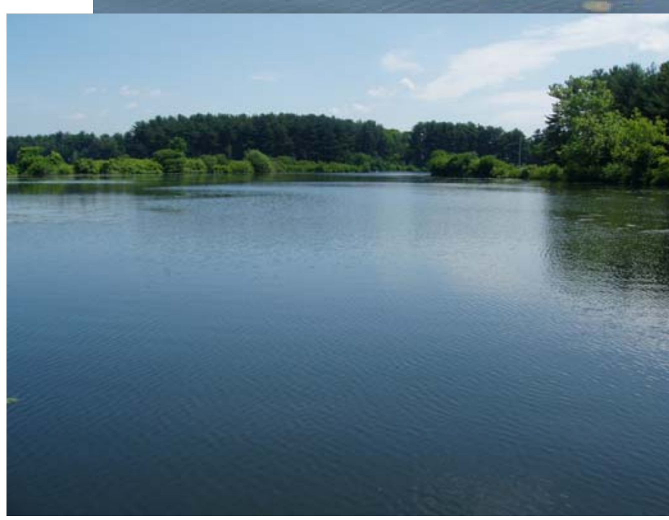
Prepared For:

Regional Water Authority

South Central Connecticut Regional Water Authority

A BIOLOGICAL ASSESSMENT OF UPPER LAKE WHITNEY



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Introduction

Lake Whitney is one of 15 reservoirs in the South Central Connecticut Regional Water Authority (SCCRWA) system, but water has not been withdrawn for potable supply use since 1991. With the anticipated completion of a new treatment facility, water withdrawals are planned to resume in 2005. Lake Whitney's lower watershed is heavily urbanized and the SCCRWA is implementing a number of watershed management actions to control water quality impacts caused by nonpoint sources of contaminants. In addition, the SCCRWA will be operating the treatment plant in accordance with a Management Plan designed to balance the water needs of the region with those of the environment. The shallow nature of Lake Whitney's upper basin makes it susceptible to substantial exposure of bottom sediments when lake drawdowns exceed two feet.

In response to public concerns raised about the effect of future water withdrawals on the shallow upper basin, the SCCRWA commissioned the upper Lake Whitney Management Study in 2000 to determine the most environmentally sensitive and cost effective way to manage upper Lake Whitney as a water supply while maintaining the ecological and aesthetic quality of the area (Milone and MacBroom, Inc. et al., 2002). The study concluded that watershed management actions should take priority over dredging of accumulated sediments, as dredging would provide minimal water quality benefits while damaging potentially valuable habitat. Hydrologic modeling of water levels under various scenarios conducted as part of the study concluded that drawdowns as a result of public water supply withdrawals will be extremely infrequent. However, extended lake drawdowns of noticeable extent and duration related to maintenance of the dam and various town and state bridges crossing the lake will occur just as they have in the period since August 1991 when the reservoir and the original water treatment plant were removed from service as a public water supply.

As part of an ongoing effort to document existing conditions and to provide baseline information for ongoing environmental monitoring after water withdrawals resume, the SCCRWA requested that ENSR repeat the 2000 biological assessment of upper Lake Whitney. This report represents an effort by ENSR to re-evaluate the biological features of upper Lake Whitney. Since the 2000 study, the reservoir was drawn down for maintenance activities on two occasions. From August to November 2000, Lake Whitney was drawn down by a maximum of about 1.6 ft for dam maintenance (Figure 1). Water levels were unaffected by SCCRWA operations in 2001 and 2002 (Figures 2 and 3). In October and November 2003 the reservoir was drawn down by a maximum of 3.9 ft, also for dam maintenance (Figure 4). Following the June biological sampling of this year, the reservoir's water level was again lowered from early July to late August, reaching a maximum drawdown of about 6 feet below spillway elevation (Figure 5).

Figure 1. Water level graph for Lake Whitney during 2000.

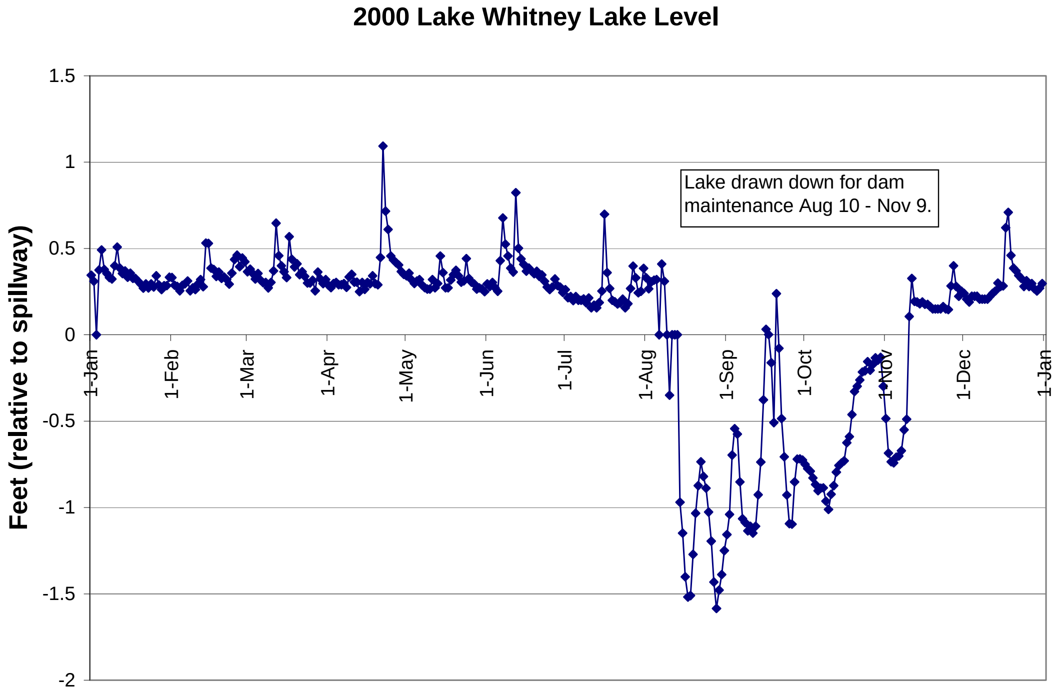


Figure 2. Water level graph for Lake Whitney during 2001.

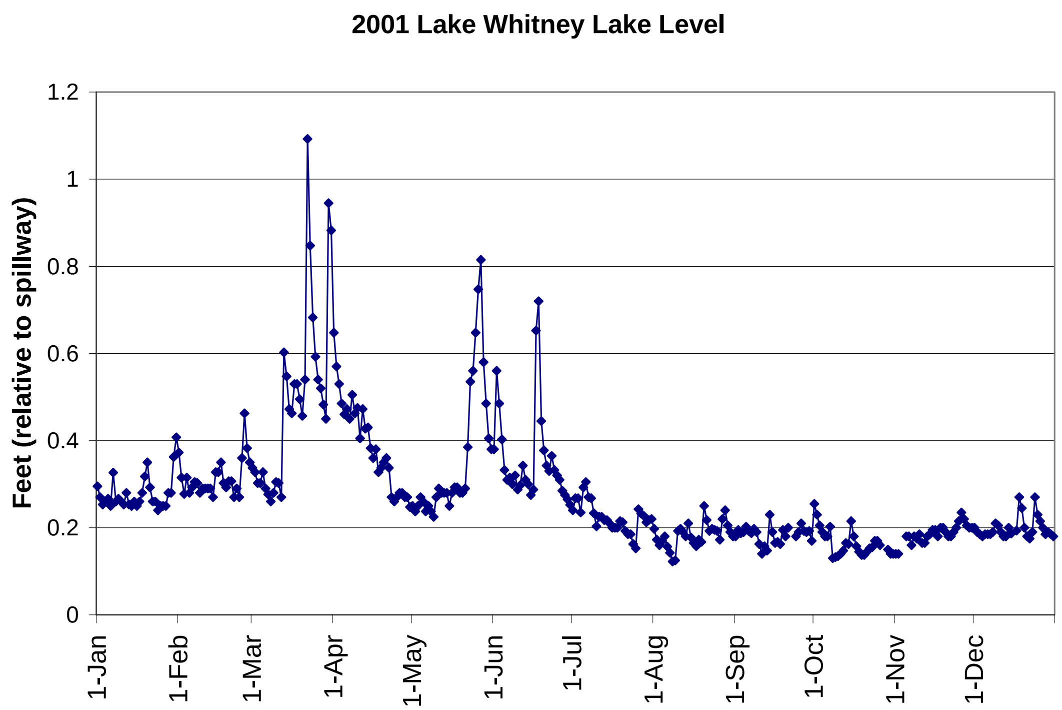


Figure 3. Water level graph for Lake Whitney during 2002.

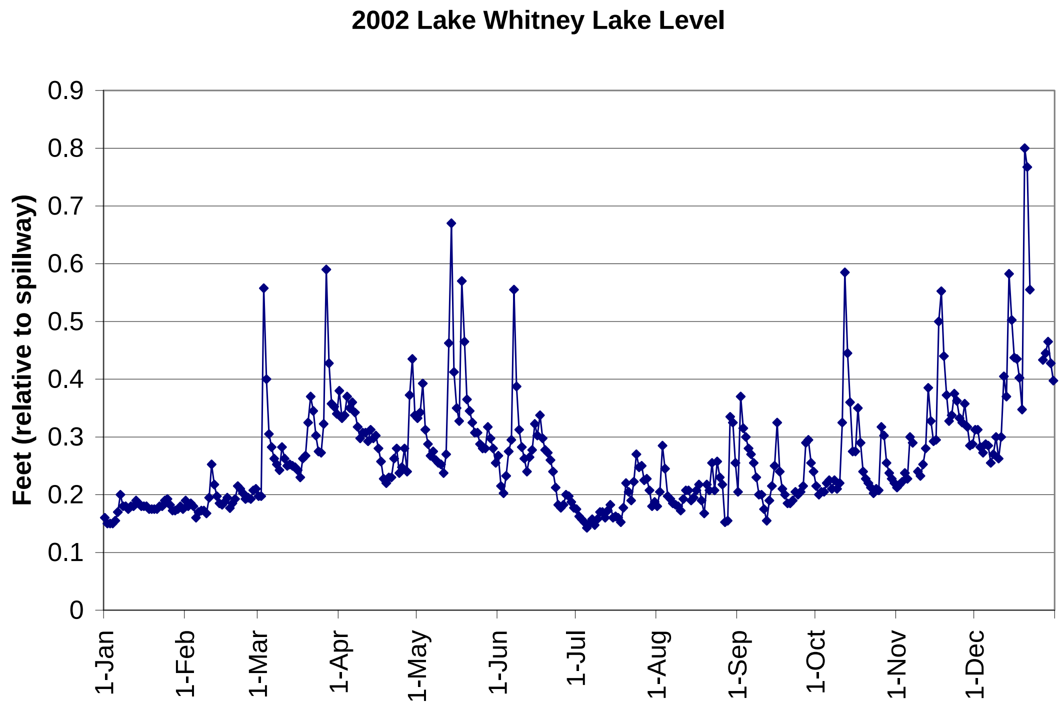


Figure 4. Water level for Lake Whitney during 2003.

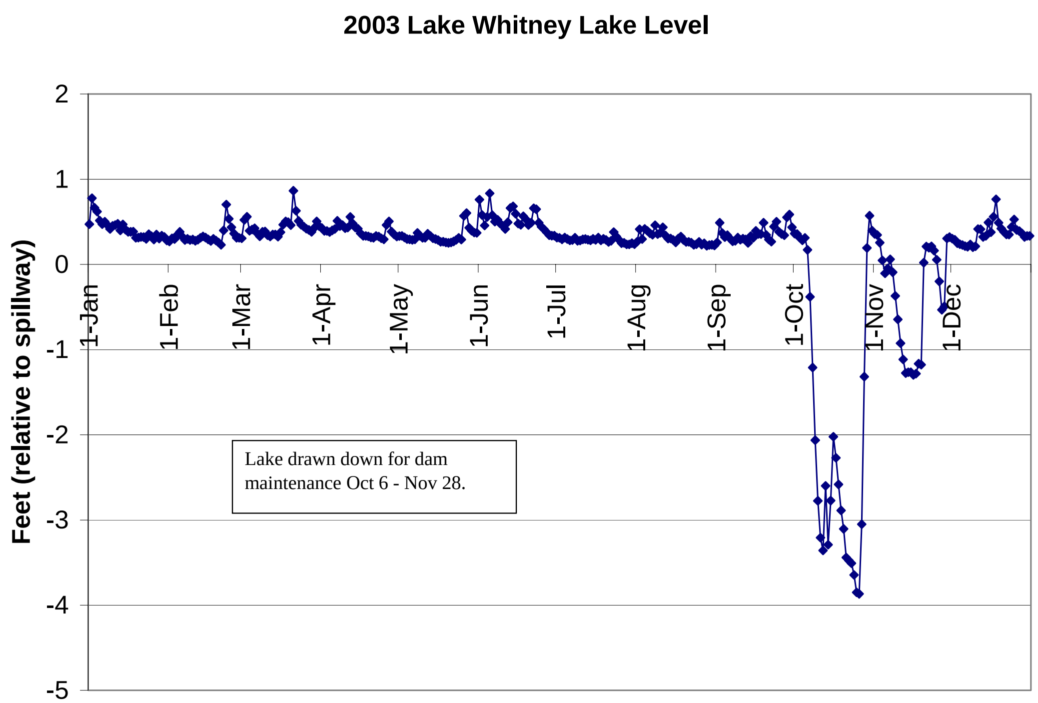
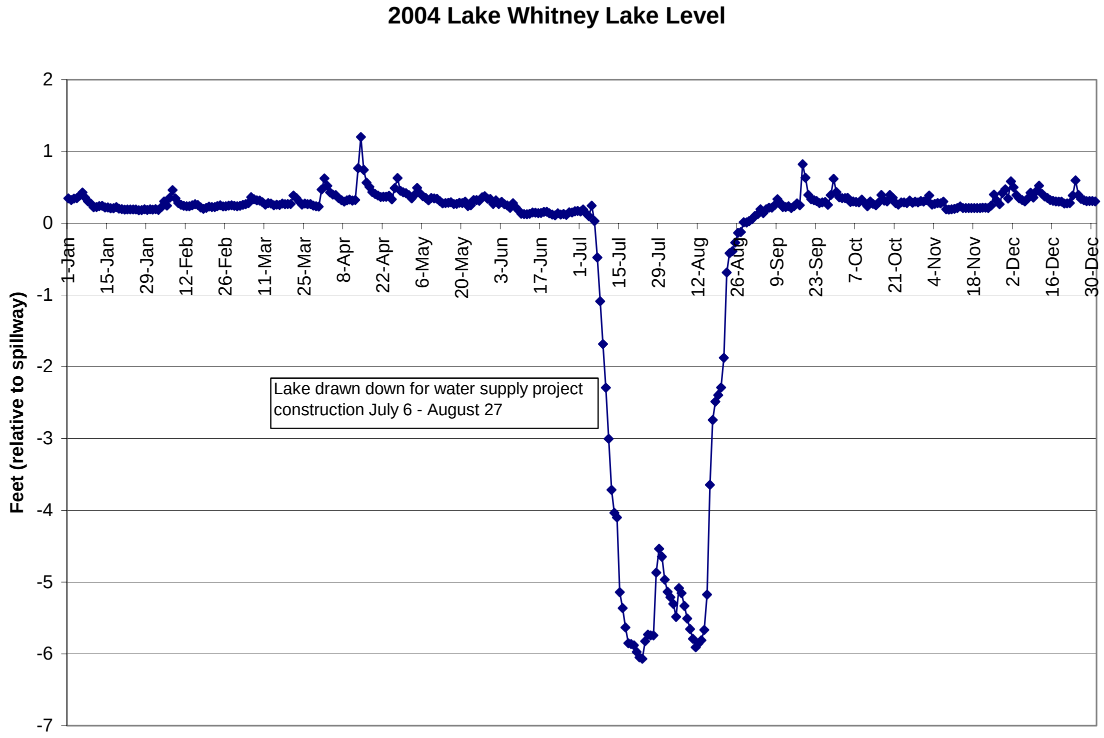


Figure 5. Water level for Lake Whitney during 2004.



Methods

This assessment incorporates evaluations of phytoplankton, zooplankton, aquatic macrophytes, benthic macroinvertebrates, fish, and water quality in upper Lake Whitney. Phytoplankton were assessed from a whole water sample collected as a near-surface grab sample once on June 15, 2004 and once on July 26, 2004. Samples were preserved in gluteraldehyde, concentrated by settling, and examined under phase contrast optics at 400X. Cell counts were converted to biomass estimates on a volumetric basis based on cell measurements.

Zooplankton were collected with a 53 micron mesh net towed through up to 30 meters of water on an oblique angle, yielding a sample of about 100 ml that represents nearly 1000 liters of lake water. One sample was collected at the June 15, 2004 phytoplankton sampling site. The sample was preserved and settled in the same manner as the phytoplankton, and examined at 100X under brightfield optics. Individual counts were converted to biomass estimates based on measured organism dimensions.

Macrophytes were mapped by assessing composition and density at numerous points along multiple transects across the lake on June 15, 2004. In addition to recording the species of plants and their overall and relative abundance, water depth and sediment type were also noted. A rating system was used to evaluate cover (two dimensions) and biovolume or biomass (three dimensions). In this system, a 0 represents no plants, while a 5 represents complete cover or filling of the water column. Ratings of 1 through 4 correspond to quartiles in between (i.e., 1-25%, 26-50%, 51-75%, and 76-99%). An additional visual observation was made on September 2, 2004 to examine the impacts of the lake drawdown on the macrophyte community.

Benthic macroinvertebrates were collected on June 15, 2004 with a D-frame dip net according to Rapid Bioassessment Protocols (EPA 1999). Basically, all habitats within the area of the selected stations are sampled for a timed interval and the collected invertebrates are identified and counted. The dip net was used in water up to 5 ft deep, generally in areas of plants and soft sediments. Invertebrates were sorted, and identified with the help of dichotomous keys.

Fish were assessed on June 15, 2004 by visual observation and through the use of gill nets. Plant densities proved too high for summer seining, and the sediment was too unsteady to allow electroshocking with a backpack unit. Sinking 1.0 inch bar monofilament gill nets were used to sample the fish community in Lake Whitney. Gill nets were set and checked approximately every 2 hours. Each captured fish was measured to the nearest mm, and weighed to the nearest gram before being released.

Results

Water quality as measured on June 15, 2004 with a Hydrolab Datasonde are presented in Table 1.

Table 1. Water quality data for four stations at Lake Whitney collected on June 15, 2004.

Date	Depth (meters)	Temp (deg, C)	Dissolved Oxygen (% saturation)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	*In vivo* Chlorophyll *a* (μg/L)	pH (SU)	Conductivity (mS/cm)
6/15/04	0	22.39	93.6	8.12	0.8	0	8.33	0.2650
6/15/04	1	20.60	78.2	7.02	5.5	0.2	7.68	0.2654
6/15/04	1.84	19.69	72.5	6.63	9.5	0	7.54	0.2663
6/15/04	1.88	19.44	70.1	6.44	9.1	0	7.47	0.2679

Phytoplankton

The location of phytoplankton sampling is indicated in Figure 6. Phytoplankton cell counts are provided in Table 2, while biomass estimates are provided in Table 3. Diatoms (Bacillariophyta) and golden algae (Chrysophyta) were the major components of the phytoplankton, although representatives of two other algal divisions were encountered. In the June 2004 sample both cryptomonads (Cryptophyta) and green algae (Chlorophyta) were present, but only chlorophytes were present in the July 2004 sample. Unlike the 2000 phytoplankton sampling, no blue-greens (more properly cyanobacteria) were present during the 2004 sampling. Taxonomic richness of the assemblage was higher in July 2004 than in June 2004, but evenness (normalized diversity) was lower in July than June. The same pattern was observed in 2000 between the spring and summer samples. Taxonomic richness and evenness values were similar to the 2000 sampling and spanned the moderate range. Once again the composition of the phytoplankton community suggested high nutrient levels, but cyanophyte blooms were absent, probably as a function of rapid flushing during the wetter 2004 period.

Overall cell counts and biomass estimates were low in the June sample and moderate in the July sample. High flushing would appear to be a dominant influence in this system. Another important factor is probably light, which is reduced below the water surface by high turbidity. This turbidity includes organic remains of algae and vascular plants, but is also a function of visibly high levels of fine suspended inorganic particles in the incoming water. The combination of low light and high flushing can limit the accumulation of phytoplankton biomass in upper Lake Whitney.

Figure 6. Map of upper Lake Whitney including sampling locations for phytoplankton, zooplankton, invertebrates and gill net set locations.

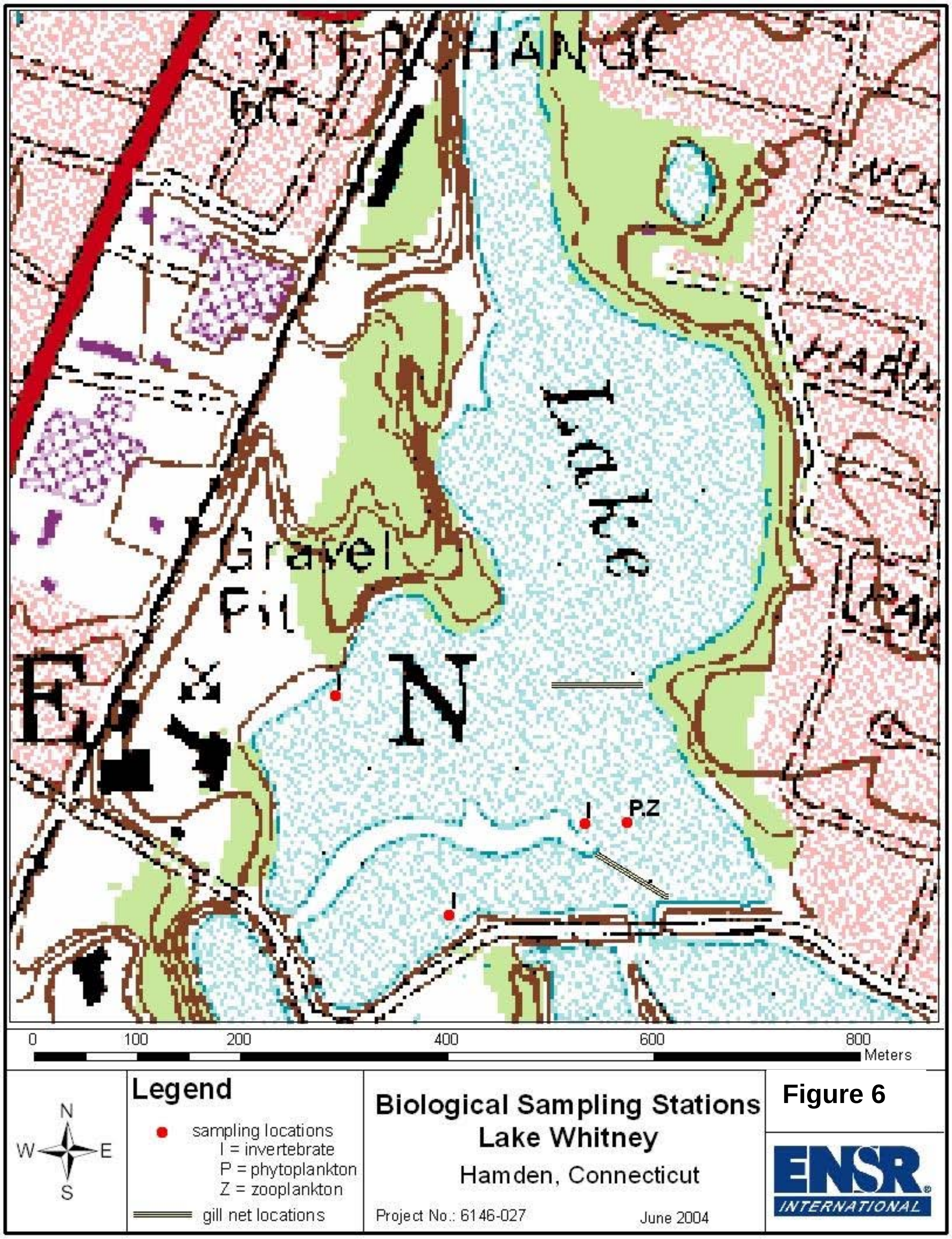


Table 2. Phytoplankton density (cells/mL) for the samples collected in upper Lake Whitney in June and July 2004.

	phytoplankton density (cells/mL)	
	15-Jun-2004	26-Jul-2004
taxon	LW-1	LW-bridge
Bacillariophyta:		
Achnanthidium /related taxa	24	360
Amphora	0	90
Asterionella	288	30
Aulacoseira	300	1830
Cocconeis	0	30
Cyclotella	0	30
Cymatopleura	0	30
Cymbella /related taxa	0	120
Diatoma	0	180
Fragilaria /related taxa	168	330
Gomphonema /related taxa	0	90
Gyrosigma	0	30
Melosira	48	120
Meridion	12	210
Navicula /related taxa	48	270
Nitzschia	12	1020
Stephanodiscus	48	30
Surirella	0	30
Synedra	36	600
Tabellaria	24	0
Chlorophyta:		
Ankistrodesmus	24	30
Eudorina	144	0
Pandorina	96	0
Scenedesmus	144	120
Staurastrum	12	30
Volvox	336	0
Chrysophyta:		
Dinobryon	72	60
Cryptophyta:		
Cryptomonas	72	0

Table 2 (continued). Phytoplankton density (cells/mL) for the samples collected in upper Lake Whitney in June and July 2004. S-W is Shannon-Wiener diversity index.

	15-Jun-2004	26-Jul-2004
summary statistics	LW-1	LW-bridge
density (cells/mL)		
Bacillariophyta	1008	5430
Chlorophyta	756	180
Chrysophyta	72	60
Cryptophyta	72	0
Cyanophyta	0	0
Eugelnophyta	0	0
Pyrrhophyta	0	0
total phytoplankton	1908	5670
taxonomic richness		
Bacillariophyta	11	19
Chlorophyta	6	3
Chrysophyta	1	1
Cryptophyta	1	0
Cyanophyta	0	0
Eugelnophyta	0	0
Pyrrhophyta	0	0
total phytoplankton	19	23
S-W diversity index	1.08	1.00
evenness index	0.85	0.73

Table 3. Phytoplankton biomass (μg/L) for the samples collected in upper Lake Whitney in June and July 2004.

	phytoplankton biomass (ug/L)	
	15-Jun-2004	26-Jul-2004
taxon	LW-1	LW-bridge
Bacillariophyta		
Achnanthidium /related taxa	2.4	36
Amphora	0	126
Asterionella	57.6	6
Aulacoseira	90	549
Cocconeis	0	12
Cyclotella	0	75
Cymatopleura	0	240
Cymbella /related taxa	0	210
Diatoma	0	54
Fragilaria /related taxa	50.4	99
Gomphonema /related taxa	0	90
Gyrosigma	0	96
Melosira	115.2	288
Meridion	3.6	63
Navicula /related taxa	24	135
Nitzschia	9.6	1140
Stephanodiscus	62.4	75
Surirella	0	120
Synedra	115.2	2640
Tabellaria	19.2	0
Chlorophyta		
Ankistrodesmus	7.2	3
Eudorina	57.6	0
Pandorina	9.6	0
Scenedesmus	14.4	12
Staurastrum	9.6	24
Volvox	33.6	0
Chrysophyta		
Dinobryon	216	180
Cryptophyta		
Cryptomonas	115.2	0

Table 3 (continued). Phytoplankton biomass (μg/L) for the samples collected in upper Lake Whitney in June and July 2004.

summary statistics	15-Jun-2004 LW-1	26-Jul-2004 LW-bridge
biomass (ug/L)		
Bacillariophyta	549.6	6054
Chlorophyta	132	39
Chrysophyta	216	180
Cryptophyta	115.2	0
Cyanophyta	0	0
Eugelnophyta	0	0
Pyrrhophyta	0	0
total phytoplankton	1012.8	6273

Zooplankton

The location of zooplankton sampling is indicated in Figure 6. Zooplankton counts and biomass estimates are provided in Table 4. Zooplankton included protozoans, rotifers, copepods, and cladocerans. Cladocera form the major zooplankton component, but they still fall below densities desirable for phytoplankton biomass control (densities >20 larger individuals/L or biomass >200 µg/L as indicative thresholds). Taxonomic richness and evenness were moderate and did not vary appreciably between the 2000 and 2004 sampling events. Average body length in 2004 was low, as were organism density and biomass values, reflecting the 2000 results. Phytoplankton food resources are of generally good quality, and while phytoplankton quantity is not high, it should support a larger zooplankton community. Rapid flushing of upper Lake Whitney may minimize accumulation of zooplankton. Predation is also likely to be a strong influence, with abundant planktivorous fish indicated. The very low abundance of zooplankton provides limited food for the fish community and almost no grazing pressure on algae.

Table 4. Zooplankton density (#/L) and biomass (μg/L) for the sample collected in upper Lake Whitney during June 2004.

	Density (#/L)		Biomass (μg/L)
	LW-1Z		LW-1Z
	15-Jun-2004		15-Jun-2004
taxon			
PROTOZOA			
Ciliophora	3.4		0.1
ROTIFERA			
Asplanchna	0.3		0.4
Conochilus	0.1		0.0
Synchaeta	0.1		0.0
COPEPODA			
Cyclops	0.3		0.7
Mesocyclops	0.1		0.1
Diaptomus	0.2		0.1
Other Copepoda-Nauplius	0.7		1.9
CLADOCERA			
Bosmina	2.8		2.7
Ceriodaphnia	1.9		4.9
Chydorus	0.1		0.1
Daphnia ambigua	0.4		2.0

summary statistics		summary statistics	
density (#/L)		**biomass (μg/L)**	
Protozoa	3.4	Protozoa	0.1
Rotifera	0.6	Rotifera	0.4
Copepoda	1.3	Copepoda	2.7
Cladocera	5.2	Cladocera	9.8
Other Zooplankton	0.0	Other Zooplankton	0.0
Total Zooplankton	10.4	Total Zooplankton	13.0
Taxonomic Richness			
Protozoa	1	**S-W diversity index**	0.79
Rotifera	3	**evenness index**	0.73
Copepoda	4		
Cladocera	4	**mean body length**	
Other Zooplankton	0	all forms	0.29
Total Zooplankton	12	Crustaceans	0.42

Macrophytes

Macrophytes are a visibly dominant feature of upper Lake Whitney in the summer (Figure 7). Mapping points and transects are shown in Figure 8. Maps of total plant cover and total plant biovolume are presented in Figures 9 and 10. Collected macrophyte data are provided in Table 5.

Cover by macrophytes varied throughout the lake, with the densest cover in the inlet cove. Some areas in the inlet cove experience cover between 75 and 100%. As expected, macrophyte coverage was greatest near shore, and decreased with increased distance from the shore, where the dominant species was filamentous green algae. Biovolume followed a similar pattern, but never exceeded the 75% level. The presence of largely floating (e.g., duckweed) or floating leaved (e.g., lilies) species gives an impression of greater plant biomass than really exists in this lake. Areas of densest cover and biovolume contained both waterlilies and the submergent waterweed (*Elodea*) or algal mats.

Upper Lake Whitney hosts relatively few plant species, with swamp loosestrife (*Decodon verticillatum*) being the only aquatic plant noted other than the plants mentioned above. All species present are tolerant of low light or prefer shallow water (where low light is less of an issue), but all are native species. Lack of invasive macrophytes within upper Lake Whitney is a positive attribute.

Duckweed (*Lemna minor*) was found mainly in the western and southwestern coves. This floating vascular plant depends upon the water column for nutrition and is an indicator of high nutrient levels, especially for nitrate. As it is not anchored to the sediment, this plant can be flushed through the system readily, and probably is delivered to upper Lake Whitney on a regular basis.

Waterweed (*Elodea canadensis*) is a rooted submergent vascular plant that tolerates low light and high sediment loads. It is present throughout the entire upper Lake Whitney except for the western cove. Waterweed was not found in the southwestern cove during the 2000 survey, and has increased in cover throughout upper Lake Whitney since 2000 This could represent natural variability, as plant communities are not static, but as waterweed is tolerant of high turbidity and low light, an increase over the wet years of 2003 and 2004 is consistent with the ecology of this plant.

Waterlilies (*Nymphaea odorata* and *Nuphar variegata*) are mainly peripheral species in upper Lake Whitney, but provide the densest surface cover and dominate the plant assemblage where they occur. Lilies cover nearly all the inlet channel and occupy a major portion of the western cove. Lily cover and abundance appears to be unchanged from 2000.

Benthic algal mats are not obvious in upper Lake Whitney, as they are submergent growths at the sediment-water interface. Algal mats are the dominant macrophytes in areas without vascular plants, but do not achieve the densities sometimes associated with nutrient rich sediments in shallow areas. The filamentous green alga *Spirogyra* was especially abundant. Observed blue-green mats included mainly species of *Oscillatoria*, but were not especially abundant or dense in 2004. Low light and high flushing rate are probably major factors in controlling these mats, as with the phytoplankton.

Maximum water depth in upper Lake Whitney is only about 10 ft, with much of the upper basin less than 5 ft deep. Surficial sediments in upper Lake Whitney are primarily mucks and sands, with some larger rocks and various leaf litter and other woody debris.

Figure 7. A photograph of the inlet cove in upper Lake Whitney on June 15, 2004.

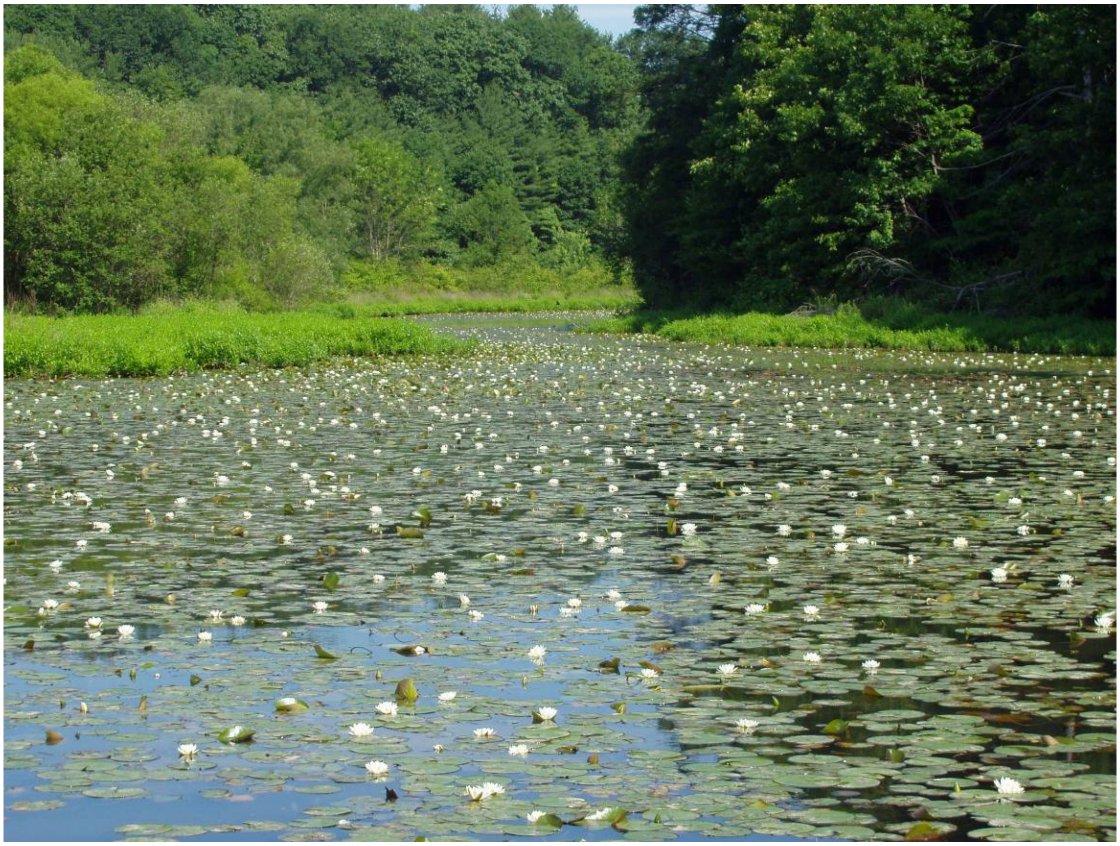


Figure 8. A map of upper Lake Whitney containing aquatic macrophyte survey transects and points.

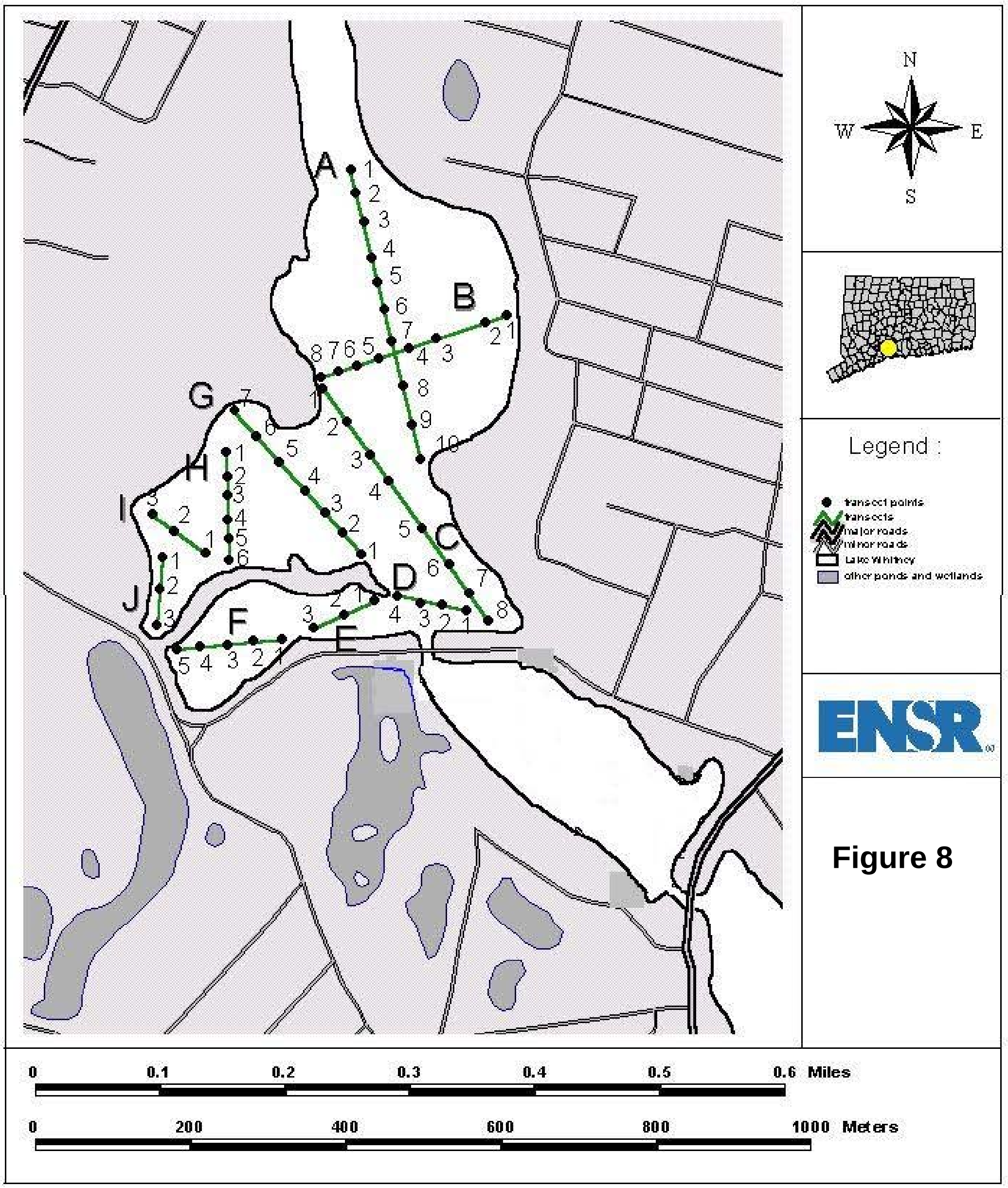


Figure 9. A map of upper Lake Whitney and corresponding plant cover on June 15, 2004.

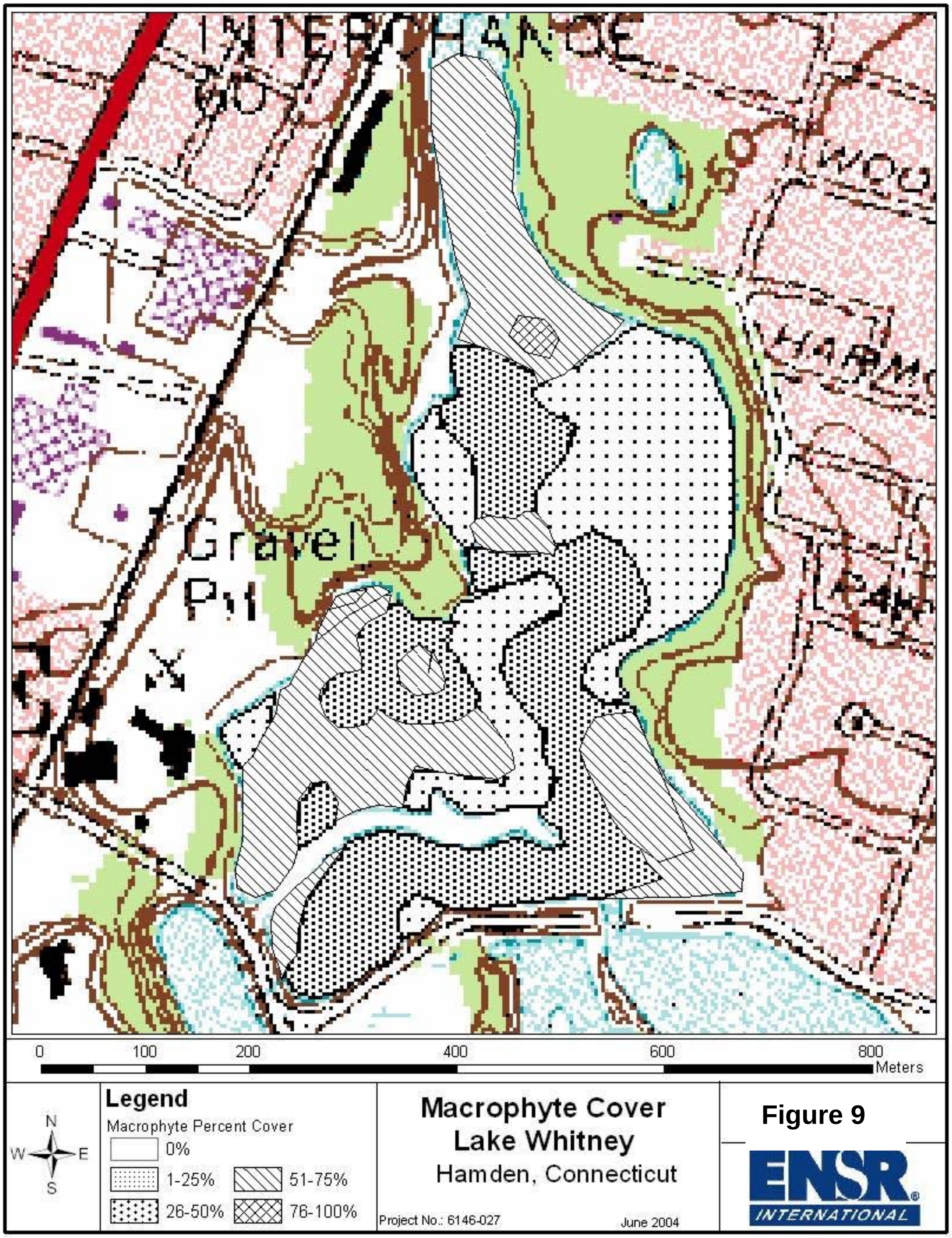


Figure 10. A map of upper Lake Whitney and corresponding plant biovolume on June 15, 2004.

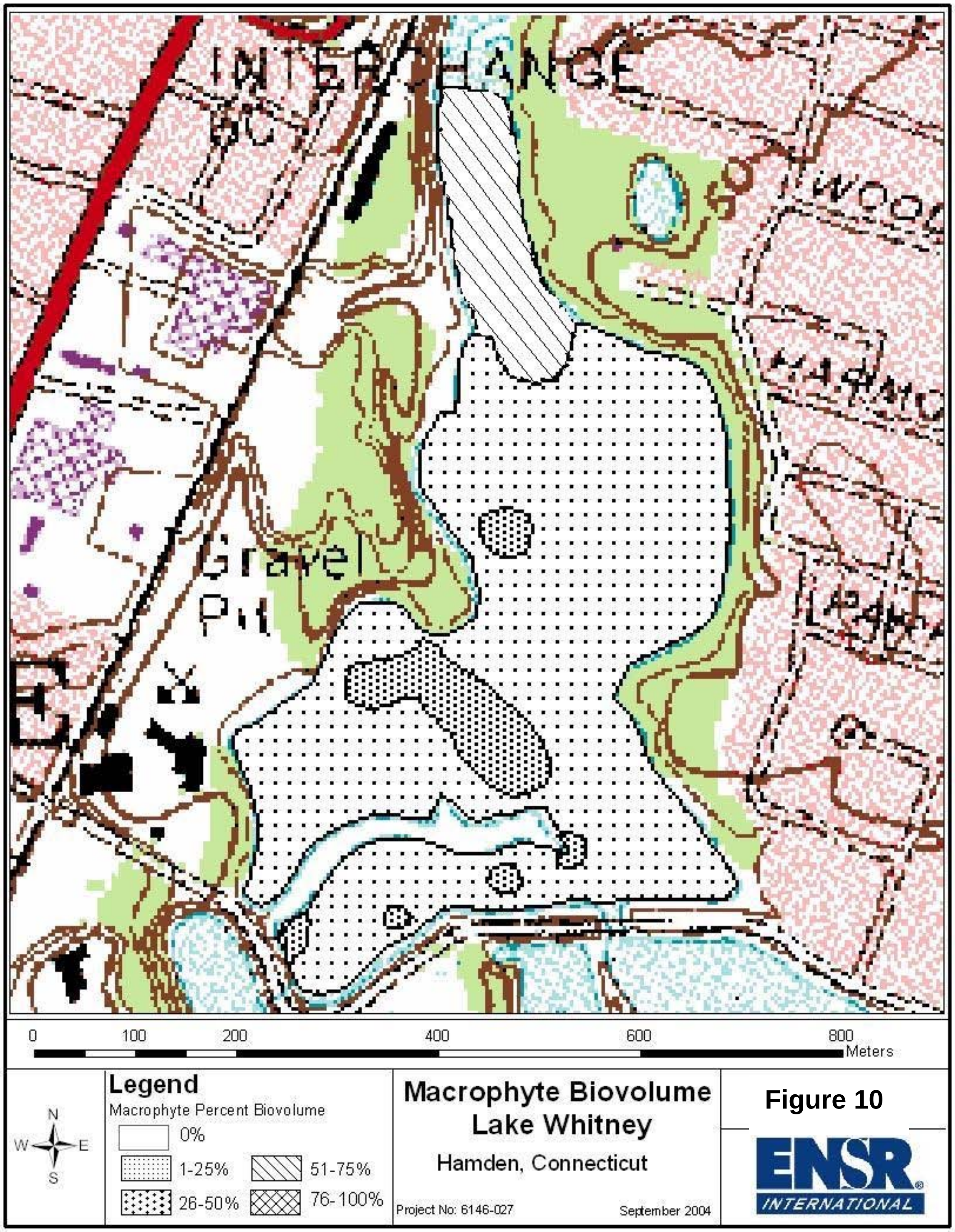


Table 5. Physical characteristics (water depth, sediment type), total plant percent cover and biovolume, and plant taxa recorded at each transect point during the survey (15-June-2004). Plant taxa are reported left to right from the most abundant to the least abundant for each transect point. For full names of plant taxa, sediment type codes, and total plant percent cover and biovolume codes, see notes at the end of table.

	water depth			total plant		
trans. pt. ID	m	ft	sediment type	% cover	% biovol.	plant taxa (% relative abundance)
A-1	0.6	2.0	mu	3	3	Nod, alg
A-2	0.4	1.3	mu	3	3	Nod, alg
A-3	0.3	1.0	mu	4	3	Nod, Nvaa, Dve, alg
A-4	0.2	0.6	mu	1	1	Nod, Nvaa, alg
A-5	0.3	0.9	mu	2	1	Nvaa
A-6	0.3	1.1	mu	1	1	alg, Eca, Nod, Nvaa
A-7	0.5	1.5	mu	1	1	alg, Nvaa
A-8	0.7	2.2	mu	2	1	alg, Eca, Nod
A-9	1.7	5.5	mu	2	1	Eca, alg, Nod
A-10	2.3	7.5	mu	1	1	alg, Eca, Nod
B-0	0.3	1.1	sa	2	1	Nod, alg
B-1	1.0	3.4	mu	1	1	alg, Nod
B-2	1.0	3.3	mu	1	1	alg, Nod
B-3	0.6	2.0	mu	1	1	alg, Eca
B-4	0.6	2.0	mu	1	1	alg, Eca, Nod
B-5	0.4	1.4	mu, sa	1	1	alg, Eca, Nod
B-6	1.1	3.5	mu	3	2	Eca, alg
B-7	1.1	3.5	mu	3	2	Eca, alg, Nod
B-8	1.5	4.9	mu	1	1	alg, Eca
C-1	1.1	3.6	mu	2	1	alg, Eca, Nod
C-2	1.5	4.9	mu	1	1	alg, Eca
C-3	1.4	4.5	mu	2	1	Eca, alg
C-4	1.7	5.5	mu	2	1	alg, Eca
C-5	1.0	3.4	sa	3	1	alg, Eca
C-6	1.4	4.7	mu	3	1	alg, Eca, Nod
C-7	1.6	5.2	mu	3	1	alg, Eca, Nod
C-8	2.0	6.5	mu	3	1	alg, Eca
D-1	1.7	5.5	mu	2	1	alg, Eca
D-2	1.7	5.6	mu	2	1	alg
D-3	2.6	8.5	mu	1	1	alg, Eca
D-4	1.8	6.1	mu	3	2	Eca, alg, Nod, Lmi, Wco
E-1	2.3	7.5	mu	2	1	alg, Eca
E-2	2.7	9.0	mu	3	2	alg, Eca
E-3	1.3	4.2	sa, ro	2	1	alg, Nod, Lmi
F-1	1.5	5.0	sa, ro	1	1	alg, Nod
F-2	2.2	7.2	mu	3	2	alg, Nod
F-3	2.7	8.8	mu	2	1	alg
F-4	2.2	7.3	mu	2	1	alg, Eca, Nod
F-5	1.5	5.0	mu	3	2	alg, Eca, Nod, Lmi, Wco

Table 5 (continued). Physical characteristics (water depth, sediment type), total plant percent cover and biovolume, and plant taxa recorded at each transect point during the survey.

trans. pt. ID	water depth m	water depth ft	sediment type	total plant % cover	total plant % biovol.	plant taxa (% relative abundance)
G-1	2.8	9.2	mu	1	1	alg, Eca, Lmi, Nod
G-2	2.1	6.9	mu	2	2	alg, Eca
G-3	1.7	5.6	mu	3	2	alg, Eca
G-4	2.0	6.7	mu	2	2	alg, Eca
G-5	1.6	5.2	mu	3	2	alg, Eca, Nod
G-6	1.0	3.3	mu, sa	2	1	alg, Eca, Nod
G-7	1.1	3.6	mu	3	1	alg
H-1	1.2	4.0	mu	3	2	alg, Nod
H-2	1.3	4.3	mu	2	1	alg, Nod
H-3	1.1	3.5	mu	2	1	alg, Nod
H-4	0.9	3.1	mu	3	1	alg, Nod
H-5	1.1	3.5	mu	3	1	alg, Nod
H-6	0.9	3.0	mu	3	1	alg, Nod, Lmi
I-1	0.9	3.0	mu, sa	2	1	alg, Nod
I-2	1.2	4.0	mu	1	1	alg, Lmi, Wco, Nod
I-3	1.4	4.5	mu	3	1	alg, Nod, Lmi, Wco
J-1	1.2	4.0	mu	3	1	alg, Nod, Lmi, Wco
J-2	1.2	3.8	mu	3	1	alg, Lmi, Wco, Nod
J-3	1.2	4.1	mu	3	1	alg, Nod, Lmi, Wco, Nva

Notes:

sediment type: **co** - cobble; **gr** - gravel; **ll** - leaf liter; **mu** - muck; **ro** - rock; **sa** - sand

plant taxa: **alg** - green algae (Chlorophyta); **cya** - blue-green algae (Cyanophyta)
Dve - *Decodon verticillatum* (swamp loosestrife);
Eca - *Elodea canadensis* (waterweed);
Lmi - *Lemna minor* (duckweed);
Nod - *Nymphaea odorata* (fragrant or white-flower waterlily)
Nva - *Nuphar variegata* (yellow-flower waterlily)
Wco - *Wolfia columbiana* (watermeal)

Benthic Macroinvertebrates

Locations of benthic invertebrate sampling are shown in Figure 6. Data for the types of organisms found are provided in Table 6.

Overall low habitat quality (mucky bottom, low density of truly submerged vascular plants) and possibly high fish predation, both forces with possible strong local effects, could limit macroinvertebrate communities in Lake Whitney.

Most of the invertebrate taxa found in Lake Whitney were tolerant of impacted environments and/or opportunistic species (e.g., pulmonate snails; sowbugs, scuds such as *Gammarus* and the mayfly *Caenis*). Lack of large-bodied invertebrate taxa in Lake Whitney suggests possible strong predation by fish. In particular, common carp (abundant in upper Lake Whitney) is known to cause drastic reductions in invertebrate densities. Accordingly, total macroinvertebrate species diversity was relatively low in 2004. Taxonomic richness in 2004 (18) was lower than but comparable to the 2000 survey (26); the same taxa were abundant. The macroinvertebrate community present in 2004 is similar to the community observed in 2000.

The macroinvertebrate community of Lake Whitney was characterized by dominance by primary consumers, but a small but diverse assemblage of predators (e.g., damselfly larvae, the Dobsonfly larva *Corydalus*) indicates that Lake Whitney supports multiple trophic levels within the benthic invertebrate community. Overall low invertebrate density, diversity, and body size once more suggest that fish predation may be high in Lake Whitney. In the absence of intense predation, it is possible that a relatively complex benthic food web would develop.

Table 6. Taxonomic and ecological (feeding ecology) characterization of each benthic macroinvertebrate taxon found in Upper lake Whitney in June 2004. For those taxa with multiple feeding mode, primary and secondary modes are given. Generalist primary consumers feed on both living and dead plant tissues with no evident preference. Feeding ecology obtained from several sources, mainly Thorp and Covich (1991), Merrit and Cummins (1995), and direct observations by ENSR staff.

					feeding group(s)	
phylum or subphylum	class	order or subclass	family	taxon	primary	secondary
Mollusca	Gastropoda	Pulmonata	Physidae	Physa gyrina	generalist	
Mollusca	Gastropoda	Pulmonata	Planorbidae	Gyraulus parvus	generalist	
Mollusca	Gastropoda	Pulmonata	Lymnaeidae	Lymnaea columella	generalist	
Annelida	Oligochaeta	Tubificida	Tubificidae	Tubificidae sp.	detritivore	
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	Lumbriculidae sp.	detritivore	
Annelida	Hirudinea	Rhynchobdellida	Glossiphoniidae	Glossiphonia complanata	predator	
Chelicerata	Acari	Acariformes		Hydrachnidia sp.	predator	
Crustacea	Malacostraca	Amphipoda	Gammaridae	Gammarus sp.	generalist	
Uniramia	Insecta	Odonata	Zygoptera	Enallagma sp.	predator	
Uniramia	Insecta	Ephemeroptera	Caenidae	Caenis sp.	detritivore	
Uniramia	Insecta	Megaloptera	Corydalidae	Corydalus sp.	predator	detritivore
Uniramia	Insecta	Hemiptera	Corixidae	Palmacorixa sp.	generalist	
Uniramia	Insecta	Coleoptera	Haliplidae	Peltodites sp.	herbivore	
Uniramia	Insecta	Diptera	Chironomidae	Tanypodinae spp.	predator	
Uniramia	Insecta	Diptera	Chironomidae	Chironominae spp.	generalist	
Uniramia	Insecta	Hemiptera	Veliidae			
Uniramia	Insecta	Diptera	Psychodidae			
Uniramia	Insecta	Diptera (pupae)				

Fish

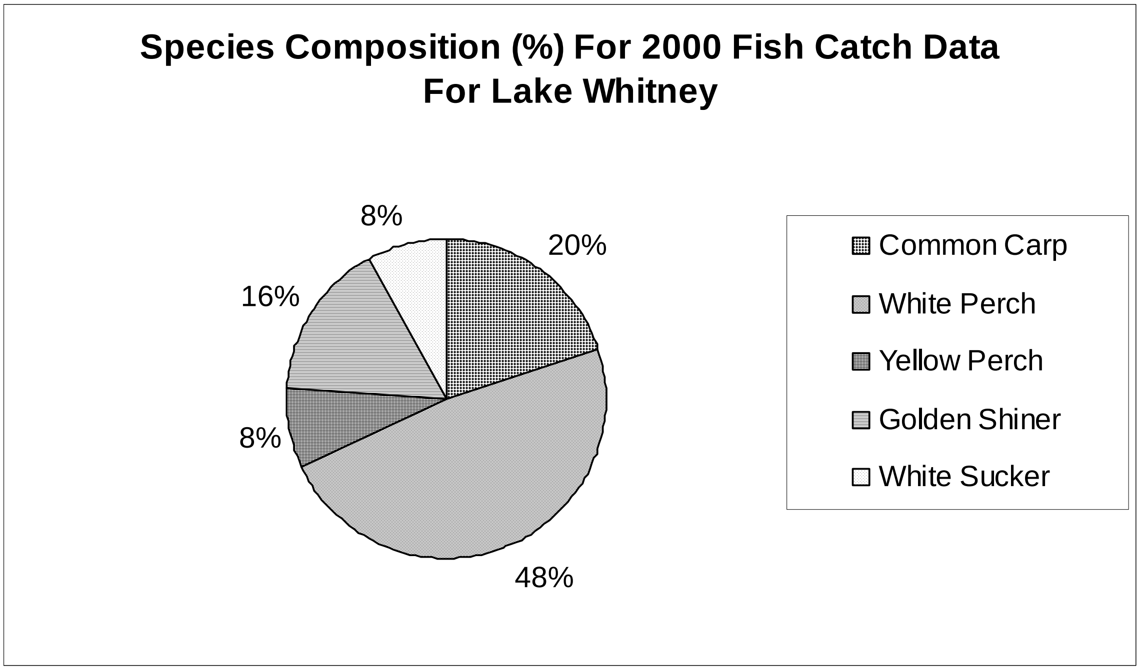
Locations of gill net sets are shown in Figure 6, and fish data are presented in Table 7. In addition to the species listed in Table 7, several species were visually observed, including largemouth bass, common carp and numerous sunfish species. Centrarchids are adept at avoiding gill nets, however, and other sampling was not possible within the physical constraints of the lake and the time allotted for assessment. Common carp appeared to be concentrated in the northern cove; these larger fish are not likely to be captured in 1.0 inch gill nets, but are easily visible in the shallow areas that they frequent in upper Lake Whitney.

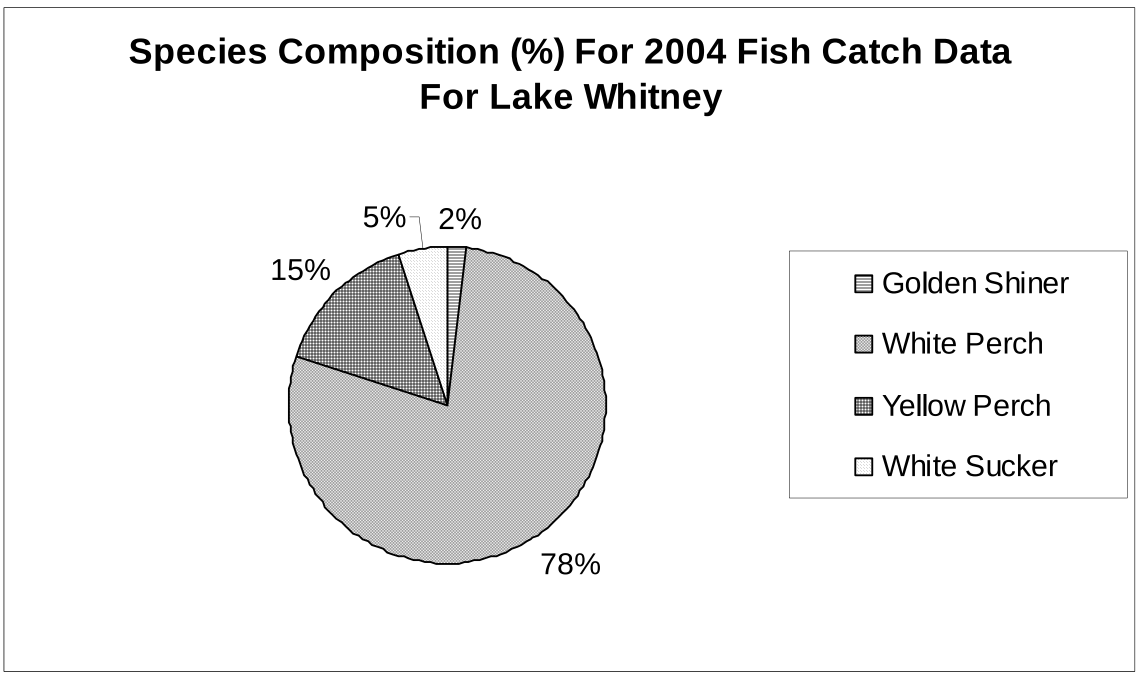
White perch were the most abundant species collected, and also dominated the biomass as seen in Figure 11. No common carp were collected in 2004, although numerous large specimens were visually observed jumping and swimming in the shallow north cove. Despite lack of captured specimens in 2004, common carp may still dominate fish biomass in the lake as seen in 2000. In addition to white perch, yellow perch, golden shiners, and white suckers were also captured. All fish appeared healthy, although a small percentage of

Table 7. Results of the gill net fish survey in upper Lake Whitney on June 15, 2004. These data do not include visual observations of species that were not collected in the gill net

Golden Shiner		White Perch								Yellow Perch		White Sucker	
TL (mm)	Wt (g)	TL (mm)	Wt (g)	TL (mm)	Wt (g)	TL (mm)	Wt (g)	TL (mm)	Wt (g)	TL (mm)	Wt (g)	TL (mm)	Wt (g)
210	95	176	58	212	120	171	66	176	58	193	79	218	131
240	175	165	52	219	133	215	138	209	108	219	111	222	126
245	198	168	55	228	140	195	93	209	97	228	135	228	130
		211	109	161	58	167	62	208	101	206	104	258	196
		219	117	201	99	209	113	219	121	193	84	248	148
		212	108	159	50	158	49	212	109	204	83	219	120
		221	119	209	116	170	61	169	65	182	69	230	135
		159	46	222	138	167	53	168	64	190	69	226	135
		219	128	158	54	175	72	157	56	223	118		
		175	60	161	58	163	59	160	61	194	87		
		164	55	203	104	197	100	206	105	211	103		
		174	62	172	61	223	145	209	121	209	105		
		205	98	162	61	170	68	195	94	208	108		
		188	92	161	51	226	135	172	62	211	80		
		226	113	169	63	200	97	180	71	218	127		
		212	116	158	53	225	132	176	58	192	91		
		158	38	160	48	225	142	159	53	210	109		
		169	60	202	101	228	148	164	58	190	73		
		169	61	228	146	220	138	164	52	192	81		
		184	79	241	188	167	62	214	105	218	113		
		169	58	220	138	170	70	164	62	201	95		
		224	132	160	41	221	143	172	61	205	94		
		206	120	165	61	210	115	160	57	202	89		
		211	120	177	64	160	49	170	68	179	72		
		177	74	154	55	161	58	215	128				
		174	59	158	54	172	64	171	69				
		161	53	169	61	177	77	169	69				
		163	57	198	105	159	60	164	59				
		156	54	174	71	160	52	159	55				
		162	60	168	75	177	77	162	57				
		173	72	184	80	222	126						

Figure 11. A graphical representation of species composition (number of fish) for the 2000 and 2004 sampling events.





yellow perch were hosting a parasitic fungus, a very common occurrence in yellow perch. As in 2000, no clupeid fishes (e.g., alewife, shad) were captured or observed in upper Lake Whitney, although zooplankton community structure in 2004 is consistent with the presence of alewife (i.e., few individuals, small body size). Other factors could also lead to this structure, including high flushing rate and predation by other planktivorous fishes such as golden shiner.

Comparisons between the 2000 and 2004 sampling data suggest that the substantial warmwater fish community present in Lake Whitney is stable. Coldwater species would not be expected to inhabit Lake Whitney. The unhindered connection to the lower portion of Lake Whitney allows fish to move freely between the lake segments, so rapid re-population after any times of stressful conditions in upper Lake Whitney is expected. Daily movements in response to food resource availability may also occur. Low zooplankton densities in upper Lake Whitney might constrain planktivorous fish growth, a common occurrence in waterbodies with high perch populations, but captured individuals appeared to have average condition factors (length vs. weight).

Many fish were readily observed over the shallow flats during the study. Habitat conditions are sufficient to sustain a thriving warmwater fish community that would be accessible to piscivorous wildlife, most notably wading birds. The fish community observed in 2004 is similar to the fish community present in 2000. Differences in gill net location and possible changes in bottom type and macrophyte density may be responsible for the differences in catch, mainly the lack of carp in gillnet samples (although they were readily observed in the lake).

Discussion

The biological attributes of upper Lake Whitney appear minimally changed from 2000 condition. Phytoplankton, zooplankton, macrophyte, macroinvertebrate and fish populations are very similar to those observed in 2000. A drawdown ranging up to six feet that lasted over a month in summer of 2004 was performed to allow construction at the Lake Whitney dam, and appears to have had slight impacts on the system with regard to aquatic macrophytes. Refilling began in mid-August and was completed over the weekend of August 28.

A substantial portion of the lake bottom was exposed (Figure 12) during the drawdown, consistent with projections in the 2002 report. From limited visual observation on September 2, 2004, it appeared that most areas of vascular plants were exposed, subjecting the plants to drying and related damage. Upon refill in August, there appeared to be a reduction in the waterlilies *Nuphar varigata* and *Nymphaea odorata.* Given that there appears to be no significant differences in the flora and faunal communities between the 2000 and 2004 sampling events, the lake drawdowns in 2000 and 2003 resulted in no major and lasting impact on the lake ecosystem. The drawdown of 2004 was more severe and occurred during the prime growing season, so additional monitoring will be needed to determine if the 2004 drawdown has had a greater impact than those of 2000 and 2003.

Drawdowns are a common management technique for controlling susceptible rooted plant growth (Holdren et al. 2001). Studies on other lakes performed by ENSR have indicated that vegetative communities typically recover from drawdown impacts in about two years, although there is certainly variability based on the plant community and severity and timing of drawdown. The lack of significant change in the plant and wildlife communities in Lake Whitney between 2000 and 2004 is consistent with those previous lake drawdown studies. Monitoring in the future may discern any lasting effects, but most postulated impacts are transient. The SCCRWA plans to periodically repeat the data collection performed here to assess any long-term changes in biological communities.

Figure 12. Photograph of Lake Whitney during the drawdown, July 19, 2004, looking north toward the inlet cove from Waite Street. Lake level = 5.9 ft below spillway elevation.

References

Holdren, C., W. Jones, and J. Taggart. 2001. Managing Lakes and Reservoirs. N. Am. Lake Manage. Soc. and Terrene Inst., in coop. with Off. Water Assess. Watershed Prot. Div. U.S. Environ. Prot. Agency, Madison, WI.

Merritt R. W., & K. W. Cummins (editors), 1996. An Introduction to the Aquatic Insects of North America, third Edition. Kendall/Hunt Publishing, Dubuque, IA.

Milone and MacBroom 2002. CH2M Hill, ENSR, Roald Haestad, Inc. Upper lake Whitney Management Study, Mill River Watershed, Hamden, CT. Report prepared for the South Central Connecticut Regional Water Authority, New Haven, CT.

Thorp, J. H., and A. P. Covic (editors), 1991. Ecology and Classification of North American Freshwater Invertebrates. Academic Press, Sand Diego, CA.