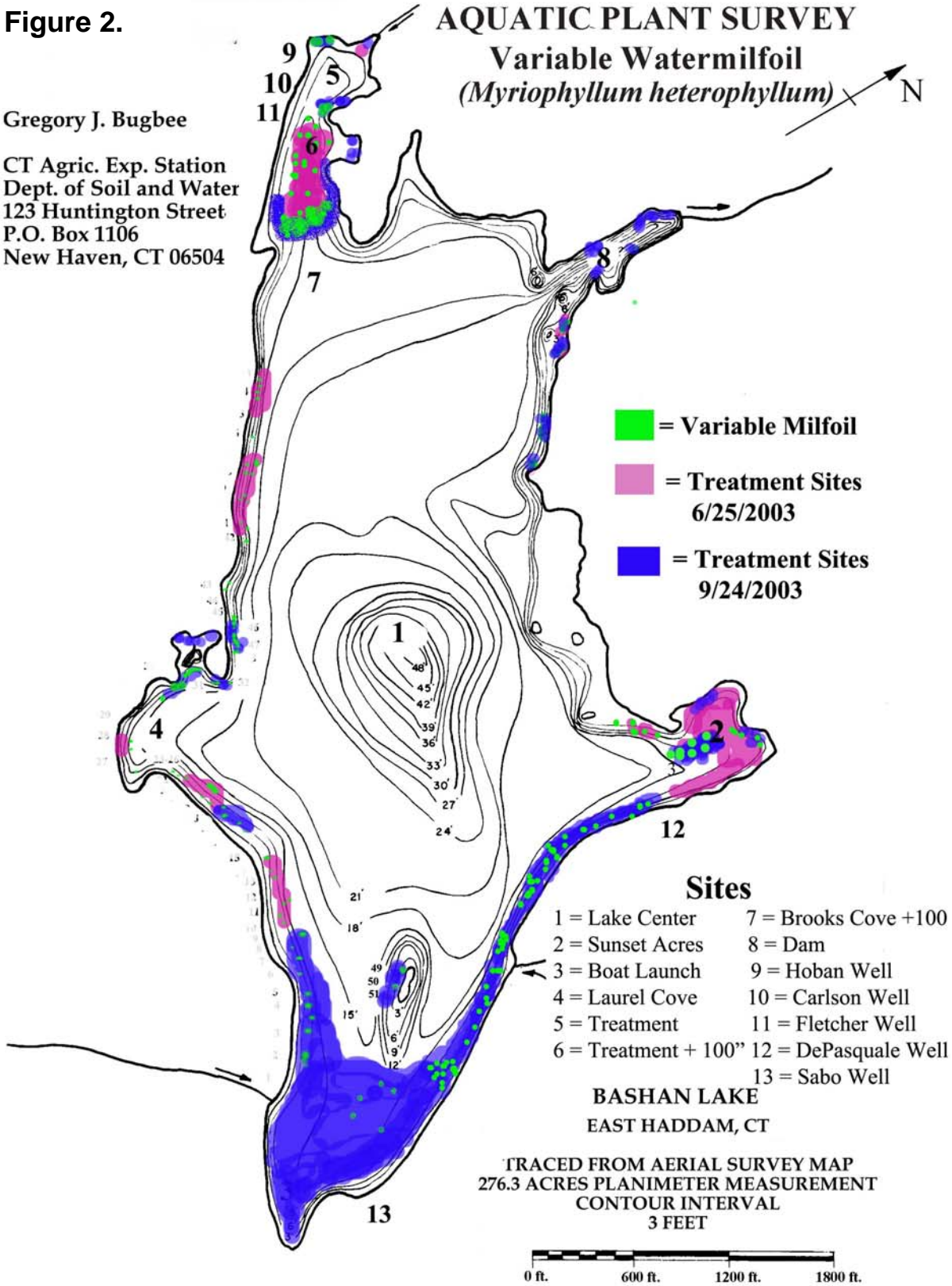


Table 2. Total phosphorus (ppb)

Site	Depth	Date					
	(m)	6/20	6/27	7/2	7/17	7/31	9/26
Center	0.5	3	39	*	2	2	1
	9.0	9	25	*	5	2	6

Table 3. Transparency with Secchi disk (m).

Site	Depth	Date					
	(m)	6/20	6/27	7/2	7/17	7/31	9/26
Center	0.5	5.1	5.0	5.5	6.0	6.5	11.0

cove site to the offshore island, from the mouth of cove by the dam to Sunset Acres and in Sunset Acres cove. None of this milfoil was near the surface where it could be chopped and spread by boat traffic. Plant fragments were, however, frequently observed floating throughout the lake and settling to the bottom in previously treated areas. This could be a reason for the sparse regrowth of milfoil in areas treated in previous years. Further information is needed on the ways variable milfoil spreads. If plant parts other than fragments are a means of spread (i.e. seeds, turions etc) then a reservoir for regenerating the milfoil may exist in the bottom sediment.

The September 24, 2003 Navigate treatments apparently yielded excellent milfoil control, however no follow-up survey was performed due to unusually cold weather. Late season Navigate/Aquacide applications continues to be considered an excellent means for controlling variable milfoil after the major uses for the lake have finished.

Water Chemistry

Water tests found total phosphorus (P) to be very low (<12 ppb, oligotrophic) on all dates, except for June 27, when P levels rose to 39 at the surface and 29 ppb bottom (Table 2). Although these high P levels occurred after the June 24 treatment, they are unlikely to have been caused by the treatment because too little time had elapsed for the release of P in dying milfoil. By July 17, the P concentrations



Table 4. Water temperature (C°).

Site	Depth (m)	Date					
		6/20	6/27	7/2	7/17	7/31	9/26
Treatment	0.5	20.8	26.9	26.1	25.4		
	2.0	20.1	21.8	24.6	24.8		
Treatment + 100	0.5	20.7	26.2	25.3	25.5		
	4.0	20.2	21.6	23.1	24.7		
Center	0.5	20.4	27.4	25.8	25.2	26.1	21.6
	1.0	20.3	23.6	25.2	25.1	26.0	21.6
	2.0	20.2	21.6	24.6	24.9	26.0	21.6
	3.0	20.2	21.1	24.3	24.8	25.9	21.6
	4.0	19.7	20.7	22.0	24.6	25.8	21.6
	5.0	19.3	21.1	21.3	24.5	25.6	21.5
	6.0	18.5	19.5	20.2	22.9	25.3	21.5
	7.0	17.7	18.6	19.1	21.2	22.3	21.5
	8.0	16.8	17.2	18.4	18.1	19.1	21.5
	9.0	14.5	15.1	14.9	15.8	16.5	20.7
	10.0	11.9	12.2	12.9	12.9	13.4	15.4
	11.0	10.6	11.0	11.0	12.0	12.1	13.0
12.0	10.1	10.0	10.2	10.9	10.9	12.6	

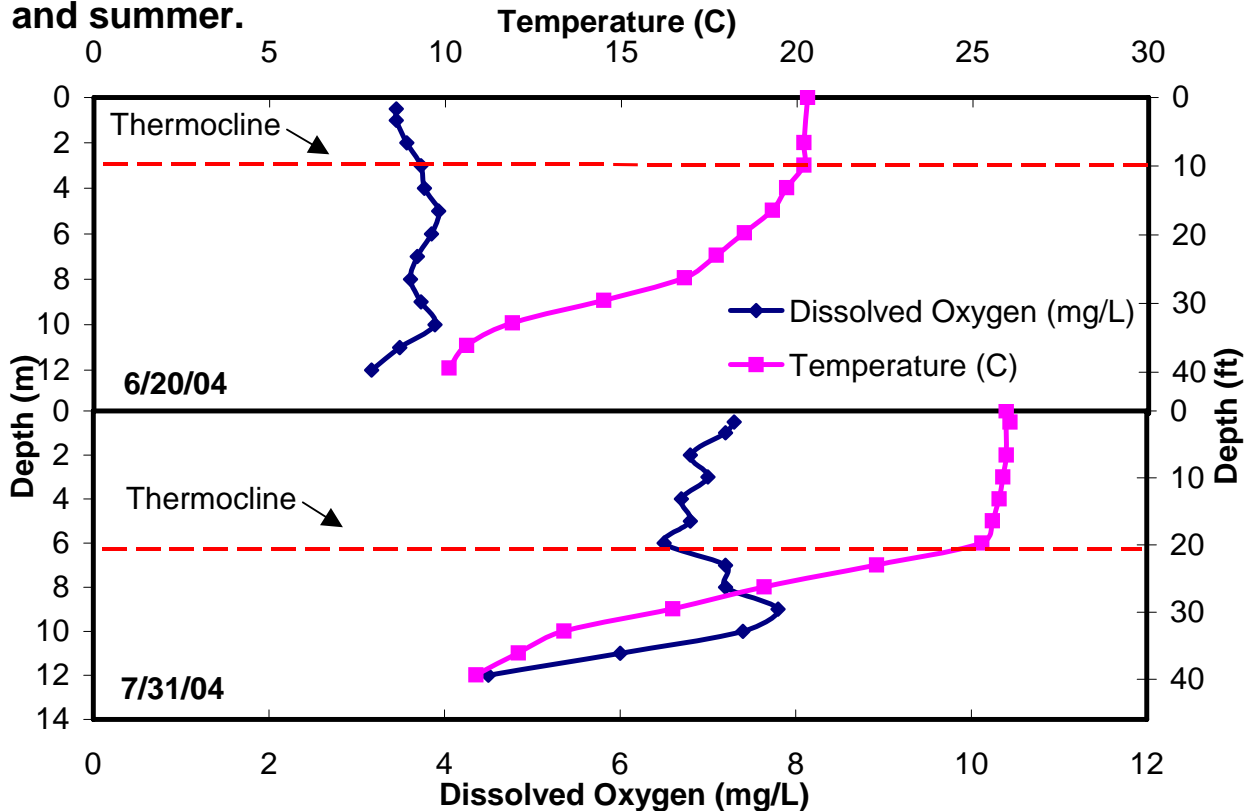
Table 5. Dissolved oxygen (ppm).

Site	Depth (m)	Date					
		6/20	6/27	7/2	7/17	7/31	9/26
Treatment	0.5	8.6	8.8	8.4	7.7		
	2.0	8.6	11.5	8.8	8.1		
Treatment + 100	0.5	8.6	8.7	7.7	7.9		
	4.0	9.1	10.4	10	7.9		
Center	0.5	8.6	8.5	8.3	8.1	7.3	7.2
	1.0	8.6	10.0	8.5	8.1	7.2	7.0
	2.0	8.9	10.1	9.0	7.7	6.8	7.0
	3.0	9.3	10.0	8.9	7.6	7.0	6.9
	4.0	9.4	9.6	9.8	7.5	6.7	6.9
	5.0	9.8	9.7	9.9	7.2	6.8	6.9
	6.0	9.6	9.7	10.1	7.5	6.5	6.9
	7.0	9.2	9.7	9.9	7.6	7.2	6.9
	8.0	9.0	9.5	10.0	7.8	7.2	6.9
	9.0	9.3	9.6	10.0	7.7	7.8	6.2
	10.0	9.7	9.8	10.5	7.3	7.4	4.5
	11.0	8.7	9	9.8	6.5	6.0	3.3
12.0	7.9	6.7	7.6	6.3	4.5	2.0	



declined to levels below 10 ppb. Total P of below 10 ppb usually indicates a lake

Figure 3. Temperature and dissolved oxygen profiles for spring and summer.



that is oligotrophic (low in nutrients). Transparency measurements found Bashan Lake to continue to be a very clear lake. Secchi measurements (Table 3) ranged from 5-6 meters (16-20 feet) in June and July to 11 meters (36 feet) in late September. This extremely clear water will favor the growth of milfoil and other vegetation in water that is deeper than other less clear lakes. Surface water temperatures (Table 4) ranged from near 20 °C (68 °F) on June 20 to around 26 °C (79 °F) on July 31. Bottom water temperatures were similar in the relatively shallow treatment sites, however in the deep lake center site, the water was considerably cooler. The water temperature at the lake centers bottom ranged between 10 and 13 °C (50 -55 °F). Dissolved oxygen (Table 5) was abundant in all surface measurements and ranged between 7.2 and 11.5 mg/l. In bottom water, dissolved oxygen concentrations were only slightly different than the surface water, exceptions occurred on July 31 and September 26, when lower levels of 4.5 and 2 mg/l respectively were observed. Dissolved oxygen levels of below 3 mg/l generally will not support healthy fish but are not uncommon in deep lakes in summer and early fall. Fish will move to areas of higher dissolved oxygen concentrations and not be harmed. Comparisons of the temperatures and dissolved oxygen profiles on June 20 and July 31 (Figure 3) found the thermocline at 3 and 6 meters (10 and 20



Table 6. pH of lake water.

Site	Depth (m)	Date					
		6/20	6/27	7/2	7/17	7/31	9/26
Treatment	0.5	5.6	5.9	6.1	5.8		
	2.0	6.0	6.2	6.1	5.9		
Treatment + 100	0.5	6.3	6.1	6.1	5.9		
	4.0	5.8	6.2	6.3	6.1		
Center	0.5	5.9	6.2	6.1	6.0	6.1	5.1
	9.0	5.9	5.5	6.1	5.8	5.5	5.9

Table 7. Alkalinity of lake water (mg/l CaCO₃).

Site	Depth (m)	Date					
		6/20	6/27	7/2	7/17	7/31	9/26
Treatment	0.5	5.9	3.3	3.5	1.1		
	2.0	3.3	3.0	3.3	3.3		
Treatment + 100	0.5	2.8	3.2	3.4	3.2		
	4.0	3.1	3.6	3.5	3.2		
Center	0.5	3.3	3.2	3.1	2.7	6.3	1.1
	9.0	3.7	2.2	3.6	2.9	2.4	3.6

feet) respectively. The pH of Bashan Lake (Table 6) was lowest on June 20 and September 26 when it ranged between 5.1 - 6.3. During July and August the pH rose to between 5.6 – 6.3. Bashan Lakes alkalinity ranged between 1.1 and 5.9 mg/l CaCO₃ (Table 7) in all samples. This alkalinity is considered low and could enhance future acidification.

2003 Summary

As in past years, granular 2,4-D ester was an effective tool for reducing variable milfoil in Bashan Lake. Lowered rates found to be effective in 2002 (from 200 lbs./A to 100 lbs/A) were again used effectively 2003. The areas of milfoil documented in 2002 along the shore from Sunset Acres towards the boat launch ramp, in deep water in the Sunset Acres cove and other areas were treated in 2003. Small areas of regrowth in the boat launch cove and Brooks Cove were treated in 2003 to prevent major reestablishment in previously treated areas. It is likely the abundance of milfoil will quite low in 2004, however pockets of milfoil are likely to be present. Tests on ground water near the treatment sites found no 2,4-D. This in conjunction with the negative well water tests performed in the previous four years continues to solidify the evidence that the treatment of milfoil in Bashan Lake with 2,4-D will not



cause contamination of nearby groundwater wells. The USEPA maximum allowable concentration level for irrigation water of 100 ppb was not exceeded in any lake water tests performed in 2003.

Suggestions for 2004

Milfoil treatments in 2004 will have to be based on spring surveillance as all known large areas of milfoil were treated in 2003 and a formal fall survey was not performed in 2003. A thorough spring milfoil survey is necessary and late spring and fall treatments should be based on the survey. Utilization of CAES's new underwater video camera could be a valuable asset for finding milfoil in less than ideal weather or in deep water. Milfoil treatments in September are preferable, however if significant milfoil is found in the spring in areas that are susceptible being chopped by motors and spread these areas should be treated as soon as possible. The rate of Navigate/Aquacide can be kept to 100 lbs./A. If requested by the BLA, CAES will apply for a CTDEP permit to treat Bashan Lake with 2000 pounds of Navigate in 2004. This will probably be more than what is necessary but what is not needed does not have to be used.

Water testing should be done prior to treatment for 2,4-D, pH, temperature, dissolved oxygen, alkalinity and clarity. These tests should be performed weekly thereafter until levels of 2,4-D are below 100 ppb in all samples and irrigation can resume. Testing should be conducted in the center of the largest treatment site, 100 feet outside the site and in the center of the lake. Samples obtained from the near the surface and bottom are suggested. A review of the water test results by a CTDEP fisheries biologist could help determine if conditions are favorable for fish or other aquatic organisms. Little or no testing of ground water wells is suggested because of no detections in 1999, 2000, 2001 2002 and 2003. Testing of wells, however, may be required by the CTDEP.

Preparation of a 2004 report for the BLA, CTDEP and town of East Haddam is suggested. This will help build a database for future assessments of lake changes and past weed control practices.

