

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

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### Introduction

The Columbia Fishery Resources Office conducted fish surveys at Nathan's Lake, a proposed component of Boyer Chute National Wildlife Refuge (NWR), in June 2001. 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 by a drainage ditch with a control structure located at the northeast corner of the lake. Nathan's Lake is approximately a 50-acre shallow lake (0.61-1.22-m) that contains aquatic vegetation throughout much of the lake and along its entire border. However, little vegetation was present in the northeast portion of the lake where a deep area (2.44-3.05-m deep) was excavated to provide overwintering habitat for fish. Because Nathan's Lake is shallow, the temperature will vary over short periods of time. The temperature of the lake during sampling was 26°C.

Nathan's Lake was formerly a productive lake with a successful fishery. Anglers harvested many desirable fish species from the lake, including black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), and channel catfish (*Ictalurus punctatus*) (Mike Ellis, personal communication). Recently, the lake had filled with sediment and dried up eliminating fish habitat. Nathan's Lake is now part of a restoration project to restore the natural functions and native species of Missouri River floodplain wetlands. The lake and its water control structures were redesigned to attract waterfowl and create a spawning habitat for Missouri River fish. Nathan's Lake remained dry until early spring 2001 when it received Missouri River water diverted through a water level control ditch to receive base flows and high flows from Deer Creek. A regraded ditch in the northeast corner of Nathan's Lake allows high water in the lake to flow back into Deer Creek. This survey was conducted to inventory and characterize the fish community of Nathan's Lake present after the restoration and spring flooding.

### Methods and Materials

The survey of Nathan's Lake was conducted using four gear types. Four stationary, experimental gill nets measuring 45.7-m x 1.8-m were used. The gill nets were divided into six panels measuring 7.6-m in length with mesh panel size measuring 1.3, 2.5, 3.8, 5.1, 6.4, and 7.6-cm. Two mini-fyke nets measuring 1.2-m x 0.6-m with a 4.5-m lead were used. Two bag seines of different sizes were also used to sample Nathan's Lake: one was 15.2-m long with 1.3-cm mesh and the other was 6.1-m long with 0.6-cm mesh. All fish captured by gill net were identified to species, weighed to the nearest gram, measured to the nearest millimeter, and returned to the water. Fish collected by seining and mini-fyke nets were preserved in 10% formalin and identified in the laboratory.

Fifteen seine samples were conducted at various locations in Nathan's Lake (Figure 2). Seine samples ranged from 0.3-m to 0.9-m in depth and were approximately 9-m in length. Seining was only performed where excessive depth and aquatic vegetation did not interfere. The gill nets were fished for two consecutive nights each, for a total of eight net nights (191.2 net hours). All gill nets were set with the smallest mesh panel closest to shore. Two gill nets were set in shallow water (0.3-m – 0.9-m) containing considerable aquatic vegetation and two were set in deeper water (0.3-m – 2.1-m) with little aquatic vegetation. One of the mini-fyke nets was set at the inlet of a ditch to Nathan's Lake, while the other was set off of one of the islands in the lake in a heavily vegetated habitat (Figure 2). Each mini-fyke net was used for one night, for a total of two net nights (49.0 net hours).

Seine catch per unit effort was calculated using the estimated 9-m long seine hauls and specifications of each seine.

Catch per unit effort for the seines was expressed as:

$$N/A$$

where N = number of fish sampled

A = estimated area (m<sup>2</sup>)(distance x seine length) sampled

Catch per unit effort for gill nets and mini-fyke nets was expressed as:

$$N/h$$

where N = number of fish captured

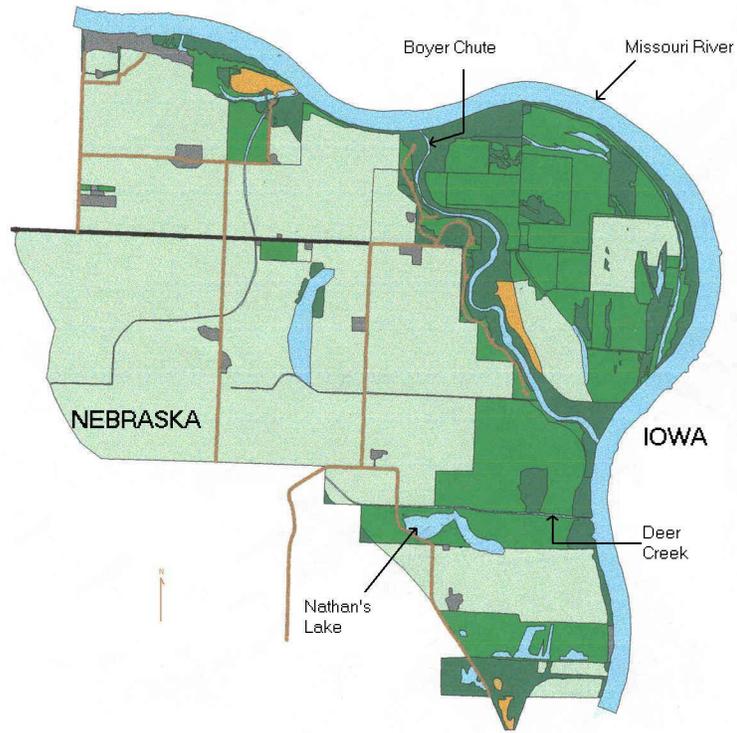
h = number of hours gear was in water

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

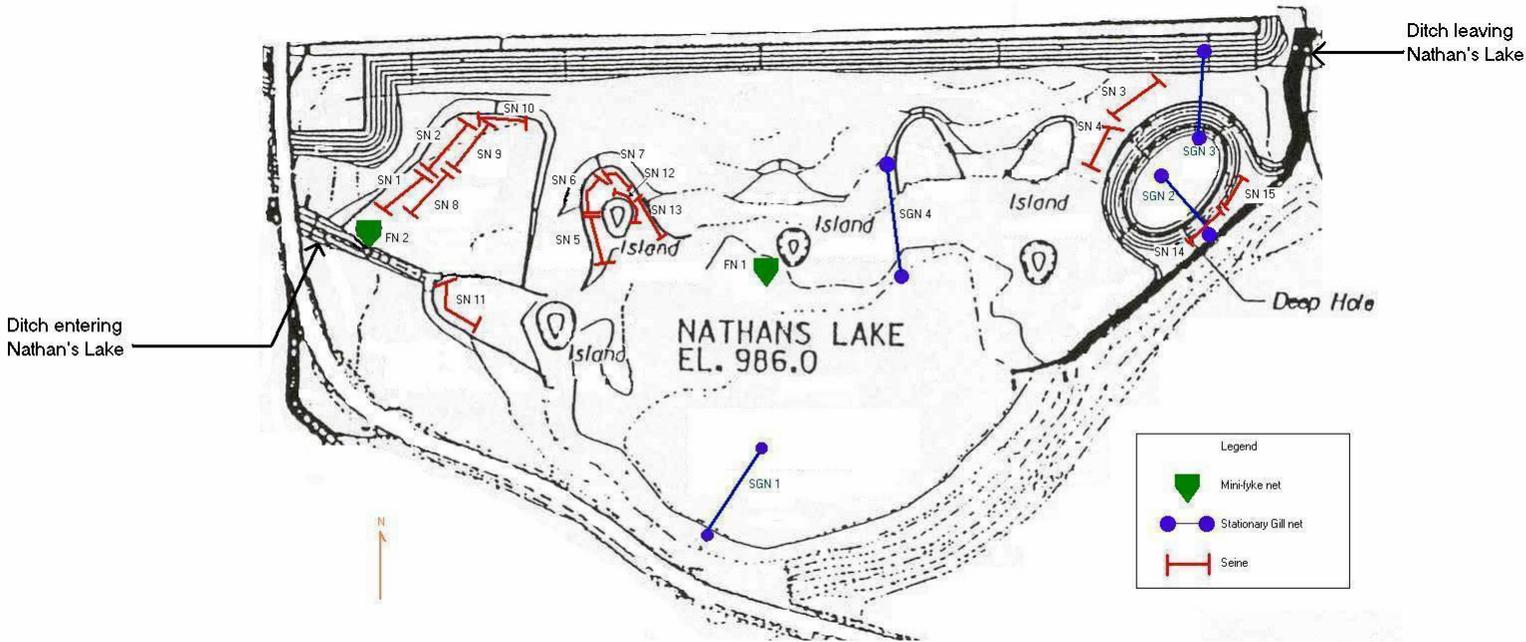
$$D = (S - 1)/\log_e(N)$$

where S = the number of species in a sample

N = the number of individuals in the sample



**Figure 1.** Location of Nathan's Lake, Washington County, Nebraska.



**Figure 2.** Sampling locations in Nathan's Lake component of Boyer Chute National Wildlife Refuge.

## Results and Discussion

Efforts to characterize the fish species present in Nathan's Lake were conducted by separately analyzing the catch of the different gear types. Large adult fish, such as bigmouth buffalo (*Ictiobus cyprinellus*) and common carp (*Cyprinus carpio*), are usually captured in a gill net. Mini-fyke nets and seines are designed to capture smaller adult species, such as shiners (*Notropis* sp.), and all juvenile fish.

### Mini-fyke Nets

The mini-fyke nets were the most effective gear at capturing fish. A total of 3,103 fish were captured in 49.0 net hours (Figure 3). This is a catch per unit effort of 63.3 fish/hour. Nine species were identified from the catch of the mini-fyke nets. Bigmouth buffalo represented 68% of the catch. Common carp were the next most abundant species found in this gear type comprising 16% of the captured fish. Small, unidentifiable sunfish comprised 9% of the mini-fyke net catch.

### 6.1-m Bag Seine

The use of the 6.1-m bag seine resulted in the capturing of 1,487 fish (Figure 4). An estimated total area of 603.9 m<sup>2</sup> sampled was used to calculate a catch per unit effort of 2.5 fish/m<sup>2</sup> sampled. Five species were identified from this gear. Juvenile bigmouth buffalo and common carp were the most abundant fish found in this gear type, representing 81% and 17% of the catch, respectively.

### 15.2 m Bag Seine

A total of 676 fish were captured using the 15.2 m bag seine in an estimated total area of 548.6 m<sup>2</sup> (Figure 5). This equals a catch per unit effort of 1.2 fish/m<sup>2</sup> sampled. Three identifiable species were captured using this technique. Juvenile bigmouth buffalo and common carp accounted for nearly all of the fish captured at 72% and 28% of the catch, respectively.

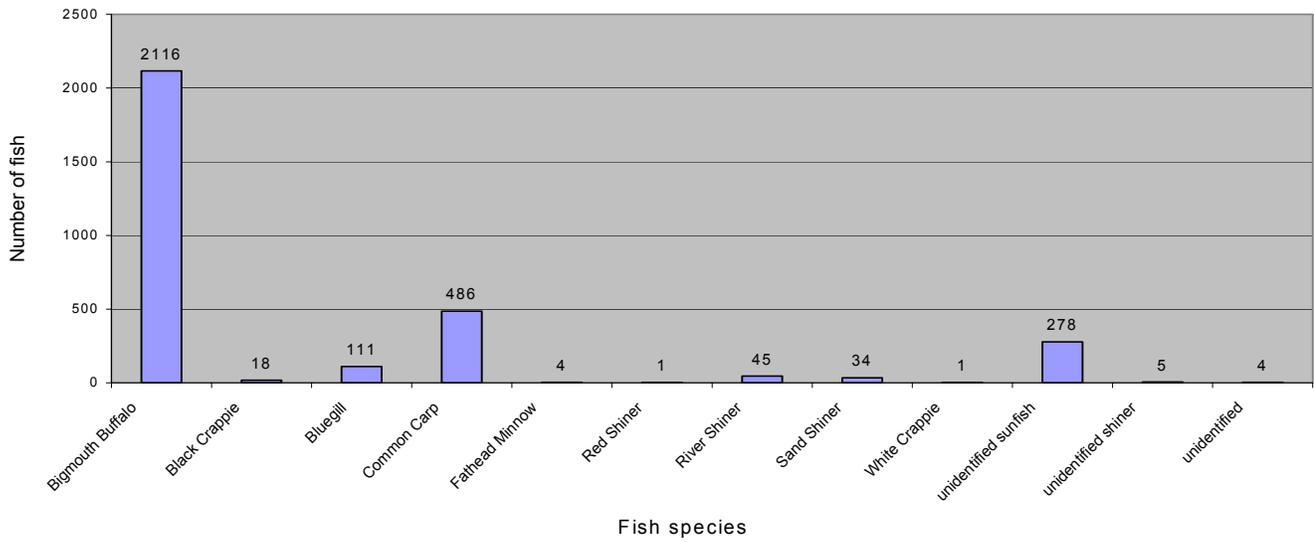
### Gill Nets

The gill nets captured 54 fish in a total of 191.2 net hours (Figure 6). This equals a catch per unit effort of 0.3 fish/hour. However, despite capturing the least amount of fish and having the lowest catch per unit effort of the gear types used, the gill nets contained more species than other gear types, capturing eight different species. Shortnose gar (*Lepisosteus platostomus*) comprised 30% of the catch, common carp accounted for 20%, red shiner (*Cyprinella lutrensis*) at 19%, and channel catfish comprised 13%. Adult bigmouth buffalo accounted for only 5.6% of the catch in the gill nets.

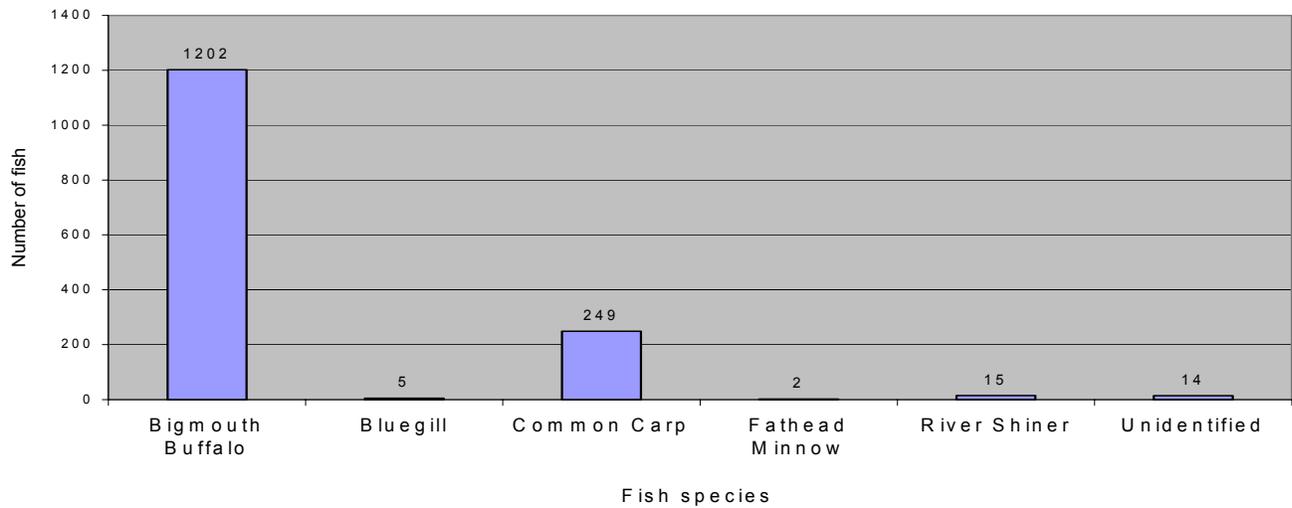
Diversity of the complete sample was determined by using Margalef's index. High values of diversity indices have been interpreted to indicate unspoiled systems (Ney 1999). The maximum diversity value using Margalef's index varies with each sample. The potential maximum diversity value of this survey was 620.0. A value of 0 would result if only one species was represented (Ney 1999). The diversity value determined for Nathan's Lake was 1.52. A small diversity value was determined because of the large number of juvenile bigmouth buffalo and common carp sampled (Figure 7), apparently after recent spawning. Bigmouth buffalo spawn in late April in water temperatures

ranging from 18 – 20°C (Burr and Heidinger 1983). Bigmouth buffalo can inhabit lowland lakes and sometimes enter small creeks to find spawning habitat (Pflieger 1997). Spring flooding of Nathan's Lake triggered a spawning response in bigmouth buffalo.

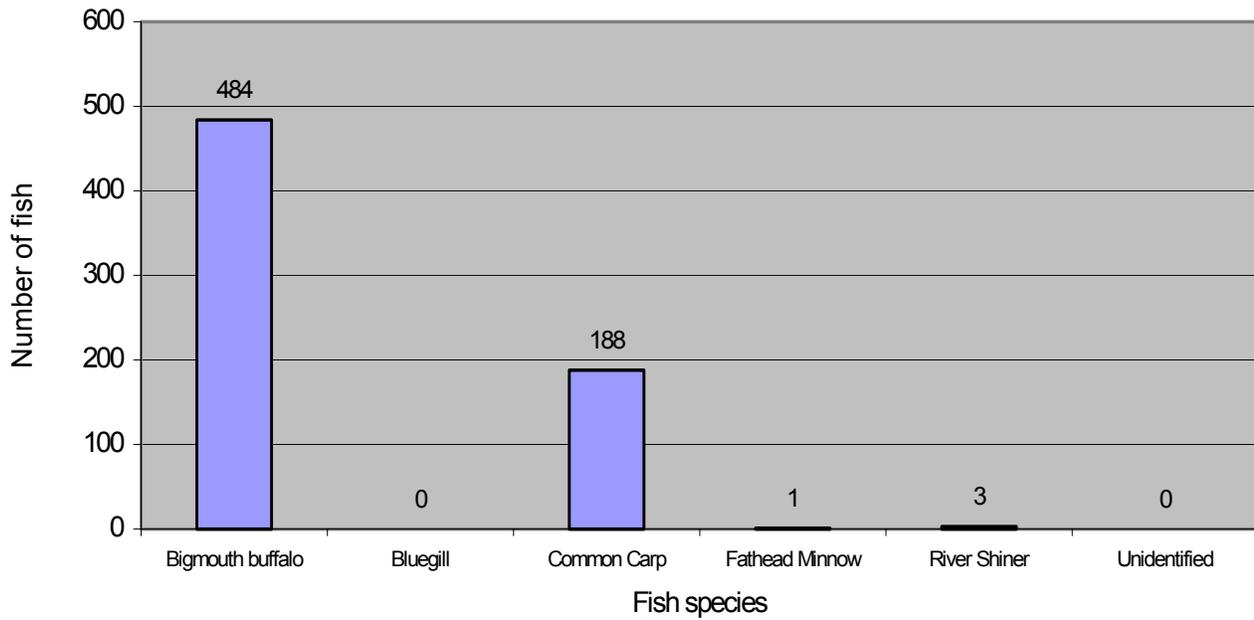
Nathan's Lake also provides habitat for wildlife other than fish. Crayfish were captured in every sampling gear used. Snapping turtles (*Chelydra serpentina serpentina*) were captured in the gill nets and mini-fyke nets. Remains of several fish were found in the gill nets, suggesting turtles and/or shortnose gar feeding on the entangled fish. A leopard frog (*Rana* sp.) and tadpole were captured in a mini-fyke net and a painted turtle (*Chrysemys picta* sp.) was found in a gill net.



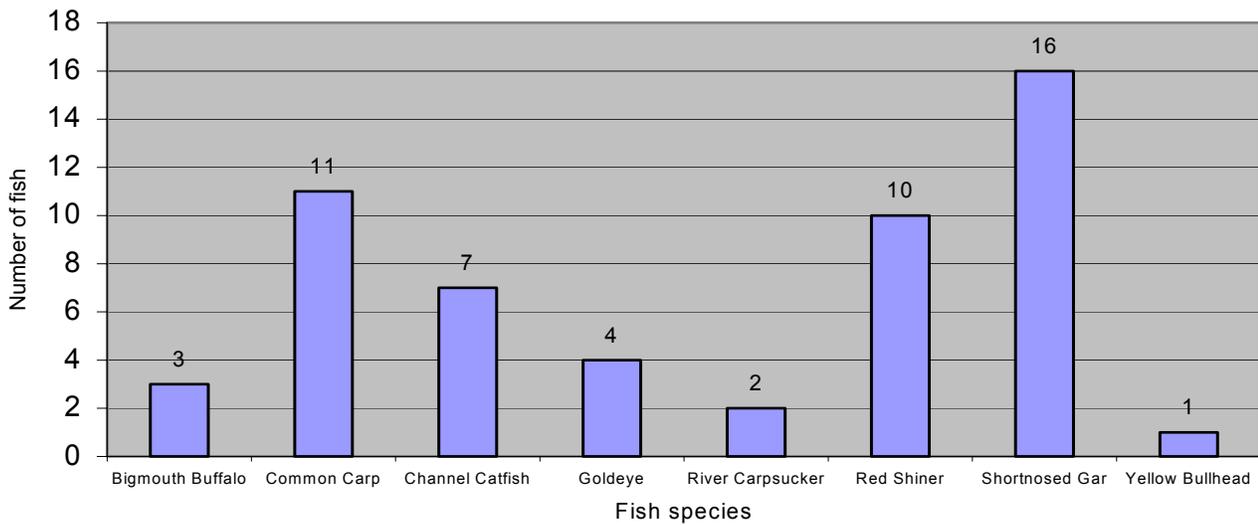
**Figure 3. Fish collected by mini-fyke nets at Nathan's Lake, Boyer Chute NWR, June 2001.**



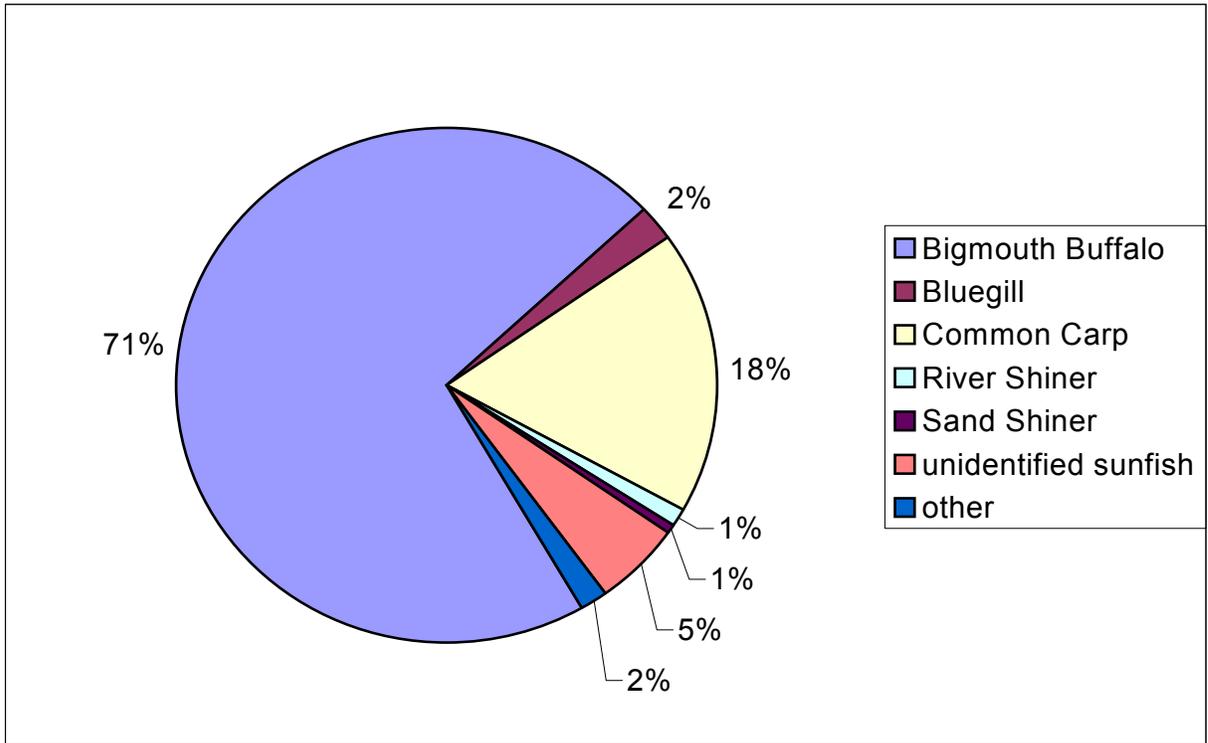
**Figure 4. Fish collected by 6.1-m seine in Nathan's Lake, Boyer Chute NWR, June 2001.**



**Figure 5. Fish collected by 15.2-m seine in Nathan's Lake, Boyer Chute NWR, June 2001.**



**Figure 6. Fish collected by gill nets at Nathan's Lake, Boyer Chute NWR, June 2001.**



**Figure 7. Fish collected in Nathan's Lake by combined gear types.**

**Table 1. Species collected at Nathan's Lake in June 2001.**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Number of fish</b>
Bigmouth Buffalo	<i>Ictiobus cyprinellus</i>	3805
Black Crappie	<i>Pomoxis nigromaculatus</i>	18
Bluegill	<i>Lepomis macrochirus</i>	116
Channel Catfish	<i>Ictalurus punctatus</i>	7
Common Carp	<i>Cyprinus carpio</i>	934
Fathead Minnow	<i>Pimephales promelas</i>	7
Goldeye	<i>Hiodon alosoides</i>	4
Red Shiner	<i>Cyprinella lutrensis</i>	11
River Carpsucker	<i>Carpionodes carpio</i>	2
River Shiner	<i>Notropis blennioides</i>	63
Sand Shiner	<i>Notropis ludibundus</i>	34
Shortnose Gar	<i>Lepisosteus platostomus</i>	16
White Crappie	<i>Pomoxis annularis</i>	1
Yellow Bullhead	<i>Ameiurus natalis</i>	1
Unidentifiable		18
Unident. Shiner		5
Unident. Sunfish		278
<b>Total fish</b>		<b>5320</b>

## **Conclusion**

There are different aquatic habitats found in Nathan's Lake including the deep, excavated area found in the northeast part of the lake and densely vegetated border. There is also a sustainable fish community that has come from the Missouri River `` found within these habitats. The results of this survey included 14 identified species (Table 1) present in a lake that was dry only a few months prior to sampling. Increased connectivity to the Missouri River across a broader range of river discharges may result in an increase in fish abundance and greater species richness (Kubisiak 1996).

The presence of crayfish and rough fish, such as the bigmouth buffalo and common carp, found in isolated wetlands provide a food source for shorebirds and other floodplain animals. Deeper areas will provide permanent habitat for fish species more commonly found in lentic environments.

Larval and juvenile fish abundance and species composition varies with time, environmental factors and river conditions (Turner et. al. 1994). The species composition of Nathan's Lake was greatly affected when these fish moved into Nathan's Lake to spawn away from the Missouri River. If connectivity to the Missouri River is increased by more flow from drainage ditches, species composition will continue to change. Further studies should be performed to adequately assess the species composition and richness of Nathan's Lake over the range of seasons, conditions, and floodplain connectivity.

## **Acknowledgments**

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