Lake Chautauqua Habitat Rehabilitation and Enhancement Project Fisheries Response

August 2005

Cover: Configuration of Lake Chautauqua with a north and south pool divided by a levee. (Photograph taken by the Illinois Natural History Survey at a 6 ft. river stage in September 1984.)

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by

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Executive Summary

Lake Chautauqua has been an integral component of the Illinois River National Wildlife Refuge System since its purchase by the U.S. Fish and Wildlife Service in 1936. This 1,450-ha lake has historically been a diverse and productive system and has been used extensively as a resting area for migrating waterfowl. Lake Chautauqua was divided into two compartments by a cross levee in 1969 to facilitate multiple management needs. However, the cross levee failed in 1970 and further attempts to repair the levee were largely unsuccessful for the next two decades. Coupled with the unsuccessful attempts at levee repair was a decline in fish and wildlife populations due largely to loss of habitat through sedimentation. In 1992, Lake Chautauqua was chosen as a Habitat Rehabilitation and Enhancement Program (HREP) site where the cross levee would be repaired to assist with water level management and sediments would be compacted or dredged to facilitate water removal. The project was completed in 1997 and established the present physical make up of the lake. The north 480-ha pool is generally managed as a deeper water unit that holds water year-round. This unit is intended for submersed and emergent aquatic vegetation through relatively stable water levels to provide habitat for waterfowl and fish. The south 970-ha pool is managed to stimulate moist-soil plant growth for waterfowl and shorebird use. The management strategy for the south pool is to allow it to fill during normal spring flooding and then dewater the compartment in summer through a single control structure. The goal for this HREP project was to enhance waterfowl and fish habitats. Therefore, staff at the Illinois River Biological Station, Illinois Natural History Survey has been conducting studies on fish communities to assess their responses to HREP activities.

The main goal of this report is to summarize the fish community responses to the HREP construction efforts at Lake Chautauqua. Habitat issues for fish were largely focused on the stable water levels for the north pool. Therefore, our specific objectives include assessing changes in fish community composition and structure and assessments of length-frequency distributions on the basis of pre- and post-construction collection efforts. Included in this assessment is a summary of the 2002 field collection effort that has not been in previous annual reports.

Sampling was conducted annually in each of the two periods: pre- (1991–1993) and post-construction (2000–2002) to assess fish community responses in the north pool. Standardized fish collection gears were used during both sample periods following protocols outlined by the Environmental Management Program's Long Term Resource Monitoring Program and typically included day electrofishing and fyke nets. Gill nets were also used to further sample open-water habitats. These gears have species and size-specific biases, but when used collectively they provide a fairly complete assessment of nearshore and offshore fish communities. The resulting analyses include data from all collection gears for community composition (species richness) analyses, but are gear specific for analyses conducted on community structure (relative abundance) data. We tested for differences among communities using Bray-Curtis similarity values, a common index of similarity used in ecological research.

Fish community composition showed little variability with 46 species collected in both sampling periods. Accordingly, Analysis of Similarity tests for differences in species that make up the fish communities between the two periods were not significantly different (R = 0.037; $P = 0.60$). However, fish community structure appears to be different between the two periods for most gears. For example, community structure from fyke nets suggests two distinct communities that cluster by pre- and post-construction times. A similar pattern was observed with the gill net data. Generally, increased abundances of forage species like gizzard shad *Dorosoma cepedianum* and sport fish like white crappie *Pomoxis annularis*, black crappie *P. nigromaculatus*, largemouth bass *Micropterus salmoides*, and white bass *Morone chrysops* along with declines of less desirable fish species (e.g., common carp *Cyprinus carpio*) contributed most significantly to community structure differences. These changes hint at a positive response to the present management practices that have resulted

from HREP construction. These observations are re-enforced by visibly documented increases in recreational angling for some species after construction.

Larval fish production has also been monitored in the south management unit since 1996. Unfortunately, this effort generally post-dates HREP construction activities in Lake Chautauqua, but the emphasis here has been on assessing the reproduction potential of Illinois River fish in this lake as a secondary benefit. Backwater lakes that flood in the spring, like the south pool of Lake Chautauqua, can be a valuable asset to riverine fish communities that have evolved to capitalize on this seasonally available habitat for spawning and nursery efforts. Since 1996, there have not been significant changes in taxa composition or structure as cyprinid and clupeid species dominated the catch throughout the study. Production of sport fish species varied considerably and preliminary analyses show some dependence on water level. However, it appears that Lake Chautauqua is heavily used as a spawning and nursery area by riverine fish with estimates of fish evacuated during the dewatering period that averaged about 135 million fish per year.

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Abstract: Lake Chautauqua has been an integral component of the Illinois River National Wildlife Refuge System since its purchase by the U.S. Fish and Wildlife Service in 1936. The main goal of this report is to summarize the fish community responses to the Habitat Restoration and Enhancement Program (HREP) construction efforts at Lake Chautauqua aimed at improving habitat for fish and wildlife. Our specific objectives include assessing changes in fish community composition and structure and assessments of length-frequency distributions on the basis of pre- and post-construction collection efforts. Included in this assessment is a summary of the 2002 field collection effort that has not been presented in previous annual reports. Fish community composition showed little variability with 46 species collected in both the pre- and post-sampling periods. Accordingly, Analysis of Similarity tests for differences in species that make up the fish communities between the two periods were not significantly different ($R = 0.037$; $P = 0.60$). However, fish community structure appears to be different between the two periods for most gears. Generally, increased abundances of forage species like gizzard shad *Dorosoma cepedianum* and sport fish like white crappie *Pomoxis annularis*, black crappie *P. nigromaculatus*, largemouth bass *Micropterus salmoides*, and white bass *Morone chrysops* along with declines of less desirable fish species (e.g., common carp *Cyprinus carpio*) contributed most significantly to community structure differences. These changes hint at a positive response to the present management practices that have resulted from HREP construction.

Key words: fish, Illinois River, Lake Chautauqua, restoration

Introduction

Rivers and their associated floodplain complexes are a valuable and integral part of every major ecotype and alteration of these systems has a long and varied history throughout the world. Many of these changes are a direct result of various management practices designed to meet human needs including flood control, power generation, navigation, irrigation, agriculture, and recreation. Dominant management practices used to meet these needs have typically involved altering flow and habitat availability through impoundment, channelization, leveeing, and water diversion. All of these practices have far ranging temporal and spatial effects on the physical and biological processes that define a given ecosystem. Biotic changes can range from local changes in community composition and/or structure to broader extirpations of species or entire communities and changes in fundamental processes (e.g., nutrient cycling, bioenergetics, etc.).

The effects of these modifications are beginning to be ameliorated in some systems and while the science of restoring large rivers is relatively young, attempts to repair damaged systems because of human impacts are emerging in several places around the world. For example, the Environmental Management Program in the Upper Mississippi River System has focused on restoring natural resources within the Upper Mississippi and Illinois Rivers since 1986. Specifically, the Habitat Rehabilitation and Enhancement Projects (HREP) portion of the Environmental Management Program has targeted restoring and protecting fish and wildlife habitat. A myriad of established restoration techniques can be readily implemented, but most HREP projects are designed to address major problems within the Upper Mississippi River System including a need for increased backwater habitat quantity and quality, island construction, improved water quality, reconnected channels with their floodplains, and flow or water level remediation.

A major challenge in assessing the efficacy and impacts of these restoration techniques is centered around determining how biotic communities respond to the physical changes. Consequently, it has been critical to establish, *a priori*, a scientifically rigorous and explicit monitoring design to ensure that the most efficient use of time and money are implemented with the greatest information return. Fortunately, many of the HREP projects were designed with this insight in mind, establishing baseline conditions before project initiation that can be used to measure changes after completion of the project. This approach readily provides an opportunity to identify the success or failure of a project in terms of its restoration goals that can be fed into an adaptive management feedback process to improve existing and future restoration projects. One such example of the assessment capabilities through the HREP process is Lake Chautauqua along the Illinois River (Figure 1). Lake Chautauqua, a 1,450-ha Illinois River backwater lake, is owned and managed by the U.S. Fish and Wildlife Service as part of its Illinois River National Wildlife and Fish Refuge System.

Historically, the Lake Chautauqua area was comprised of a mosaic of floodplain forest and wetted habitats ranging from deep-water side channels to shallow pools and exposed soil areas (Starrett and Fritz 1965). By the early 1900s, however, considerable effort had been put forth to use this area for row crop agriculture. As a result, a drainage and levee district was created in 1916 to facilitate agricultural practices in the Chautauqua drainage and levee district. Attempts to farm the resulting drained land continued to the mid-1920s when the land was abandoned because of high crop rate failures from frequent flooding. The area now known as Lake Chautauqua was purchased by the Department of Interior and became part of the National Refuge

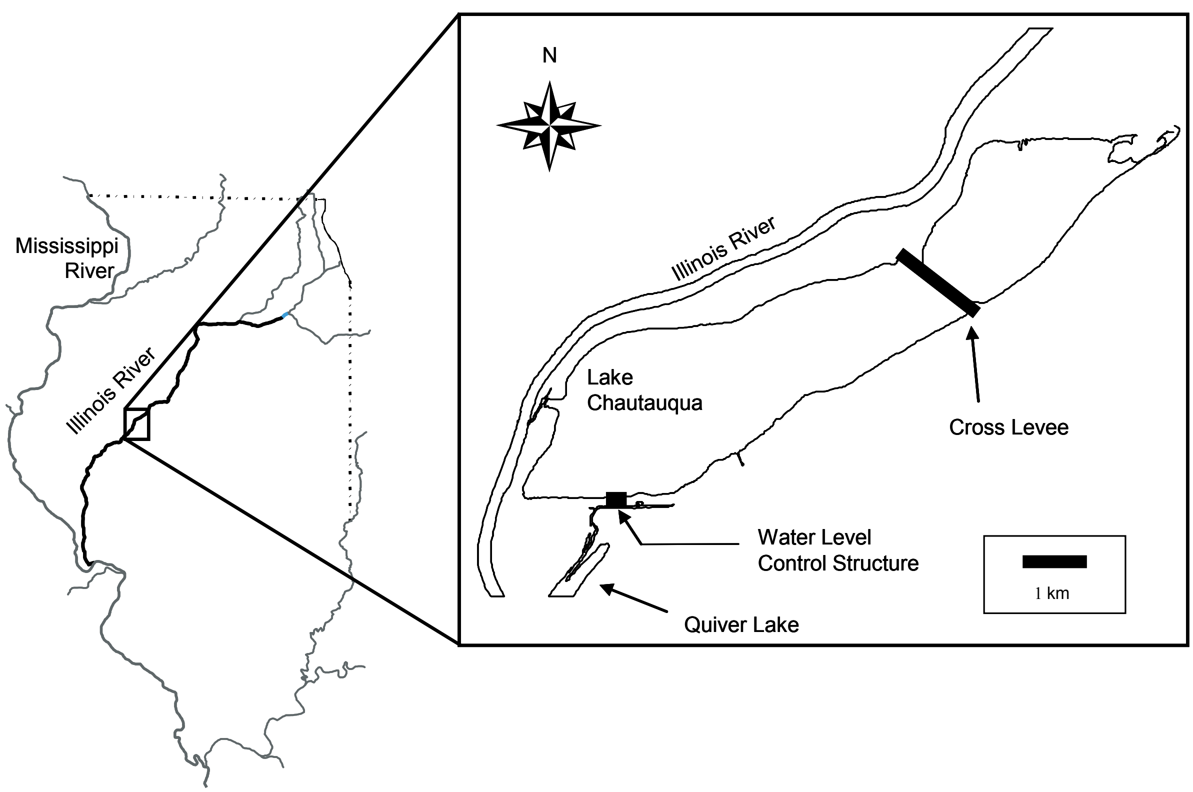


Figure 1. Lake Chautauqua on the Illinois River, near Havana, Illinois. The drawing represents the present configuration of the lake with a north and south pool divided by a levee, with a water control structure on the south pool.

System in 1936. The levees were maintained to allow some water level management, but the lake was generally permanently connected to the Illinois River (Irons et al. 1997).

Initially, Lake Chautauqua was a diverse resource that maintained an economic as well as ecological value (Starrett 1958). For example, the value of the fishery alone at Lake Chautauqua was worth nearly $104,000 in 1954 ($708,000 in 2003 dollars) from commercial and recreational harvest (Starrett 1958). However, noticeable declines in habitat quality because of sedimentation issues along the Illinois River began to become evident by the 1960s. A cross-lake levee, dividing the lake into a north and south pool, was constructed in 1969 in an attempt to combat the sediment problem and other habitat issues. Unfortunately, the levee was breeched and significantly damaged during flooding events in 1970 to the extent that the levee was not viable for water level management. The result was a degraded system that, among other problems, was subjected to excessive sedimentation rates and highly variable water levels that probably led to declines in aquatic and terrestrial biota. Lake Chautauqua remained in this condition until the mid-1990s when the HREP program initiated a management plan that provided for repairs to the levee and improved water level management capabilities to reduce sedimentation and enhance available habitat. These restoration efforts were completed in 1997.

Under the extant HREP management plan (U.S. Army Corps of Engineers 1991), the Lake Chautauqua cross levee was repaired to establish a permanently and seasonally wetted area in the lake, thereby re-establishing a north and south pool. This essentially created two differently functioning systems. The management plan for the north pool of Lake Chautauqua included maintaining stable water levels to promote submersed aquatic vegetation. The general intent is to provide aquatic habitat that can be used by fish, migratory waterfowl, and migratory shorebirds. A secondary goal for the north pool was to develop a high quality sport fishery because the north pool can be managed for stable water levels that could maintain sustainable populations of native sport and prey fish species.

The south pool is now managed for moist-soil conditions that produce habitat and food plants in the fall for migrating waterfowl and shorebirds. This management approach typically requires the south pool to fill and hold water through early to midsummer, then be drained for a short period to allow moist-soil plant growth. While the south cell is not permanently wetted, it is highly successful in producing fish in the spring of the year as demonstrated by previous fish production and escapement studies (Irons et al. 1997; Stoeckel et al. 1999; Lemke and Pegg 2001).

The hydrograph of the Illinois River remains heavily influenced by water level management (Sparks et al. 1998) that can cause daily water level fluctuations in excess of 0.25 m. Many aquatic habitat issues can be directly correlated to these fluctuations. Therefore, the management of the north pool of Lake Chautauqua has centered around maintaining stable water levels to create desirable habitat for fish and wildlife species. This has ultimately required levee construction to establish a semi-permanent isolation from the Illinois River.

The main goal of this report is to summarize the fish community responses to the HREP construction efforts at Lake Chautauqua. Our specific objectives include assessing changes in fish community composition and structure and assessments of length-frequency distributions on the basis of pre- and post-construction collection efforts. However, a summary of the 2002 field collection effort that has not been included in previous annual reports are presented first.

Methods

South Pool Larval Fish Sampling (2002 Summary)

Sampling for young-of-year fish in the south pool was conducted at five nearshore (within 50 m of shoreline) and five offshore (>50 m from shoreline) sites twice weekly from May to July 2002. All sites were randomly selected from a geographical information system coverage of Lake Chautauqua and all fish were collected using paired ichthyoplankton nets. Each net had rectangular openings with dimensions of

30.5 cm x 45.7 cm with 500-µm mesh netting. A standard tow was a 10-min haul at each site to sample an approximately similar volume of water for each sampling episode. We used General Oceanics flow meters (Model 2030, General Oceanics, Inc., Miami, FL) mounted in the center of the net to get accurate estimates of the actual volume of water sampled. The exact volume of water filtered by each net was then calculated as follows:

$$\text{Volume (m}^3\text{)} = A*K*R*C$$

where A = area of the net opening (m^2),
K = constant from flow meter (2.687),
R = number of revolutions from flow meter, and
C = volumetric conversion value (0.01).

At the end of each standardized tow, all collected fish were anesthetized using sodium bicarbonate and immediately preserved in 10% buffered sugar formalin. All fish were then brought to the laboratory for identification and further data collection. Larval fish were identified using 1–4× magnification and identified to family, genus, or species as was practical using keys by Auer (1982), Hogue et al. (1976), and May and Gasaway (1967). Cross-polarized lighting was used to count myomeres when necessary. Total lengths were also measured for a subset of individuals using a video imaging system.

The total number of fish caught in both nets (each paired tow) was divided by the total volume of water sampled to obtain estimates of number of fish per cubic meter for each sample site. These data were averaged for each daily sampling episode to achieve a mean abundance estimate for nearshore and offshore habitats as well as entire pool estimates. Abundances of key taxa were also plotted against time to identify peak periods of larval fish abundances. Comparisons of larval fish community differences between offshore and nearshore habitats for presence or absence of species (composition) and relative abundances (structure) were also tested using Analysis of Similarity (ANOSIM; Clarke 1993).

North Pool Pre- and Post-construction Comparisons

Data collection focused on gathering information that characterized changes in the fish community of the north pool of Lake Chautauqua in response to HREP construction. The ensuing sampling scheme resulted in two collection periods. The first sample period (1991–1993) was used as the pre-construction period; whereas the second sample period (2000–2002) reflected the post-construction fish community.

Fish were collected from three fixed sites along the shoreline to characterize the nearshore fish community. Collection methods followed standardized techniques used for the Long Term Resource Monitoring Program (LTRMP; Gutrueter et al. 1995). Sampling gears typically included day electrofishing, fyke nets, and mini-fyke nets. Electrofishing runs were 15 min in duration and all nets were set for one 24-hour period. Target sample sizes for each gear were typically two electrofishing runs or two net sets of each net type per site three times per year corresponding with the LTRMP fish sampling design. This sampling design targets a spring or early summer (June 15–July 31), summer (August 1–September 15), and fall (September 16–October 31) sampling effort to document seasonal habitat use and recruitment among other aspects of the fish community. Water levels in the pre-construction period because of the lack of water control structures allowed intermittent connection to the river and ultimately unstable water levels that precluded a full complement of gears in some instances in the 1991–1993 sampling effort (Table 1). The levee repairs did establish relatively stable water levels that allowed a full suite of sampling in the post-construction period.

We also used gill nets at one open-water site each year to characterize similarity in the Lake Chautauqua fish population among dominant habitats. The sample size for the gill net sampling followed that of the nearshore sampling. In 2001 and 2002, we also set tandem fyke and tandem mini-fyke nets (Gutrueter et al. 1995) to validate

Table 1. Summary of effort used to collect fish in the pre- (1991–1993) and post-construction (2000–2002) periods of the Habitat Rehabilitation and Enhancement Project in the north pool of Lake Chautauqua, Illinois. Some gears were not sampled because of limited access during pre-construction years. Units of effort for each gear are described in the text.

	Pre-construction			Post-construction		
Gear	**1991**	**1992**	**1993**	**2000**	**2001**	**2002**
Day electrofishing	–	4	10	18	18	18
Fyke net	11	12	16	18	18	18
Mini-fyke net	–	2	10	18	18	18
Gill net	1	4	6	6	6	6
Tandem fyke net	1	–	–	–	6	6
Tandem mini-fyke net	–	–	–	–	6	6

whether the open-water community was being appropriately sampled with the gill nets.

Fish were identified to species in the field and measured for total length. Additionally, a subsample of each management species (identified below) was weighed in the fall to get measures of fish condition. We also measured several water quality variables: conductivity (µS/ cm), dissolved oxygen (mg/L), Secchi disk (cm), and water temperature (°C) at each site following the LTRMP protocols.

Management Species Designation for the North Pool

The original management plan for the north pool called for a complete renovation of the fish community through extensive drawdowns and chemical applications to remove the existing, pre-construction fish. The intended renovation would be completed by supplemental stockings of specific sport and prey fish only. The drawndown activities did happen, but the chemical application (i.e., rotenone) did not occur in the HREP construction phase. Therefore, remnants of the pre-construction fish community were still found within the lake after completion of the project. However, the Illinois Department of Natural Resources did stock 182 kg of bluegill *Lepomis macrochirus*, 113.4 kg of black crappie *Pomoxis nigromaculatus*, 91 kg of fathead minnow *Pimephales promelas*, and 120,000 largemouth bass fingerlings *Micropterus salmoides* (25–50 mm total length) in spring 1999. Further stockings of 40 adult largemouth bass and 20,000 channel catfish *Ictalurus punctatus* (~150 mm) continued in summer and fall 1999. Because of concerns over genetic stocks, bluegill and bass stocks originated at Spring Lake, Tazwell County, Illinois (adjacent to project area), and raised at Jake Wolf Fish Hatchery, Manito, Illinois. Channel catfish came from the Illinois Department of Natural Resources Little Grassy Fish Hatchery and were of unspecified stocks (Dan Stephenson, Illinois Department of Natural Resources, Division of Fisheries, personal communication). As per the original HREP plan, the five stocked species will be referred to as “managed species;” whereas other important species such as gizzard shad *Dorosoma cepedianum*, common carp *Cyprinus carpio*, white bass *Morone chrysops*, freshwater drum *Aplodinotus grunniens*, and white crappie *Pomoxis annularis* will be termed “nonmanaged species.” The nomenclature signifies only that species excluded from the managed group were not originally intended to make up part of the fish community in the north pool after construction.

Data Analyses

Analyses of data collected in 2002 were summarized as follows: First, we present effort and catch summaries for each gear. Second, we present individual species population information like relative abundance, size structure, population stock density (PSD), and relative stock density (RSD). Finally, we present a brief summary of water quality variables measured at fish collection sites.

Catch-per-unit-effort (CPUE) for electrofishing was expressed as number of fish caught per 15-min run, and CPUE for netting was expressed as number of fish caught per net day. Abundance estimates were typically averaged among sites to characterize the fish community of the entire north pool. Standard errors were calculated for CPUE.

Comparisons of pre- and post-construction communities were performed using multivariate techniques such as ANOSIM, cluster analysis, and nonmetric multidimensional scaling for community composition and structure. The ANOSIM is a multivariate technique that is somewhat similar, in concept, to univariate Analysis of Variance. A global 'R' value is determined for each ANOSIM test that reflects how similar communities are with values close to zero indicating the communities are similar and values of 1 indicating no community similarities. Analyses of community composition (i.e., richness) required similarity information estimated by Euclidean distances to develop the data matrix, whereas community structure (i.e., CPUE) required similarity information estimated by Bray-Curtis similarities. Bray-Curtis coefficients indicate the similarity of two samples, with higher coefficients indicating higher similarity (Bray and Curtis 1957). All sample abundance data were fourth-root transformed to meet assumptions of multivariate normality and to moderate the influence of extremes in species abundances. The transformed sample data were used to create a similarity matrix calculated for all pair-wise sample comparisons. Patterns in compositional and structural changes in fish communities were identified using SAS (SAS Institute, Inc. 1999) and Primer (v5; Primer-E Ltd. 2001). Changes in measured water quality variables were tested using a t-test with a Bonferroni multiple comparison correction.

Results

2002 Larval Fish Sampling (South Pool)

Larval fish sampling efforts in the south pool of Lake Chautauqua were conducted from May 7 through July 3, 2002. This sampling time frame resulted in 17 sampling days that were generally conducted twice weekly. We collected 66,383 fish representing 8 families in 2002. However, the overall catch was dominated by species represented in the Clupeidae (74%), Centrarchidae (21%), and Cyprinidae (4%) families (Figure 2). The Clupeidae family was largely represented by gizzard shad and Centrarchids dominated by sunfish (*Lepomis* spp.) and crappie (*Pomoxis* spp.) species. Many of the Cyprinid species were not well developed, preventing accurate identification to species level. Relative abundance estimates typically followed the total catch and are therefore not discussed in detail here.

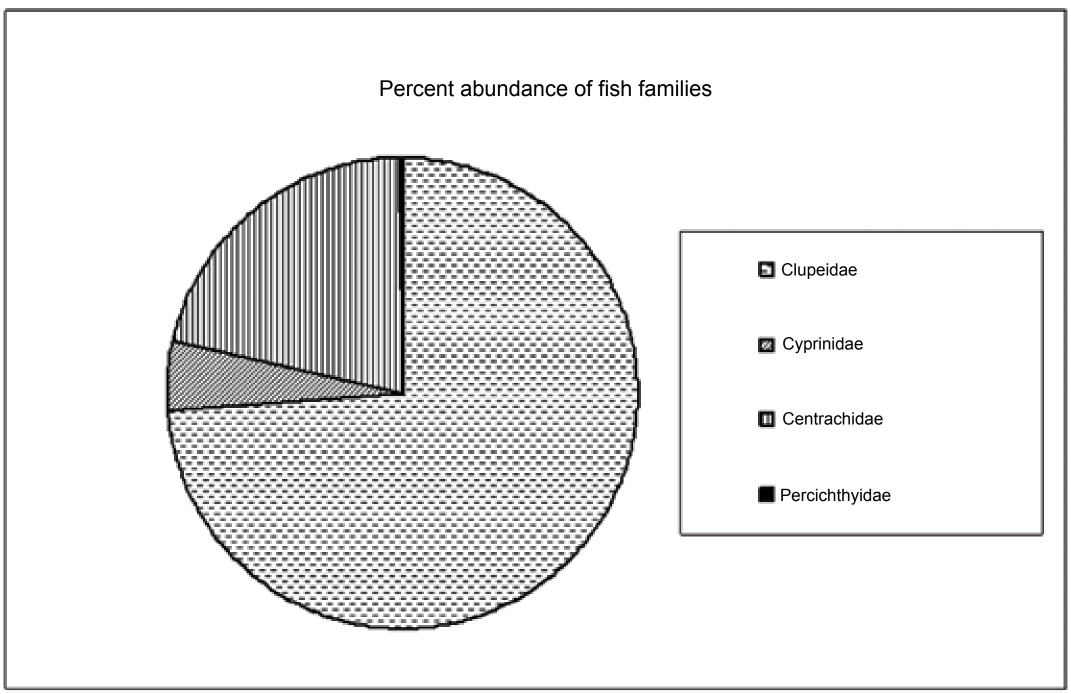


Figure 2. Percent composition of larval fish catch by family in the south pool of Lake Chautauqua, Illinois, in 2002.

The ANOSIM test for differences between larval fish communities in the offshore and nearshore habitats indicates that there were no significant differences in composition (R = 0.032; *P* = 0.917; Figure 3) or structure (R = 0.045; *P* = 0.91; Figure 4). Therefore, the data were combined for all further analyses.

Larval Clupeid abundances peaked in early June, but also had periods of higher abundances in early May and late June as well (Figure 5).

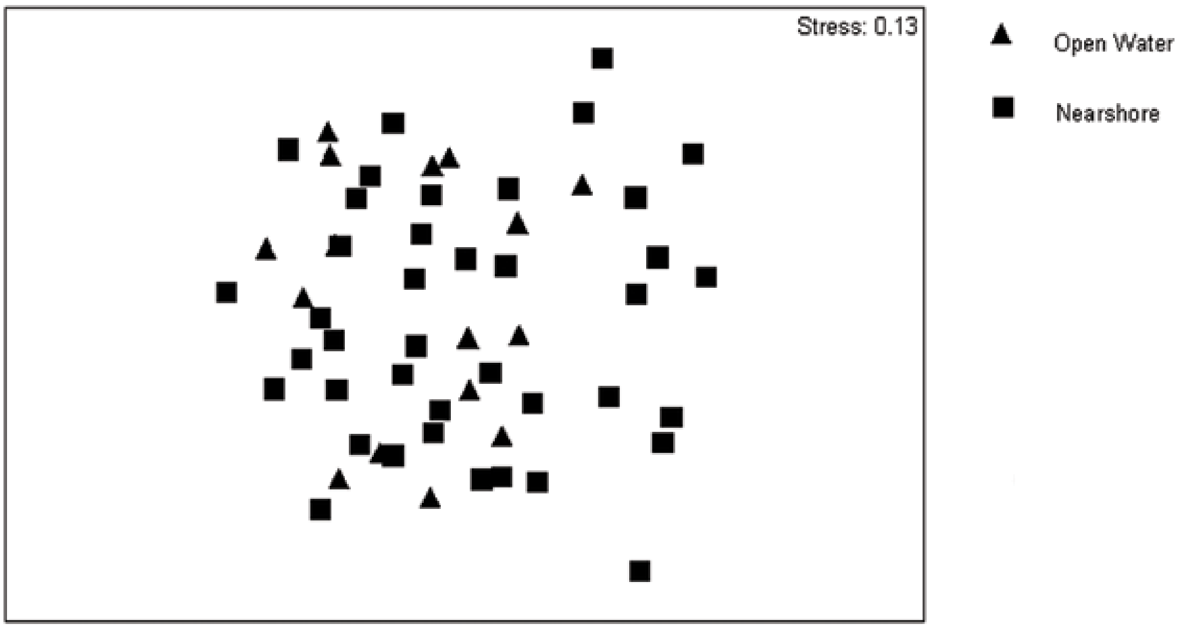


Figure 3. Nonparametric multidimensional scaling of larval fish community composition (presence or absence) on the basis of the 2002 collection efforts. Tests for differences between nearshore (*square*) and open-water (*triangle*) communities revealed no significant differences between habitat types (*P* = 0.917).

Figure 4. Nonparametric multidimensional scaling of larval fish community structure (relative abundance) on the basis of the 2002 collection efforts. Tests for differences between nearshore (*square*) and open-water (*triangle*) communities revealed no significant differences between habitat types (*P* = 0.91).

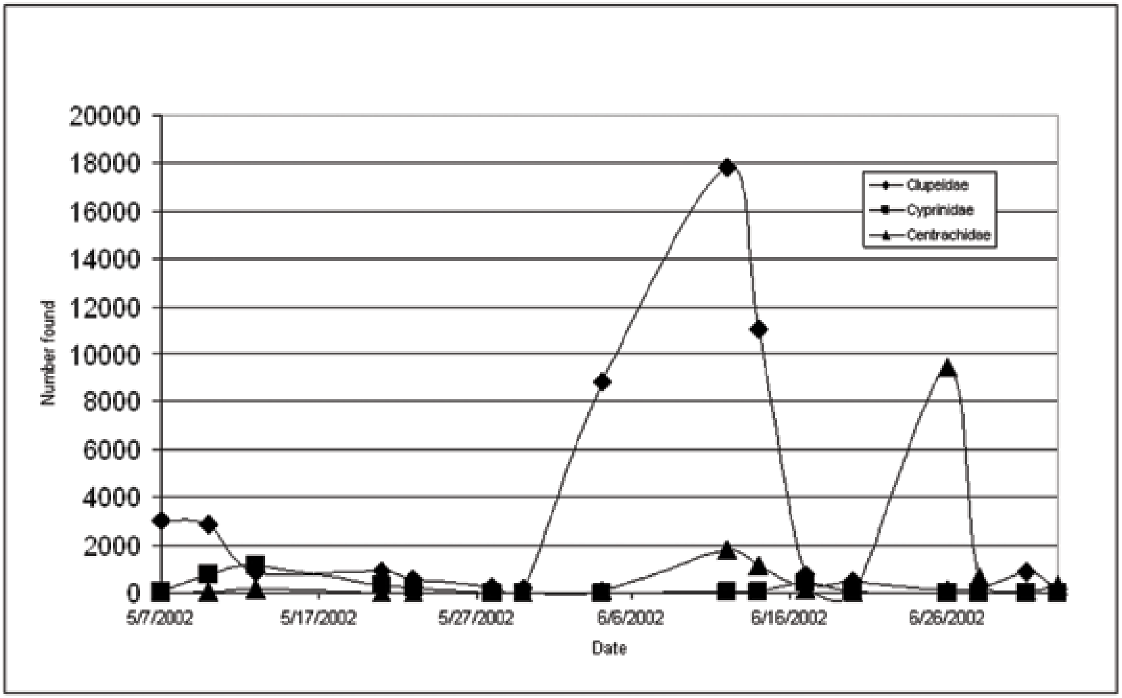


Figure 5. Total catch of larval fish from taxa representing the Clupeidae, Cyprinidae, and Centrarchidae families from early May to early July 2002 in the south pool of Lake Chautauqua, Illinois.

Centrarchid species abundances lagged behind the Clupeids by peaking in late June (Figure 5). Although the Cyprinids were generally less abundant throughout the sampling period, there were slight increases in abundances in mid-May and mid-June (Figure 5).

2002 Catch Summary (North Pool)

A full complement of gears and effort was used in 2002 (Table 1) to collect 24,368 fish representing 41 species and 2 hybrids. Bighead *Hypophthalmichthys nobilis* and silver carp *H. molitrix*, both nonnative species, were collected for the first time in the north pool. This introduction is believed to be a result of the high water levels in 2002 that established a connection from the north pool of Lake Chautauqua to the Illinois River.

Day electrofishing collected 6,110 fish representing 29 species and 2 hybrids. Gizzard shad had the highest average CPUE of 192.8 ± 44.2, followed by bluegill (38.2 ± 7.14) and white crappie (16.7 ± 5.9) individuals per run (Table 2).

Fyke nets collected 3,262 fish consisting of 29 species and 1 hybrid. The CPUE was highest for white crappie (87.8 ± 25.5), followed by black crappie (28.7 ± 9.6) and gizzard shad (13.8 ± 5.5; Table 2).

Mini-fyke nets collected 11,209 fish representing 19 species in 2002. Mini-fyke nets also caught 46% of the total catch and averaged 617.6 ± 213.2 individuals per net set. The CPUE was highest for gizzard shad (530.6 ± 269.6), followed by emerald shiner *Notropis atherinoides* (33.8 ± 11.4), threadfin shad *Dorosoma petenense* (28.9 ± 61.8), and bullhead minnow *Pimephales vigilax* (9.7 ± 14.4; Table 2) individuals per net set.

Gill nets collected 1,820 fish consisting of 21 species. The CPUE was highest for gizzard shad (92.7 ± 23.9), followed by white bass (40.7 ± 12.5), white crappie (36.7 ± 12.1), and freshwater drum (29.3 ± 6.3; Table 2.). All gizzard shad caught by gill nets were adult fish 200 to 440 mm in size.

Tandem fyke nets fished at the open-water site in the north pool of Lake Chautauqua caught 1,262 fish consisting of 12 species and 1 hybrid (Table 2). Catch rates were dominated by white crappie (117.7 ± 20.5), gizzard shad (25.7 ± 13.1), and freshwater drum (20.7 ± 6.2).

Table 2. Mean catch-per-unit-effort by species (common and scientific name) for day electrofishing (number per 15-min run) and for fyke, gill, mini-fyke, tandem fyke, and tandem mini-fyke nets (all expressed as number per net day) used to characterize the 2002 fish community in the north pool of Lake Chautauqua, Illinois.

Species	Day electrofishing	Fyke net	Gill net	Mini-fyke net	Tandem fyke net	Tandem mini-fyke net
Bighead carp *Hypophthalmichtlys nobilis*	–	0.2	15.3	–	5.0	–
Bigmouth buffalo *Ictiobus cyprinellus*	2.0	0.1	3.7	–	–	–
Black bullhead *Ameiurus melus*	0.6	–	–	–	–	–
Black crappie *Pomoxis nigromaculatus*	4.0	28.7	0.7	0.1	7.3	1.0
Bluegill *Lepomis macrochirus*	38.2	12.5	–	3.2	12.0	3.3
Bowfin *Amia calva*	–	0.1	–	–	–	–
Brown bullhead *Ameiurus nebulosus*	–	0.1	0.7	–	0.3	–
Bullhead minnow *Pimephales vigilax*	4.9	–	–	9.7	–	–
Channel catfish *Ictalurus punctatus*	1.9	0.8	11.3	0.6	0.7	–
Common carp *Cyprinus carpio*	8.3	1.1	15.0	0.1	0.7	–
Emerald shiner *Notropis atherinoides*	10.7	–	0	33.8	–	–
Flathead catfish *Pylodictis olivaris*	0.1	–	–	–	–	–
Freshwater drum *Aplodinotus grunniens*	4.8	11.9	29.3	0.4	20.7	3.0
Gizzard shad *Dorosoma cepedianum*	192.8	13.8	92.7	530.6	25.7	111.7
Golden redhorse *Moxostoma erythrurum*	–	0.2	–	–	–	–
Golden shiner *Notemigonus crysoleucas*	5.3	0.2	–	2.7	–	–
Goldfish *Carassius auratus*	0.1	–	–	–	–	–
Grass carp *Ctenopheryngodon idella*	–	0.1	–	–	–	–
Green sunfish *Lepomis cyanellus*	3.9	–	–	0.2	–	–
Green sunfish *x* bluegill *L. cyanellus x L. macrochirus*	0.1	–	–	–	–	–
Highfin carpsucker *Carpiodes velifer*	–	0.1	–	–	–	–
Largemouth bass *Micropterus salmoides*	14.9	0.3	0.7	0.1	–	–
Logperch *Percina caprodes*	0.4	–	–	–	–	–
Orangespotted sunfish *Lepomis humilis*	2.8	0.3	–	2.7	–	–
Quillback *Carpiodes cyprinus*	–	–	1.3	–	–	–
Redear sunfish *Lepomis microlophus*	–	0.11	–	–	–	–

Table 2. Continued.

Species	Day electrofishing	Fyke net	Gill net	Mini-fyke net	Tandem fyke net	Tandem mini-fyke net
Red shiner *Cyprinella lutrensis*	0.7	–	–	1.4	–	–
River carpsucker *Carpiodes carpio*	0.6	2.4	0.7	–	–	–
Shorthead redhorse *Moxostoma macrolepidotum*	0.1	0.6	0.3	–	–	–
Shortnose gar *Lepisosteus platostomus*	–	0.4	5.0	–	0.3	–
Silverband shiner *Notropis shumardi*	–	–	–	0.1	–	–
Silver carp *Hypophthalmichthys molitrix*	–	–	0.3	–	–	–
Skipjack herring *Alosa chrysochloris*	0.2	0.1	26.3	–	–	–
Smallmouth buffalo *Ictiobus bubalus*	1.2	0.7	–	–	–	–
Spottail shiner *Notropis hudsonius*	0.2	–	–	0.2	–	–
Spotted gar *Lepisosteus oculatus*	–	0.3	–	–	–	–
Threadfin shad *Dorosoma petenense*	9.6	0.3	2.3	28.9	0.3	–
White bass *Morone chrysops*	11.7	6.1	40.7	1.3	11.0	0.7
White crappie *Pomoxis annularis*	16.7	87.8	36.7	1.2	117.7	12.3
White perch *Morone americana*	0.1	0.4	2.3	–	0.3	–
White perch *x* yellow bass *M. americana × M. mississippiensis*	0.2	1.4	0.7	–	2.3	–
Yellow bass *M. mississippiensis*	0.7	9.4	17.3	–	6.0	0.7
Yellow bullhead *Ameiurus natalis*	1.8	0.4	–	0.2	–	0.3

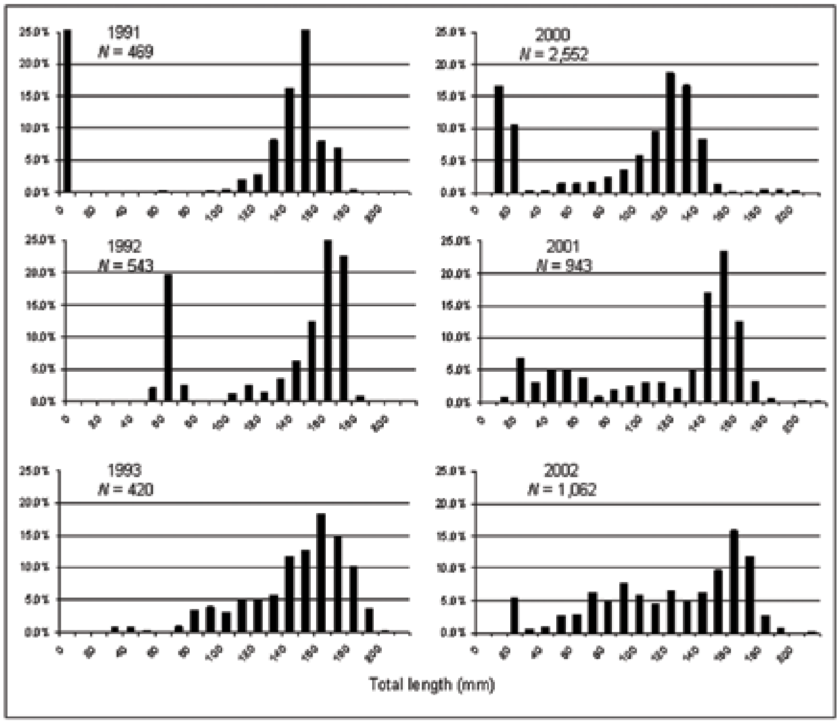
Tandem mini-fyke nets collected 798 individuals from 8 species (Table 2). Catches were dominated by gizzard shad (111.7 ± 99.1) and white crappie (12.3 ± 4.5).

Managed Species Summary

A total of 1,062 bluegills were caught with all gears in 2002. The length-frequency distribution (Figure 6) shows fish ranging from 20 to 200 mm (PSD = 50; RSD [200] = 0.02). The size structure suggests two peaks in abundances; one at about 100 mm, probably representing reproduction in 2000 and another peak at 160 mm representing fish produced in the lake or stocked the previous year.

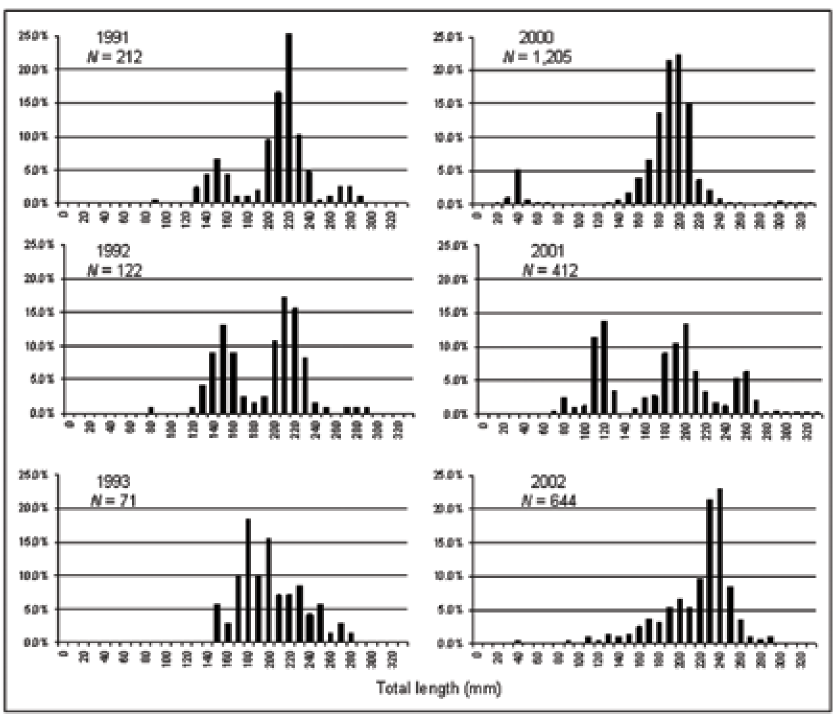
A total of 644 black crappies were caught with all gears in 2002. The length-frequency distribution (Figure 7) shows fish ranging from 40 to 300 mm (PSD = 82; RSD [250] = 14). The black crappie size structure suggests that little reproduction and consequent recruitment of young-of-year individuals occurred in 2002 and that the population is dominated by individuals that range between 200 and 250 mm.

A total of 280 largemouth bass were caught with all gears in 2002. The length-frequncy distribution (Figure 8) shows fish ranging from



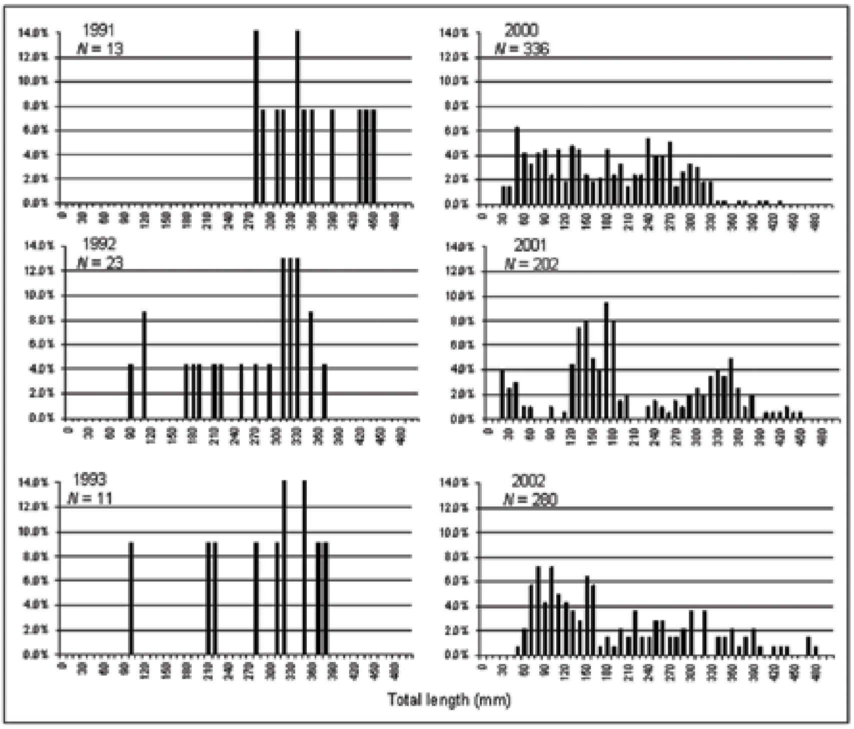
	PSD	RSD-P
1991	58	0.0
1992	80	0.0
1993	61	0.2
2000	4	0.3
2001	54	0.6
2002	50	0.2

Figure 6. Length-frequency distribution (total length) of bluegills *Lepomis macrochirus* caught in all gears in the pre- (1991–1993) and post-construction (2000–2002) periods in the north pool of Lake Chautauqua, Illinois. Size structure index values (proportional stock density [PSD]; relative stock density [RSD] for preferred size classes) are also given for each year.



	PSD	RSD-P
1991	79	7
1992	58	3
1993	54	11
2000	48	1
2001	59	22
2002	82	14

Figure 7. Length-frequency distribution (total length) of black crappies *Pomoxis nigromaculatus* caught in all gears in the pre- (1991–1993) and post-construction (2000–2002) periods in the north pool of Lake Chautauqua, Illinois. Size structure index values (proportional stock density [PSD]; relative stock density [RSD] for preferred size classes) are also given for each year.



	PSD	RSD-P
1991	77	31
1992	71	0
1993	70	0
2000	27	2
2001	74	9
2002	51	17

Figure 8. Length-frequency distribution (total length) of largemouth bass Micropterus salmoides caught in all gears in the pre- (1991–1993) and post-construction (2000–2002) periods in the north pool of Lake Chautauqua, Illinois. Size structure index values (proportional stock density [PSD]; relative stock density [RSD] for preferred size classes) are also given for each year.

50 to 480 mm (PSD = 51; RSD [380] = 17). There is no clear indication of year class peaks among the size groups >200 mm. However, relatively high abundances of fish <100 mm suggest a successful reproductive year in 2002 for largemouth bass.

A total of 130 channel catfish were caught in 2002. The length-frequency distribution (Figure 9) shows fish ranging from 60 to 500 mm (PSD = 33; RSD [610] = 0.0). There are slight indications of a bimodal size structure in the north pool channel catfish population. The first mode centered around 100 mm suggests natural reproduction; whereas the second peak at about 320 mm represents adults or subadults that are available to sustain the population into the future.

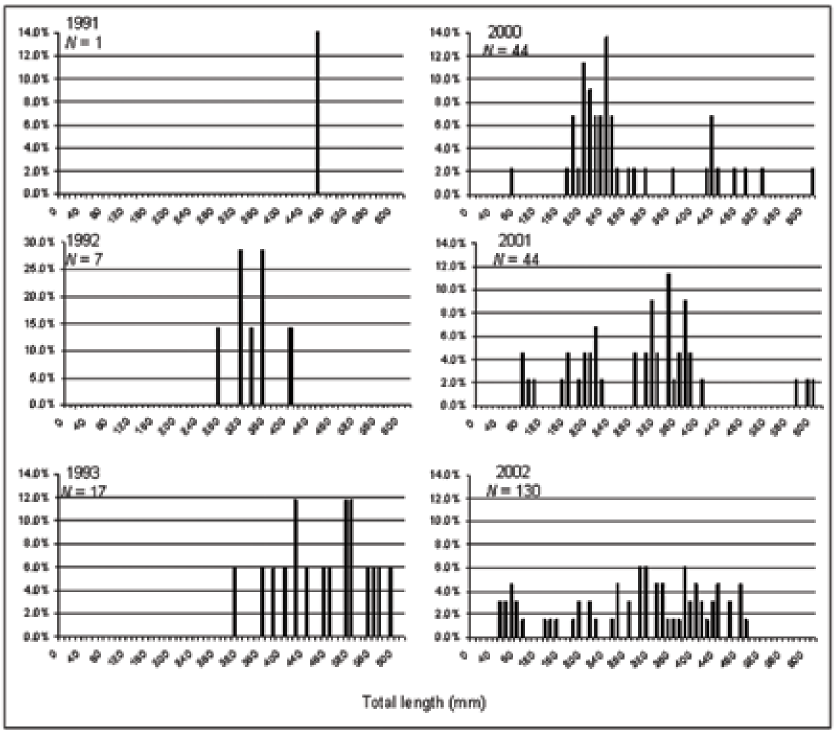
Fathead minnows were not caught in 2002. This species was stocked in 1999 to provide forage for Centrarchid species in the lake. However, annual collection of nonmanaged species such as gizzard shad, golden shiners *Notemigonus crysoleucas*, bullhead minnows, and emerald shiners should be suitable surrogates for fathead minnows as forage for predator species in the lake.

Nonmanaged Species Summary

A total of 14,143 gizzard shad were caught with all gears in 2002. The length-frequency distribution (Figure 10) shows fish ranging from 30 to 400 mm. Year classes from previous years were strong so there was not a large influx of young-of-year gizzard shad in 2002. However, a diverse size range is still found in Lake Chautauqua indicating that the gizzard shad population is viable and self-sustaining.

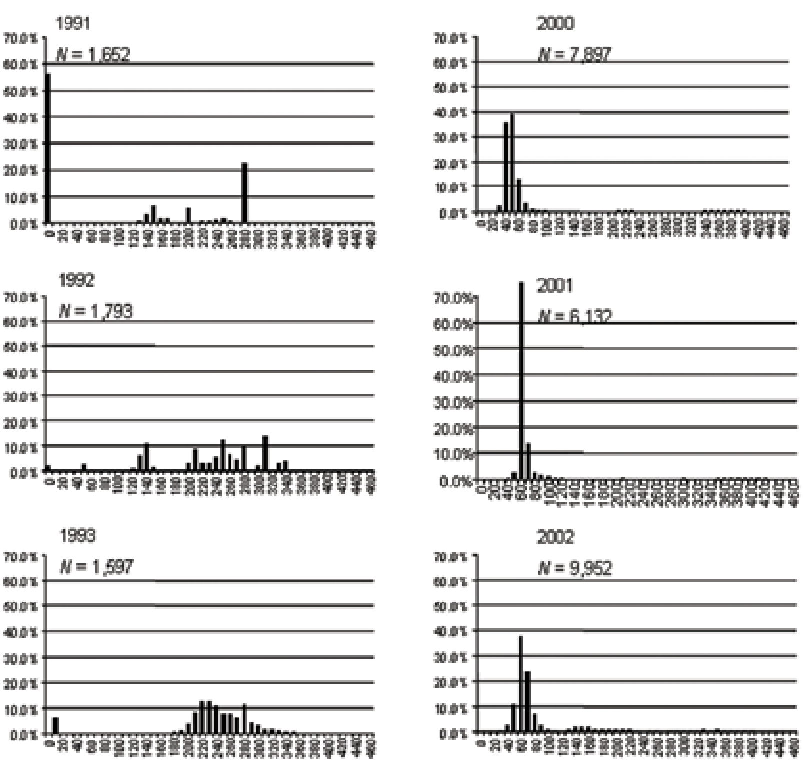
A total of 266 common carp were caught with all gears in 2002. The length-frequency distribution (Figure 11) shows fish ranging from 90 to 680 mm. There is limited evidence of successful spawning by common carp, and the size structure of this species is heavily skewed to larger individuals.

A total of 2,902 white crappies were caught with all gears in 2002. The length-frequency distribution (Figure 12) shows fish ranging from 30 to 300 mm. Two peaks were present in this distribution, one at 120 mm representing recruitment of the 2001 year class and the second



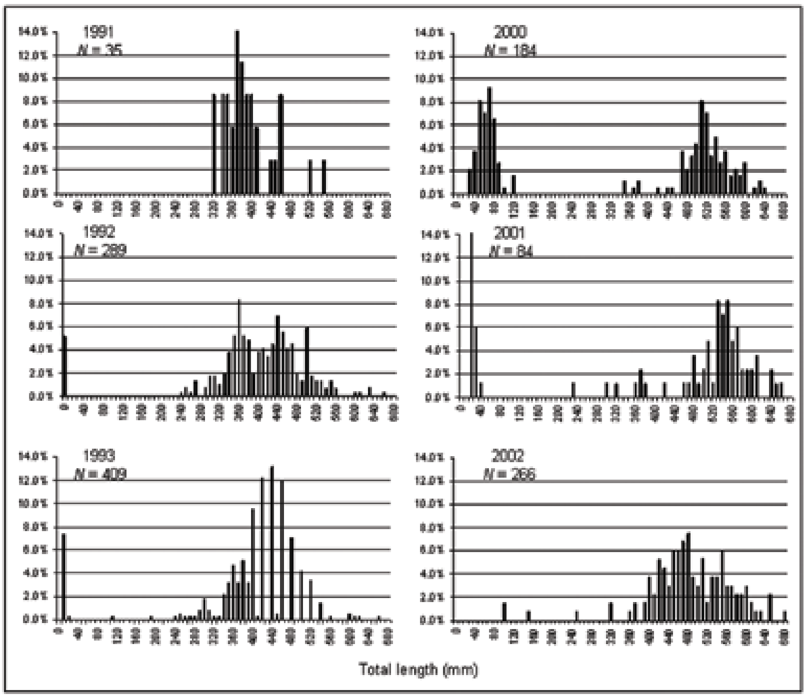
	PSD	RSD-P
1991	100	0
1992	0	0
1993	77	0
2000	69	8
2001	11	0
2002	33	0

Figure 9. Length-frequency distribution (total length) of channel catfish *Ictalurus punctatus* caught in all gears in the pre- (1991–1993) and post-construction (2000–2002) periods in the north pool of Lake Chautauqua, Illinois. Size structure index values (proportional stock density [PSD]; relative stock density [RSD] for preferred size classes) are also given for each year.



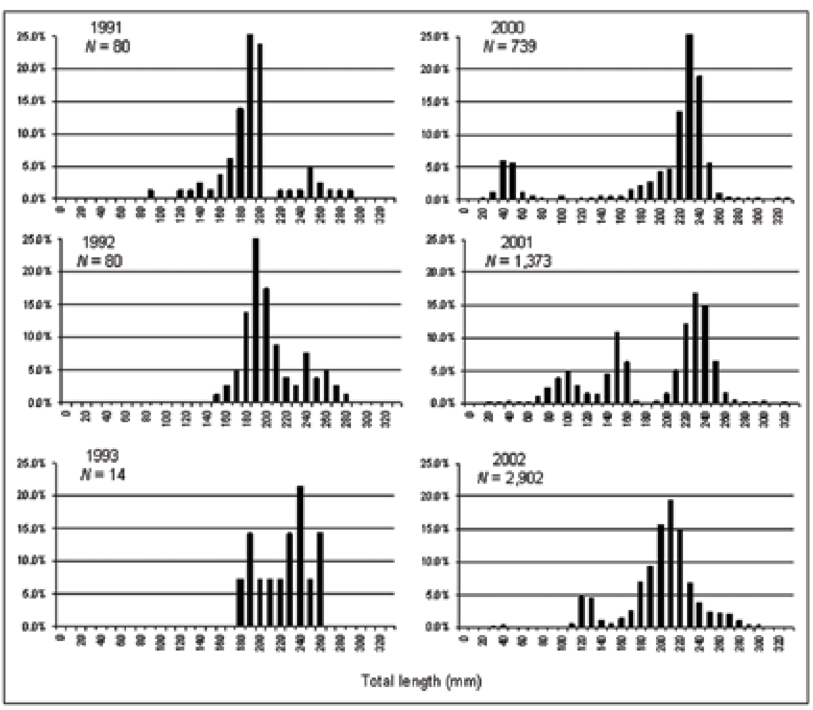
	PSD
1991	71
1992	41
1993	25
2000	76
2001	89
2002	57

Figure 10. Length-frequency distribution (total length) of gizzard shad *Dorosoma cepedianum* caught in all gears in the pre- (1991–1993) and post-construction (2000–2002) periods in the north pool of Lake Chautauqua, Illinois. Size structure index value (proportional stock density [PSD]) is also given for each year.



	PSD	RSD-P
1991	26	3
1992	56	6
1993	62	3
2000	95	43
2001	90	68
2002	91	34

Figure 11. Length-frequency distribution (total length) of common carp *Cyprinus carpio* caught in all gears in the pre- (1991–1993) and post-construction (2000–2002) periods in the north pool of Lake Chautauqua, Illinois. Size structure index values (proportional stock density [PSD]; relative stock density [RSD] for preferred size classes) are also given for each year.



	PSD	RSD-P
1991	40	12
1992	53	13
1993	79	21
2000	90	9
2001	72	11
2002	72	8

Figure 12. Length-frequency distribution (total length) of white crappies *Pomoxis annularis* caught in all gears in the pre- (1991–1993) and post-construction (2000–2002) periods in the north pool of Lake Chautauqua, Illinois. Size structure index values (proportional stock density [PSD]; relative stock density [RSD] for preferred size classes) are also given for each year.

one at 210 mm representing fish produced in the lake.

A total of 662 freshwater drum were caught with all gears in 2002. The length-frequency distribution (Figure 13) shows fish ranging from 70 to 550 mm. The size structure had a peak at 120 mm and centered around 280 mm.

A total of 656 white bass were caught with all gears in 2002. The length-frequency distribution (Figure 14) shows fish ranging from 40 to 370 mm. Two peaks were present in this distribution, one at 80 mm representing natural reproduction in 2002 and the second one at 195 mm producing fish before 2002.

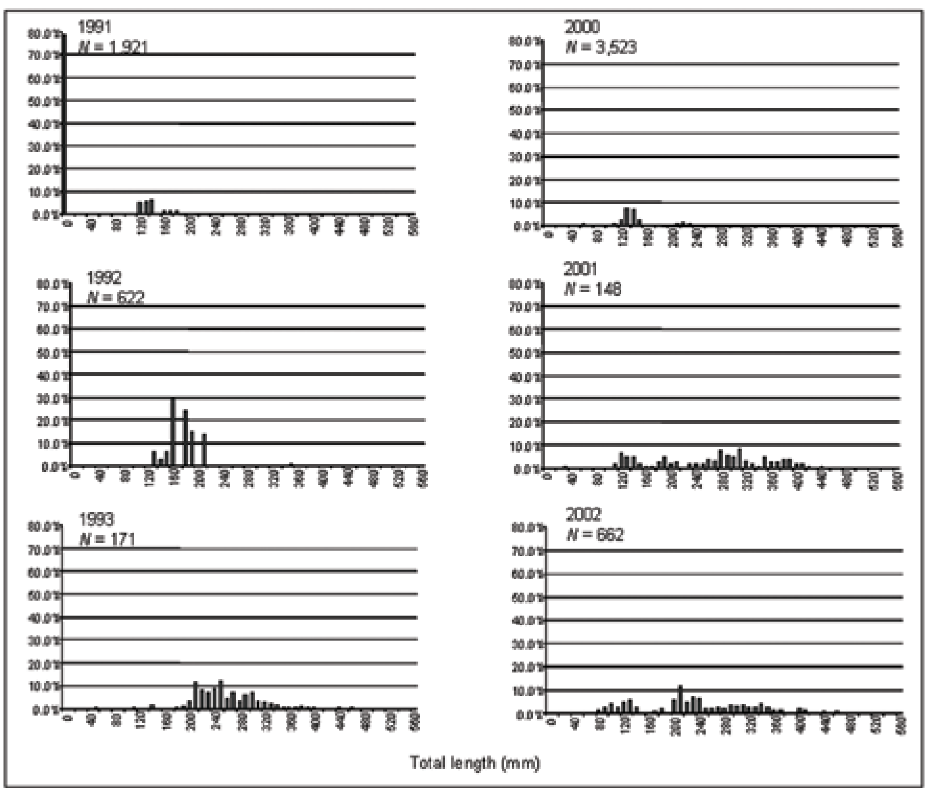
Water Quality

Conductivity from all sites sampled in 2002 ranged from 418 to 476 µS/cm with an average of 453 µS/cm. The dissolved oxygen from all sites sampled ranged from 5.1 to 10 mg/L with an average of 6.7 mg/L. Secchi disk readings from all sites ranged from 9 to 67 cm with an average of 22 cm. Water temperature from all sites sampled ranged from 20.2 to 26.5°C with an average of 22.5°C. Mean water depth at the sample sites was 1.2 m and ranged from 0.5 to 3.5 m (Table 3).

North Pool Fish Community Response

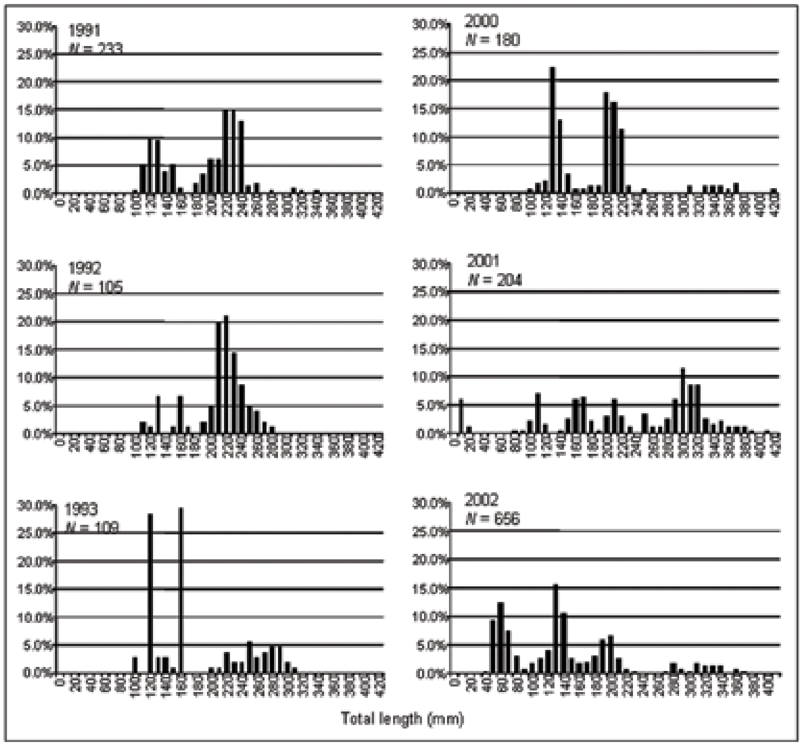
A total of 77,341 fish representing 54 species and 3 hybrids were collected in the pre- and post-construction periods. Both pre- and post-construction sample periods collected 46 species with 8 unique species collected each period (Table 4). Three of the unique species caught in the post-construction period (bighead carp, silver carp, white perch *Morone americana*) were nonnative species that became established in La Grange Reach of the Illinois River in the mid-1990s.

Changes in the fish community were desired and expected as a result of this HREP project on the basis of the original management plan. Therefore, we might expect a complete change



	PSD	RSD-P
1991	0	0
1992	7	0
1993	24	4
2000	16	4
2001	58	17
2002	37	9

Figure 13. Length-frequency distribution (total length) of freshwater drum *Aplodinotus grunniens* caught in all gears in the pre- (1991–1993) and post-construction (2000–2002) periods in the north pool of Lake Chautauqua, Illinois. Size structure index values (proportional stock density [PSD]; relative stock density [RSD] for preferred size classes) are also given for each year.



	PSD	RSD-P
1991	46	2
1992	38	0
1993	44	4
2000	15	12
2001	65	46
2002	28	19

Figure 14. Length-frequency distribution (total length) of white bass *Morone chrysops* caught in all gears in the pre- (1991–1993) and post-construction (2000–2002) periods in the north pool of Lake Chautauqua, Illinois. Size structure index values (proportional stock density [PSD]; relative stock density [RSD] for preferred size classes) are also given for each year.

in fish communities to be something similar to Figure 15 where the similarity between the two communities is much lower than within the sample periods. The ANOSIM tests between the two sample periods for the north pool of Lake Chautauqua indicate no significant difference (R = 0.019; P = 0.50) between the pre- and post-construction community composition probably because of the species presence or absence being nearly identical. However, there does appear to be some differences when looking at a cluster analysis (Figure 16) of the composition data. Comparing 1991 and 1992 to 2000 and 2001 sample years resulted in a fairly distinct delineation between the two sample periods. However, 1993 and 2002 sample years break out as being composed of different species. The north pool was physically connected to the Illinois River in these 2 years, so it is probable that the Illinois River fish community contributed some species to Lake Chautauqua at those times, resulting in differences in species composition.

The community composition analyses revealed little differences between the two sample periods because the overall species richness did not change considerably. However, a more meaningful assessment of the fish community is in assessing the community structure in the form of how each species contributes to the overall make up of the community. Because the sample gears use different allocations of effort, collective assessment using data from a

Table 3. Summary of summer water quality conditions in the north pool of Lake Chautauqua, Illinois, in 2002.

Variables	Mean	Standard error	Minimum	Maximum
Water temperature (°C)	22.5	0.02	20.2	26.5
Conductivity (μS/cm)	453	0.29	418	476
Secchi depth (cm)	22	0.18	9	67
Dissolved oxygen (mg/L)	6.70	0.01	5.1	10.0
Water depth (m)	1.2	0.01	0.5	3.5

Table 4. Mean catch-per-unit-effort by species (common and scientific name) for gill nets (number per net day), day electrofishing (number per 15-min run), fyke nets (number per net day), and mini-fyke nets (number per net day) in the pre- (1991–1993) and post-construction (2000–2002) periods of the Habitat Rehabilitation and Enhancement Project in the north pool of Lake Chautauqua, Illinois.

Species	Gill net		Day electrofishing		Fyke net		Mini-fyke net	
	Pre-construction	Post-construction	Pre-construction	Post-construction	Pre-construction	Post-construction	Pre-construction	Post-construction
Bighead carp *Hypophthalmichlys nobilis*	0.00	5.11	–	–	0.00	0.70	–	–
Bigmouth buffalo *Ictiobus cyprinellus*	3.67	3.28	0.80	0.69	1.89	0.09	0.40	0.00
Black buffalo *I. niger*	0.06	0.06	0.05	0.00	0.02	0.00	–	–
Black bullhead *Ameiurus melas*	0.33	0.00	0.80	0.19	0.59	0.04	0.13	0.00
Black crappie *Pomoxis nigromaculatus*	0.00	1.56	0.75	3.07	11.07	32.57	0.03	1.11
Bluegill *Lepomis macrochirus*	0.22	1.39	26.88	28.98	30.32	34.06	0.23	16.04
Bowfin *Amia calva*	–	–	0.05	0.00	0.07	0.11	–	–
Brown bullhead *Ameiurus nebulosus*	2.94	0.56	6.48	0.02	7.50	0.46	0.03	0.02
Bullhead minnow *Pimephales vigilax*	–	–	0.00	5.76	–	–	0.63	9.04
Carp × goldfish hybrid *Cyprinus carpio × auratus*	0.08	0.00	0.00	0.06	0.00	0.04	–	–
Channel catfish *Ictalurus punctatus*	0.72	7.78	0.60	0.78	0.12	0.41	0.00	0.19
Common carp *Cyprinus carpio*	8.53	7.56	20.53	5.80	7.26	0.89	1.30	0.57
Creek chub *Semotilus atromaculatus*	–	–	–	–	0.03	0.00	–	–
Emerald shiner *Notropis atherinoides*	–	–	1.98	3.59	–	–	1.67	13.93

Table 4. Continued.

Species	Gill net		Day electrofishing		Fyke net		Mini-fyke net	
	Pre-construction	Post-construction	Pre-construction	Post-construction	Pre-construction	Post-construction	Pre-construction	Post-construction
Flathead minnow *Pimephales promelas*	–	–	0.05	0.00	–	–	0.03	0.02
Flathead catfish *Pylodictis olivaris*	–	–	0.00	0.04	–	–	–	–
Freshwater drum *Aplodinotus grunniens*	5.92	25.78	0.25	3.04	72.82	64.09	5.00	0.74
Gizzard shad *Dorosoma cepedianum*	110.14	56.22	23.30	360.74	76.46	5.57	4.47	357.26
Golden redhorse *Moxostoma erythrurum*	–	–	–	–	0.00	0.07	–	–
Golden shiner *Notemigonus crysoleucas*	0.00	0.28	0.00	3.61	0.03	0.11	0.00	3.41
Goldeye *Hiodon alosoides*	0.06	0.00	–	–	–	–	–	–
Goldfish *Carassius auratus*	–	–	0.45	0.06	2.01	0.02	–	–
Grass carp *Ctenopharyngodon idella*	–	–	–	–	0.00	0.04	–	–
Green sunfish *Lepomis cyanellus*	–	–	1.80	2.83	0.40	0.39	0.03	0.69
Green sunfish × bluegill *L. cyanellus × L. macrochirus*	–	–	0.00	0.07	0.08	0.00	–	–
Highfin carpsucker *Carpiodes velifer*	0.28	0.00	–	–	0.00	0.04	–	–
Johnny darter *Etheostoma nigrum*	–	–	–	–	–	–	0.03	0.00
Largemouth bass *Micropterus salmoides*	0.08	0.44	2.18	13.91	0.63	0.70	0.00	0.37

Table 4. Continued.

Species	Gill net		Day electrofishing		Fyke net		Mini-fyke net	
	Pre-construction	Post-construction	Pre-construction	Post-construction	Pre-construction	Post-construction	Pre-construction	Post-construction
Logperch *Percina caprodes*	–	–	0.00	0.15	–	–	0.13	0.00
Longear sunfish *Lepomis megalotis*	–	–	0.05	0.00	–	–	–	–
Longnose gar *Lepisosteus osseus*	0.06	0.00	–	–	–	–	–	–
Orangespotted sunfish *Lepomis humilis*	–	–	0.13	2.52	0.02	0.39	0.00	1.93
Quillback *Carpiodes cyprinus*	0.00	0.44	–	–	0.46	0.00	–	–
Red shiner *Cyprinella lutrensis*	–	–	0.75	0.26	–	–	1.30	0.48
Redear sunfish *Lepomis microlophus*	–	–	–	–	0.02	0.06	–	–
River carpsucker *Carpiodes carpio*	1.33	0.28	0.38	0.24	1.26	1.13	–	–
Sauger *Stizostedion canadense*	0.11	0.11	–	–	0.11	0.00	–	–
Shorthead redhorse *Moxostoma macrolepidotum*	0.56	0.11	0.25	0.04	1.06	0.20	0.03	0.00
Shortnose gar *Lepisosteus platostomus*	0.67	3.39	0.58	0.00	3.12	0.59	1.40	0.13
Silver carp *Hypophthalmichthys molitrix*	0.00	0.11	–	–	–	–	–	–
Silver chub *Macrhybopsis meeki*	–	–	0.20	0.00	–	–	0.03	0.00
Silverband shiner *Notropis shumardi*	–	–	–	–	–	–	0.00	0.04

Table 4. Continued.

Species	Gill net		Day electrofishing		Fyke net		Mini-fyke net	
	Pre-construction	Post-construction	Pre-construction	Post-construction	Pre-construction	Post-construction	Pre-construction	Post-construction
Skipjack herring *Alosa chrysochloris*	0.00	8.78	0.00	0.07	0.00	0.04	–	–
Smallmouth bass *Micropterus dolomieu*	–	–	0.05	0.00	–	–	–	–
Smallmouth buffalo *Ictiobus bubalus*	0.78	0.72	0.15	0.48	0.79	0.37	–	–
Spottail shiner *Notropis hudsonius*	–	–	0.00	0.07	–	–	0.00	0.07
Spotted gar *Lepisosteus oculatus*	0.00	0.28	0.10	0.02	0.10	0.20	0.00	0.04
Threadfin shad *Dorosoma petenense*	0.28	0.78	1.00	3.26	0.53	0.11	0.00	9.65
Warmouth *Lepomis gulosus*	–	–	0.00	0.04	0.13	0.00	–	–
Western mosquitofish *Gambusia affinis*	–	–	0.00	0.06	–	–	0.43	0.22
White bass *Morone chrysops*	1.00	26.44	0.18	4.11	11.77	3.30	0.00	0.74
White crappie *Pomoxis annularis*	0.00	16.83	0.05	10.19	4.89	45.81	0.17	1.80
White perch *Morone americana*	0.00	1.39	0.00	0.04	0.00	0.26	–	–
White perch × yellow bass *M. americana × M. Mississippiensis*	0.00	0.28	0.00	0.09	0.00	0.59	–	–
Yellow bass *M. mississippiensis*	0.06	9.17	0.18	0.70	2.45	5.37	0.00	0.09
Yellow bullhead *Amieurus natalis*	0.08	0.22	0.25	0.83	0.85	0.74	0.07	0.15
Yellow perch *Perca flavescens*	–	–	–	–	0.04	0.00	–	–

Figure 15. Expected fish community composition clustering responses to the Habitat Rehabilitation and Enhancement Project construction and management of the north pool, Lake Chautauqua, Illinois, using Euclidean distance to delineate clusters.

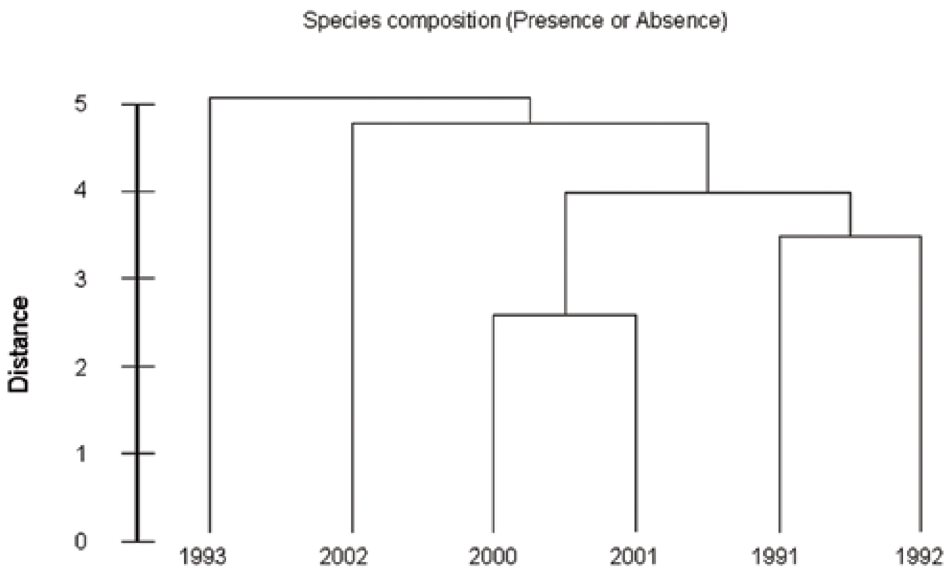


Figure 16. Fish community composition cluster analysis for all gears with pre- (1991–1993) and post-construction (2000–2002) catch data in the north pool, Lake Chautauqua, Illinois, using Euclidean distance.

combination of all gears is not feasible. Hence, gear-specific analyses were used to provide insight into the response to HREP management at Lake Chautauqua.

Tests (ANOSIM) comparing pre- and post-construction electrofishing were significant ($R = 0.75$; $P = 0.10$) indicating the fish community sampled by this gear was structurally different between the two periods. Changes in relative abundances (CPUE) that most contributed to this difference were gizzard shad that increased from 23.3 to 360.7, white crappie increased from 0.05 to 10.2, largemouth bass increased from 2.2 to 13.9, and common carp decreased from 20.5 to 5.8 individuals per electrofishing run (Table 4; Figure 17).

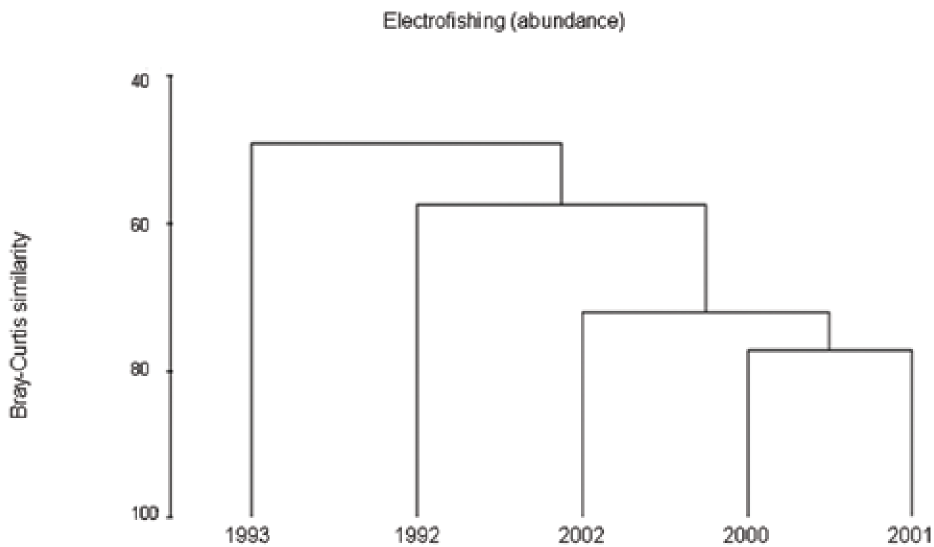


Figure 17. Fish community structure cluster analysis for day electrofishing with pre- (1991–1993) and post-construction (2000–2002) catch data in the north pool, Lake Chautauqua, Illinois, using Bray-Curtis Similarity data. No data were available for 1991 because of low water levels.

Fyke nets also showed a difference in community structure between the sample periods (R = 0.926, $P = 0.10$). Major contributions to this difference include an increase in relative abundance for white crappie (4.9 to 45.8 per net), black crappie (11.1 to 32.6 per net), and a decrease in common carp (7.6 to 0.9 per net; Table 4; Figure 18).

The ANOSIM tests for differences between communities using mini-fyke nets were also significant although the amount of variability explained was low (R = 0.22; $P = 0.10$). Larger differences in community structure mainly focused around increases in gizzard shad (4.5 to 357.3 per net), bluegill (0.2 to 16.0 per net), bullhead minnow (0.6 to 9.0 per net), and emerald shiner (1.7 to 13.9) abundances.

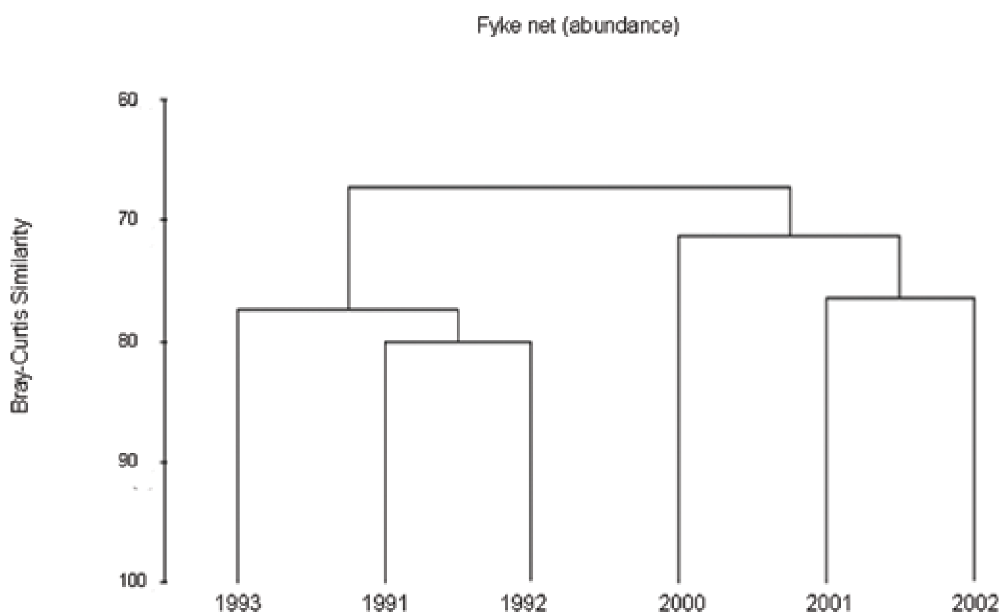


Figure 18. Fish community structure cluster analysis for fyke nets with pre- (1991–1993) and post-construction (2000–2002) catch data in the north pool, Lake Chautauqua, Illinois, using Bray-Curtis Similarity data.

Decreases in common carp abundances (1.3 to 0.6 per net) also contributed to the change in community structure (Table 4; Figure 19).

Characterization of the open-water areas of the lake was made using gill nets. The ANOSIM tests for differences between pre- and post-construction were significant (R = 0.44; P = 0.10) indicating there was a shift in the open-water fish community. This shift was due in large part to increases in white crappie (0.0 to 16.8 per net), white bass (1.0 to 26.4 per net), yellow bass *Morone mississippiensis* (0.1 to 9.2 per net), and channel catfish (0.7 to 7.8 per net) relative abundances (Table 4; Figure 20).

Responses of water quality conditions measured in the north pool of Lake Chautauqua were mixed. Maximum water depth and water temperature were not significantly different between the two sample periods. However, water transparency (e.g., Secchi depth) was higher in the post-construction sample period; whereas dissolved oxygen and conductivity were lower in the same time frame (Table 5).

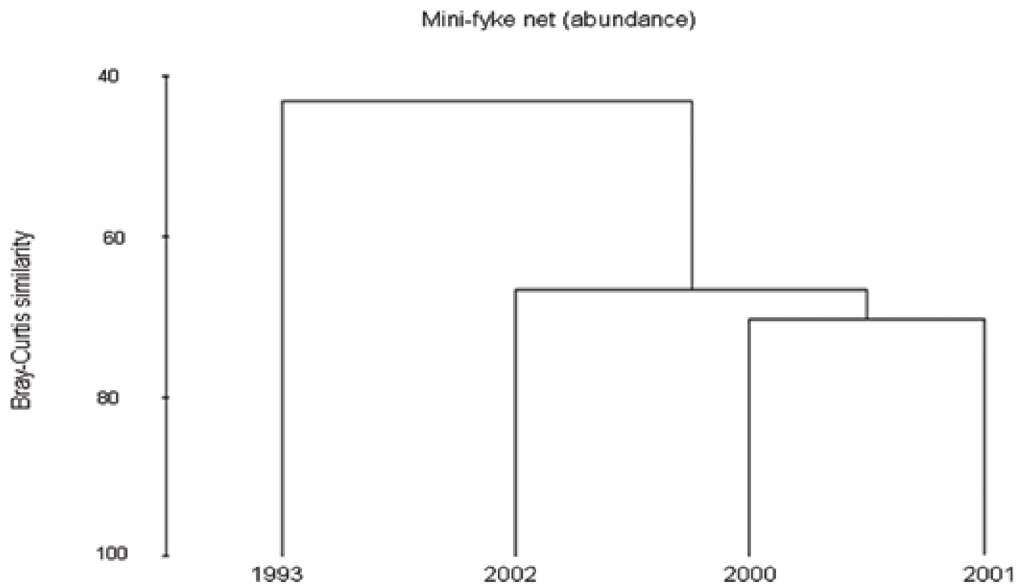


Figure 19. Fish community structure cluster analysis for mini-fyke nets with pre- (1991–1993) and post-construction (2000–2002) catch data in the north pool, Lake Chautauqua, Illinois, using Bray-Curtis Similarity data. Mini-fyke data were not available for 1991–1992.

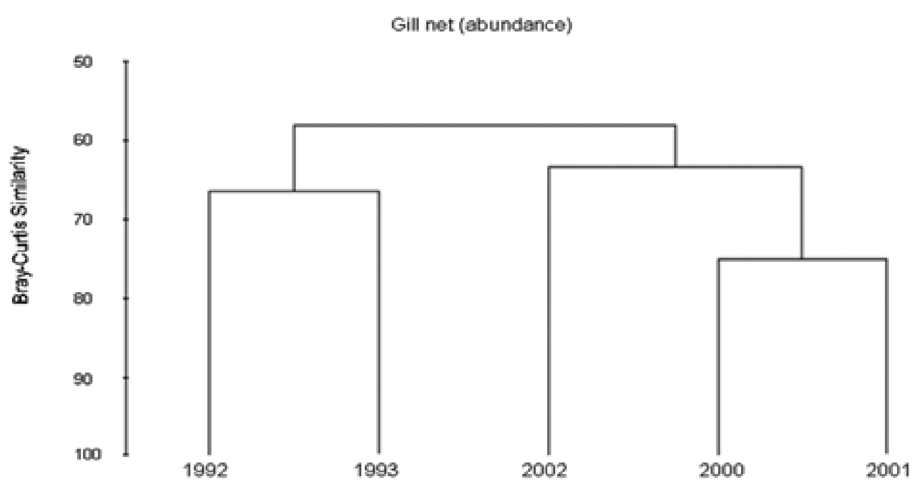


Figure 20. Fish community structure cluster analysis for gill nets with pre- (1991–1993) and post-construction (2000–2002) catch data in the north pool, Lake Chautauqua, Illinois, using Bray-Curtis Similarity data. Data for 1991 were not available.

Table 5. Mean water conditions in pre- (1991–1993) and post-construction (2000–2002) periods at Lake Chautuaqua, Illinois. Pre-construction data from the Long Term Resource Monitoring Program water quality component; post-construction data from this Habitat Rehabilitation and Enhancement Project study. Standard errors are listed in parentheses and asterisks indicate significant differences ($P < 0.05$) after Bonferroni corrections.

Measure	Pre-construction	Post-construction
Maximum depth (m)	1.02 (0.11)	1.05 (0.04)
Secchi depth (cm)*	15.8 (1.73)	24.6 (0.77)
Water temperature (°C)	24.5 (0.89)	22.9 (0.33)
Dissolved oxygen (mg/L)*	9.9 (0.51)	7.8 (0.13)
Specific conductance (µS/cm)*	473 (8.06)	435 (4.64)

Discussion

Larval Fish

Floodplain rivers like the Illinois River are dynamic systems that rely heavily on the interactions between the river and its floodplain to function properly (Ward and Stanford 1995). Many aquatic organisms use inundated areas of a floodplain to take advantage of the diverse habitat that is available during wet periods. Fish production from the floodplain can be a major source of biomass to the main channel once flooding has ceased (Ward and Stanford 1995). For example, Jackson (1993) reported that fish recruitment was much higher in areas where the floodplain was inundated during spawning on the Yalabusha River, Mississippi. Our study confirms this phenomenon in the Illinois River because we have collected larval fish in the south pool of Lake Chautauqua during periods when there is enough water to effectively sample that area. This confirms that the south pool is at the very least a nursery area, but also probably provides significant spawning habitat when flooded. The contribution of fish from Lake Chautauqua to Illinois River fish populations is not yet known and warrants further study. However, the contribution of fish from the south pool is believed to be substantial. Proof of this hypothesis lies in the fact that estimates of larval fish being transferred to the Illinois River, by way of a gravity-fed water release structure, from the south pool could average 135 million individuals per year (Janvrin et al. 2003). This information suggests that while the south pool is managed specifically for moist-soil plant production for waterfowl, there remains a substantial benefit to the regional fish community.

Management Species Size Structure

Changes in the size structure of several of the managed species also suggest a response to HREP management. In the pre-construction period, largemouth bass numbers were relatively low and had low annual recruitment (Figure 8). However, by 2000, the largemouth bass population was represented by multiple year classes that included young-of-year individuals. Similarly, PSD and RSD estimates were high in the pre-construction period indicating the population structure was biased towards larger individuals. The post-construction period indices were variable but do appear to be stabilizing at values that indicate a healthy largemouth bass population.

Bluegill population structure was similar to that of largemouth bass in that the population was dominated by larger individuals in the pre-construction period (Figure 6). The post-construction period was characterized as having more year classes and a more desirable size structure. The PSD values indicate fairly good abundances of fish larger than stock size (80 mm). However, the number of fish larger than the preferred class (200 mm) has remained consistently low and may require additional fishery management practices to sustain a balanced population.

Recruitment and size structure for black crappie generally showed a lack of consistent reproduction in both sample periods. The population typically consisted of fish >200 mm except in 2000 and 2001 when smaller fish were present (Figure 7). This situation resulted in inflated PSD and RSD values for black crappie. Although white crappie were not specifically identified as a management species, they followed a similar trend as that illustrated by black crappie. Size structure indices again indicated a dominance of larger individuals that probably represent one or possibly two year classes, with little stable reproductive success.

Few channel catfish were collected before the construction in the north pool of Lake Chautauqua (Figure 9). Therefore, reliable size structure assessments could not be made. However, a wide range of size classes of catfish were found in the lake in the post-construction period that indicates successful reproduction and recruitment to the sport fish population.

North Pool Fish Community Response

The species composition of the north pool of Lake Chautauqua did not significantly change from the pre- to post-construction sampling periods. There were some slight differences given that eight unique species were collected each period, but no major shifts in the species composition were observed. Explanations for this response are twofold. First, the lack of a chemical treatment to remove any remaining fish in the standing water in construction conceivably allowed some species to survive and re-establish in the post-construction lake. Secondly, the connection to the Illinois River in 1993 and 2002 probably had a strong influence on the community composition because source populations of many of the riverine fish had at least intermittent access to the lake. The establishment of three nonnative species ––bighead carp, silver carp, white perch––in La Grange Reach during the post-construction period explains minor discrepancies in species composition.

Initial assessments of the fish community composition of the north pool may lead to a conclusion that little has changed in response to the HREP construction at Lake Chautauqua because there was little change in species richness. While the species composition did not significantly change, fish community structure on the basis of the relative abundance data do show considerable change. Here, every gear showed a dramatic change in the fish community that was highlighted by increases in desired species that include most of the key management species as well as several other desirable sport and forage species coupled with a decline in the abundances of common carp, an undesirable species. Reasons for these changes are conceivably a response to the HREP construction that provided stable water levels.

Generally, a fish community is influenced by habitat composition and habitat stability. Fish communities are then established in response to the habitat as well as other environmental conditions. In simple terms, fish assemblages can be predicted on the basis of the stability of these conditions with a fairly high degree of certainty following paradigms like Southwood's (1977) habitat template. The basic premise is that fish assemblages in stable environments will support species that rely upon stable resources. This assemblage usually consists of long- and short-lived species (Townsend and Hildrew 1994). Conversely, highly variable environments support a more opportunistic fish assemblage that can take advantage of resources as they become available (Poff 1992; Townsend and Hildrew 1994; Poff and Allan 1995). Assemblages in highly variable environments will typically be dominated by short-lived species or species that are not desirable (e.g., common carp). Before HREP construction, the water levels in the north pool were subjected to the same highly variable water levels that the Illinois River is subjected to providing an unstable environment (Sparks et al. 1998) that was conducive to the establishment and propagation of less desirable species. However, once stable water levels were established, the more desirable sport (i.e., predators) and prey species that are native to the Illinois River were able to establish naturally functioning populations. Additionally, the nonmanaged species that provide a prey base for some of the managed species may actually allow for a more stable food web than would have been present under the original HREP management plan.

Changes in the fish community from pre- to post-construction suggest that the goal to establish a viable sport fish community has been accomplished. The actual composition and structure of species found in the north pool of Lake Chautauqua are somewhat different than originally intended in that only five species were identified for stocking after the lake was drained in the construction phase. The facts that the lake were not entirely drained and that the Illinois River has overtopped the levee have presumably been significant contributors to this result. However, the existing fish community is represented by surrogate species that can serve the same function as the stocked species. Therefore, the fish community has developed into a desirable fishery that has attracted significant recreational attention after HREP construction (M. Pegg, unpublished data). Establishment of aquatic vegetation has been sporadic at best since construction was completed and additional restoration and/or management practices may need to be implemented to facilitate the creation of functioning vegetation communities in the north pool of Lake Chautauqua. As aquatic vegetation becomes established throughout the lake, additional fish sampling should be conducted to assess the continued fish responses.

Conclusions

- The south pool of Lake Chautauqua is a nursery area for young-of-year fish that could influence regional fish populations within the Illinois River Basin. The extent of this contribution remains unknown, but warrants further investigation.
- The fish community composition in the north pool changed little between the pre- and post-construction periods. This outcome was probably because of an incomplete removal of all fish in construction and also to intermittent connectivity to the Illinois River in high flow periods in 1993 and 2002.
- Fish community structure did change significantly with reductions in abundances of less desirable fish like common carp compared to increased abundances of sport fish like largemouth bass, crappie species, and prey fish, like gizzard shad and emerald shiner.
- Population structure of the designated management species indicates some level of recruitment in the post-construction sample period. However, size structure data suggest that some additional management, particularly for bluegill, may be warranted to establish a more balanced population.
- Generally, the fish response to HREP construction (e.g., levee repair and water level control mechanisms) was positive. Therefore, it seems that stable water levels have allowed the establishment of a diverse community to also sustain a sport fish community. Future monitoring should continue to be conducted at Lake Chautauqua to ensure that the project maintains or continues to improve fish communities.
- Permanent stands of aquatic vegetation have yet to become established throughout the north pool of Lake Chautauqua. Therefore, assessment of the fish community should persist as efforts continue to introduce native aquatic plants into the pool.

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