

**2002 Fish Survey of Nathan's Lake, Boyer Chute
National Wildlife Refuge**

Corey Lee
Fisheries Technician

U.S. Fish and Wildlife Service
Columbia Fishery Resources Office
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Introduction

The Columbia Fishery Resources Office conducted a fish survey in August 2002, at Nathan's Lake, a component of Boyer Chute National Wildlife Refuge (NWR). Boyer Chute NWR is located in the Missouri River floodplain about three miles north of Omaha, NE and four miles southeast of Ft. Calhoun, NE. Nathan's Lake is located about one mile southwest of Boyer Chute (Figure 1) in Washington County and is connected to the Missouri River at river mile 633.0 by Deer Creek. Nathan's Lake is approximately a 50-acre wetland complex. Because the lake is a shallow, wetland area, water levels and temperature vary over short periods of time. A deep area (1.52-3.05-m deep) was excavated to provide overwintering habitat for fish in the northeast portion of the lake.

Fifty-three percent of wetlands in the contiguous United States were lost in a 200-year period between the 1780's and the 1980's, because of urbanization and drainage for agriculture (Dahl 1990). Restoration of aquatic ecosystems to benefit fish and wildlife resources can be made by the U.S. Army Corps of Engineers under Section 206 of the Water Resources Development Act of 1996. Nathan's Lake was renovated by the U.S. Army Corps of Engineers, Omaha District, as part of a Section 206 project to re-establish the natural ecosystem of the Missouri River floodplain wetlands. The lake was redesigned and water control structures were added to help maintain water levels in the lake to attract waterfowl and create a spawning habitat for Missouri River fish. Nathan's Lake receives water from a diversion weir, which runs through West Wetland, to receive base flows and high flows from Deer Creek. A regraded ditch with a water level control structure in the northeast corner of Nathan's Lake allows high water to flow back into Deer Creek.

Nathan's Lake remained dry until early spring 2001 when it received water from Deer Creek. This was due to Deer Creek backing up at the confluence of the Missouri River during a high river stage (highest stage was 21.55 ft on April 29, 2001). Water from the Missouri River can reach Nathan's Lake at the river stage of 22.0 ft (54,000 cfs, el. 984.6 ft.) at the I-480 bridge in Omaha/Council Bluffs (29 miles downstream from the Missouri River-Deer Creek confluence), even if Deer Creek is completely dry during this time (Bryan Schultz, Boyer Chute NWR, personal contact). At this level fish can immigrate to Nathan's Lake from Deer Creek or the Missouri River. During the 2001 fish survey, Nathan's Lake was found to be primarily a rearing area for young of the year bigmouth buffalo (*Ictiobus cyprinellus*) and common carp (*Cyprinus carpio*) (Lee and Davison 2001). This fish survey was conducted in August 2002, in order to continue to study the fish community of Nathan's Lake. In order to further study the interactions between the river and Nathan's Lake in 2002 and 2001, Missouri River 2002 river stage data was compared to river stage data recorded in 2001.

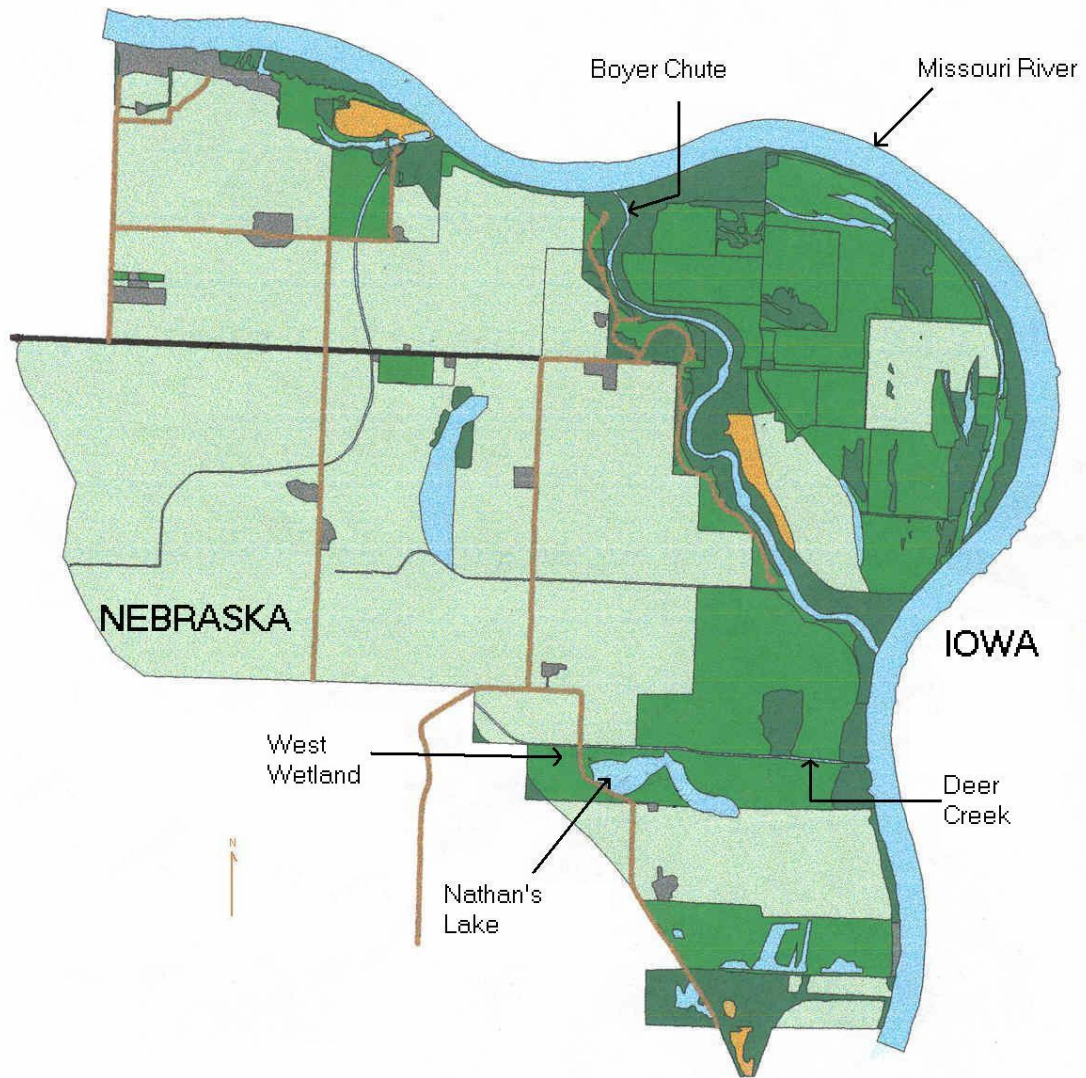


Figure 1. Location of Nathan's Lake, part of the Boyer Chute National Wildlife Refuge, Washington County, Nebraska.

Methods and Materials

Two gear types were used to survey the fish community of Nathan's Lake. The gill net was 30.5-m x 1.8-m, and was divided into four 7.6-m alternating panels of 5.1-cm and 2.5-cm mesh. Two gill nets were set with the 2.5-cm mesh panel closest to shore. Large adult fish, such as bigmouth buffalo (*Ictiobus cyprinellus*) and common carp (*Cyprinus carpio*), are usually captured in a gill net. Seines are designed to capture smaller adult species, such as shiners (*Notropis* spp.), and all juvenile fish. The beach seine measured 7.6-m long, 2.4-m deep with 0.6-cm mesh, and was used to sample the shoreline areas of Nathan's Lake. Catch per unit effort (CPUE) was calculated for each seine haul, and expressed as fish/10 m².

Fish species captured in Nathan's Lake in August 2002 were identified by separately analyzing the catch of the two gear types. All fish captured by gill net were identified to species, measured to the nearest millimeter, and returned to the water. Fish collected by seining were identified and measured in the field when possible, or preserved in 10% formalin, then identified and measured in the laboratory.

CPUE for seines was expressed as:

$$N/A$$

where N = number of fish sampled

A = estimated area (10 m²)(distance x seine length) sampled

CPUE for gill nets was expressed as:

$$N/H$$

where N = number of fish captured

H = number of hours gear was in water

Diversity of the sample was calculated using Margalef's index (Ney 1999):

$$D = (S - 1)/\log_e(N)$$

where S = the number of species in a sample

N = the number of individuals in the sample

River stages at Blair, NE were obtained from the U.S. Army Corps of Engineers for April 1, 2001 to September 1, 2001 and for April 1, 2002 to September 1, 2002 (Bryan Baker, USACE, personal contact) to make comparisons and to determine what changes, if any, had occurred.

Results

As a result of the dry conditions at Nathan's Lake, sampling was only accomplished in the deep area (2.1-m.) that provides fish overwintering habitat. Five seine samples and two gill net samples were conducted in the only area of Nathan's Lake that contained water (Figure 2). The temperature of the water in this area during sampling was 24.4°C. Seine samples ranged from 0.0-m to 1.1-m in depth and ranged from approximately 20-m to 30-m in length. Gill nets were fished during the day, for a total of 10.0 net hours. The nets were set in water (0.2-m – 1.8-m) with little or no aquatic vegetation.

Seine

Five seine samples were conducted in Nathan's Lake. Depth of seine samples ranged from 0.0 - 1.1-m. A total of 605 fish were captured, representing 16 species, using the seine. The average CPUE for the five seine hauls was 6.23 fish/10 m² (Table 1). Sixteen identifiable species, along with many *Hybognathus* spp., four other Centrarchid spp., and one striped bass hybrid (*Morone saxatilis* X *M. chrysops*) were captured using this technique (Figure 3). *Hybognathus* spp. were only identified to genus because of the difficulty in identifying to species. Four individual Centrarchid spp. were only identified to family due to their small size (< 20 mm). *Hybognathus* spp. and fathead minnows (*Pimephales promelas*) accounted for more than half of the fish captured in the seine hauls, at 41% and 17% respectively.

Table 1. CPUE and lengths of each seine haul conducted at Nathan's Lake, August 2002.

Seine Haul	CPUE (fish/10 m ²)	Seine Haul Lengths (m)
Seine 1	8.83	30
Seine 2	4.68	30
Seine 3	4.26	20
Seine 4	6.30	20
Seine 5	7.08	25
Average	6.23	25

Stationary Gill Net (SGN)

A total of 22 fish were captured in two gill net sets. The gill nets were fished for 4.9 hours (SGN 1) and 5.1 hours (SGN 2). Average CPUE for the gill nets was 2.18 fish/hour (Table 2). The gill nets captured fewer fish than seines, similar to gill nets in 2001 (Lee and Davison). Ten species were captured in the gill nets (Figure 3), with goldeye (*Hiodon alosoides*) being most abundant (32%).

Table 2. Catch per unit effort of gill nets at Nathan's Lake, August 2002.

Gill Net	CPUE (fish/hr)
SGN 1	1.42
SGN 2	2.93
Average	2.18

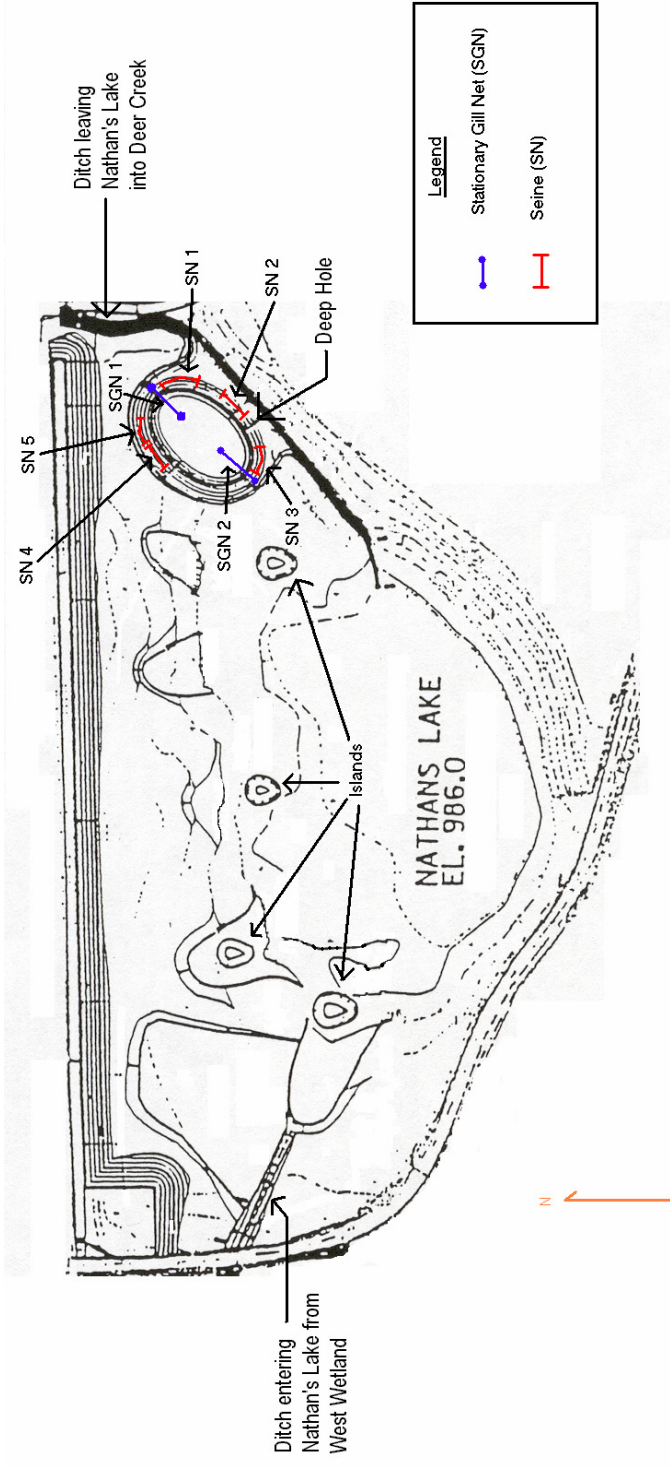


Figure 2. Sampling locations in Nathan's Lake, a component of the Boyer Chute National Wildlife Refuge, August 13, 2002.

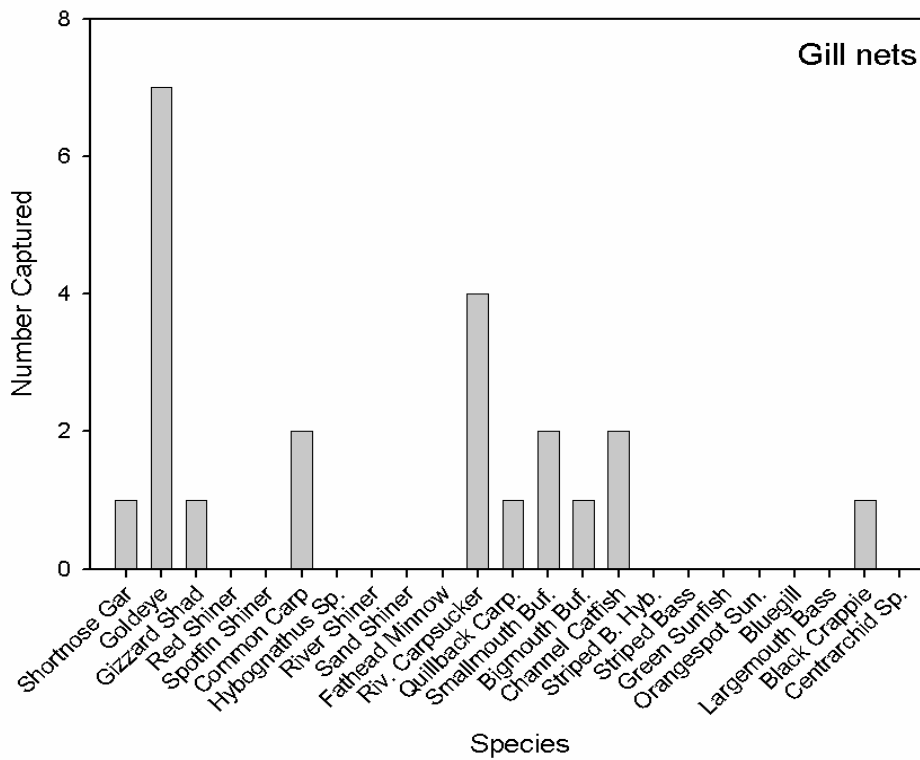
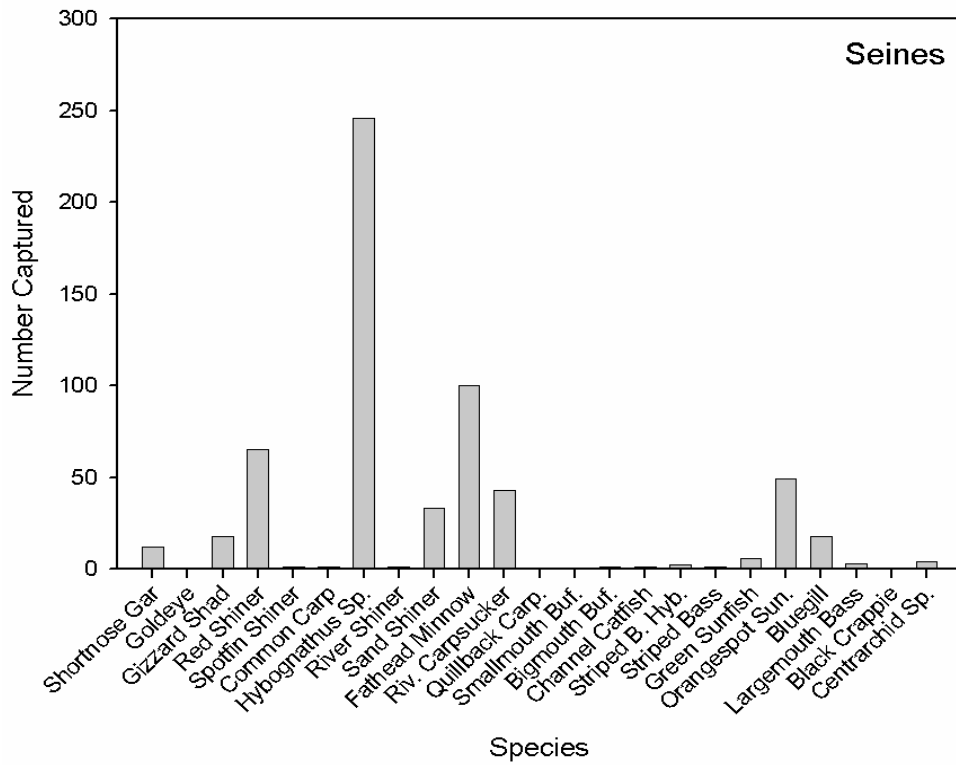


Figure 3. Fish collected by seine hauls (top) and gill nets (bottom) at Nathan’s Lake, Boyer Chute NWR, in August 2002.

Some variability existed in the species captured in 2002 from the species captured in 2001 (Table 3). In 2002, no young of the year bigmouth buffalo or common carp were captured. Nearly 80% of the captured individuals in the 2002 sample were adult orangespot sunfish (*Lepomis humilis*) and adult Cyprinid species (Figure 4). In 2001, nearly 90% of 5320 fish captured in Nathan's Lake were young of the year bigmouth buffalo or common carp (Figure 5).

Table 3. Presence and absence of fish species collected at Nathan's Lake from all gears in June 2001 and August 2002, conducted by the Columbia FRO.

Common Name	Scientific Name	2001	2002
Shortnose Gar	<i>Lepisosteus platostomus</i>	X	X
Goldeye	<i>Hiodon alosoides</i>	X	X
Gizzard Shad	<i>Dorosoma cepedianum</i>		X
Red Shiner	<i>Cyprinella lutrensis</i>	X	X
Spotfin Shiner	<i>Cyprinella spiloptera</i>		X
Common Carp	<i>Cyprinus carpio</i>	X	X
Unidentifiable Hybognathus Spp.			X
Unidentifiable Notropis Spp.		X	
River Shiner	<i>Notropis blennius</i>	X	X
Sand Shiner	<i>Notropis ludibundus</i>	X	X
Fathead Minnow	<i>Pimephales promelas</i>	X	X
River Carpsucker	<i>Carpionodes carpio</i>	X	X
Quillback Carpsucker	<i>Carpionodes cyprinus</i>		X
Smallmouth Buffalo	<i>Ictiobus bubalus</i>		X
Bigmouth Buffalo	<i>Ictiobus cyprinellus</i>	X	X
Yellow Bullhead	<i>Ameiurus natalis</i>	X	
Channel Catfish	<i>Ictalurus punctatus</i>	X	X
Striped Bass	<i>Morone saxatilis</i>		X
Striped Bass Hybrid	<i>Morone saxatilis</i> X <i>M. chrysops</i>		X
Unidentifiable Centrarchid Spp.		X	X
Green Sunfish	<i>Lepomis cyanellus</i>		X
Orangespot Sunfish	<i>Lepomis humilis</i>		X
Bluegill	<i>Lepomis macrochirus</i>	X	X
Largemouth Bass	<i>Micropterus salmoides</i>		X
White Crappie	<i>Pomoxis annularis</i>	X	
Black Crappie	<i>Pomoxis nigromaculatus</i>	X	X
Unidentifiable		X	

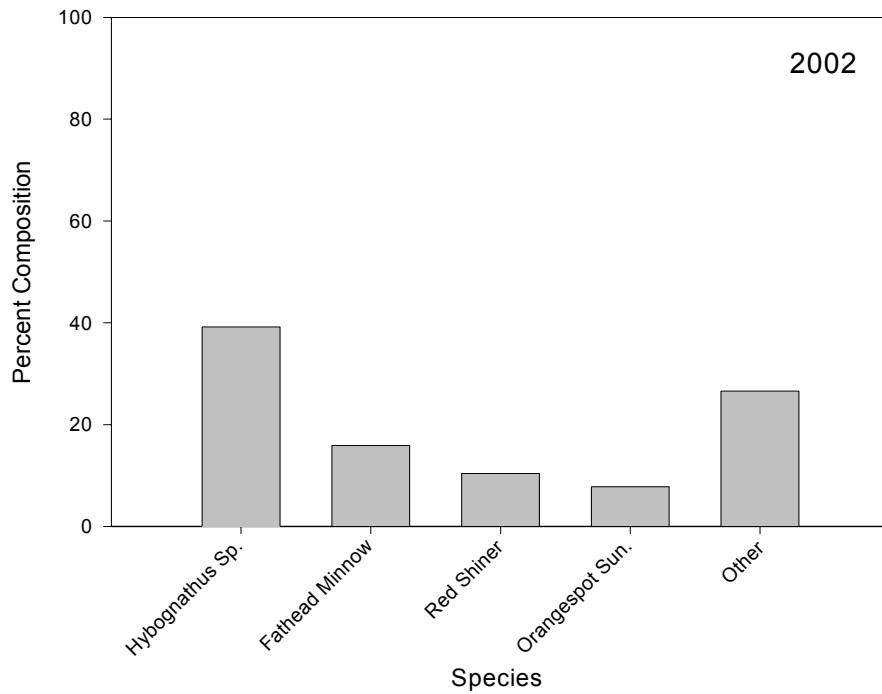


Figure 4. Percent composition of most abundant species captured in 2002, using all gear types in Nathan's Lake.

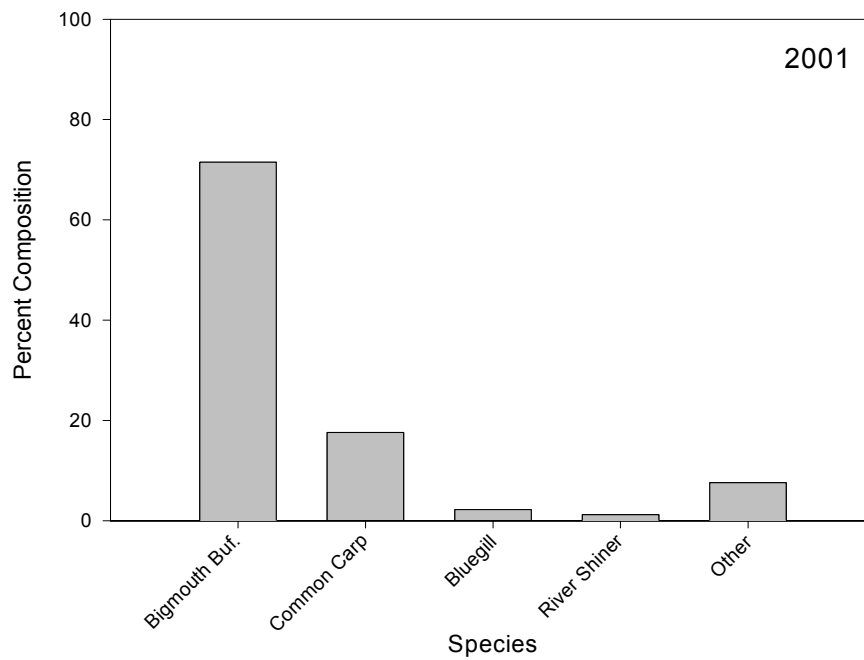


Figure 5. Percent composition of most abundant species captured in 2001, using all gear types in Nathan's Lake.

Diversity of this sample was determined by using Margalef's index. High values of diversity indices indicate unspoiled systems (Ney 1999). The maximum diversity value using Margalef's index varies with each sample. The potential maximum diversity value of this survey was 63.1. A value of 0 would result if only one species was represented. The diversity value determined for Nathan's Lake was 3.21. A small value was determined because of the large proportion of *Hybognathus* spp. and fathead minnows captured in the sample.

Missouri River Data

The Missouri River had very different flow patterns between the spring/summer of 2001 and the spring/summer of 2002. River stage data collected by the U.S. Army Corps of Engineers at Blair, Nebraska (river mile 648.3) was examined from April 1, 2001 to September 1, 2001 and from April 1, 2002 to September 1, 2002. During the months of April and May 2001, the Missouri River had a period where it was over a stage of 19 ft. for 17 consecutive days and 21 days total. Of those 21 days the Missouri River was between a stage of 20-22 ft. for 10 consecutive days (Figure 6). Water from the Missouri River can reach Nathan's Lake at the river stage of 22.0 ft, even if Deer Creek is completely dry. Because of the high stage of the Missouri River during spring 2001, Deer Creek did not need a discharge of 5 cfs to flow downstream to allow fish passage from the Missouri River into Nathan's Lake in spring of 2001. In stark contrast to this, the Missouri River did not reach a stage higher than 17 ft. during April 1 through September 1, 2002 (Figure 6). During this period, Deer Creek would have needed a flow of at least 5 cfs or more to be above an elevation of 984.6 ft. at the inlet, only achievable by snowmelt or runoff, in order for riverine fish to have access into Nathan's Lake (Bryan Schultz, Boyer Chute NWR, personal contact). It was less likely that fish immigrated into Nathan's Lake from the Missouri River during 2002.

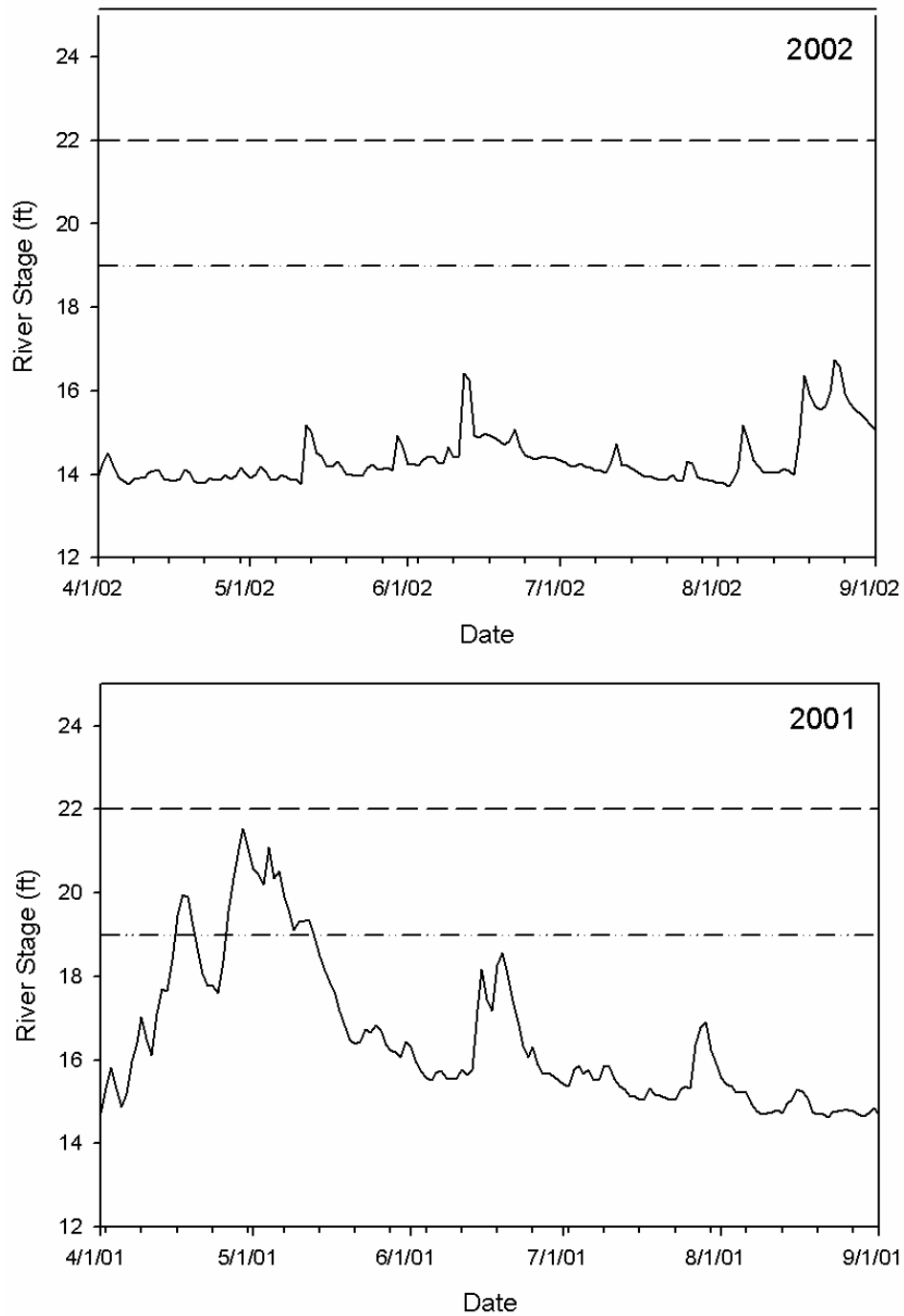


Figure 6. Missouri River stage data recorded from April 1 to September 1, 2001, and from April 1, 2002 to September 1, 2002 at Blair, Nebraska (River mile 648.3) by the U.S. Corps of Engineers 2002 (Bryan Baker, USACE, personal contact). Water from the Missouri River can reach Nathan’s Lake at the river stage of 22.0 ft (dashed line), even if Deer Creek is completely dry. In 2001, the Missouri River was over a stage of 19 ft. (dash/dotted line) for 17 consecutive days and 21 days total, however, it did not reach this stage during 2002.

Discussion

Because the Missouri River levels were low in 2002, the connectivity of Nathan's Lake to the river was restricted, thereby decreasing the water levels in the lake. The decrease in connectivity may have prevented adult riverine fish from reaching the lake to spawn in spring of 2002. Riverine fish such as the bigmouth buffalo and smallmouth buffalo enter creeks during rising water levels of spring flooding to find lowland lakes and wetland areas required for spawning habitat (Sargent 1996; Pflieger 1997). Since Nathan's Lake water levels are partially based on the Missouri River stage, it would be difficult during a dry year such as 2002, to inundate the wetland for the entire year. This dry year has directly affected the fish community of Nathan's Lake by concentrating all of the remaining fish in the lake into the deep area initially intended for overwintering habitat. This concentration of fish due to low water allows wading birds, such as herons, and other predators, including piscivorous fish species, the opportunity for increased forage (Sargent 1996).

The concentration of fish may have affected the diversity estimation by increasing the diversity value of Nathan's Lake. This may be because all fish in Nathan's Lake were forced into the deep area as the lake dried, thus making all species of fish in the lake more available for sampling. The more species that are captured, the higher value achieved on the diversity index.

A high water event in either the Missouri River or Deer Creek is needed to allow the possibility for Nathan's Lake to be re-established as a potential habitat for riverine fish to spawn. It is crucial that at least one of these waterways to have a high water event to present the possibility for a passageway for riverine fish to migrate upstream in Deer Creek into Nathan's Lake, provided beaver dams are not obstructive in the creek.

Acknowledgments

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