ILLINOIS NATURAL
HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

University of Illinois
Prairie Research Institute
Mark R. Ryan, Executive Director

Illinois Natural History Survey
Geoffrey A. Levin, Acting Director
Forbes Natural History Building
1816 South Oak Street
Champaign, IL 61820
217-333-6880

The Nature Conservancy's Emiquon Nature Preserve

Fish and Aquatic Vegetation Monitoring

Annual Report

Todd D. VanMiddlesworth and Andrew F. Casper

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Floodplain restoration monitoring of the aquatic vegetation and fish communities of The Nature Conservancy's
Emiquon Nature Preserve 2007-Present
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Disclaimer

Under contract with The Nature Conservancy (TNC), fish and aquatic vegetation monitoring (2007-present) was conducted on Thompson and Flag lakes of TNC's Emiquon Nature Preserve by the Illinois Natural History Survey, Illinois River Biological Station (INHS-IRBS) in order to evaluate a series of key ecological attributes (KEA) relevant to restoration success. This report presents a summary of data collected in 2015. The findings, conclusions, and views expressed herein are those of the researchers and should not be considered as the official position of TNC or the INHS.

Executive Summary

Key Ecological Attributes (KEA's) for the fish and aquatic vegetation communities are used to evaluate the progress of the restoration efforts at Thompson and Flag lakes of The Nature Conservancy's Emiquon Nature Preserve. A total of 19 KEA criteria were monitored monthly between 4/21/2015-10/23/2015. Of those criteria set by the Emiquon Science Advisory Council, 15 were met in 2015.

The 2015 water transparency values were within the desired range (Secchi depths no less than half the maximum water depth when a site is ≤1.5 m deep). However, when 2015 results are compared to 2014, we see that the mean monthly transparencies for April-May were lower than the same period in 2014. In contrast, transparencies between June-October were higher than the corresponding in 2014. Thus, while KEA criteria are being met, there is still room for improvement.

The aquatic vegetation community in 2015 continued to be dominated by native aquatic plant species. Despite the dominance by natives, two invasive aquatic plants - Eurasian watermilfoil and curly-leaf pondweed were among the species collected in 2015. Eurasian watermilfoil and curly-leaf pondweed, while still not dominant, were found at more sites and at a higher density than in 2014. An invasive submersed aquatic vegetation species known as Egeria was collected for the first time in 2014 since restoration but was not observed or collected in 2015. If this increase in density of these non-natives is an on-going trend, then consideration may need to be given on how to manage these invasive plants.

The fish community in 2015 continued to be dominated by an increasing number of native species. Despite this, the KEA goal of collecting ≥25 native fish species was not met. Bluegill dominated our catches in 2015 while catches of other desirable native fishes including freshwater drum, grass pickerel, and longnose gar were present but low in numbers. Despite the low numbers of these native fishes, these were still the highest catches for these species ever observed at the Emiquon Preserve. Of the 21 fish species collected in 2015, only one non-native species consisting of the common carp was collected. Total common carp catch was lower than 2014 catches and was the lowest catch of this species since restoration.

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Introduction

Historically, Thompson and Flag lakes were two of the most productive backwater lakes in the Illinois River Valley (Havera et al. 2003). However, both lakes were disconnected from the Illinois River and reduced to agricultural drainage ditches in the early 1900s when they became one of the largest farms in Illinois. These former floodplain lakes remained disconnected behind levees and in agricultural production until 2006. The Nature Conservancy purchased this property in 2000 and began aquatic restoration in 2007. A group of Key Ecological Attributes (KEA's) were developed in 2004 by the Emiquon Science Advisory Council (i.e. The Nature Conservancy and partners) to serve as the driving management tool, success criteria, and a basis for monitoring endpoints used in this document to describe the Emiquon restoration. Prior to the 2007 restoration, rotenone was applied to the agricultural drainage ditches to eradicate all fish species and allow a new start. The site was allowed to naturally fill through precipitation and >30 native fish species were stocked based on historical records of both lakes (Havera et al. 2003). The Illinois Natural History Survey's Illinois River Biological Station has been monitoring the aquatic vegetation and fish communities since 2007. The resulting data is used to evaluate whether the project has been successful in restoring the property based on KEA goals (VanMiddlesworth and Casper 2014, 2015, VanMiddlesworth et al. 2014).The knowledge gained may aid in future management efforts at the Emiquon Nature Preserve and other floodplain restoration efforts.

Aquatic Vegetation Sampling and Results

Aquatic Vegetation Sampling and Gear Effort - Thompson/Flag lakes

We conducted aquatic vegetation sampling monthly at 30 random sites May-September, 2015 at both Thompson and Flag lakes (Table 1). These former floodplains were sampled as one water body that were spatially stratified into north, middle, and south units. We also sampled an additional 30 random sites (60 total sites) in July and August during the peak of the growing season. The density of submersed aquatic vegetation (SAV) is based on percent coverage on a vegetation rake, while emergent, non-rooted floating-leaved, and rooted floating-leaved aquatic vegetation density is estimated by percent cover observed within a 2 m circle around the boat. All aquatic vegetation data was collected according to Yin et al. (2000).

Aquatic Vegetation Species Collected and Observed - Thompson/Flag lakes

We collected and/or observed 15 aquatic plant species (submersed, emergent, non-rooted floating-leaved, and rooted floating-leaved) at 175 out of 210 random sites in 2015 (Table 2, 3). Community composition at vegetated sites was dominated by submersed aquatic vegetation (i.e. coontail *Ceratophyllum demersum*), followed by 10 other submersed aquatic plant species. Emergent aquatic vegetation community composition was minimal at our sampling sites, but included unidentified *Typha* spp. (broad-leaved cattail *Typha latifolia* or narrow-leaved cattail *Typha angustifolia*). In addition, one non-rooted floating-leaved aquatic plant known as Lemnaceae was represented by *Lemna* spp. Rooted floating-leaved species were represented by creeping water primrose *Jussiaea lutea*, American lotus *Nelumbo lutea*, and water shield *Brasenia* schreberi. Water shield was primarily observed throughout the northeast portion of Thompson Lake but was not present at our sampling sites in 2015.

Curly-leaf pondweed *Potamogeton crispus* and Eurasian watermilfoil *Myriophyllum spicatum* were the only non-native species of aquatic plants collected in 2015 (Table 3). The non-native Egeria *Egeria densa* (newly discovered in the Emiquon Preserve in 2014) was not observed or collected in 2015.

Fish Sampling and Results

Fish Sampling and Gear Effort - Thompson Lake

We conducted monthly fish sampling April-October, 2015 at Thompson Lake using a multiple gear approach at both random and fixed sites (Table 1). Flag Lake was not sampled due to shallow water depth and dense aquatic vegetation beds that foul our sampling gears. Fish sampling did not use the spatially stratified (north, middle, south) approach of the aquatic vegetation sampling and instead consisted of 28 pulsed-DC boat electrofishing runs (15 minutes each), 28 fyke net sets (24 hours each), and 28 mini-fyke net sets (24 hours each) at shoreline or pseudo-shoreline (used for shoreline gear) sites. Seven tandem fyke net sets (24 hours each) and seven tandem mini-fyke net sets (24 hours each) were also deployed at open water (pelagic) sites. All gears were fished according to Gutreuter et al. (1995).

Total Fish Catch (All Gears) – Thompson Lake

We collected 6,945 fishes representing 21 species and 10 families in 2015. Composition was dominated (in descending order) by bluegill *Lepomis macrochirus* followed by gizzard shad *Dorosoma cepedianum*, black crappie *Pomoxis nigromaculatus*, largemouth bass *Micropterus salmoides*, pumpkinseed *Lepomis gibbosus*, unidentified young-of-the-year (YOY) *Lepomis* spp. (bluegill or pumpkinseed *Lepomis gibbosus* with lengths <40 mm), and golden shiner *Notemigonus crysoleucas*. Approximately 15 other fish species made up the remainder of the total catch. Fish species that either survived the 2007 rotenone, were unintentionally stocked, or were introduced from the Illinois River due to flooding in 2013 and 2015 include gizzard shad, common carp, shortnose gar *Lepisosteus platostomus*, yellow bullhead *Ameiurus natalis*, freshwater drum *Aplodinotus grunniens*, black bullhead *Ameiurus melas*, and bigmouth buffalo *Ictiobus cyprinellus* (Table 4). Common carp *Cyprinus carpio* was the only non-native fish species collected in 2015.

Catch-per-Unit Effort (CPUE)(All Gears) – Thompson Lake

We collected 15 fish species while electrofishing in 2015, which comprised 39% of the total catch by all gears. Community composition was dominated by gizzard shad, followed by largemouth bass, bluegill, and golden shiner. Approximately 11 other fish species made up the remainder of the catch while electrofishing. Common carp was the only non-native fish species collected while electrofishing in 2015. Catch rates of fish species varied by gear (Table 5, 6, 7, 8, 9).

Key Ecological Attributes (KEA's) Results

Of 19 relevant KEA criteria related to the aquatic vegetation and fish communities, 19 KEA's were addressed and the goals of 15 were met in 2015.

Submersed Aquatic Vegetation

KEA 1: Underwater Irradiance
Indicator: Secchi disc transparency
Desired Range: Submersed aquatic vegetation target areas, Secchi disc reading ≥half the maximum water depth in ≤1.5 m, measured during late spring/early summer
Goal Met: Yes

Secchi disc transparencies taken from all aquatic vegetation and fish monitoring site littoral areas with ≤1.5 m water depth April-May were ≥half the maximum water depth 61% of the time in 2015. Those collected June-October were ≥half the maximum water depth 87% of the time in 2015. Fixed Secchi disc transparencies collected monthly at three fixed sites (north YSI pole, pumphouse mouth, pumpstation) and two fixed pelagic fish sites (tandem fyke net, tandem mini-fyke net) had a mean of 44.80 cm during April-May and 59.76 cm during June-October in 2015.

KEA 2: Hydrology
Indicator: Water depth
Desired Range: Rate of water rise does not exceed 1.5 cm/day during the growing season (May-September); Water level fluctuations (rise) do not exceed 1 m total (May-September)
Goal Met: Yes; Yes

We only used water gauge data that was collected from the Emiquon pumphouse on a day to day basis and excluded all days when no data was collected which indicated a water rise ≥1.5 cm/day during the growing season (May-September) only 20.3% of the time in 2015. Increases in water level fluctuation did not exceed 1 m total May-September, 2015 (Figure 1).

KEA 3: Community Composition
Indicator: Percent natives vs. non-natives (invasives)
Desired Range: ≤10% non-natives, e.g., Eurasian watermilfoil *Myriophyllum spicatum*, curly-leaf pondweed *Potamogeton crispus*
Goal Met: No

Of the total aquatic vegetation (submersed, emergent, and floating-leaved) collected and observed at random sites during May-September, 2015, 24.31% was composed of non-native species: Eurasian watermilfoil (24.03%), curly-leaf pondweed (0.28%) (Table 3).

Emergent/ Floating-leaved Vegetation

KEA 4: Hydrology
Indicator: Stable water depth
Desired Range: Rate of water rise does not exceed 1.5 cm/day during the growing season (May-September); Water level fluctuations (rise) do not exceed 1 m total (May-September)
Goal Met: Yes; Yes

We only used water gauge data that was collected from the Emiquon pumphouse on a day to day basis and excluded all days when no data was collected which indicated a water rise ≥1.5 cm/day during the growing season (May-September) only 20.3% of the time in 2015. Increases in water level fluctuation did not exceed 1 m total May-September, 2015 (Figure 1).

KEA 5: Community Composition
Indicator: Percent natives vs. non-natives (invasives)
Desired Range: ≥90% dominance by native species
Goal Met: Yes

There were no non-native emergent or floating-leaved aquatic plant species observed in 2015 (Table 3).

Fish (Riverine and Backwater)

KEA 6: Fish Community Assemblages
Indicator: Number of native species populations
Desired Range: ≥25 native species represented (very good = ≥30 native species)
Goal Met: No

21 fish species (20 native and 1 non-native) were collected in 2015. (Table 4).

KEA 7: Fish Community Assemblages
Indicator: Number of native species populations
Desired Range: Native species ≥50% of number; Native species ≥50% of total biomass
Goal Met: Yes

Native fish species dominated the fish community representing 99.6% of the total catch and 90.5% of the total biomass in 2015 (Table 4).

KEA 8: Fish Community Composition
Indicator: Native predatory fish population
Desired Range: Very good = ≥100 largemouth bass *Micropterus salmoides* CPUE while electrofishing and bowfin *Amia calva* present, good = 75-100 largemouth bass CPUE, fair = 50-75 largemouth bass CPUE, poor = <50 largemouth bass CPUE
Goal Met: Yes (fair)

Largemouth bass was the dominant predator collected with a CPUE of 70/hour (550 total collected by all gears) using pulsed-DC boat electrofishing in 2015. Of the other potential predators, bowfin were present with a total of 45 collected along with 33 spotted gar *Lepisosteus oculatus*, 9 shortnose gar, and 3 longnose gar *Lepisosteus osseus* in 2015 (Table 4, 5). Criteria for largemouth bass CPUE being considered very good, good, fair, and poor was provided and used by Illinois Department of Natural Resources district fisheries biologists.

KEA 9: Spawning
Indicator: Water dissolved oxygen
Desired Range: 4 ppm oxygen (very good = ≥5 ppm and <200% saturation oxygen)
Goal Met: Yes (very good)

Monthly mean dissolved oxygen concentrations decreased from 9.2 ppm to 5.2 ppm during April-September, but increased to 8.6 ppm in October, 2015. All monthly mean dissolved oxygen concentrations were above the desired range in 2015 (Figure 2). Percent saturation was not measured in 2015.

KEA 10: Spawning
Indicator: Substrate variability and structure (large woody debris)
Desired Range: Subset representing several of the following types present: diverse shoreline, shade, fallen trees, open areas, and submerged plants (very good = all types present)
Goal Met: Yes (very good)

During 2015, there was an abundance of diverse shoreline habitats, open areas, and emergent, floating-leaved, and submersed aquatic vegetation. There was minimal shading by trees, but shade was made abundant by aquatic vegetation. Large woody debris was minimal.

KEA 11: Spawning
Indicator: Frequency of April/May connection to the river
Desired Range: Every three years for long-lived species, more frequently for short-lived species (very good = annual connection)
Goal Met: Yes, (good)

The Emiquon and coal creek levees were breeched resulting in a one-way connection during a historic flood event during April-May, 2013 (Emiquon and coal creek levees breached) and major flood event (nearly historic) May-July, 2015 (coal creek levee breached and pumphouse ditch levee sand boils occurred). Soon after, the river crested during these flood events, Emiquon was disconnected for the remainder of both years.

KEA 12: Nursery
Indicator: Accessibility for riverine fish
Desired Range: Presence of YOY freshwater drum *Aplodinotus grunniens*, goldeye *Hiodon alosoides*, bigmouth buffalo *Ictiobus cyprinellus* (very good = all of the above plus paddlefish *Polyodon spathula*)
Goal Met: Yes

Young-of-year (YOY) goldeye, bigmouth buffalo, and paddlefish were absent in our 2015 collections. However, we collected 1 YOY freshwater drum, as well as 1 adult freshwater drum and 1 adult bigmouth buffalo in 2015 (Table 4).

KEA 13: Nursery
Indicator: Native fish larvae
Desired Range: Dominance of native species
Goal Met: Yes

All fish were considered young-of-the-year (YOY) if they measured <100 mm in total length, except YOY unidentified *Lepomis* spp. (bluegill or pumpkinseed <40 mm) and included black crappie, bluegill, freshwater drum, gizzard shad, largemouth bass, longnose gar, pumpkinseed, unidentified *Ameiurus* spp., warmouth *Lepomis gulosus*, and yellow bullhead *Ameiurus natalis*. Other species including golden shiner and starhead topminnow *Fundulus dispar* may be considered adults at <100 mm. Native fish species dominated comprising 99.9% of the total YOY catch. Gizzard shad dominated the YOY catch and only one non-native larval fish species was collected in 2015, which consisted of 5 YOY common carp <100 mm (Figure 3-14).

KEA 14: Feeding
Indicator: Presence of adults in good condition
Desired Range: Mean relative weights 90-110%
Goal Met: Yes

We used published standard weight equations (Neumann, Guy, and Willis 2012, Schneider, Laarman, and Gowing 2000) to determine relative weights of fish species collected in 2015. Relative weight outliers were not included in our analyses and were most likely due to inaccurate weight measurements caused from wind and wave action. Mean relative weights of bluegill (103%), pumpkinseed (108%), warmouth (116%), black crappie (98%), white crappie (97%), largemouth bass (94%), bowfin (95%), and shortnose gar (98%) were well within the desired range. Other species including longnose gar (83%) and spotted gar (86%) were not within the desired range. Undesirable fish species, such as gizzard shad, had a mean relative weight of 94%. Non-native fish species including the common carp, had a mean relative weight of 106% (Table 10, Figure 15-24).

KEA 15: Feeding
Indicator: Distribution of abundant aquatic vegetation
Desired Range: 25-40% of the littoral area contains abundant vegetation during July-August
Goal Met: Yes

Out of all littoral (≤1.5 m water depth) aquatic vegetation and fish sampling sites during July-August, 100% displayed abundant aquatic vegetation in 2015 (Figure 25).

KEA 16: Over-wintering
Indicator: Percent of deep (oxygen rich) water
Desired Range: Water depth (5% >3 m, 10% 2-3 m, 25% 1-2 m, 60% <1 m); Dissolved oxygen (4.0-6.0 ppm at 2 m depth); Water temperature ≥1 °C (34 °F) at 2 m depth
Goal Met: Yes; Yes; Yes

Percent of deep water at Thompson and Flag lakes was calculated in 2015 using a bathymetry map at 434 ft asl (Figure 25). Approximately 15.4% of Thompson and Flag lakes showed water depths >3 m, 22.4% at 2-3 m, 39.3% at 1-2 m, and 22.9% at <1 m in 2015. Dissolved oxygen (ppm)/ temperature (°C) profiles were collected at ten fixed sites on Thompson and Flag lakes targeting shallow and deep water ditch areas during March 16, 2015 to evaluate over-wintering fish habitat (Figure 26). Dissolved oxygen concentrations at all ten fixed sites were well within or exceeded the desired range of 4.0-6.0 ppm at ≥2 m water depth and temperatures at all sites from surface to bottom exceeded the desired range of ≥1 °C at ≥2 m water depth (Figure 27).

KEA 17: Over-wintering
Indicator: Presence of backwater species
Desired Range: Water temperature ≥34 °F based on the needs of freshwater drum (Bodensteiner & Lewis 1992)
Goal Met: Yes

Water temperatures collected on March 16, 2015 at all fixed dissolved oxygen (ppm)/temperature (°C) profile sites (≥2 m water depth) were ≥34 °F (Figure 26, 27).

KEA 18: Over-wintering
Indicator: Concentrations of over-wintering native species
Desired Range: Maximum electrofishing CPUE (hot spots) for wintering native species exclusive of gizzard shad *Dorosoma cepedianum* and minnows >1500 individuals/hr and >5 species (very good = >2000/hr)
Goal Met: No

Two pulsed-DC electrofishing sites (15 minute run each) within the pumphouse ditch, as well as 1 fyke net (24 hour set), mini-fyke net (24 hour set), tandem fyke net (24 hour set), and tandem mini-fyke net (24 hour set) were set throughout Thompson Lake at fixed locations used in routine fish monitoring at Thompson Lake during March 25, 2015 to evaluate over-wintering fish habitat (Table 11).

KEA 19: Feeding
Indicator: Secondary production delivered to the river
Desired Range: Loading and timing of plankton, macroinvertebrates, and fish delivered to the river
Goal Met: No

The Emiquon and coal creek levees were breeched resulting in a one-way connection during a historic flood event during April-May, 2013 (Emiquon and coal creek levees breached) and major flood event (nearly historic) May-July, 2015 (coal creek levee breached and pumphouse ditch levee sand boils occurred). Soon after, the river crested during these flood events, Emiquon was disconnected for the remainder of both years and secondary production was not delivered to the river.

Discussion of KEA's

Submersed Aquatic Vegetation Assemblage

The majority of the water transparencies that were measured by a Secchi disc collected were within the desired range stated by KEA 1 (Secchi depths no less than half the maximum water depth when a site is ≤1.5 m deep). When 2015 results are compared to 2014, we see that the mean monthly Secchi disc transparencies during April-May were lower (not statistically different) in 2015 ($n = 20$, $df = 16$, $t = 1.66$, $p = 0.12$) and higher (not statistically different) during June-October in 2015 ($n = 50$, $df = 39$, $t = 0.80$, $p = 0.42$).

Daily water level fluctuations collected from the Emiquon pumphouse water gauge during 2014-2015 (May-September) were within the desired ranges stated by KEA 2 (rate of water rise does not exceed 1.5 cm/day; water rise does not exceed 1 m total) each year. Water level was higher in 2015 than previous years due to precipitation and a major flood event (nearly historic) and remained high throughout 2015. KEA 2 will become more applicable once a connection between the Emiquon Preserve and the Illinois River is established.

Although aquatic vegetation was dominated by native plant species, its total density still made up more than 10% non-native plant species. Eurasian watermilfoil and curly-leaf pondweed were the only non-native aquatic plant species collected. Eurasian watermilfoil was collected at more sites and at a higher density in 2015 (149 out of 210 sites; 24.03%) than in 2014 (139 out of 210 sites; 20.42%) (Figure 28). While Egeria, collected for the first time in 2014, was not collected or observed in 2015, Curly-leaf pondweed was collected at more sites and at a higher density in 2015 (5 out of 210 sites; 0.28%) than in 2014 (1 out of 210 sites; 0.03%) (Figure 29). Curly-leaf pondweed was collected at a much lower density than Eurasian watermilfoil. Also, curly-leaf pondweed seeds and vegetative parts are consumed by dabbling and diving ducks, as well as coots (Catling and Dobson 1985). If our non-native aquatic plant species collections continue to increase, additional management efforts will need to be considered.

Emergent/Floating-leaved Vegetation Assemblage

Water level and transparency are primary factors influencing vegetation. As discussed for KEA 2, daily water level fluctuations collected from the Emiquon pumphouse water gauge during 2014-2015 (May-September) were within the desired ranges stated by KEA 2 (rate of water rise does not exceed 1.5 cm/day; water rise does not exceed 1 m total) each year. Water level was higher in 2015 than previous years due to precipitation and a major flood event (nearly historic) and remained high throughout 2015. KEA 2 and 4 will become more applicable once a connection between the Emiquon Preserve and the Illinois River is established.

No invasive emergent or floating-leaved aquatic plant species were observed in 2015. All samples represented native species meeting the goal of KEA 5 (≥90% dominance by native species). American lotus was observed in 47 large beds within the Preserve (17 in the north portion, 7 in the middle portion, and 23 in the south portion) (Figure 30). Also, water shield was primarily observed throughout the northeast portion of Thompson Lake. We will continue to monitor the emergent and floating-leaved aquatic plant species closely for non-native species.

Fish (Riverine and Backwater) Assemblage

Native species comprised 99.6% of the total catch and 90.5% of the total biomass collected by all gears in 2015. We collected a total of 21 species (20 native, 1 non-native) of which bluegill was the most abundant with 2,878 fish comprising 41.44% of the total fish collected in 2015. Bluegill catch with lengths 40-291 mm in 2015 (2,878 fish) decreased from that of 2014 (3,413 fish). This decrease may be attributed to lower catchability of these fish with our gears due to higher water levels during 2015. Common carp were the only non-native fish species collected during April-October, 2015 ($n = 25$; April = 0, May = 5, June = 14, July = 1, August = 2, September = 2, and October = 1). Common carp were collected by all gears except the tandem fyke nets. Sixty-eight percent of common carp (17 out of 25) were collected with pulsed-DC boat electrofishing between April-October, 2015. Common carp lengths ranged from 20-731 mm and the catch rate was lower in 2015 than in 2014. All common carp collected at Emiquon were euthanized (Figure 31).

Gizzard shad dominated the total electrofishing catch with a CPUE of 208 fish/hr in 2015. Largemouth bass CPUE which were standardized to account for the difference in surface area due to changing water levels during 2014-2015, was fair with a total of 70 fish/hr while electrofishing in 2015 which was up (not statistically different) from a poor 44 fish/hr in 2014 ($n = 14$, $df = 12$, $t = 1.41$, $p = 0.18$). Largemouth bass was the dominant predator collected in 2015 (550 total collected by all gears), up from 522 in 2014. Bowfin were present in our collections and increased from 41 in 2014 to 45 in 2015. Spotted gar ($n = 33$), shortnose gar ($n = 9$), and longnose gar ($n = 3$) were present in our 2015 catches, as well as our 2014 catches. All bowfin collected ranged from 329-723 mm, spotted gar ranged from 341-608 mm, and shortnose gar ranged from 539-606 mm in total length. Increased catch rates of larger specimens for some of these species may be due to introduction by a historic flood event in 2013, major flood event in 2015, and recruitment since restoration.

Mean monthly dissolved oxygen concentrations exceeded the desired range in 2015 even though they decreased from 9.2 ppm to 5.2 ppm during April-September and then increased to 8.6 ppm in October. Diverse shoreline habitats, open areas, and emergent, floating-leaved, and submersed aquatic vegetation were abundant in 2015. There was minimal shading by trees, but shade from submersed, emergent, and floating-leaved aquatic plant species was made abundant. Large woody debris was minimal, but some were present near ditch and the old gravel pit areas in 2015. The Emiquon and coal creek levees were breeched resulting in a one-way connection during a historic flood event during April-May, 2013 (Emiquon and coal creek levees breached) and major flood event (nearly historic) May-July, 2015 (coal creek levee breached and pumphouse ditch levee sand boils occurred), which partially met the goal of KEA 11 (spawning habitat availability every/river connection every three years). Soon after, the river crested during these flood events, Emiquon was disconnected for the remainder of both years. Also, nursery habitats and accessibility for riverine fishes (KEA 12) was temporarily applicable during the 2013 and 2015 flood events.

Native fish larvae dominance (KEA 13) was addressed using total catch of YOY species. All fish were considered YOY if they measured <100 mm in total length, except YOY unidentified *Lepomis* spp. (bluegill or pumpkinseed <40 mm) and included black crappie, bluegill, freshwater drum, gizzard shad, largemouth bass, longnose gar, pumpkinseed, unidentified *Ameiurus* spp., warmouth, and yellow bullhead. Other species including golden shiner and starhead topminnow may be considered adults at <100 mm. YOY unidentified *Ameiurus* spp. most likely represent black or brown bullhead. Black and brown bullhead ≥10 mm can be distinguished from yellow bullhead by pigmented chin barbels (Simon and Wallus, 2004). Native fish species dominated comprising 99.9% of the total YOY catch. Gizzard shad dominated the YOY catch and only one non-native larval fish species was collected in 2015, which consisted of 5 YOY common carp <100 mm. Although young-of-year (YOY) goldeye, bigmouth buffalo, and paddlefish were absent in our 2015 collections, we collected one YOY freshwater drum, as well as 1 adult freshwater drum and 1 adult bigmouth buffalo in 2015, which may have been introduced from the 2013 and 2015 flood events.

Mean relative weights of native fish such as bluegill, pumpkinseed, warmouth, black crappie, white crappie, largemouth bass, bowfin, and shortnose gar were well within their desired ranges, while other fishes such as longnose gar and spotted gar were below their desired ranges in 2015. Undesirable fish species, such as gizzard shad, were within their desired range in 2015. Mean relative weight of non-native fish such as common carp displayed very good body condition (well within desired range) in 2015. The gizzard shad populations have induced a trophic cascade in other lentic ecosystems. The likely cascade would be that gizzard shad feed on zooplankton, which may control phytoplankton dynamics through predation. Common carp populations have been implicated in the degradation of similar shallow lake ecosystems. This is a result of their benthic feeding behaviors which uproots aquatic macrophytes and suspends sediments and nutrients into the water column. They may also decrease water clarity indirectly by reducing macroinvertebrate and zooplankton abundance, causing an increase in phytoplankton abundance (Bajer et al. 2009, Bajer and Sorensen 2010, Weber et al. 2010). Although both Gizzard shad and Common carp create reduced water transparency and primary productivity through different mechanisms such as suppression of zooplankton and sediment bioturbation, they both have the potential to be a strong negative impact on phytoplankton and zooplankton resources that indirectly support a healthy fish assemblage.

All littoral (≤1.5 m water depth) aquatic vegetation and fish sampling sites during July-August, 2014-2015 displayed abundant aquatic vegetation exceeding the desired range of KEA 15 (25-40% of the littoral area containing abundant vegetation for fish and wildlife.

The quality of over-wintering habitat, characterized by KEA's 16-19, is a key seasonal factor for maintaining a robust year-round native fish assemblage. KEA 16 was addressed on March 16, 2015. Dissolved oxygen (ppm)/ temperature (°C) profiles were collected at ten fixed sites targeting shallow and deep water ditch areas to evaluate over-wintering fish habitat. Percent of deep water was calculated using a bathymetry map and a water surface elevation of 434 ft asl. Our results suggest that Thompson and Flag lakes were made up of primarily deep water habitat. Dissolved oxygen concentrations at all ten fixed sites were well within or exceeded their desired ranges for dissolved oxygen and water temperature. Therefore, over-wintering habitat seems to be abundant.

Because over-wintering habitat is often limited in the backwaters of the Illinois River Valley, KEAs 17 and 18 are meant to evaluate this at Emiquon. Winter water temperature profiles were collected on March 16, 2015 to evaluate the quality of over-wintering fish habitat at ten fixed sites (≥2 m water depth). All ten were ≥34 °F from surface to bottom meaning that the goal of KEA 17 was met. In addition, a variety of fishing gears were set throughout Emiquon at fixed locations (shallow vs. deep water) used in routine fish monitoring during March 25, 2015 to evaluate over-wintering fish habitat. Although the goal of KEA 18 was not met in 2015, we believe that the deep water ditches are still serving as suitable over-wintering habitat for fishes. Most of the fish sampled for KEA 18 were collected in deep water. This suggested that fishes may be over-wintering in these deep water habitats. We could not quantify secondary production delivered to the Illinois River (KEA 19) because no pumping occurred from 2014-2015 and the connection during the flood events in 2013 and 2015 were only one-way (Illinois River to Emiquon).

Bycatch

Incidental turtle bycatch from Thompson Lake in 2015 consisted of 7 western painted turtles (*Chrysemys picta belli*) and 1 red-ear slider turtle (*Trachemys scripta elegans*). Turtle bycatch decreased from 11 individuals in 2014. All turtles were returned to the water after recording carapace length and sex.

We collected 2 unidentified mussel spp. (floater group, *Genus spp*.) while conducting aquatic vegetation monitoring in 2015. Both mussels (10 mm, 110 mm) was collected with an aquatic vegetation sampling rake while conducting aquatic vegetation surveys. All mussels collected were returned to the water. No snakes were captured in 2015.

Additional Information

The Illinois River experienced major flooding during May-July, 2015 that resulted in a one-way connection to the Emiquon Preserve. During this flood event, the coal creek levee overtopped which introduced floodwater to the north highway underpass into Emiquon. Also, floodwater was introduced into the Emiquon pumphouse ditch through sand boils in the levee. Soon after, the Illinois River crested and Emiquon was disconnected for the remainder of 2015. This was the second time that the Illinois River has been connected to the Emiquon Preserve since the early 1900's. The Nature Conservancy used seines to collect fishes coming into the Emiquon Preserve through the sand boils and over the coal creek levee. Additionally, the Illinois Natural History Survey's Illinois River Biological Station used fyke nets and mini-fyke nets to collect fishes coming over the coal creek levee and into the Emiquon Preserve. All fish collected and observed coming into the Emiquon Preserve were recorded (Table 12). All native fish that were stranded in pools of standing water outside the Emiquon Preserve were placed back into the water.

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Peer-Reviewed Publications

1. Andrew F. Caper, Hua Chen, Heath M. Hagy, and Michael J. Lemke. River and river floodplain restoration: The middle reach of the Illinois River. 2015. Chapter 7 in ecological restoration in the Midwest: Putting theory into practice. Society for Ecological Restoration and Island Press. *In Review*.

2. Andrew F. Casper, Todd D. VanMiddlesworth, and Nerissa N. McClelland. Diversity and abundance of submerged aquatic vegetation during the first eight years of restoration in a riverine floodplain wetland. 2015. Hydrobiologia. *In Review*.

3. Todd D. VanMiddlesworth, Nerissa N. McClelland, Greg G. Sass, Andrew F. Casper, Timothy W. Spier, and Mike J. Lemke. Biotic interactions and fish community succession during a large-scale floodplain restoration of The Nature Conservancy's Emiquon Preserve, Illinois, USA, 2007-2014. 2015. Hydrobiologia. *Published*.

4. Todd D. VanMiddlesworth, Greg G. Sass, Bradley A. Ray, Timothy W. Spier, John Lyons, Nerissa N. McClelland, and Andrew F. Casper. Food habits and relative abundances of bowfin, spotted gar, and largemouth bass: implications for controlling common carp. 2015. Hydrobiologia. *In Review*.

5. Todd D. VanMiddlesworth. Food habits of bowfin, spotted gar, and largemouth bass at The Nature Conservancy's Emiquon Preserve, Illinois; Reelfoot Lake, Tennessee; and four Wisconsin lakes: Implications for controlling common carp population growth. 2014. The school of graduate studies of Western Illinois University. Master's Thesis. *Published*.

6. Nerissa N. Michaels. Biomanipulation of the largemouth bass *Micropterus salmoides* population to control invasive species and eutrophication at The Nature Conservancy's Emiquon Preserve. 2011. The school of graduate studies of Western Illinois University. Master's Thesis. *Published*.

Popular Publications

1. Michael J. Lemke, Andrew F. Casper, Todd D. VanMiddlesworth, Heath M. Hagy, Jeffery Walk, Douglas Blodgett, and Keenan E. Dungey. Ecological Response of Floodplain Restoration to Flooding Disturbance: A Comparison of the Effects of Heavy and Light Flooding. 2014. Proceedings of the World Environmental & Water Resources Congress (American Society of Civil Engineers). *Published*.

2. Todd D. VanMiddlesworth, Greg G. Sass, and Timothy W. Spier. The feeding habits and relative abundances of bowfin, spotted gar, and largemouth bass: can native piscivores control invasive common carp? 2014. INHS Reports. *Published*.

3. Emiquon Partnership. Experience Emiquon Brochure. Havana Printing Company. 2013. *Published*.

Technical Reports

1. Todd D. VanMiddlesworth and Andrew F. Casper. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring Annual Report. INHS Technical Report 2015 (02).

2. Todd D. VanMiddlesworth and Andrew F. Casper. Short-term effects of initial flood disturbance on restoration projects. NSF RAPID Final Report. 2014.

3. Greg G. Sass, Bradley A. Ray, Todd D. VanMiddlesworth, Bryan Matthias, and John Epifanio. Modeling food web interactions and assessing feeding habits of bowfin, gar, and largemouth bass: a comparative study between The Nature Conservancy's Emiquon Preserve, Illinois and Reelfoot Lake, Tennessee. Contractual Final Report to The Nature Conservancy. 2014.

4. Levi E. Solomon, Richard M. Pendleton, Andrew F. Casper, Nathan T. Grider, and Rob Hilsabeck. Changes in the fish community at The Nature Conservancy's Merwin Preserve at Spunky Bottoms. INHS Technical Report 2014 (31).

5. Todd D. VanMiddlesworth and Andrew F. Casper. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring Annual Report. INHS Technical Report 2014 (11).

6. Todd D. VanMiddlesworth and Andrew F. Casper. The Nature Conservancy's Merwin Preserve Fish and Aquatic Vegetation Monitoring Annual Report. INHS Technical Report 2014 (12).

7. Todd D. VanMiddlesworth, Nerissa N. Michaels, and Andrew F. Casper. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring 6-year (2007-2012) Report. INHS Technical Report 2014 (01).

8. Todd D. VanMiddlesworth, Nerissa N. Michaels, and Andrew F. Casper. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring Annual Report. INHS Technical Report 2013 (02).

9. Todd D. VanMiddlesworth, Nerissa N. Michaels, Greg G. Sass. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring Annual Report. INHS Technical Report 2012 (01).

10. Todd D. VanMiddlesworth, Nerissa N. Michaels, Greg G. Sass. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring Annual Report. INHS Technical Report 2011 (06).

11. Nerissa N. Michaels and Greg G. Sass. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring Annual Report. INHS Technical Report 2010 (14).

12. Nerissa N. Michaels and Greg G. Sass. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring Annual Report. INHS Technical Report 2009 (10).

13. Nerissa N. Michaels and Greg G. Sass. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring Annual Report. INHS Technical Report 2008 (56).

Grants Funded

1. Michael J. Lemke, Andrew F. Caper, Keenan E. Dungey, and Heath M. Hagy. Short term effects of initial flood disturbance on restoration projects. 2013. NSF RAPID grant. $148,210.

2. Greg G. Sass, Bradley A. Ray, Todd D. VanMiddlesworth, Bryan Matthias, Rob Ahrens, Micheal S. Allen, and John Epifanio. Modeling food web interactions and assessing feeding habits of bowfin, gar, and largemouth bass: a comparative study between The Nature Conservancy's Emiquon Preserve, Illinois and Reelfoot Lake, Tennessee. 2013. $8,172.

3. Greg G. Sass, Bradley A. Ray, Todd D. VanMiddlesworth, Jack W. Grubaugh, and John D. Lyons. Feeding habits of bowfin, gar, and largemouth bass: a comparative study between The Nature Conservancy's Emiquon Preserve, Illinois; Reelfoot Lake, Tennessee, and four southeastern Wisconsin lakes. 2012. $6,350.

4. Greg G. Sass, Bradley A. Ray, Todd D. VanMiddlesworth, and Jack W. Grubaugh. Feeding habits of bowfin, gar, and largemouth bass: a comparative study between The Nature Conservancy's Emiquon Preserve, Illinois and Reelfoot Lake, Tennessee. 2011. $1,905.

Data Presentations at Meetings and Abstracts

1. Andrew F. Casper. Floodplain restoration in rivers: expectations, results, and controversies. Department of Biology, University of Dubuque, IA. October 2015. Platform Presentation.

2. Todd D. VanMiddlesworth, Andrew F. Casper, and Nerissa N. McClelland. Aquatic vegetation and fish community monitoring at The Nature Conservancy's Emiquon Nature Preserve. Biennial Governor's Conference on the Management of the Illinois River System, Peoria, IL. October 2015. Platform Presentation.

3. Andrew F. Casper. Successional dynamics of submerged aquatic vegetation – restoration, resiliency, and response to flooding. Biennial Symposium of the International Society for River Science, La Crosse, WI. August 2015. Platform Presentation.

4. Todd D. VanMiddlesworth and Andrew F. Casper. The Nature Conservancy's Emiquon Preserve: aquatic vegetation and fish community monitoring, 2007-2014. Biennial Symposium of the International Society for River Science, La Crosse, WI. August 2015. Poster Presentation.

5. Todd D. VanMiddlesworth, Greg G. Sass, Timothy W. Spier, Bradley A. Ray, and Andrew F. Casper. Biocontrol of invasive fish species using native predators in a large floodplain restoration. Biennial Symposium of the International Society for River Science, La Crosse, WI. August 2015. Platform Presentation.

6. Andrew F. Casper. Floodplain restoration in rivers: expectations, results, and controversies. Sam Parr Biological Field Station, Kinmundy, IL. June 2015. Platform Presentation.

7. Todd D. VanMiddlesworth and Andrew F. Casper. The Nature Conservancy's Emiquon Preserve: aquatic vegetation and fish community monitoring, 2007-2014. Illinois American Fisheries Society Meeting, Grafton, IL. March 2015. Poster Presentation.

8. Sally McClure, Tharran Hobson, Denim Perry, Todd D. VanMiddlesworth, Levi E. Solomon, Richard M. Pendleton, and Andrew F. Casper. The Nature Conservancy's Merwin Preserve: fish community monitoring, 1999-2014. Emiquon Science Symposium, Lewistown, IL. February 2015. Poster Presentation.

9. Todd D. VanMiddlesworth and Andrew F. Casper. The Nature Conservancy's Emiquon Preserve: aquatic vegetation and fish community monitoring, 2007-2014. Emiquon Science Symposium, Lewistown, IL. February 2015. Poster Presentation.

10. Todd D. VanMiddlesworth, Andrew F. Casper, and Nerissa N. McClelland. Aquatic vegetation and fish community response to restoration at The Nature Conservancy's Emiquon Preserve: implications for floodplain restoration and management. Midwest Fish and Wildlife Conference, Indianapolis, IN. February 2015. Platform Presentation.

11. Andrew F. Casper. Expectations for biotic responses to floodplain restoration in large rivers: insights from the Emiquon and Merwin experiences. Department of Zoology Seminar Series, Southern Illinois University Carbondale, IL. December 2014. Platform Presentation.

12. Andrew F. Casper. Expectations for biotic responses to floodplain restoration in large rivers: insights from the Emiquon and Merwin experiences. Department of Aquaculture and Applied Sciences, Auburn University, AL. October 2014. Platform Presentation.

13. Heath M. Hagy, Chris Hine, Aaron Yetter, Michelle Horath, Joshua Osborn, Andrew Casper, and Todd D. Vanmiddlesworth. Biotic responders to floodplain connectivity: The tradeoffs. Illinois Water Conference, Urbana, IL. October 2014. Platform Presentation.

14. Todd D. VanMiddlesworth, Andrew F. Casper, Heath M. Hagy, Michael J. Lemke, and Keenan E. Dungey. Fish and aquatic vegetation response to different flood regimes at The Nature Conservancy's Emiquon and Merwin Preserves: Implications for floodplain connection. Illinois Water Conference, Urbana, IL. October 2014. Platform Presentation.

15. Todd D. VanMiddlesworth, Greg G. Sass, Timothy W. Spier, Bradley A. Ray, and Andrew F. Casper. The feeding habits and relative abundances of bowfin, spotted gar, and largemouth bass: Can native piscivores control invasive common carp? National American Fisheries Society, Quebec City, Canada. August 2014. Platform Presentation.

16. Michael J. Lemke, Andrew F. Casper, Todd D. VanMiddlesworth, Heath M. Hagy, Jeffery Walk, Douglas Blodgett, and Keenan E. Dungey. Ecological response of floodplain restoration to flooding disturbance: a comparison of the effects of heavy and light flooding. Proceedings of the world environmental and water resources congress (American society of civil engineers), Portland, OR. June 2014. Platform Presentation.

17. Todd D. VanMiddlesworth, Greg G. sass, Timothy W. Spier, and Bradley A. Ray. The feeding habits and relative abundances of bowfin, spotted gar, and largemouth bass: Can native piscivores control invasive common carp? Mississippi River Research Consortium, La Crosse, WI. April 2014. Poster Presentation.

18. Andrew F. Casper, Heath M. Hagy, Michael J. Lemke, Todd D. VanMiddlesworth, Jeffrey Walk, and Douglas Blodgett. Ecological response of floodplain restoration to flooding disturbance: A comparison of the effects of heavy and light flooding. Emiquon Science Symposium, Lewistown, IL. March 2014. Platform Presentation.

19. Andrew F. Casper, Heath M. Hagy, Todd D. VanMiddlesworth, Nerissa N. McClelland, Christopher Hine, Aaron Yetter, Michelle Horath, Randolph Smith, and Joshua Stafford. Vegetation response to restoration and management of Emiquon Preserve, 2007-2012. Emiquon Science Symposium, Lewistown, IL. March 2014. Platform Presentation.

20. Todd D. VanMiddlesworth, Nerissa N. McClelland, and Andrew F. Casper. Emiquon fish community response to restoration, 2007-2013. Emiquon Science Symposium, Lewistown, IL. March 2014. Platform Presentation.

21. Todd D. VanMiddlesworth, Greg G. Sass, Timothy W. Spier, and Bradley A. Ray. The feeding habits and relative abundances of bowfin, spotted gar, and largemouth bass: Can native piscivores control invasive common carp? Emiquon Science Symposium, Lewistown, IL. March 2014. Poster Presentation.

22. Madeleine M. Young, Levi E. Solomon, Rich M. Pendleton, and Andrew F. Casper. The status and trends of bluegill in the La Grange reach of the Illinois River with comparisons to a restored, disconnected floodplain. Emiquon Science Symposium, Lewistown, IL. March 2014. Poster Presentation.

23. Todd D. VanMiddlesworth, Greg G. Sass, Timothy W. Spier, and Bradley A. Ray. The feeding habits of native piscivorous fishes: Can they control common carp? Illinois American Fisheries Society Meeting, Bloomington, IL. March 2014. Poster Presentation.

24. Andrew F. Casper, Heath M. Hagy, Todd D. VanMiddlesworth, Nerissa N. Michaels, Christopher Hine, Aaron Yetter, Michelle Horath, Randolph Smith and Joshua Stafford. Vegetation response to restoration and management of Emiquon Preserve, 2007–2012. Society for Ecological Restoration World Conference on Ecological Restoration, Madison, WI. October 2013. Platform Presentation.

25. Todd D. VanMiddlesworth, Nerissa N. McClelland, and Andrew F. Casper. Emiquon Fish community Response to 6 Years of Restoration. Society for Ecological Restoration World Conference on Ecological Restoration, Madison, WI. October 2013. Platform Presentation.

26. Todd D. VanMiddlesworth, Greg G. Sass, Timothy W. Spier, and Bradley A. Ray. Relative abundance and feeding habits of native piscivorous fishes at The Nature Conservancy's Emiquon Preserve and Reelfoot Lake: Can native fish control common carp? Society for Ecological Restoration World Conference on Ecological Restoration, Madison, WI. October 2013. Poster Presentation.

27. Todd D. VanMiddlesworth, Nerissa N. Michaels, Greg G. Sass, Bradley A. Ray, and Timothy W. Spier. Is there a native recipe for controlling common carp? Annual Meeting of the American Fisheries Society, Little Rock, AR. September 2013. Platform Presentation.

28. Nerissa N. Michaels, Greg G. Sass, and Timothy W. Spier. The biomanipulation of the largemouth bass *Micropterus salmoides* population to control eutrophication and invasive species at The Nature Conservancy's Emiquon Preserve. Annual Emiquon Science Symposium, Dickson Mounds Museum, Lewistown, IL. March 2013. Poster Presentation.

29. Todd D. VanMiddlesworth, Nerissa N. Michaels, and Andrew F. Casper. The Nature Conservancy's Emiquon Preserve: importance of aquatic restoration to nature and people. Annual Emiquon Science Symposium, Dickson Mounds Museum, Lewistown, IL. March 2013. Platform Presentation.

30. Todd D. VanMiddlesworth, Greg G. Sass, Timothy W. Spier, and Bradley A. Ray. Relative abundance and feeding habits of bowfin, spotted gar, and largemouth bass at The Nature Conservancy's Emiquon Preserve and Reelfoot Lake: Can native fish control common carp? Annual Emiquon Science Symposium, Dickson Mounds Museum, Lewistown, IL. March 2013. Poster Presentation.

31. Todd D. Vanmiddlesworth, Greg G. Sass, Timothy W. Spier, and Bradley A. Ray. Relative abundance and feeding habits of bowfin, spotted gar, and largemouth bass at The Nature Conservancy's Emiquon Preserve and Reelfoot Lake: Can native fish species control invasive common carp? Prairie Lightning Mini-Symposium, Urbana, IL. September 2012. Poster Presentation.

32. Todd D. VanMiddlesworth, Greg G. Sass, Timothy W. Spier, and Bradley A. Ray. Relative abundance and feeding habits of bowfin, spotted gar, and largemouth bass at The Nature Conservancy's Emiquon Preserve and Reelfoot Lake: Can native fish species control invasive common carp? Annual Meeting of the American Fisheries Society, St. Paul, MN. August 2012. Poster Presentation.

33. Todd D. VanMiddlesworth, Greg G. Sass, Timothy W. Spier, and Bradley A. Ray. Relative abundance and feeding habits of bowfin, spotted gar, and largemouth bass at The Nature Conservancy's Emiquon Preserve and Reelfoot Lake: can native fish species control invasive common carp? Annual Meeting of the Mississippi River Research Consortium. Lacrosse, WI. April 2012. Platform Presentation.

34. Todd D. VanMiddlesworth, Nerissa N. Michaels, Greg G. Sass, and Timothy W. Spier. The Fishes of Thompson Lake. Science Lecture Series, Dickson Mounds Museum, Lewistown, IL. March 2012. Platform Presentation.

35. Nerissa N. Michaels and Todd D. VanMiddlesworth. Aquatic vegetation monitoring at The Nature Conservancy's Emiquon Preserve, 2007-2011. Annual Emiquon Science Symposium, Dickson Mounds Museum, Lewistown, IL. March 2012. Platform Presentation.

36. Todd D. VanMiddlesworth, Nerissa N. Michaels, and Greg G. Sass. The Nature Conservancy's Emiquon Preserve: Fish Community Monitoring, 2007-2011. Annual Emiquon Science Symposium, Dickson Mounds Museum, Lewistown, IL. March 2012. Platform Presentation.

37. Nerissa N. Michaels, Greg G. Sass, and Timothy W. Spier. The biomanipulation of the largemouth bass *Micropterus salmoides* population to control invasive species and eutrophication at The Nature Conservancy's Emiquon Preserve. Annual Meeting of the American Fisheries Society, Seattle, WA. September 2011. Poster Presentation.

38. Nerissa N. Michaels, Greg G. Sass, and Timothy W. Spier. The biomanipulation of the largemouth bass *Micropterus salmoides* population to control invasive species and eutrophication at The Nature Conservancy's Emiquon Preserve. Annual Meeting of the Midwest-Great Lakes Society for Ecological Restoration Chapter Meeting, Springfield, IL. April 2011. Platform Presentation.

39. Nerissa N. Michaels, Greg G. Sass, and Timothy W. Spier. The emerging food web in a newly restored floodplain lake: The Nature Conservancy's Emiquon Preserve. Annual Meeting of the Illinois Chapter of the American Fisheries Society, Peoria, IL. March 2011. Platform Presentation.

40. Todd D. VanMiddlesworth, Greg G. Sass, Timothy W. Spier, and Nerissa N. Michaels. Physiological refuges from predation based on dissolved oxygen concentrations at The Nature Conservancy's Emiquon Preserve. Western Illinois University, Biological Applications in GIS, BIOL 452 (G). May 2011. Poster Presentation.

41. Todd D. VanMiddlesworth, Greg G. Sass, Timothy W. Spier, Nerissa N. Michaels, Michael A. McClelland, Stephen M. Tyszko, and Thad R. Cook. Aquatic vegetation and fish community monitoring at The Nature Conservancy's Emiquon Preserve: testing for regime shifts in ecosystem state. Annual Meeting of the Mississippi River Research Consortium. Lacrosse, WI. April 2011. Poster Presentation.

42. Todd D. VanMiddlesworth, Greg G. Sass, Timothy W. Spier, Nerissa N. Michaels, Michael A. McClelland, Stephen M. Tyszko, and Thad R. Cook. Aquatic vegetation and fish community monitoring at The Nature Conservancy's Emiquon Preserve: testing for regime shifts in ecosystem state. Annual Meeting of the Midwest-Great Lakes SER Chapter, University of Illinois Springfield, IL. April 2011. Platform Presentation.

43. Nerissa N. Michaels, Greg G. Sass, and Timothy W. Spier. The emerging food web in a newly restored floodplain lake: The Nature Conservancy's Emiquon Preserve. Annual Meeting of the American Fisheries Society, Pittsburgh, PA. September 2010. Platform Presentation.

44. Nerissa N. Michaels, Greg G. Sass, and Timothy W. Spier. The Nature Conservancy's Emiquon Preserve: the emerging food web in a newly restored floodplain lake. Annual Meeting of the Mississippi River Research Consortium. Lacrosse, WI. April 2010. Platform Presentation.

45. Nerissa N. Michaels, Greg G. Sass, and Timothy W. Spier. The Nature Conservancy's Emiquon Preserve: the emerging food web in a newly restored floodplain lake. Graduate Student Research Symposium, WIU, Macomb, IL. April 2010. Platform Presentation.

46. Nerissa N. Michaels, Greg G. Sass, and Timothy W. Spier. The Nature Conservancy's Emiquon Preserve: the emerging food web in a newly restored floodplain lake. Annual Emiquon Science Symposium, Dickson Mounds Museum, Lewistown, IL. March 2010. Platform Presentation.

47. Nerissa N. Michaels, Greg G. Sass, Timothy W. Spier, Kevin S. Irons, Michael A. McClelland, Timothy M. O'Hara, and Thad R. Cook. The Nature Conservancy's Emiquon Preserve: resetting and restoring Thompson Lake. Annual Meeting of the Illinois Chapter of the American Fisheries Society Rend Lake Resort, IL. February 2010. Poster Presentation

48. Nerissa N. Michaels, Greg G. Sass, Timothy M. O'Hara, Michael A. McClelland, Kevin S. Irons, and Thad R. Cook. The Nature Conservancy's Emiquon Preserve: fish and aquatic vegetation monitoring, 2007-2009. Annual Midwest Fish and Wildlife Conference, Springfield, IL. December 2009. Platform Presentation.

49. Nerissa N. Michaels, Greg G. Sass, Timothy W. Spier, Kevin S. Irons, Michael A. McClelland, Timothy M. O'Hara, and Thad R. Cook. The Nature Conservancy's Emiquon Preserve: resetting and restoring Thompson Lake. Annual Meeting of the American Fisheries Society, Nashville, TN. September 2009. Poster Presentation.

50. Nerissa N. Michaels, Greg G. Sass, Timothy W. Spier, Kevin S. Irons, Michael A. McClelland, Timothy M. O'Hara, and Thad R. Cook. The Nature Conservancy's Emiquon Preserve: resetting and restoring Thompson Lake. UIS Emiquon Field Station Public Lecture. May 2009. Platform Presentation.

51. Nerissa N. Michaels, Greg G. Sass, Timothy W. Spier, Kevin S. Irons, Michael A. McClelland, Timothy M. O'Hara, and Thad R. Cook. The Nature Conservancy's Emiquon Preserve: resetting and restoring Thompson Lake. Annual Meeting of the Mississippi River Research Consortium, Lacrosse, WI. May 2009. Platform Presentation.

52. Nerissa N. Michaels, Greg G. Sass, Thad. R. Cook, Timothy M. O'Hara, Kevin S. Irons, and Michael A. McClelland. The Nature Conservancy's Emiquon Preserve; fish and aquatic vegetation monitoring, 2007-2008. Emiquon Science Meeting, Dickson Mounds Museum, Lewistown, IL. March 2009. Platform Presentation.

53. Nerissa N. Michaels. Predicting highly turbid zones as a limiting factor for aquatic vegetation growth using GIS and wind fetch at The Nature Conservancy's Emiquon Preserve. Western Illinois University, Biological Applications in GIS, BIOL 452 (G). May 2008. Poster Presentation.

54. Nerissa N. Michaels and Greg G. Sass. Emiquon fish and vegetation sampling 2008. Emiquon Science Meeting, Dickson Mounds Museum, Lewistown, IL. April 2008. Platform Presentation.

55. Nerissa N. Michaels, Greg G. Sass, Timothy W. Spier, Thad R. Cook, Timothy M. O'Hara, Kevin S. Irons, Michael A. McClelland, and Matt R. Stroub. The Nature Conservancy's Emiquon Preserve: resetting and restoring the Thompson Lake fish community. Annual Meeting of the Mississippi River Research Consortium, Dubuque, IA. April 2008. Poster Presentation.

56. Greg G. Sass, Kevin S. Irons, Timothy M. O'Hara, Thad R. Cook, Michael A. McClelland, Nerissa N. Michaels, Melissa L. Smith, and Matt R. Stroub. Active versus passive management of common and grass carp for backwater lake native fish restoration: a case study from the Nature Conservancy's Emiquon Preserve. Annual meeting of the Mississippi River Research Consortium, La Crosse, WI. April 2007. Platform Presentation.

57. Greg G. Sass, Kevin S. Irons, Timothy M. O'Hara, Thad R. Cook, Michael A. McClelland, Nerissa N. Michaels, Melissa L. Smith, and Matt R. Stroub. Active versus passive management of common and grass carp for backwater lake native fish restoration: a case study from the Nature Conservancy's Emiquon Preserve. Annual meeting of the Illinois Chapter of the American Fisheries Society, Shelbyville, IL. February 2007. Platform Presentation.

Outreach, Inter- and Intra-agency Collaboration

1. Discussed Emiquon fish and aquatic vegetation monitoring with WIU conservation biology class. September 2015.

2. Taught TNC interns about Emiquon fish and aquatic vegetation monitoring while they assisted with the field work. June-July 2015.

3. Assisted University of Illinois at Urbana-Champaign Associate Fisheries Biologist with bowfin and gar spp. population estimate research at the Emiquon Preserve

4. Presented "The Nature Conservancy's Emiquon Preserve: fish and aquatic vegetation monitoring, 2007-2014" to visiting scientist Dr. Scott Collin. March 2015.

5. Discussed and transferred Emiquon fish and aquatic vegetation data to UIS graduate student. October 2014.

6. Conducted electrofishing demonstration on TNC's Emiquon Preserve for WIU conservation biology class. October 2014.

7. Conducted electrofishing demonstration on TNC's Emiquon Preserve for U of I conservation biology class. October 2014.

8. Participated in interview with UIS graduate student discussing research that has been conducted at Emiquon. October 2014.

9. Participated with PBS film crew discussing our work at EMQ for Thompson Lake Exhibit at Dickson Mounds Museum. September 2014.

10. Taught TNC interns about Emiquon fish and aquatic vegetation monitoring while they assisted with the field work. June-July 2014.

11. Interviewed by film crew at the Emiquon pumphouse regarding the Emiquon reconnection. May 2014.

12. Presented "The Nature Conservancy's Emiquon Preserve" at invited lecture to PEO womens society. May 2014.

13. Participated in Emiquon job shadow/interview with UIS undergraduate student. April 2014.

14. Assisted U.S. Fish and Wildlife Service fisheries technicians with silver carp telemetry research. September 2013.

15. Conducted electrofishing demonstration on TNC's Emiquon Preserve for TNC's LEAF Interns. July 2013.

16. Conducted electrofishing demonstration and presentation on TNC's Emiquon Preserve for Spoon River College professor and ecology students. July 2013.

17. Taught TNC interns about Emiquon fish and aquatic vegetation monitoring while they assisted with the field work. June-July 2013.

18. Discussed and transferred Emiquon aquatic vegetation data to UIS graduate student. May 2013.

19. Conducted a fish session at the Emiquon Conservation Academy for high school students with UIS professor. September 2012.

20. Taught Dickson Mounds Museum employee about Emiquon fish and aquatic vegetation monitoring while they assisted with the field work. September 2012.

21. Assisted with lakeside setup at the Emiquon Complex Ramsar dedication ceremony. August 2012.

22. Conducted electrofishing demonstration and presentation on TNC's Emiquon Preserve for Spoon River College professor and ecology students. July 2012.

23. Taught TNC interns about Emiquon fish and aquatic vegetation monitoring while they assisted with the field work. June and July 2012.

24. Conducted an Emiquon master naturalist course with UIS graduate student. October 2011.

25. Taught members from the Americorps about Emiquon fish and aquatic vegetation monitoring while they assisted with the field work. September-October 2011.

26. Conducted a fish diet analysis and Emiquon research discussion lab for Springfield, IL Eagle Scouts. July 2011.

27. Assisted Dr. Richard Sparks intern with Emiquon aquatic vegetation field sampling and research. June 2011.

28. Assisted with Emiquon Preserve informational booth at the Emiquon grand opening. June 2011.

29. Conducted electrofishing demonstration and presentation on TNC's Emiquon Preserve for Pontiac, IL gifted school students. May 2011.

30. Conducted electrofishing demonstration and presentation on TNC's Emiquon Preserve for RHS high school students. May 2011.

31. Attended and proposed graduate research goals at the Emiquon Science Workshop at Dickson Mounds Museum, Lewistown, IL. January 2011.

32. Conducted electrofishing demonstration and presentation on TNC's Emiquon Preserve for RHS high school students. May 2010.

33. Conducted Emiquon Preserve tour for WIU graduate students and professor. April 2010.

34. Conducted Thompson Lake History booth at Fulton County Soil and Water Conservation District "Conservation Days" in Lewistown, IL. September 2009.

35. Conducted field demonstrations and informational presentations to voyager canoe riders from the electrofishing boat on Thompson Lake for The Nature Conservancy's 2009 Lakefest. August 2009.

36. Conducted Illinois Natural History Survey, Illinois River Biological Station booth at the INHS 150th anniversary celebration providing information on aquatic ecology including information regarding The Nature Conservancy's Emiquon Preserve. Champaign, IL. September 2008.

37. Nerissa N. Michaels. The Nature Conservancy's Emiquon Preserve. Central Christian Church Fish Fry, Havana, IL. August 2008. Presentation.

38. Assisted photographers Brian Skerry and Mauricio Handler with a tour of Thompson Lake and aquatic research at the The Nature Conservancy's Emiquon Preserve. July 2008.

Table 1. Dates of aquatic vegetation and fish sampling at Emiquon in 2015.

Month	Aquatic Vegetation Sampling Dates	Fish Sampling Dates
April		04/21/2015, 04/27/2015-04/28/2015
May	05/18/2015-05/19/2015	05/21/2015, 05/26/2015-05/27/2015
June	06/30/2015, 07/02/2015 *Included as June sampling	06/23/2015-06/24/2015, 06/29/2015
July	07/28/2015-07/31/2015	07/21/2015-07/23/2015
August	08/11/2015, 08/13/2015-08/14/2015	08/17/2015-08/18/2015
September	09/22/2015-09/23/2015	09/24/2015-09/25/2015, 09/28/2015
October		10/13/2015, 10/22/2015-10/23/2015

Table 2. Total number of vegetated and un-vegetated random aquatic vegetation sampling sites at Emiquon in 2015.

	North/Middle/South
Vegetated	175
Un-vegetated	35
Total	210

Table 3. List showing aquatic plant species observed and/or collected and percent composition of vegetated random sites at Emiquon in 2015; * represents non-native species.

	Common name	Scientific name	Family	%
	coontail	*Ceratophyllum demersum*	Ceratophyllaceae	25.25
*	Eurasian watermilfoil	*Myriophyllum spicatum*	Haloragaceae	24.03
	American pondweed	*Potamogeton nodosus*	Potamogetonaceae	19.04
	sago pondweed	*Stuckenia pectinata*	Potamogetonaceae	9.90
	leafy pondweed	*Potamogeton foliosus*	Potamogetonaceae	6.52
	southern naiad	*Najas guadalupensis*	Najadaceae	5.39
	brittle naiad	*Najas minor*	Najadaceae	4.23
	American elodea	*Elodea canadensis*	Hydrocharitaceae	1.39
	unidentified *Lemna* spp.	*Lemna spp.*	Lemnaceae	1.30
	Illinois pondweed	*Potamogeton Illinoensis*	Potamogetonaceae	0.94
	unidentified *Typha* spp.	*Typha* spp.	Typhaceae	0.94
	creeping water primrose	*Jussiaea lutea*	Onagraceae	0.40
	American lotus	*Nelumbo lutea*	Nelumbonaceae	0.34
*	curly-leaf pondweed	*Potamogeton crispus*	Potamogetonaceae	0.28
	water stargrass	*Zosterella dubia*	Pontederiaceae	0.06

Total species	**15**
Total families	**10**

Table 4. List showing total catch and percent composition for each fish species collected at Emiquon in 2015; * represents non-native species.

	Common name	Scientific name	Family	No.	%
	bluegill	*Lepomis macrochirus*	Centrarchidae	2878	41.44
	gizzard shad	*Dorosoma cepedianum*	Clupeidae	1480	21.31
	black crappie	*Pomoxis nigromaculatus*	Centrarchidae	878	12.64
	largemouth bass	*Micropterus salmoides*	Centrarchidae	550	7.92
	pumpkinseed	*Lepomis gibbosus*	Centrarchidae	338	4.87
	unidentified *Lepomis* spp.	*Lepomis* spp.	Centrarchidae	290	4.18
	golden shiner	*Notemigonus crysoleucas*	Cyprinidae	285	4.10
	white crappie	*Pomoxis annularis*	Centrarchidae	51	0.73
	warmouth	*Lepomis gulosus*	Centrarchidae	50	0.72
	bowfin	*Amia calva*	Amiidae	45	0.65
	spotted gar	*Lepisosteus oculatus*	Lepisosteidae	33	0.48
*	common carp	*Cyprinus carpio*	Cyprinidae	25	0.36
	shortnose gar	*Lepisosteus platostomus*	Lepisosteidae	9	0.13
	unidentified *Ameiurus* spp.	*Ameiurus* spp.	Ictaluridae	9	0.13
	starhead topminnow	*Fundulus dispar*	Fundulidae	5	0.07
	brown bullhead	*Ameiurus nebulosus*	Ictaluridae	4	0.06
	yellow bullhead	*Ameiurus natalis*	Ictaluridae	4	0.06
	longnose gar	*Lepisosteus osseus*	Lepisosteidae	3	0.04
	freshwater drum	*Aplodinotus grunniens*	Sciaenidae	2	0.03
	grass pickerel	*Esox americanus*	Esocidae	2	0.03
	black bullhead	*Ameiurus melas*	Ictaluridae	1	0.01
	bigmouth buffalo	*Ictiobus cyprinellus*	Catostomidae	1	0.01
	channel catfish	*Ictalurus punctatus*	Ictaluridae	1	0.01
	bluegill x pumpkinseed	*Lepomis macrochirus* x *Lepomis gibbosus*	Centrarchidae	1	0.01

Total number	**6945**
Total species	**21**
Total families	**10**

Table 5. List showing total catch, percent composition, and mean catch per unit effort (No./Hr) for each fish species collected while pulsed-DC boat electrofishing at Emiquon in 2015; * represents non-native species.

	Common name	Scientific name	Family	No.	%	No./Hr
	gizzard shad	*Dorosoma cepedianum*	Clupeidae	1456	53.10	208.00
	largemouth bass	*Micropterus salmoides*	Centrarchidae	492	17.94	70.29
	bluegill	*Lepomis macrochirus*	Centrarchidae	392	14.30	56.00
	golden shiner	*Notemigonus crysoleucas*	Cyprinidae	241	8.79	34.43
	black crappie	*Pomoxis nigromaculatus*	Centrarchidae	54	1.97	7.71
	unidentified *Lepomis* spp.	*Lepomis* spp.	Centrarchidae	33	1.20	4.71
	pumpkinseed	*Lepomis gibbosus*	Centrarchidae	25	0.91	3.57
*	common carp	*Cyprinus carpio*	Cyprinidae	17	0.62	2.43
	bowfin	*Amia calva*	Amiidae	11	0.40	1.57
	warmouth	*Lepomis gulosus*	Centrarchidae	8	0.29	1.14
	white crappie	*Pomoxis annularis*	Centrarchidae	5	0.18	0.71
	starhead topminnow	*Fundulus dispar*	Fundulidae	3	0.11	0.43
	grass pickerel	*Esox americanus*	Esocidae	2	0.07	0.29
	bigmouth buffalo	*Ictiobus cyprinellus*	Catostomidae	1	0.04	0.14
	spotted gar	*Lepisosteus oculatus*	Lepisosteidae	1	0.04	0.14
	yellow bullhead	*Ameiurus natalis*	Ictaluridae	1	0.04	0.14

Total number	**2742**
Total species	**15**
Total families	**9**

Table 6. List showing total catch, percent composition, and mean catch per unit effort (No./24 Hrs) for each fish species collected with fyke nets at Emiquon in 2015; * represents non-native species.

	Common name	Scientific name	Family	No.	%	No./24 Hrs
	bluegill	*Lepomis macrochirus*	Centrarchidae	1371	70.74	48.96
	black crappie	*Pomoxis nigromaculatus*	Centrarchidae	217	11.20	7.75
	pumpkinseed	*Lepomis gibbosus*	Centrarchidae	178	9.18	6.36
	white crappie	*Pomoxis annularis*	Centrarchidae	38	1.96	1.36
	spotted gar	*Lepisosteus oculatus*	Lepisosteidae	30	1.55	1.07
	bowfin	*Amia calva*	Amiidae	28	1.44	1.00
	largemouth bass	*Micropterus salmoides*	Centrarchidae	19	0.98	0.68
	gizzard shad	*Dorosoma cepedianum*	Clupeidae	18	0.93	0.64
	golden shiner	*Notemigonus crysoleucas*	Cyprinidae	12	0.62	0.43
	shortnose gar	*Lepisosteus platostomus*	Lepisosteidae	8	0.41	0.29
	warmouth	*Lepomis gulosus*	Centrarchidae	7	0.36	0.25
	brown bullhead	*Ameiurus nebulosus*	Ictaluridae	3	0.15	0.11
*	common carp	*Cyprinus carpio*	Cyprinidae	3	0.15	0.11
	longnose gar	*Lepisosteus osseus*	Lepisosteidae	2	0.10	0.07
	black bullhead	*Ameiurus melas*	Ictaluridae	1	0.05	0.04
	freshwater drum	*Aplodinotus grunniens*	Sciaenidae	1	0.05	0.04
	unidentified *Lepomis* spp.	*Lepomis* spp.	Centrarchidae	1	0.05	0.04
	yellow bullhead	*Ameiurus natalis*	Ictaluridae	1	0.05	0.04

Total number	**1938**
Total species	**17**
Total families	**7**

Table 7. List showing total catch, percent composition, and mean catch per unit effort (No./24 Hrs) for each fish species collected with mini-fyke nets at Emiquon in 2015; * represents non-native species.

	Common name	Scientific name	Family	No.	%	No./24 Hrs
	bluegill	*Lepomis macrochirus*	Centrarchidae	593	49.83	21.18
	unidentified *Lepomis* spp.	*Lepomis* spp.	Centrarchidae	232	19.50	8.29
	black crappie	*Pomoxis nigromaculatus*	Centrarchidae	189	15.88	6.75
	pumpkinseed	*Lepomis gibbosus*	Centrarchidae	73	6.13	2.61
	warmouth	*Lepomis gulosus*	Centrarchidae	35	2.94	1.25
	golden shiner	*Notemigonus crysoleucas*	Cyprinidae	25	2.10	0.89
	largemouth bass	*Micropterus salmoides*	Centrarchidae	21	1.76	0.75
	unidentified *Ameiurus* spp.	*Ameiurus* spp.	Ictaluridae	5	0.42	0.18
	bowfin	*Amia calva*	Amiidae	4	0.34	0.14
	gizzard shad	*Dorosoma cepedianum*	Clupeidae	4	0.34	0.14
*	common carp	*Cyprinus carpio*	Cyprinidae	2	0.17	0.07
	starhead topminnow	*Fundulus dispar*	Fundulidae	2	0.17	0.07
	spotted gar	*Lepisosteus oculatus*	Lepisosteidae	2	0.17	0.07
	longnose gar	*Lepisosteus osseus*	Lepisosteidae	1	0.08	0.04
	shortnose gar	*Lepisosteus platostomus*	Lepisosteidae	1	0.08	0.04
	yellow bullhead	*Ameiurus natalis*	Ictaluridae	1	0.08	0.04

Total number	**1190**
Total species	**14**
Total families	**7**

Table 8. List showing total catch, percent composition, and mean catch per unit effort (No./24 Hrs) for each fish species collected with tandem fyke nets at Emiquon in 2015; * represents non-native species.

Common name	Scientific name	Family	No.	%	No./24 Hrs
bluegill	*Lepomis macrochirus*	Centrarchidae	518	51.59	74.00
black crappie	*Pomoxis nigromaculatus*	Centrarchidae	398	39.64	56.86
pumpkinseed	*Lepomis gibbosus*	Centrarchidae	60	5.98	8.57
largemouth bass	*Micropterus salmoides*	Centrarchidae	8	0.80	1.14
white crappie	*Pomoxis annularis*	Centrarchidae	8	0.80	1.14
golden shiner	*Notemigonus crysoleucas*	Cyprinidae	7	0.70	1.00
bowfin	*Amia calva*	Amiidae	2	0.20	0.29
brown bullhead	*Ameiurus nebulosus*	Ictaluridae	1	0.10	0.14
channel catfish	*Ictalurus punctatus*	Ictaluridae	1	0.10	0.14
bluegill x pumpkinseed	*Lepomis macrochirus* x *Lepomis gibbosus*	Centrarchidae	1	0.10	0.14

Total number	**1004**
Total species	**9**
Total families	**4**

Table 9. List showing total catch, percent composition, and mean catch per unit effort (No./24 Hrs) for each fish species collected with tandem mini-fyke nets at Emiquon in 2015; * represents non-native species.

	Common name	Scientific name	Family	No.	%	No./24 Hrs
	unidentified *Lepomis* spp.	*Lepomis* spp.	Centrarchidae	24	33.80	3.43
	black crappie	*Pomoxis nigromaculatus*	Centrarchidae	20	28.17	2.86
	largemouth bass	*Micropterus salmoides*	Centrarchidae	10	14.08	1.43
	bluegill	*Lepomis macrochirus*	Centrarchidae	4	5.63	0.57
	unidentified *Ameiurus* spp.	*Ameiurus* spp.	Ictaluridae	4	5.63	0.57
*	common carp	*Cyprinus carpio*	Cyprinidae	3	4.23	0.43
	gizzard shad	*Dorosoma cepedianum*	Clupeidae	2	2.82	0.29
	pumpkinseed	*Lepomis gibbosus*	Centrarchidae	2	2.82	0.29
	freshwater drum	*Aplodinotus grunniens*	Sciaenidae	1	1.41	0.14
	yellow bullhead	*Ameiurus natalis*	Ictaluridae	1	1.41	0.14

Total number	**71**
Total species	**8**
Total families	**5**

Table 10. List showing mean relative weight (Wr) during 2007-2014, 2014, and 2015 for bluegill *Lepomis macrochirus* ≥ 80 mm, pumpkinseed *Lepomis gibbosus* ≥50 mm, warmouth *Lepomis gulosus* ≥80 mm, black crappie *Pomoxis nigromaculatus* ≥ 100 mm, white crappie *Pomoxis annularis* ≥100 mm, largemouth bass *Micropterus salmoides* ≥ 150 mm, all bowfin *Amia* calva with a weight recorded, longnose gar *Lepisosteus* osseus ≥20 mm, all shortnose gar *Lepisosteus platostomus* with a weight recorded, spotted gar *Lepisosteus oculatus* ≥250 mm, gizzard shad *Dorosoma cepedianum* ≥100 mm, and common carp *Cyprinus carpio* ≥200 mm collected from Emiquon.
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Common name	Scientific name	Mean Wr (2007-2014)	Mean Wr (2014)	Mean Wr (2015)
bluegill	*Lepomis macrochirus*	108%	101%	103%
pumpkinseed	*Lepomis gibbosus*	99%	105%	108%
warmouth	*Lepomis gulosus*	108%	115%	116%
black crappie	*Pomoxis nigromaculatus*	107%	99%	98%
white crappie	*Pomoxis annularis*	96%	102%	97%
largemouth bass	*Micropterus salmoides*	99%	98%	94%
bowfin	*Amia calva*	98%	95%	95%
longnose gar	*Lepisosteus osseus*	78%	91%	83%
shortnose gar	*Lepisosteus platostomus*	99%	112%	98%
spotted gar	*Lepisosteus oculatus*	87%	91%	86%
gizzard shad	*Dorosoma cepedianum*	94%	89%	94%
common carp	*Cyprinus carpio*	110%	106%	106%

Table 11. List showing total catch and percent composition for each fish species collected by all gears while evaluating over-wintering fish habitat at Emiquon during March 25, 2015.

	Common name	Scientific name	Family	No.	%
	bluegill	*Lepomis macrochirus*	Centrarchidae	110	53.14
	black crappie	*Pomoxis nigromaculatus*	Centrarchidae	32	15.46
	pumpkinseed	*Lepomis gibbosus*	Centrarchidae	26	12.56
	largemouth bass	*Micropterus salmoides*	Centrarchidae	14	6.76
	golden shiner	*Notemigonus crysoleucas*	Cyprinidae	9	4.35
	bowfin	*Amia calva*	Amiidae	3	1.45
	white crappie	*Pomoxis annularis*	Centrarchidae	3	1.45
*	common carp	*Cyprinus carpio*	Cyprinidae	2	0.97
	gizzard shad	*Dorosoma cepedianum*	Clupeidae	2	0.97
	warmouth	*Lepomis gulosus*	Centrarchidae	2	0.97
	yellow bullhead	*Ameiurus natalis*	Ictaluridae	2	0.97
	freshwater drum	*Aplodinotus grunniens*	Sciaenidae	1	0.48
	starhead topminnow	*Fundulus dispar*	Fundulidae	1	0.48

Total number	**207**
Total species	**13**
Total families	**7**

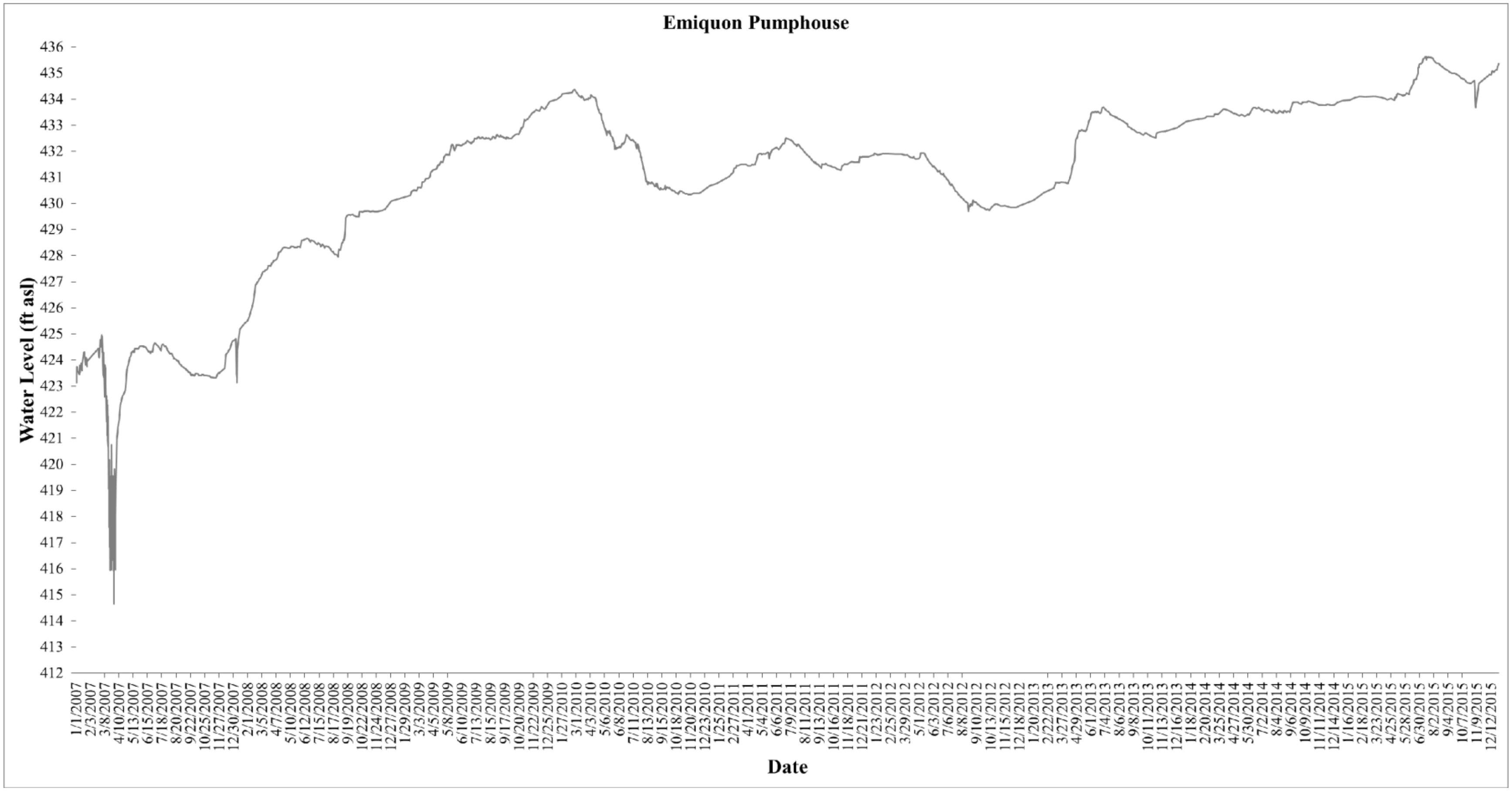
	No.	%
Total number caught in deep water	**205**	**99.03**
Total number caught in shallow water	**2**	**0.97**
Total	**207**	**100**

Table 12. List showing total catch and percent composition for each species collected and observed by The Nature Conservancy and the Illinois Natural History Survey's Illinois River Biological Station at the Emiquon sand boils and coal creek levee during the major flood event during May-July, 2015.

	Common name	Scientific name	Family	No.	%
*	unidentified *Hypopthalmichthys* spp.	*Hypopthalmichthys* spp.	Cyprinidae	106	23.71
	western mosquitofish	*Gambusia affinis*	Poeciliidae	97	21.70
	bluegill	*Lepomis macrochirus*	Centrarchidae	70	15.66
	largemouth bass	*Micropterus salmoides*	Centrarchidae	60	13.42
	unidentified *Lepomis* spp.	*Lepomis* spp.	Centrarchidae	41	9.17
*	common carp	*Cyprinus carpio*	Cyprinidae	35	7.83
	gizzard shad	*Dorosoma cepedianum*	Clupeidae	9	2.01
	warmouth	*Lepomis gulosus*	Centrarchidae	5	1.12
	black bullhead	*Ameiurus melas*	Ictaluridae	5	1.12
	unidentified *Lepisosteus* spp.	*Lepisosteus spp.*	Lepisosteidae	5	1.12
	black crappie	*Pomoxis nigromaculatus*	Centrarchidae	5	1.12
	bowfin	*Amia calva*	Amiidae	1	0.22
	blackstripe topminnow	*Fundulus notatus*	Fundulidae	1	0.22
	pumpkinseed	*Lepomis gibbosus*	Centrarchidae	1	0.22
	emerald shiner	*Netropis atherinoides*	Cyprinidae	1	0.22
	starhead topminnow	*Fundulus dispar*	Fundulidae	1	0.22
	red shiner	*Cyprinella lutrensis*	Cyprinidae	1	0.22
	bullhead minnow	*Pimephales vigilax*	Cyprinidae	1	0.22
	shortnose gar	*Lepisosteus platostomus*	Lepisosteidae	1	0.22
	bluegill x pumpkinseed	*Lepomis macrochirus* x *Lepomis gibbosus*	Centrarchidae	1	0.22

Total number	**447**
Total species	**19**
Total families	**8**

Figure 1. All Emiquon pumphouse ditch water level (ft asl) gauge readings during January-December, 2007-2015.



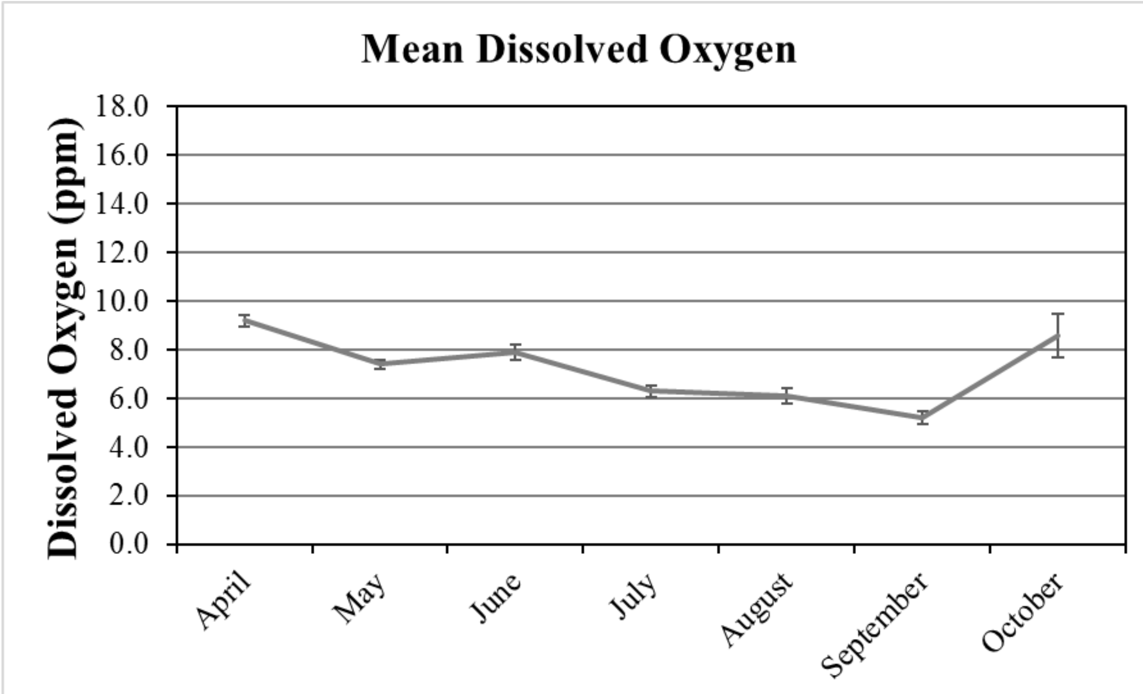


Figure 2. Monthly mean dissolved oxygen concentrations for all random aquatic vegetation and fish sampling sites at Emiquon in 2015. Error bars represent one standard error about the mean.

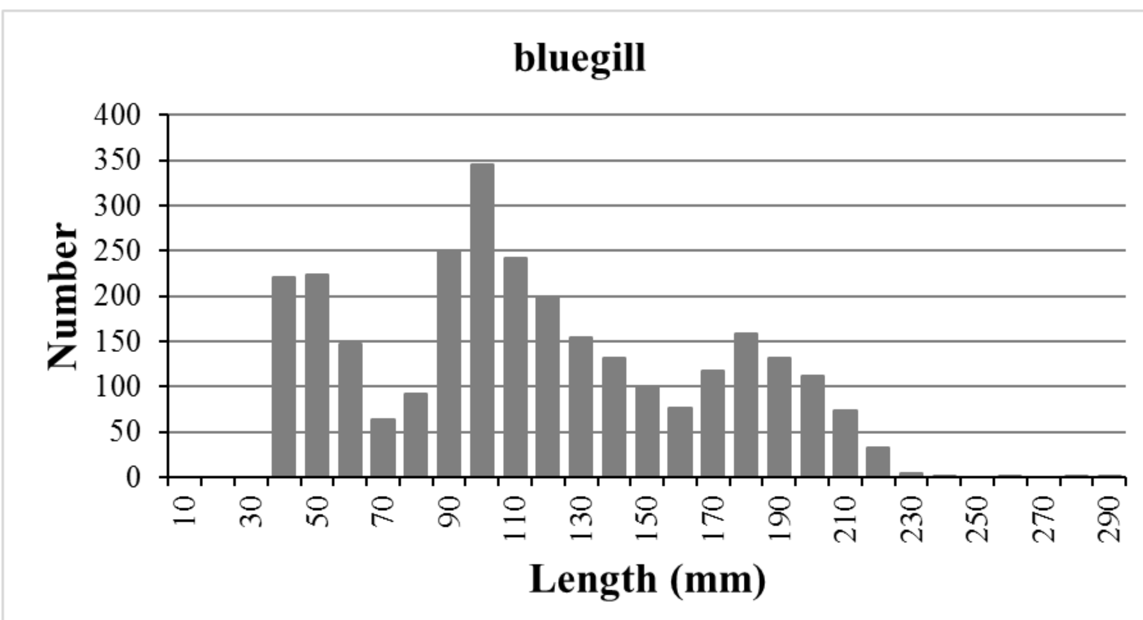


Figure 3. Length-frequency distribution for bluegill *Lepomis macrochirus* collected from Emiquon in 2015.

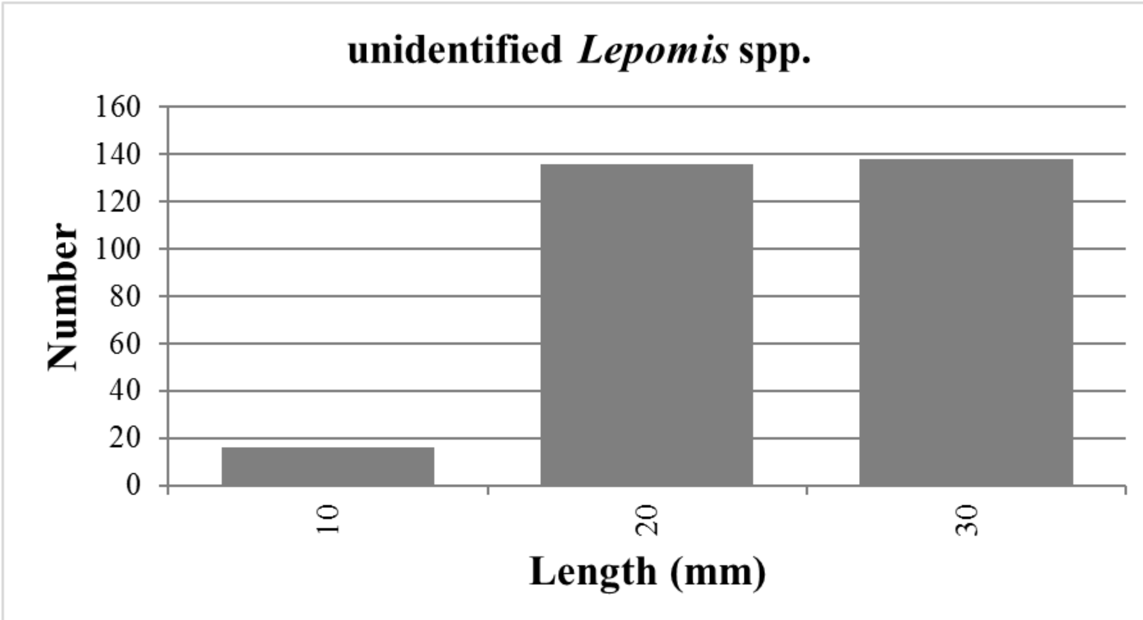


Figure 4. Length-frequency distribution for unidentified young-of-the-year (YOY) *Lepomis* spp. (bluegill *Lepomis macrochirus* or pumpkinseed *Lepomis gibbosus* with lengths <40mm) collected from Emiquon in 2015.

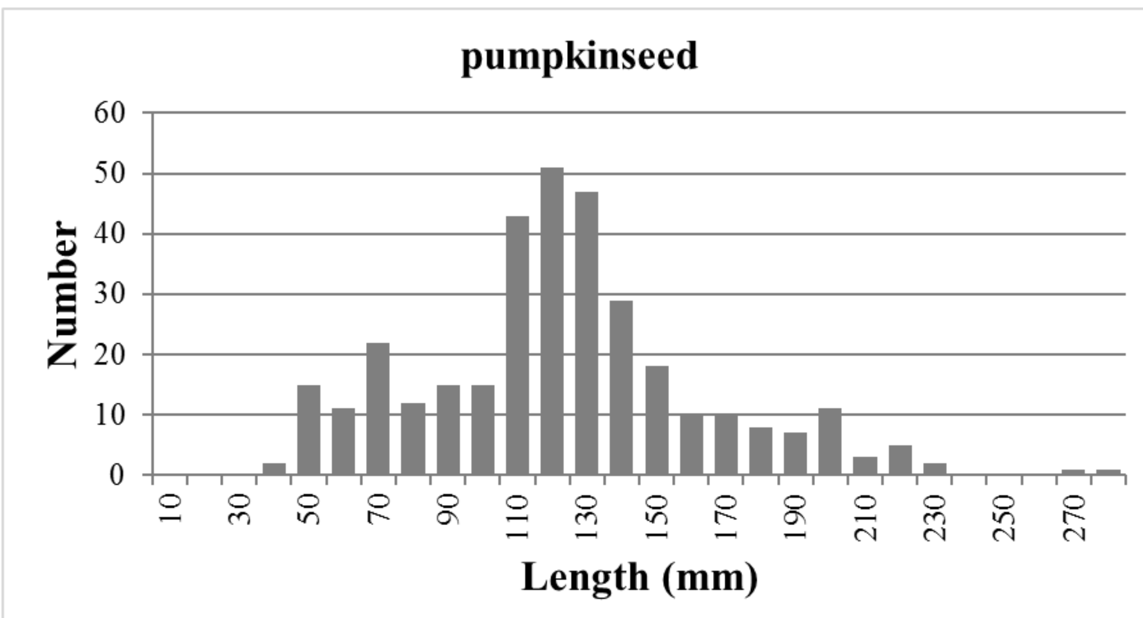


Figure 5. Length-frequency distribution for pumpkinseed *Lepomis gibbosus* collected from Emiquon in 2015.

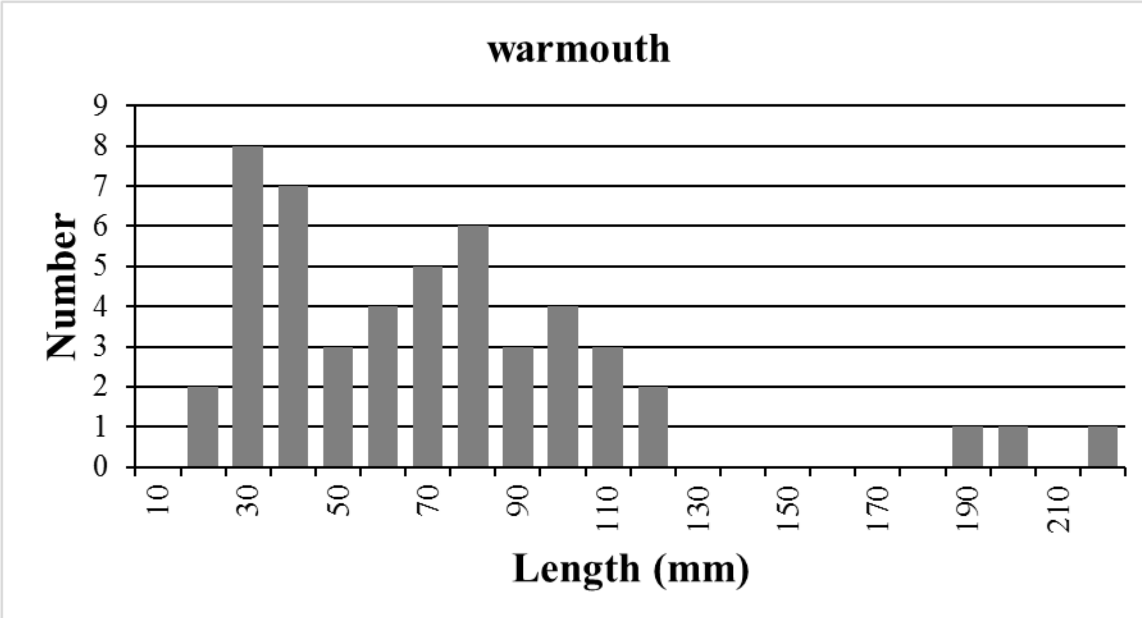


Figure 6. Length-frequency distribution for warmouth *Lepomis gulosus* collected from Emiquon in 2015.

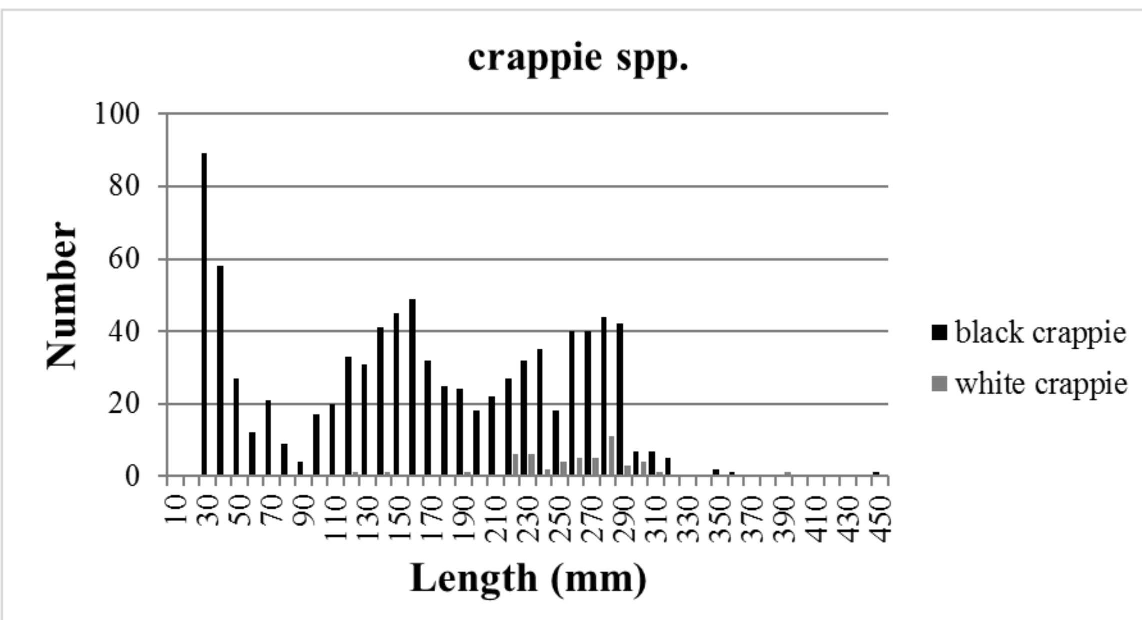


Figure 7. Length-frequency distribution for black crappie *Pomoxis nigromaculatus* and white crappie *Pomoxis annularis* collected from Emiquon in 2015.

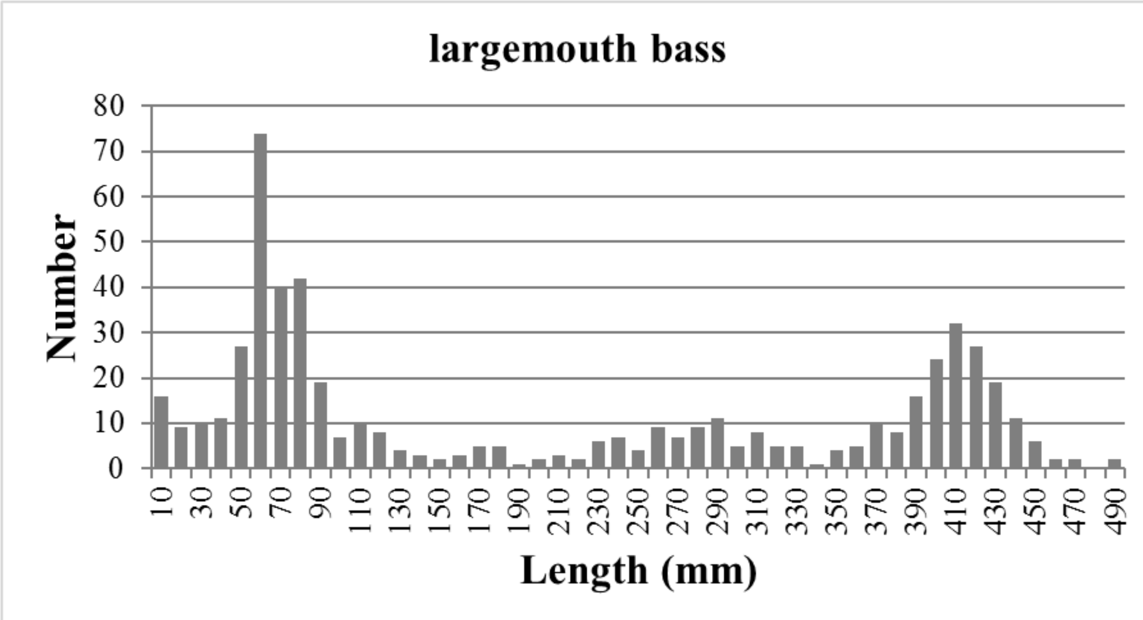


Figure 8. Length-frequency distribution for largemouth bass *Micropterus salmoides* collected from Emiquon in 2015.

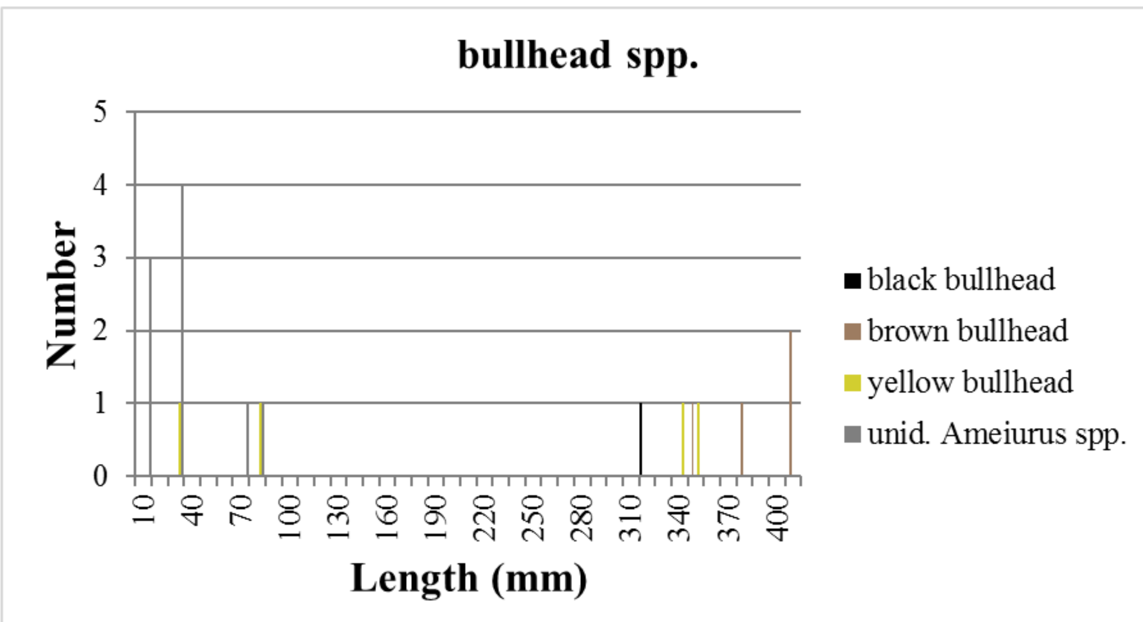


Figure 9. Length-frequency distribution for black bullhead *Ameiurus melas*, brown bullhead *Ameiurus nebulosus*, yellow bullhead *Ameiurus natalis*, and unidentified *Ameiurus* spp. collected from Emiquon in 2015.

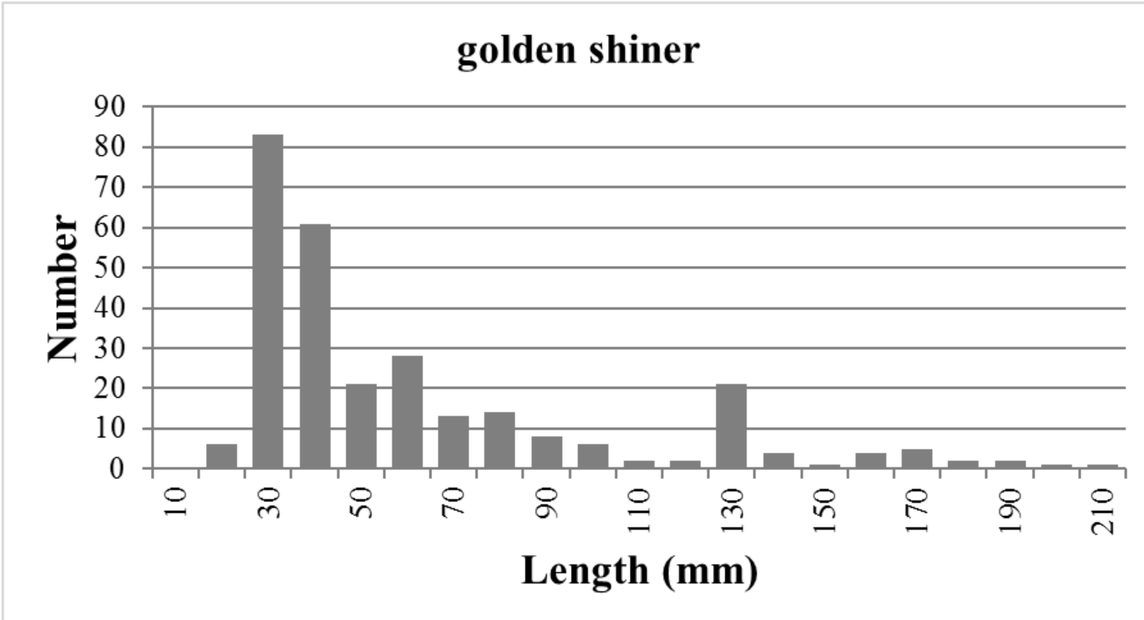


Figure 10. Length-frequency distribution for golden shiner *Notemigonus crysoleucas* collected from Emiquon in 2015.

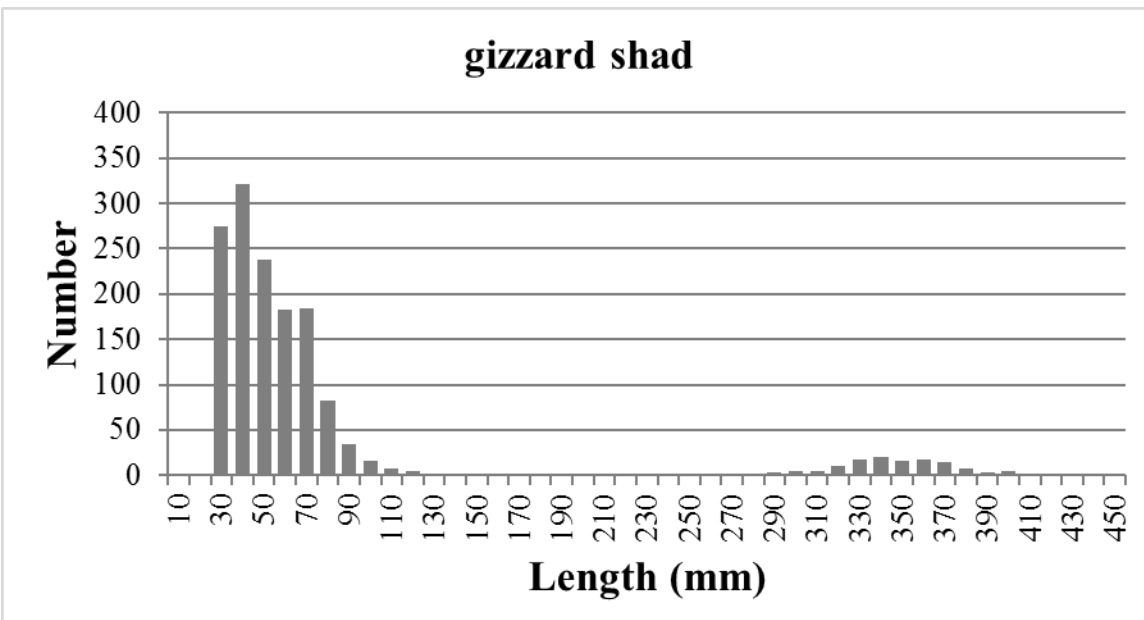


Figure 11. Length-frequency distribution for gizzard shad *Dorosoma cepedianum* collected from Emiquon in 2015.

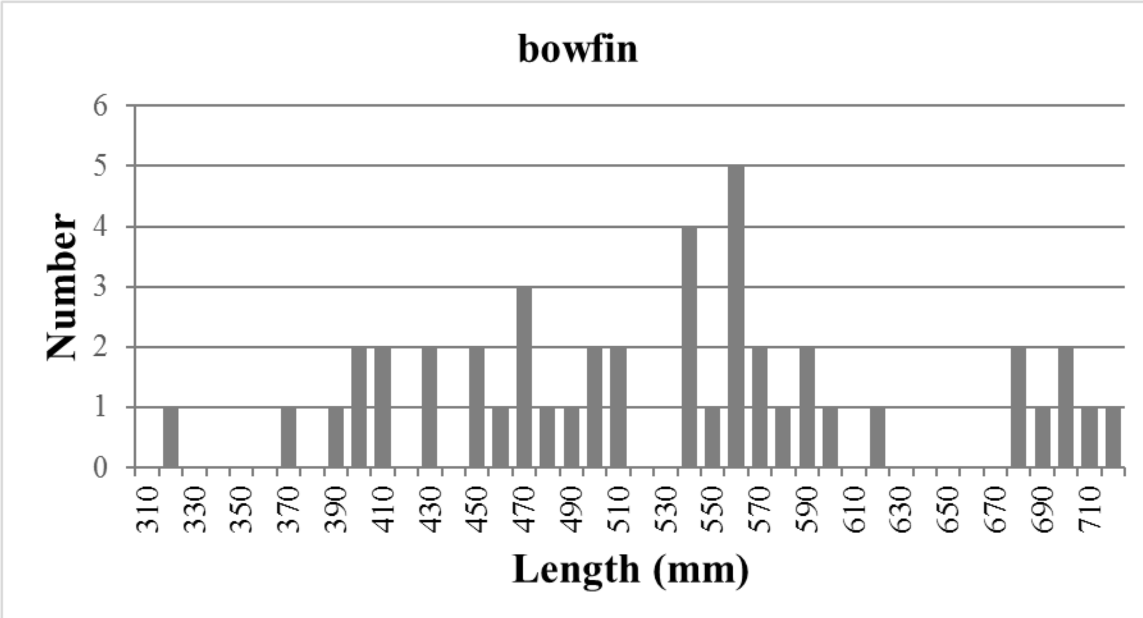


Figure 12. Length-frequency distribution for bowfin *Amia calva* collected from Emiquon in 2015.

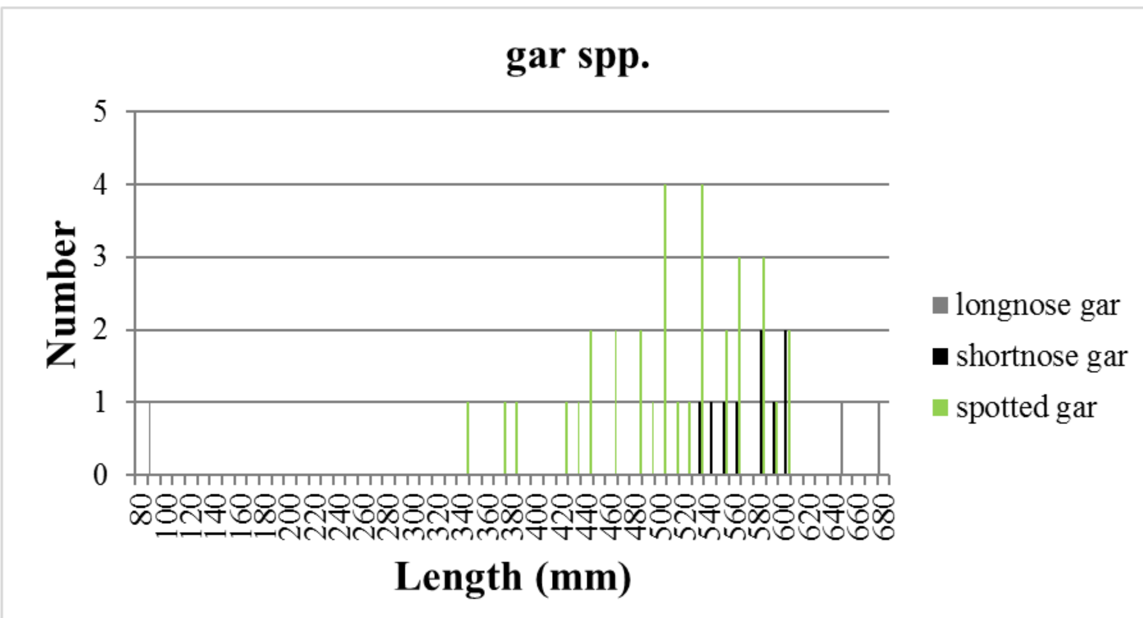


Figure 13. Length-frequency distribution for longnose gar *Lepisosteus osseus*, shortnose gar *Lepisosteus* platostomus, and spotted gar *Lepisosteus oculatus* collected from Emiquon in 2015.

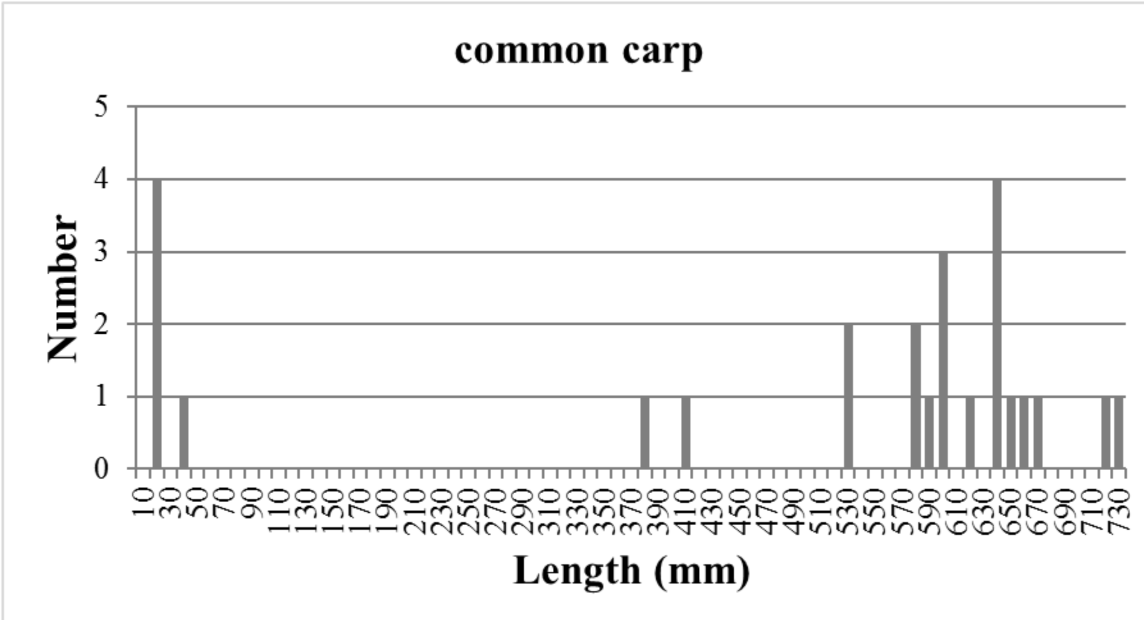


Figure 14. Length-frequency distribution for common carp *Cyprinus carpio* collected from Emiquon in 2015.

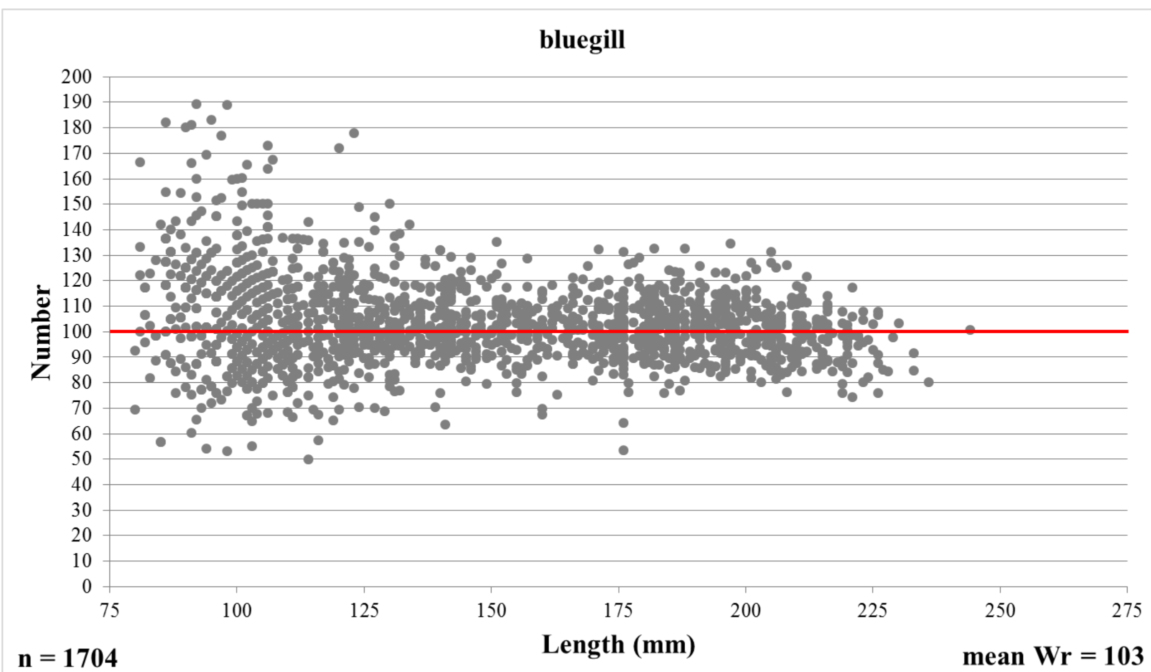


Figure 15. Relative weight (Wr) of bluegill *Lepomis macrochirus* ≥80 mm collected from Emiquon in 2015. Red line represents 100% relative weight.

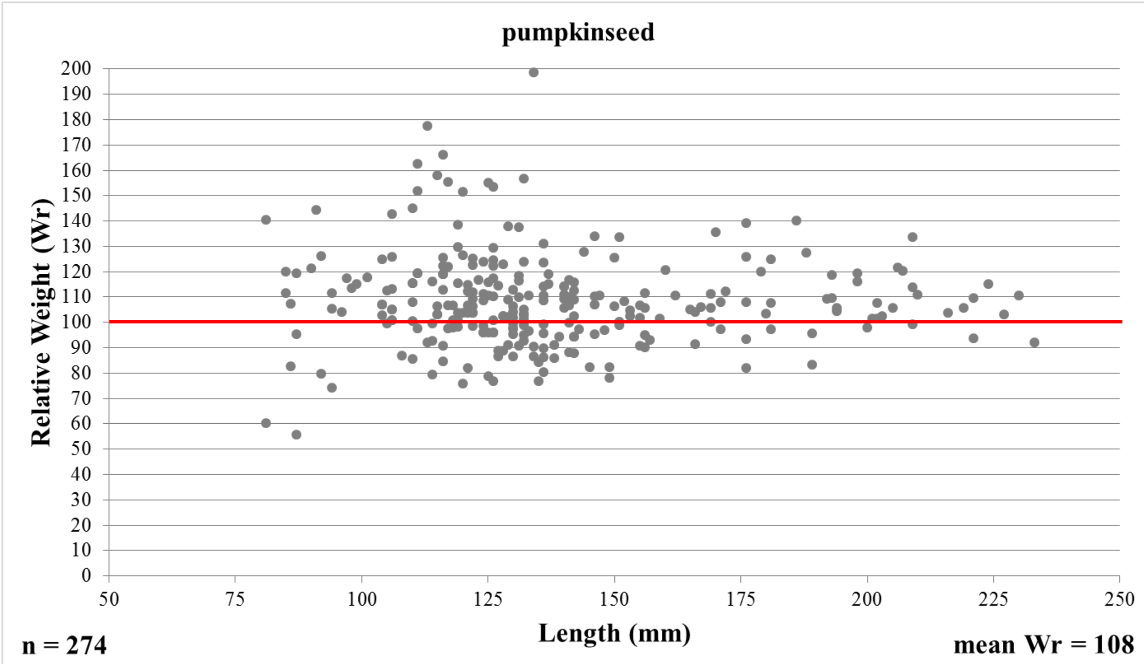


Figure 16. Relative weight (Wr) of pumpkinseed *Lepomis gibbosus* ≥ 80 mm collected from emiquon in 2015. Red line represents 100% relative weight.

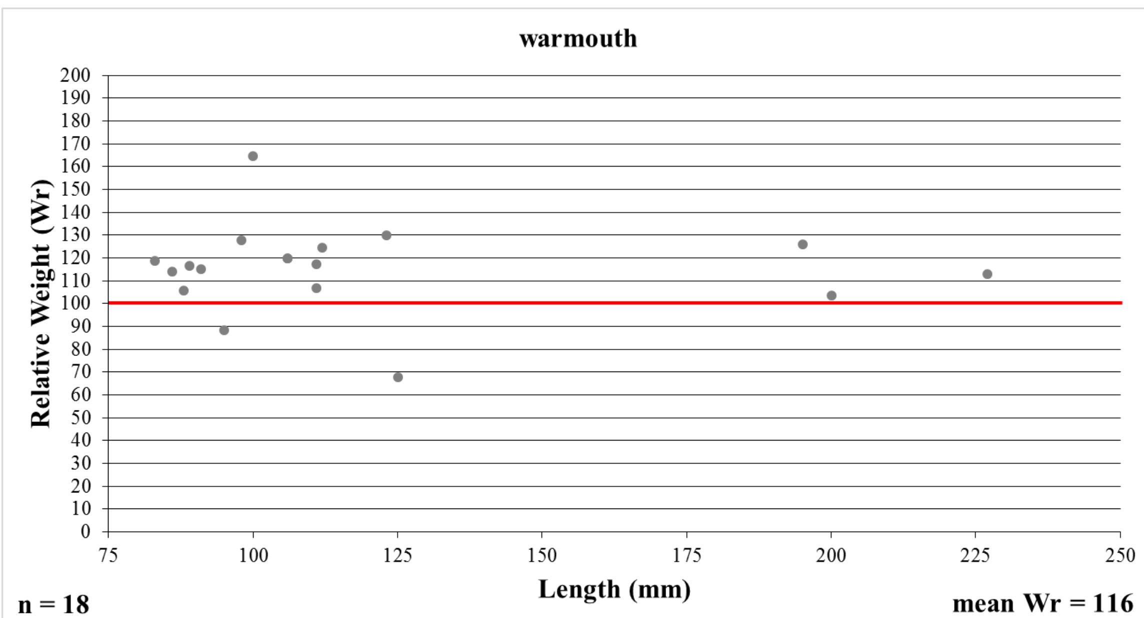


Figure 17. Relative weight (Wr) of warmouth *Lepomis gulosus* ≥80 mm collected from Emiquon in 2015. Red line represents 100% relative weight.

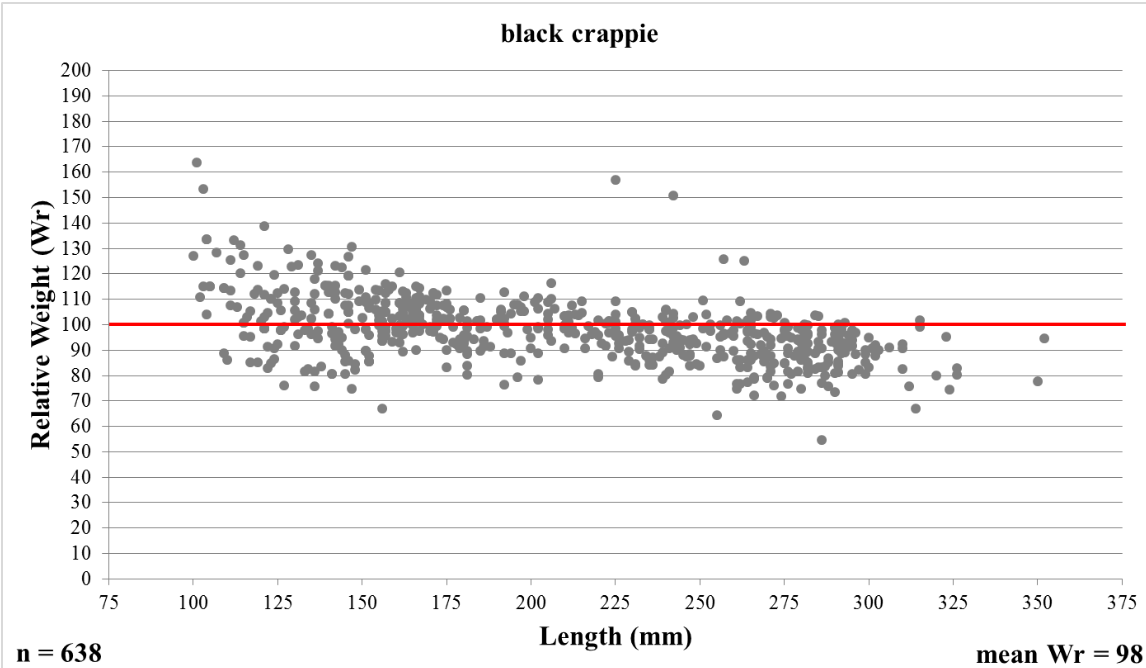


Figure 18. Relative weight (Wr) of black crappie *Pomoxis nigromaculatus* ≥100 mm collected from Emiquon in 2015. Red line represents 100% relative weight.

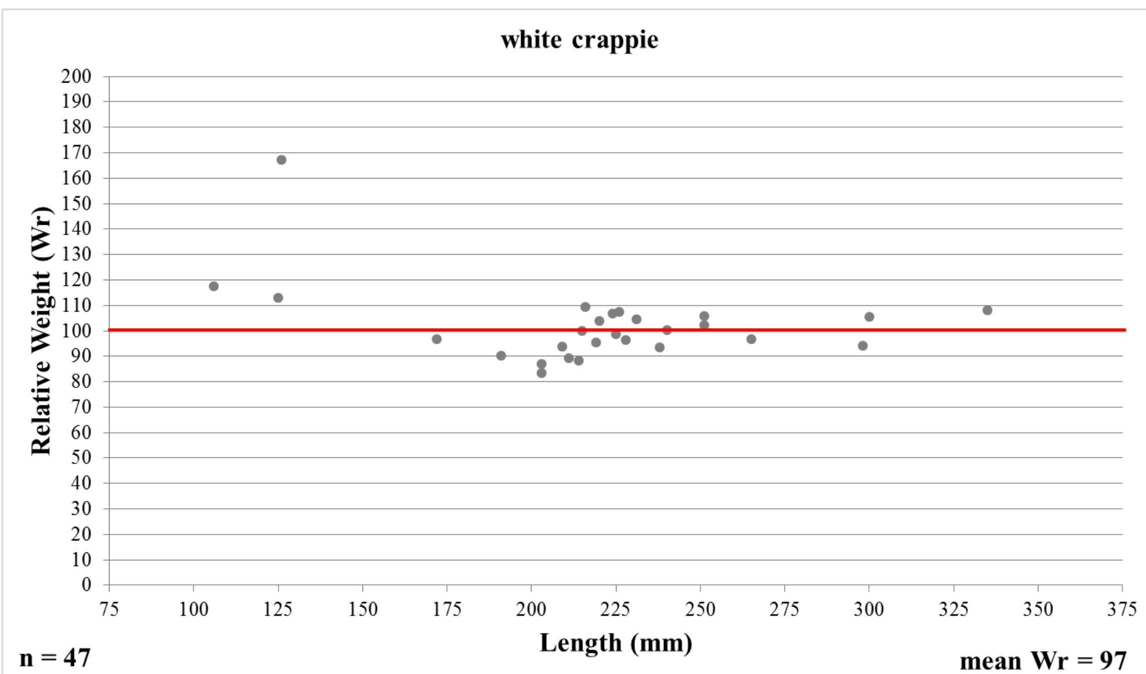


Figure 19. Relative weight (Wr) of white crappie *Pomoxis annularis* ≥100 mm collected from Emiquon in 2015. Red line represents 100% relative weight.

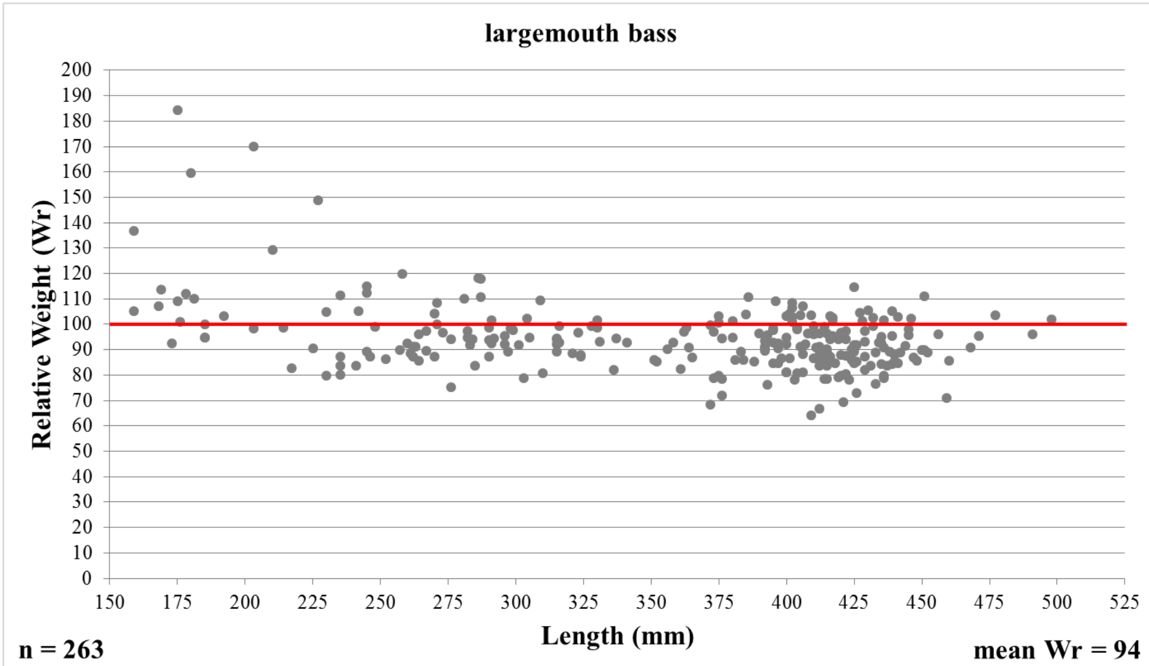


Figure 20. Relative weight (Wr) of largemouth bass *Micropterus salmoides* ≥150 mm collected from Emiquon in 2015. Red line represents 100% relative weight.

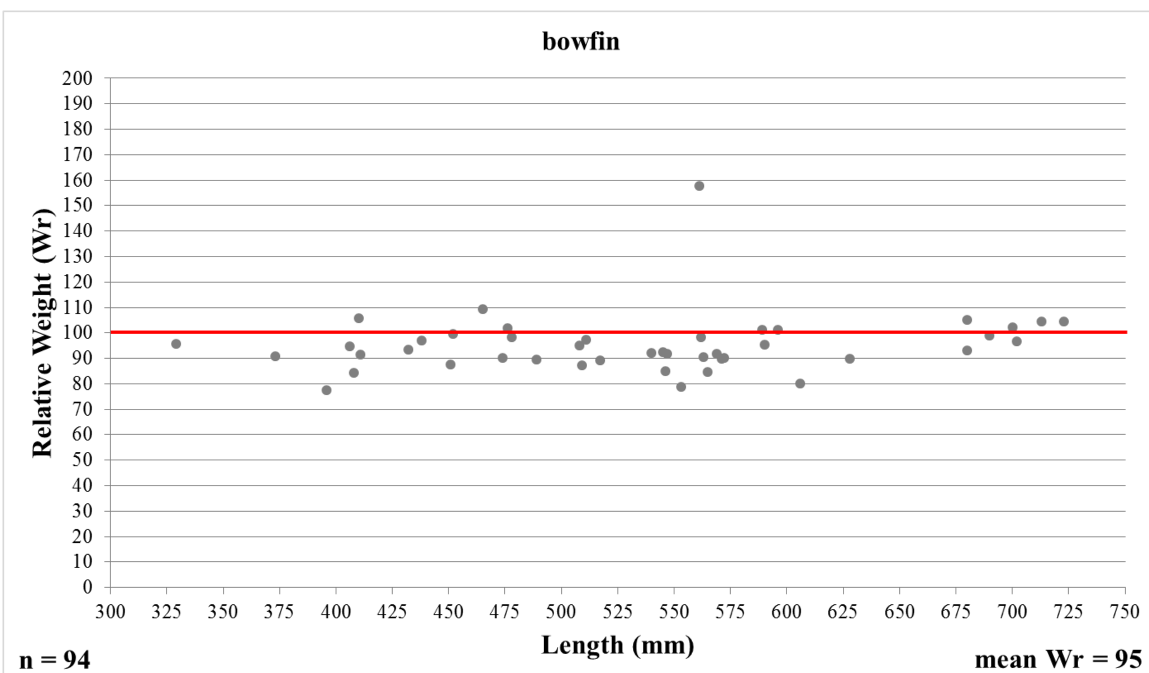


Figure 21. Relative weight (Wr) of all bowfin *Amia calva* (no minimum length) collected from Emiquon in 2015. Red line represents 100% relative weight.

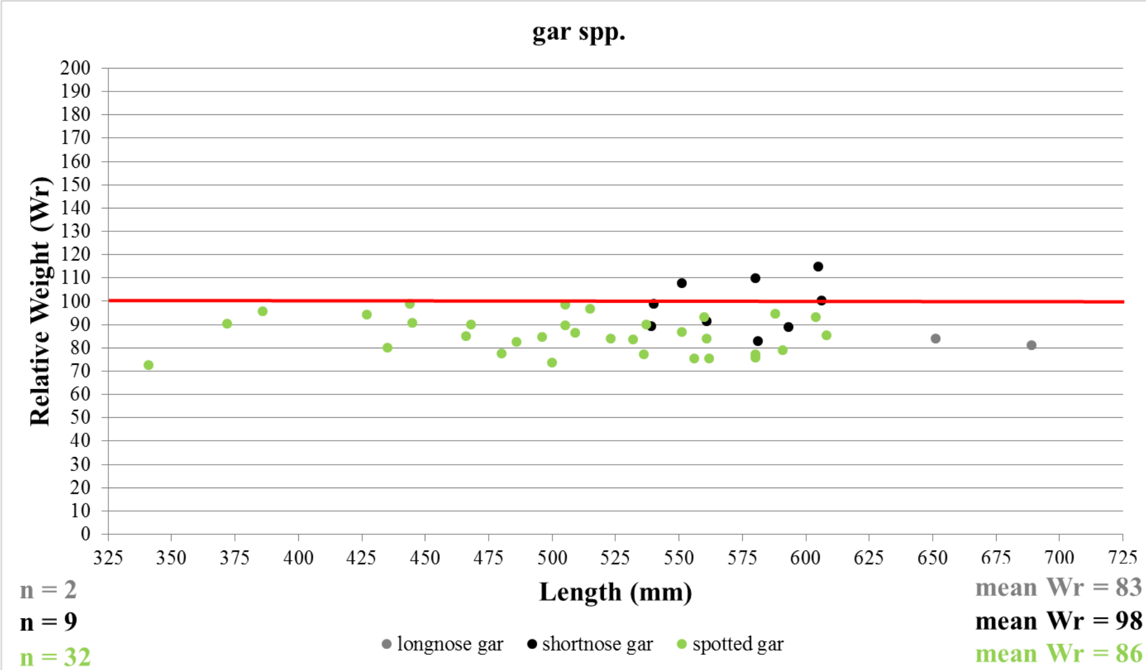


Figure 22. Relative weight (Wr) of longnose gar *Lepisosteus osseus* ≥200 mm, shortnose gar *Lepisosteus platostomus* (no minimum length), and spotted gar *Lepisosteus oculatus* ≥250 mm collected from Emiquon in 2015. Red line represents 100% relative weight.

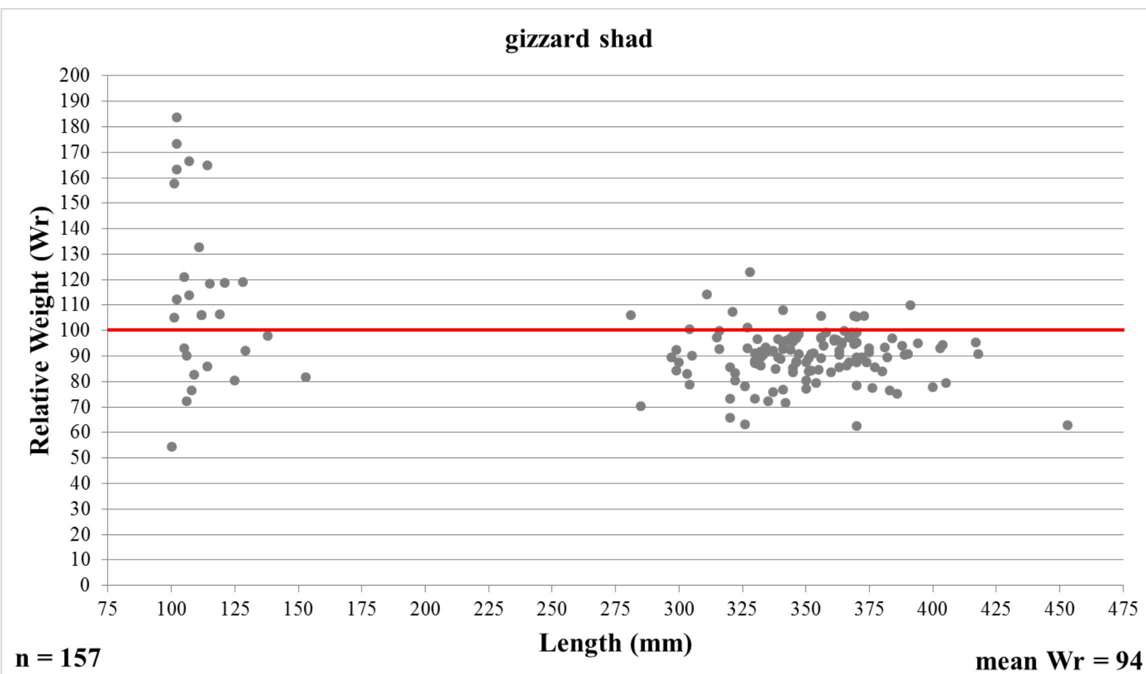


Figure 23. Relative weight (Wr) of gizzard shad *Dorosoma cepedianum* ≥100 mm collected from Emiquon in 2015. Red line represents 100% relative weight.

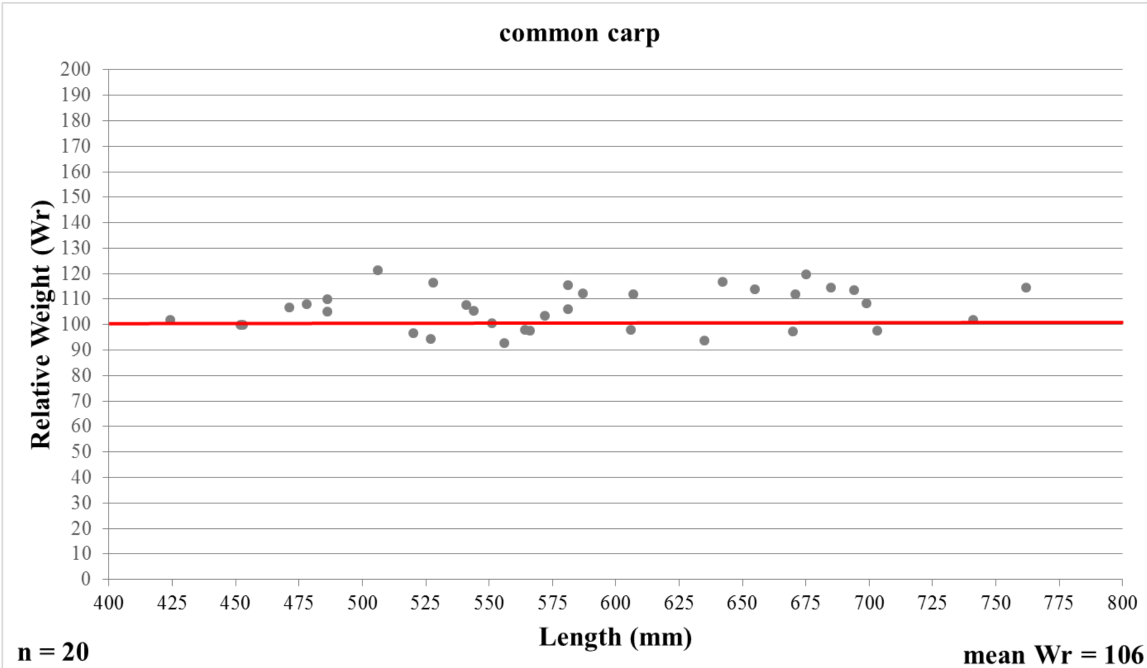
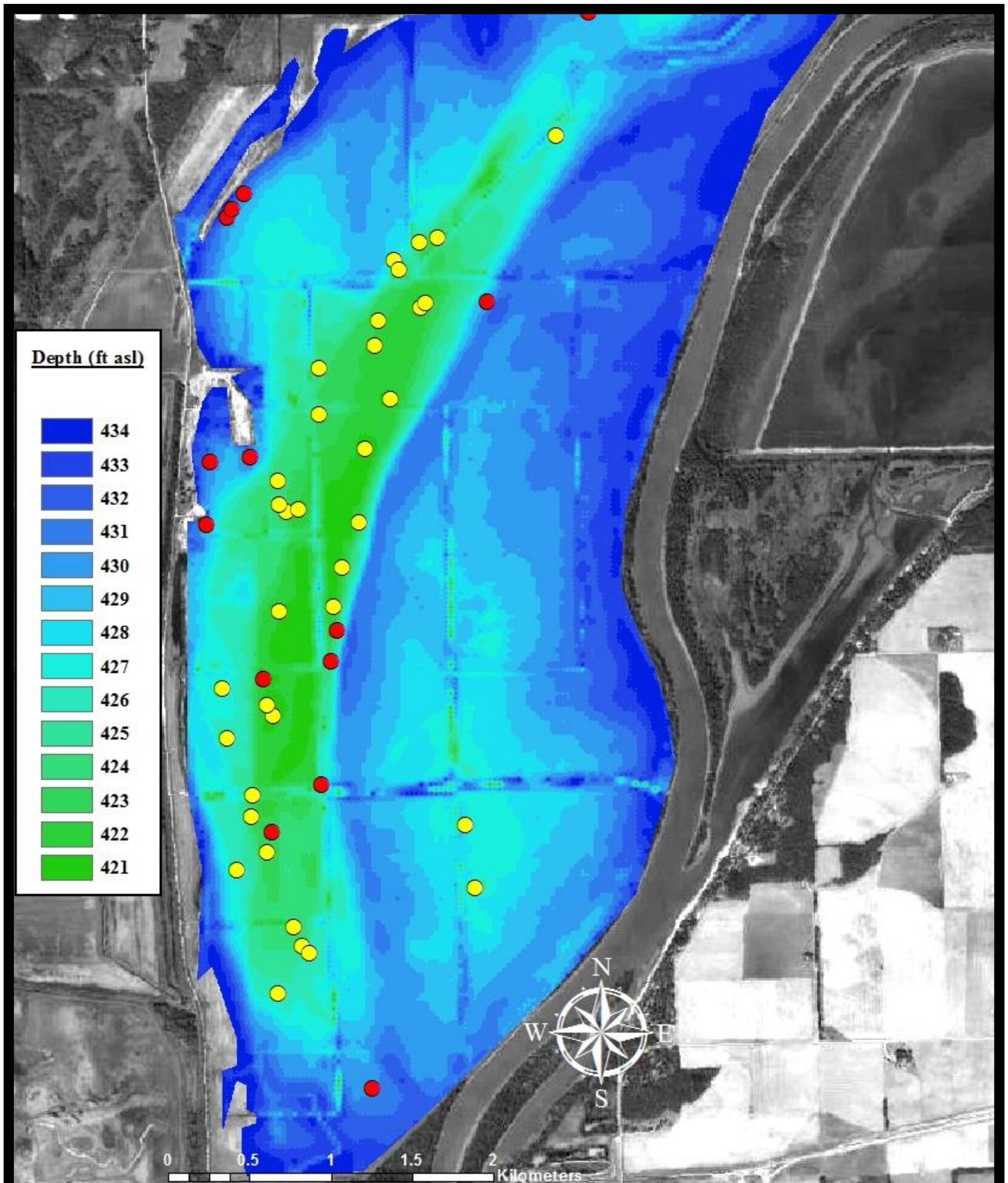


Figure 24. Relative weight (Wr) of all common carp *Cyprinus carpio* ≥200 mm collected from Emiquon in 2015. Red line represents 100% relative weight.



Key

Green = 10-14 ft of water

Yellow Dots = Unvegetated aquatic vegetation sampling sites (May-October, 2015)

Red Dots = Unvegetated fish sampling sites (April-October, 2015)

*Colored blocks represent water levels (421-434 ft asl)

Figure 25. Bathymetry of Emiquon at 434 ft asl displaying all un-vegetated aquatic vegetation and fish sampling sites between the months April-October, 2015.

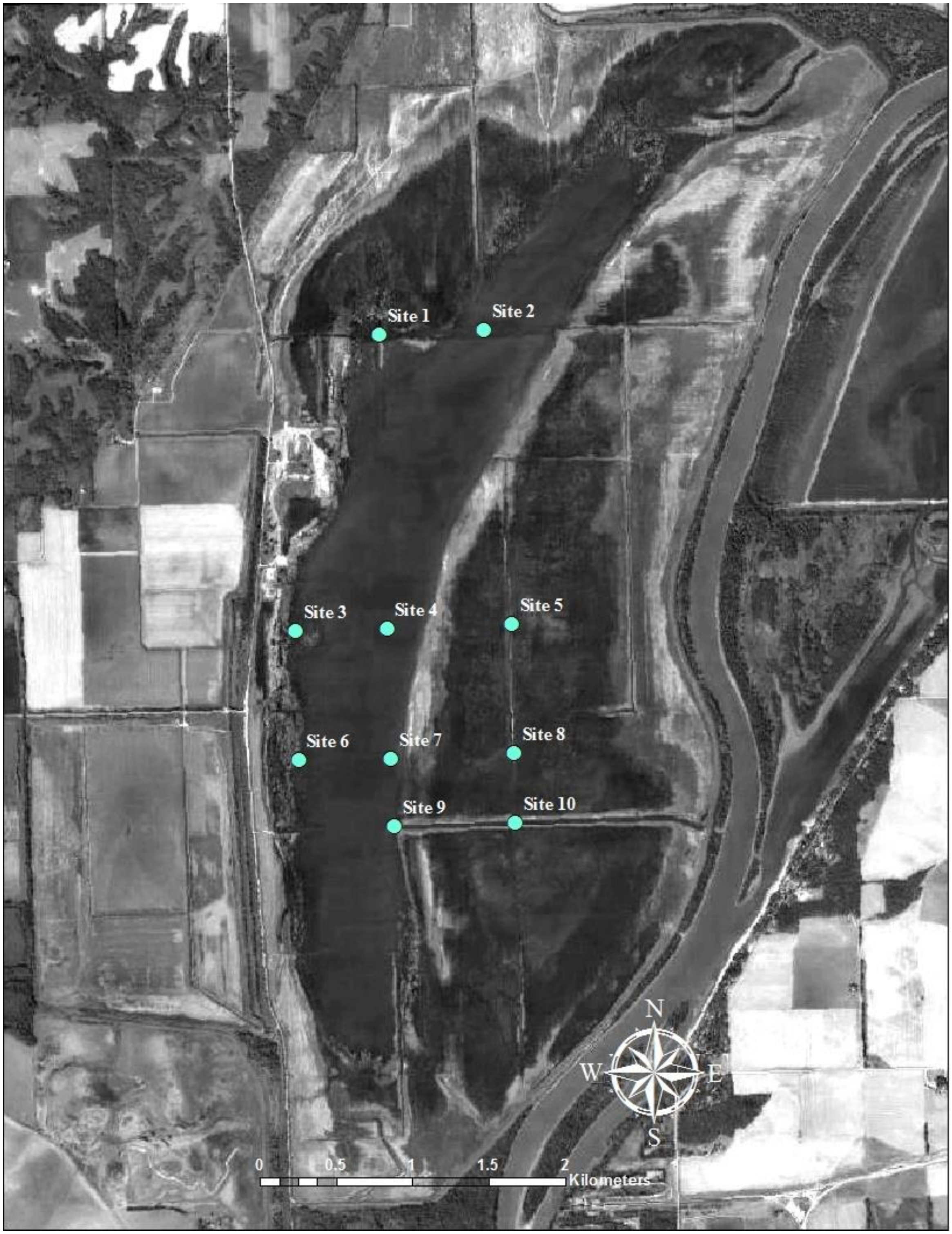
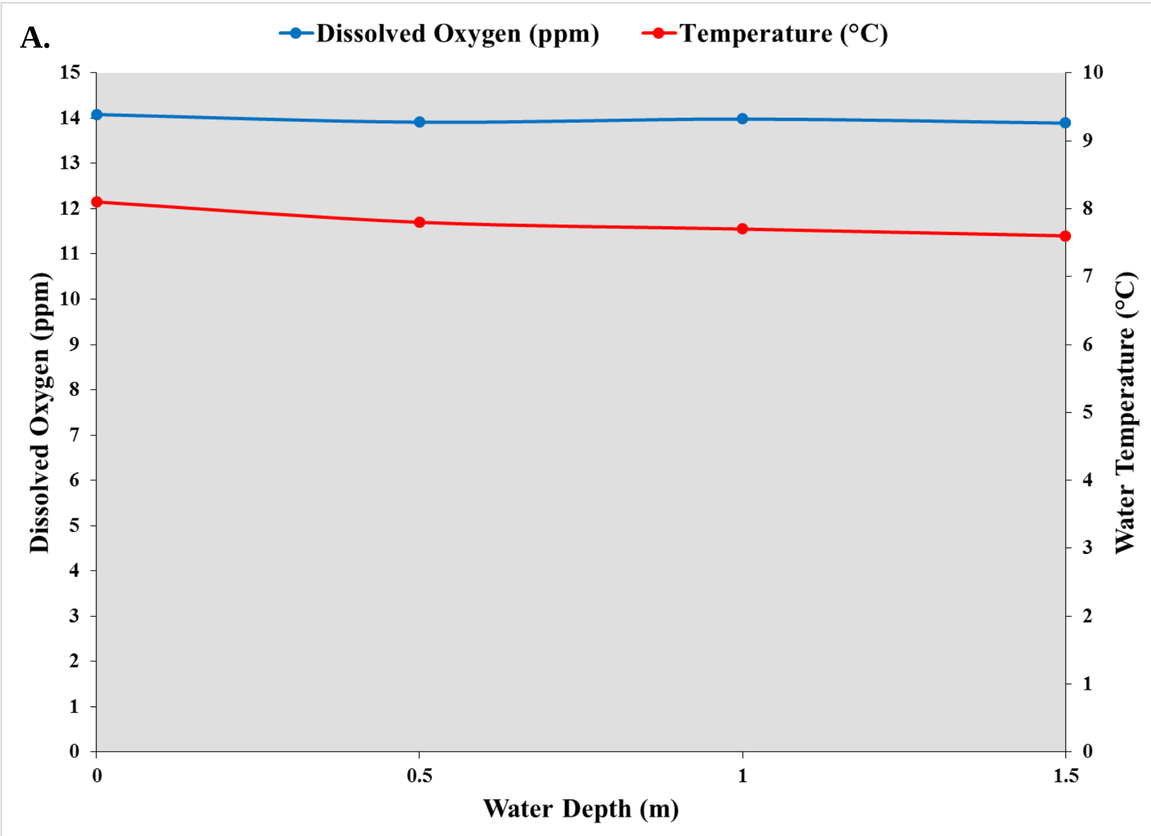
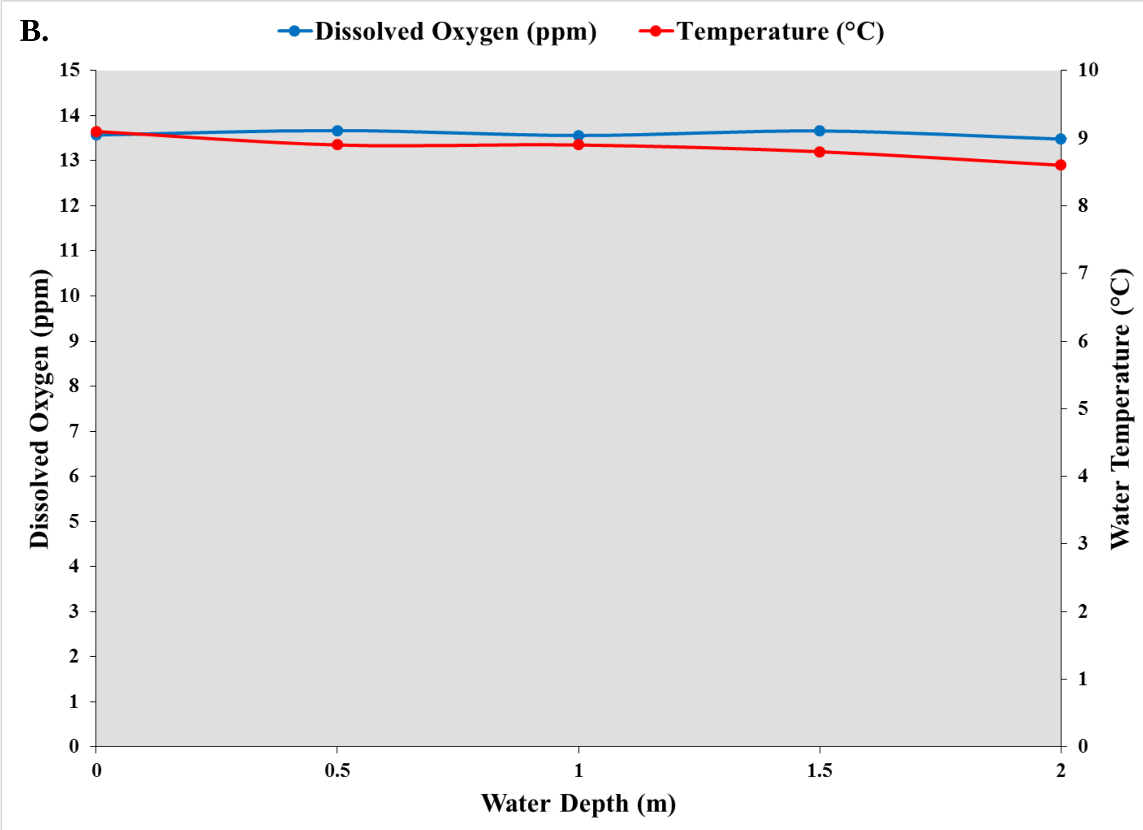
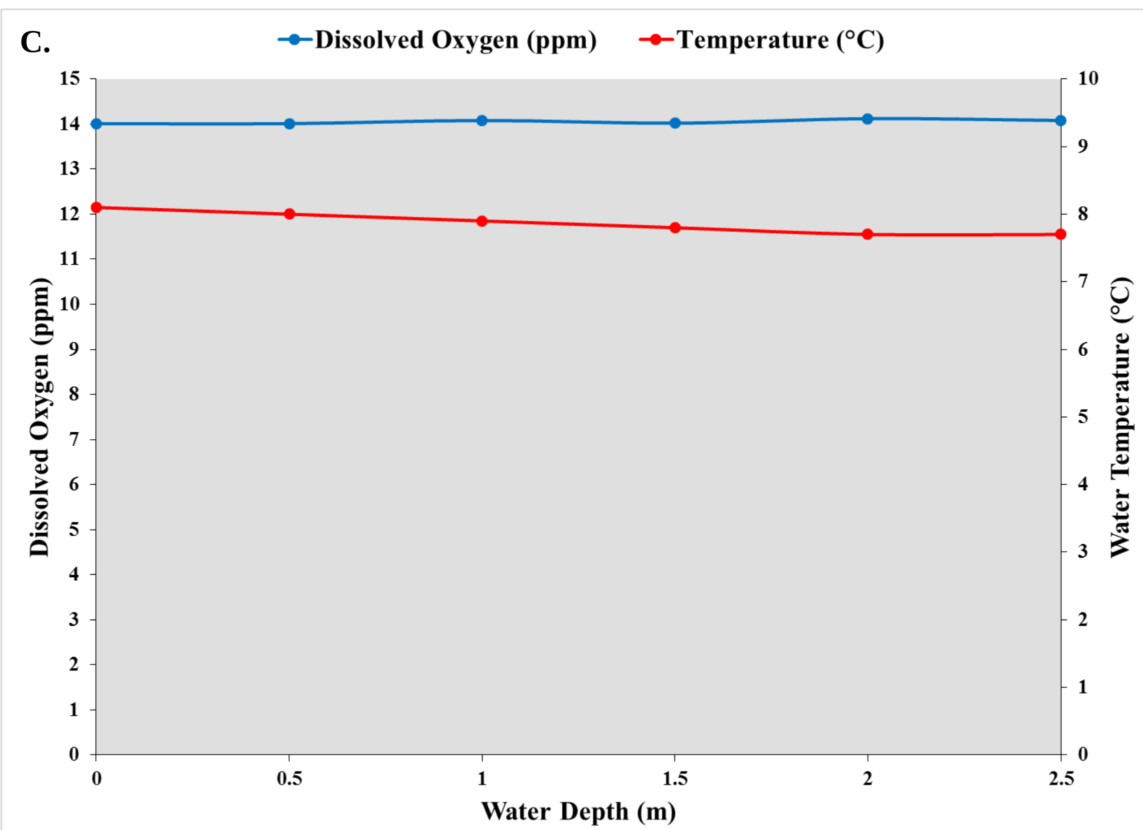


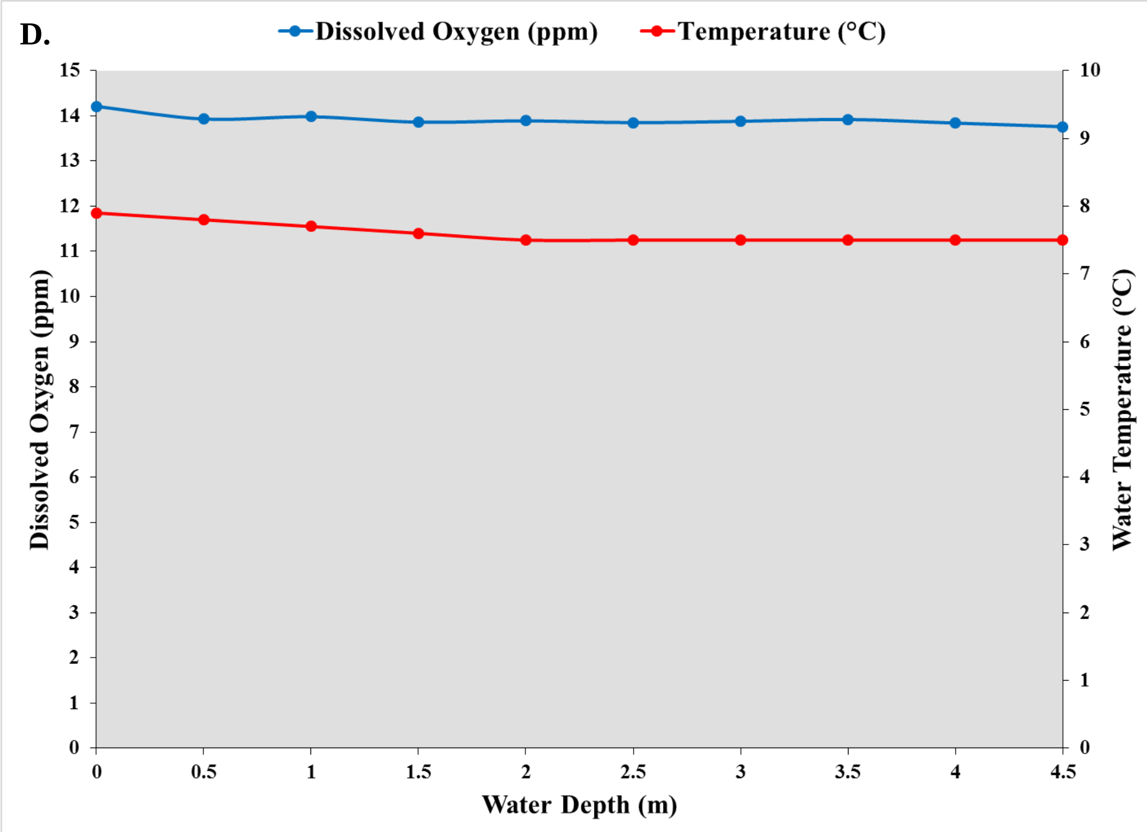
Figure 26. Map of Emiquon showing locations of dissolved oxygen (ppm)/temperature (°C) fixed sites collected on March 16, 2015.

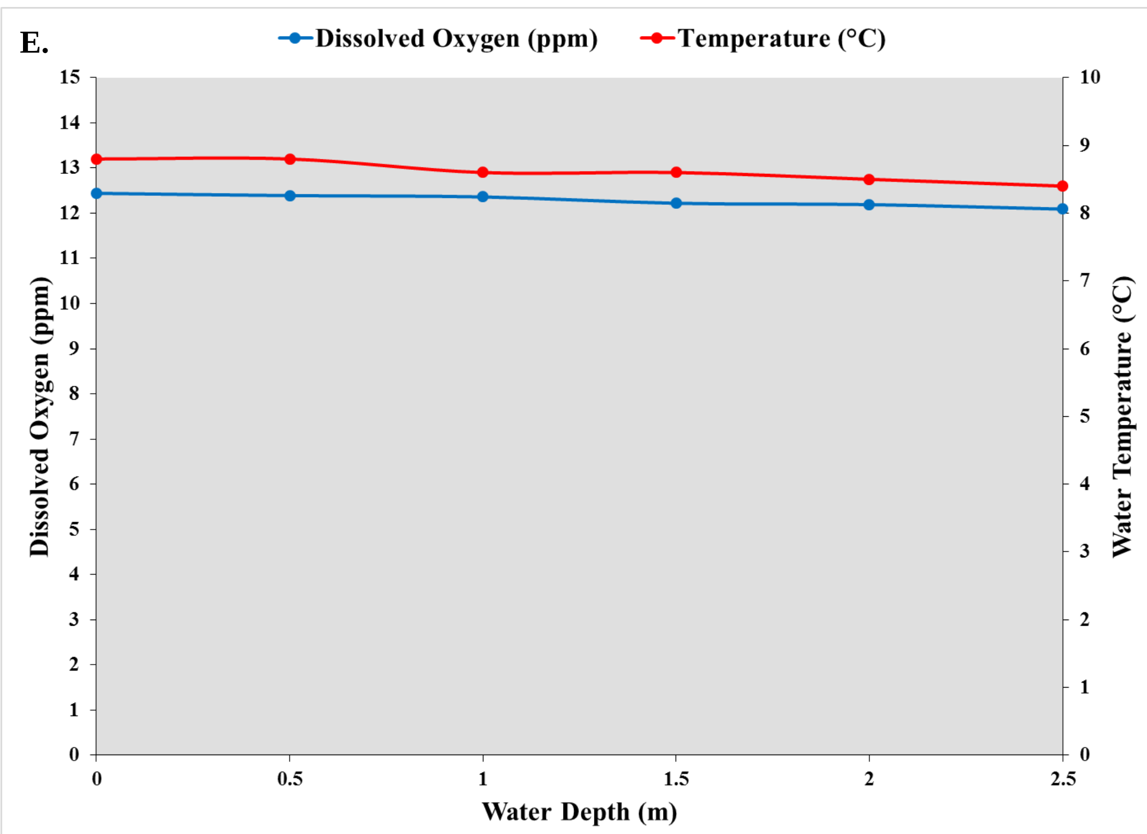
Figure 27. Dissolved oxygen (ppm)/temperature (°C) profiles collected at 10 fixed Emiquon sites on March 16, 2015 (Site #1 = A, #2 = B, #3 = C, #4 = D, #5 = E, #6 = F, #7 = G, #8 = H, #9 = I, and #10 = J) (Dissolved oxygen (ppm) = blue, Temperature (°C) = red).

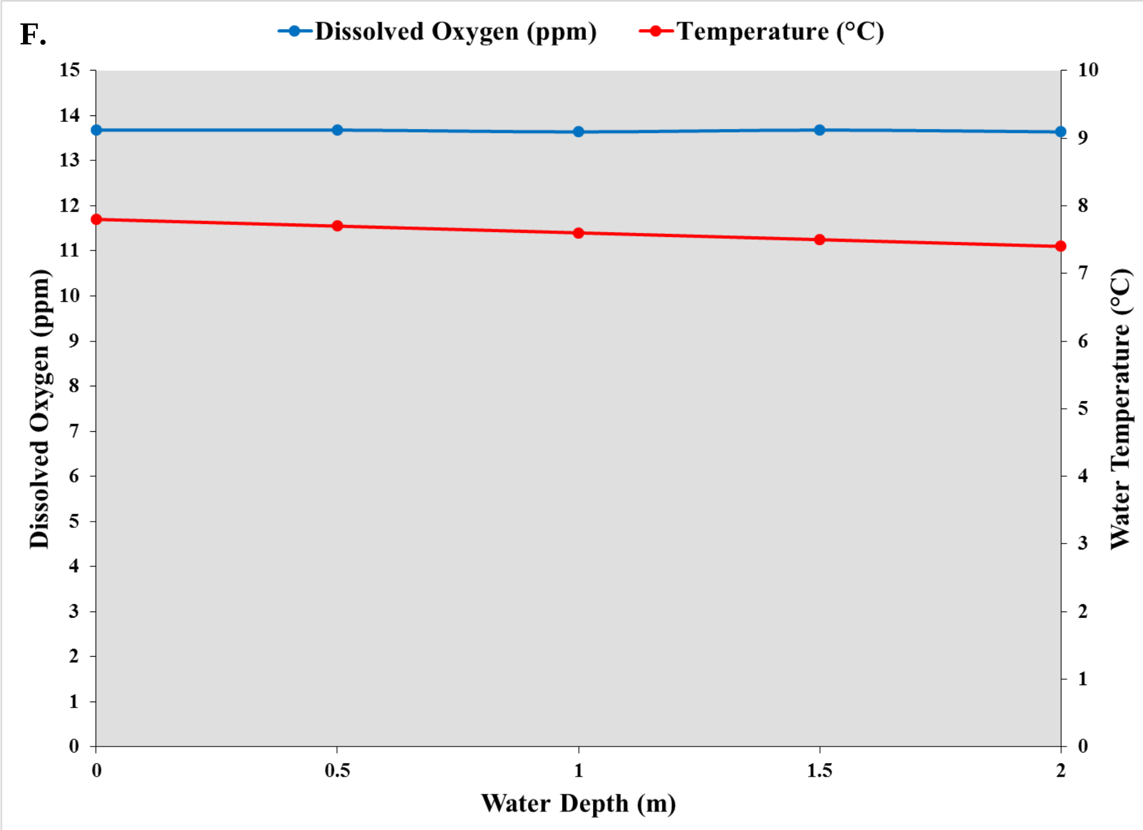


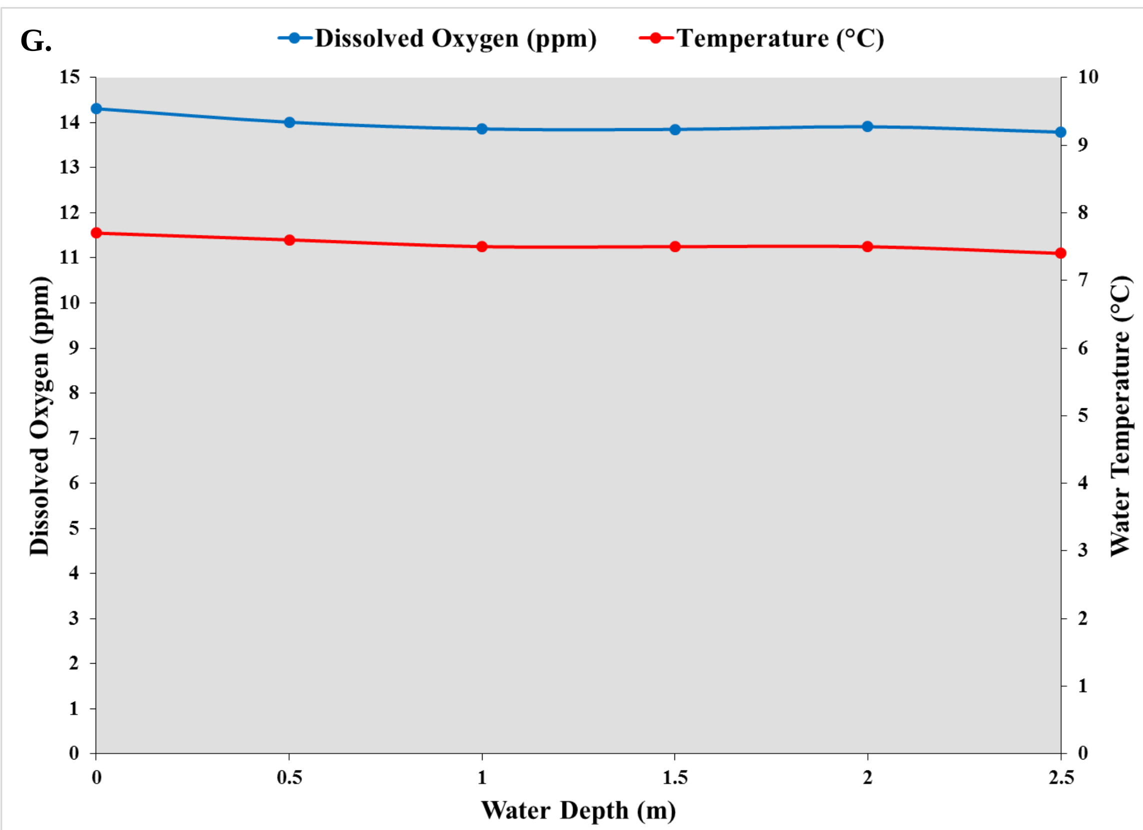

B.
Dissolved Oxygen (ppm)
Temperature (°C)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
10
9
8
7
6
5
4
3
2
1
0
0
0.5
1
1.5
2
Water Depth (m)
Dissolved Oxygen (ppm)
Water Temperature (°C)

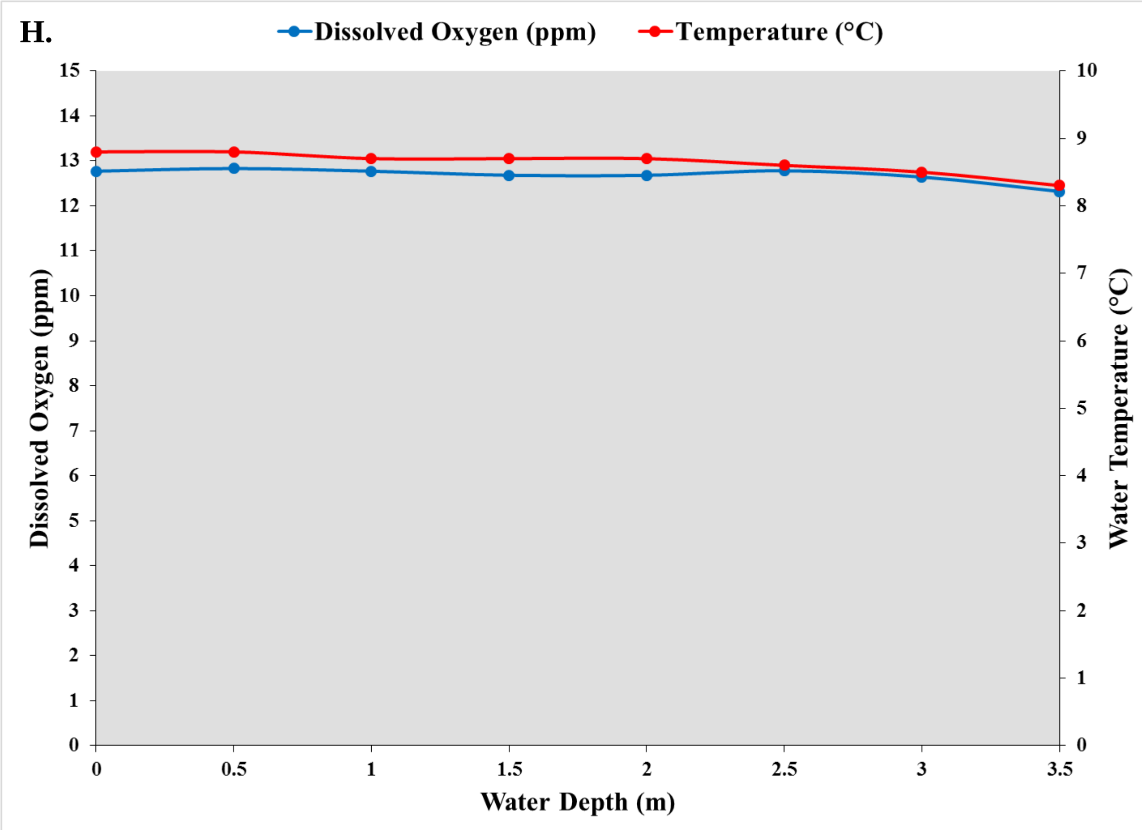

C.
Dissolved Oxygen (ppm)
Temperature (°C)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
10
9
8
7
6
5
4
3
2
1
0
0
0.5
1
1.5
2
2.5
Water Depth (m)
Dissolved Oxygen (ppm)
Water Temperature (°C)

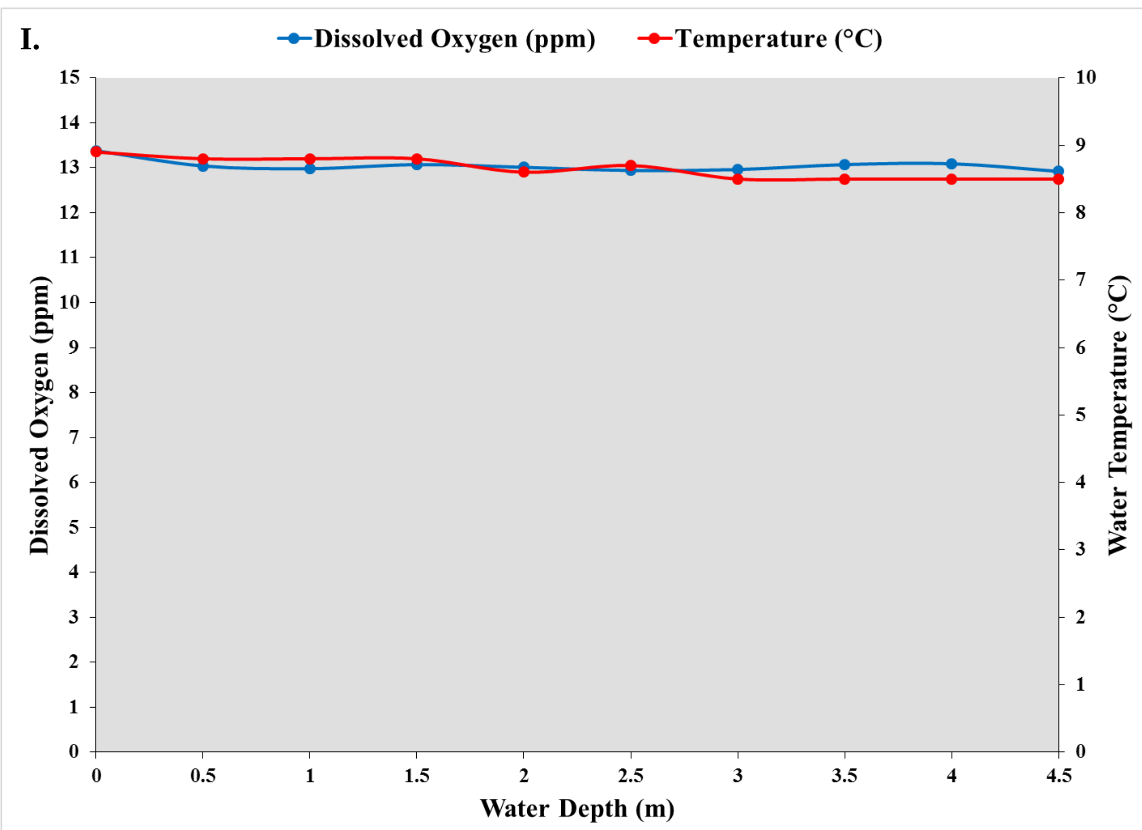

D.
Dissolved Oxygen (ppm)
Temperature (°C)
Dissolved Oxygen (ppm)
Water Temperature (°C)
Water Depth (m)

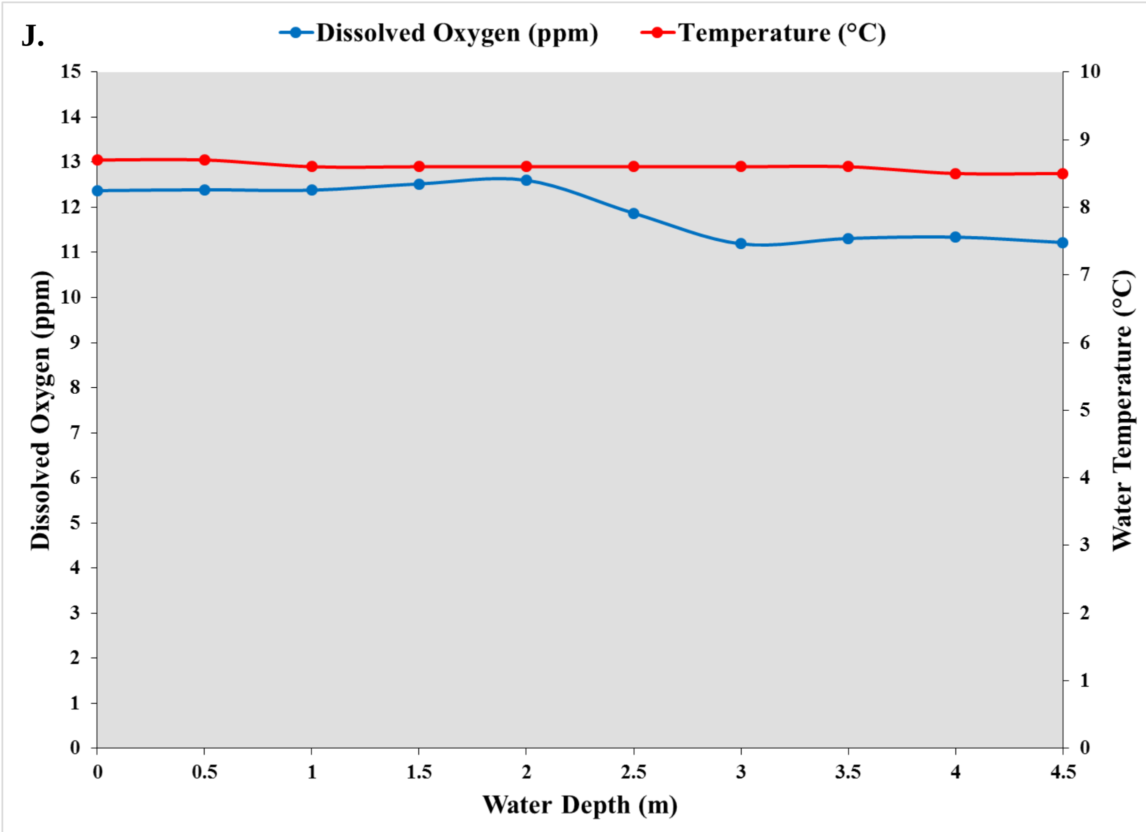

E.
Dissolved Oxygen (ppm)
Temperature (°C)
Dissolved Oxygen (ppm)
Water Temperature (°C)
Water Depth (m)


F.
Dissolved Oxygen (ppm)
Temperature (°C)
Dissolved Oxygen (ppm)
Water Temperature (°C)
Water Depth (m)
0
0.5
1
1.5
2
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
10
9
8
7
6
5
4
3
2
1
0


G.
Dissolved Oxygen (ppm)
Temperature (°C)
Dissolved Oxygen (ppm)
Water Temperature (°C)
Water Depth (m)
0
0.5
1
1.5
2
2.5
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
10
9
8
7
6
5
4
3
2
1
0


H.
Dissolved Oxygen (ppm)
Temperature (°C)
Dissolved Oxygen (ppm)
Water Temperature (°C)
Water Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5


I.
Dissolved Oxygen (ppm)
Temperature (°C)
Dissolved Oxygen (ppm)
Water Temperature (°C)
Water Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5


J.
Dissolved Oxygen (ppm)
Temperature (°C)
Dissolved Oxygen (ppm)
Water Temperature (°C)
Water Depth (m)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5

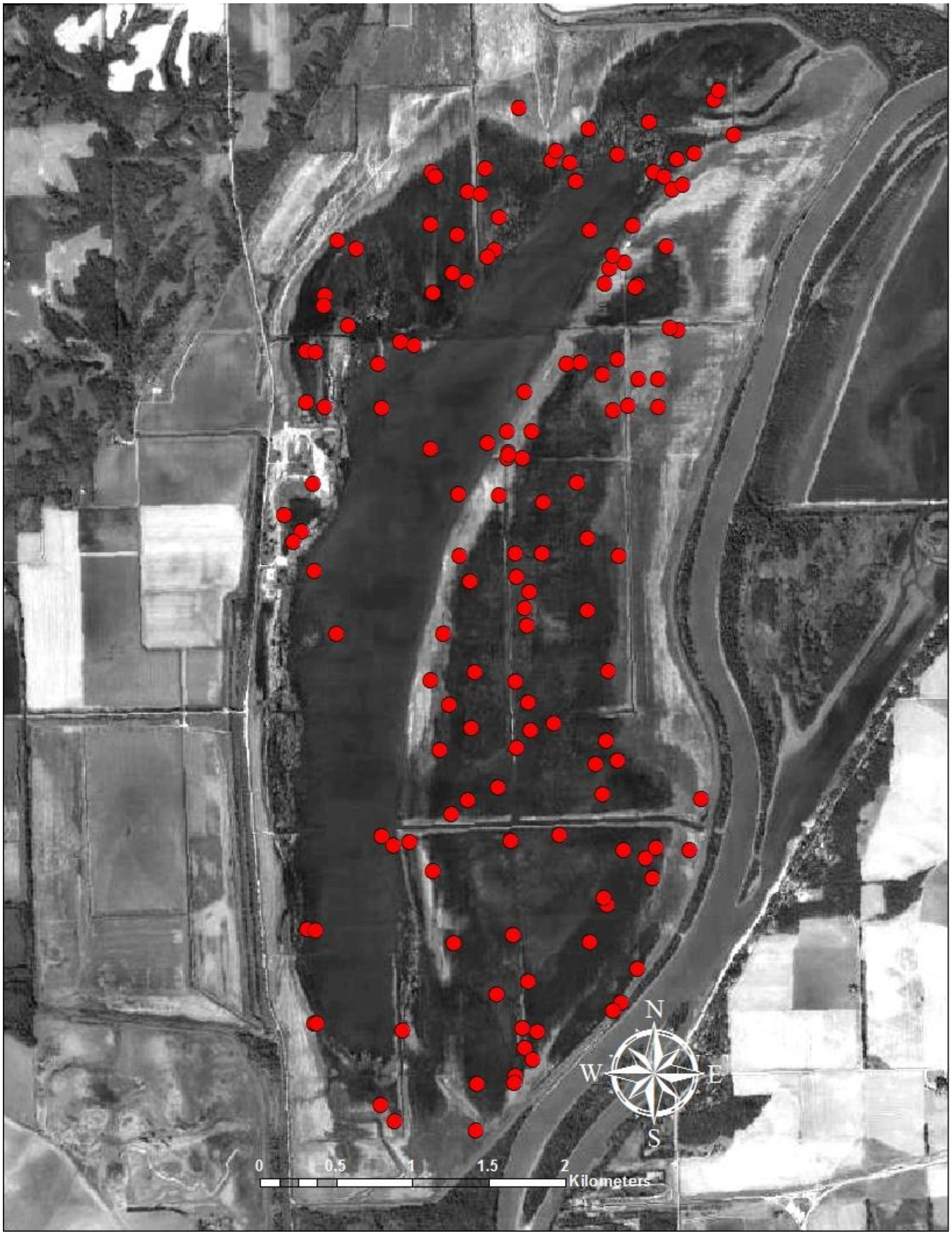


Figure 28. Map of Emiquon showing locations of Eurasian watermilfoil *Myriophyllum spicatum* collected in 2015 (149 out of 210 sites).

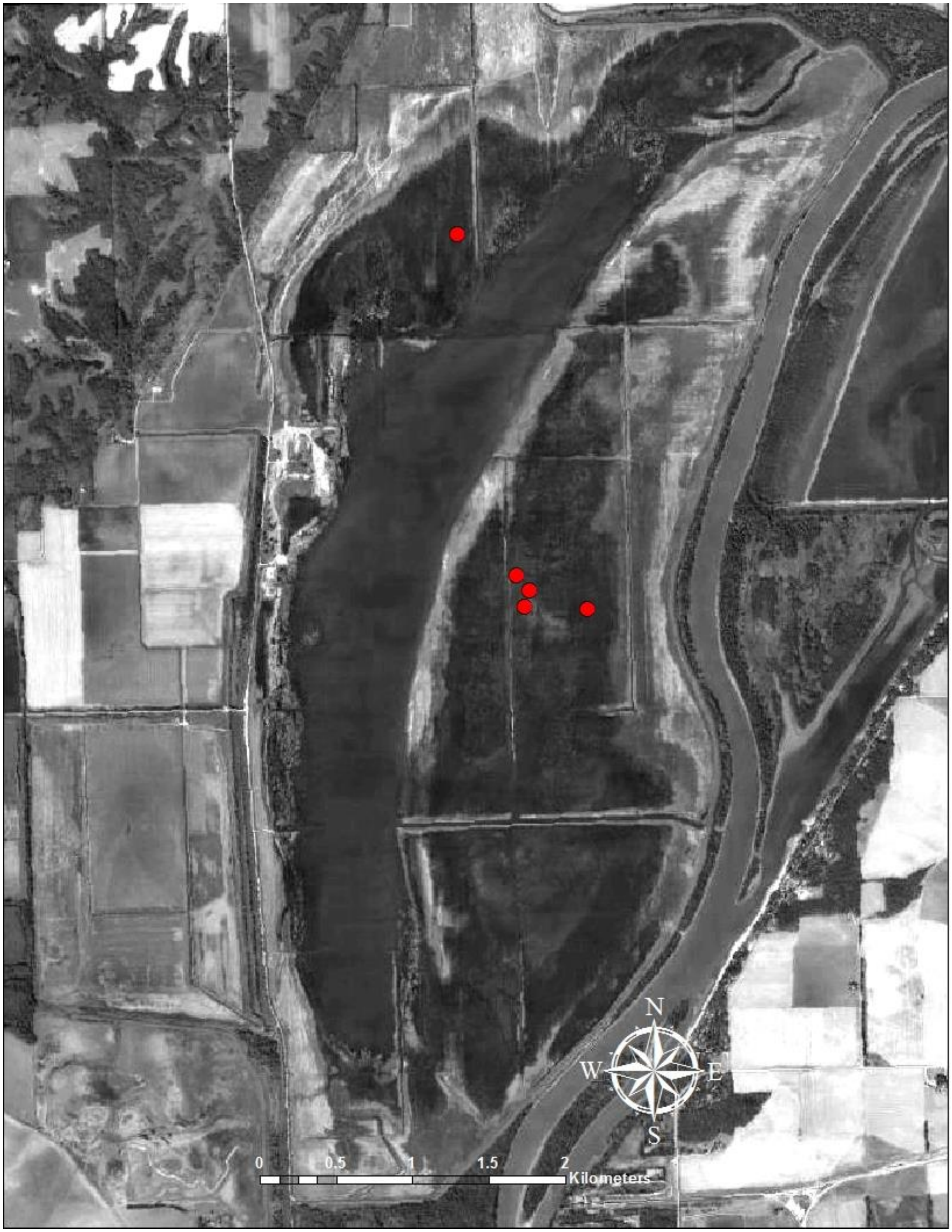


Figure 29. Map of Emiquon showing locations of curly-leaf pondweed *Potamogeton crispus* collected in 2015 (5 out of 210 sites).

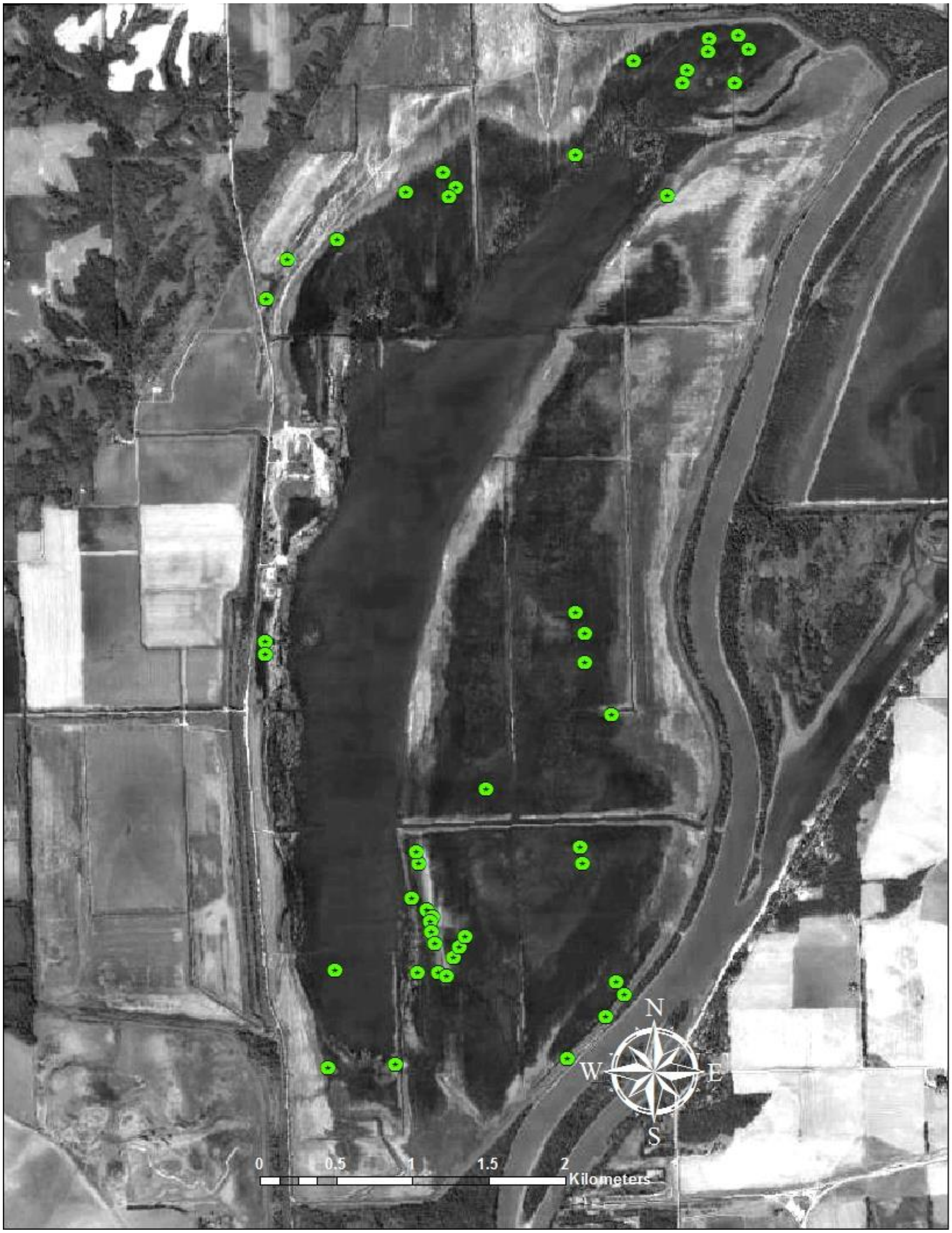


Figure 30. Map of Emiquon showing locations of American lotus *Nelumbo lutea* observed in 2015 (47 observations).

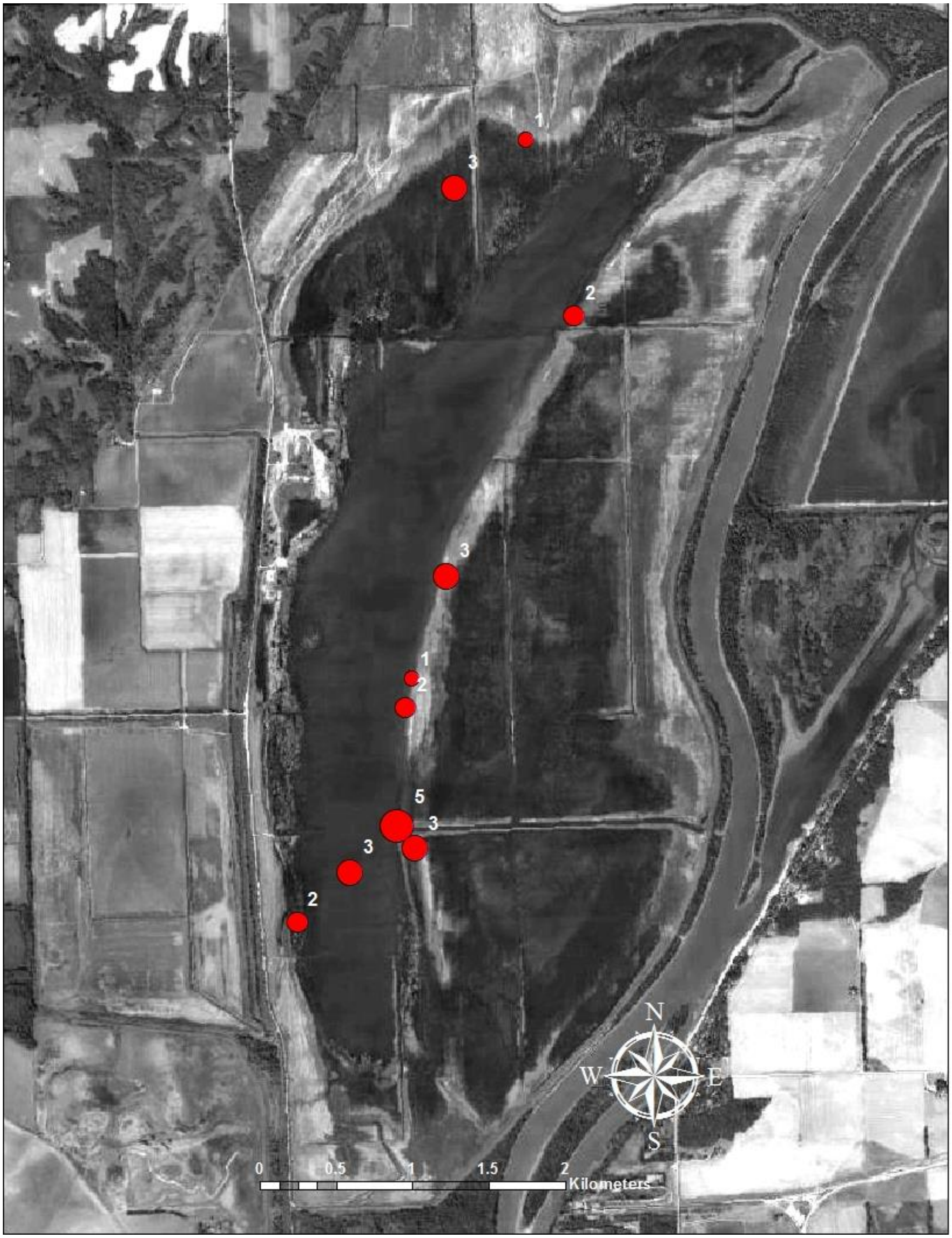


Figure 31. Map of Emiquon showing the locations and total catch of common carp *Cyprinus carpio* collected at random and fixed fish sampling sites in 2015.