ILLINOIS NATURAL HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

Estimating population size of largemouth bass and black crappie at The Nature Conservancy's Emiquon Preserve prior to reconnection to the Illinois River

Olivea M. Mendenhall, Jason A. DeBoer, Andrea K. Fritts, Mark W. Fritts, Richard M. Pendleton, Levi E. Solomon, Todd D. VanMiddlesworth, Andrew F. Casper

INHS Technical Report 2017 (12)

Issued on 3/15/2017

Unrestricted

University of Illinois at Urbana Champaign
Prairie Research Institute
William Shilts, Executive Director

Illinois Natural History Survey
Brian D. Anderson, Director
1816 South Oak Street
Champaign, IL 61820
217-333-6830

Estimating population size of largemouth bass and black crappie at The Nature Conservancy's Emiquon Preserve prior to reconnection to the Illinois River

Olivea M. Mendenhall, Jason A. DeBoer, Andrea K. Fritts, Mark W. Fritts, Richard M. Pendleton, Levi E. Solomon, Todd D. VanMiddlesworth, Andrew F. Casper

Abstract:

Prior to completion of the water control structure at The Nature Conservancy's Emiquon Nature Preserve (Emiquon), a mark-recapture study was conducted on largemouth bass *Micropterus salmoides* and black crappie *Pomoxis nigromaculatus* to estimate the populations of both species. Largemouth bass > 150 mm and black crappie > 100 mm were captured using pulsed-DC electrofishing, fyke nets, and tandem fyke nets and double tagged using T-bar style clear tags. Results of this study show very large populations of both species, with populations of largemouth bass estimated at 21,090 (17,110-27,484) and black crappie estimated at 205,042 (91,198-490,563). Information gained in this study will allow Nature Conservancy managers to make informed decisions on future management actions and allow for potential evaluation of those management actions on two major components of the recreational fishery at Emiquon.

Introduction:

Largemouth bass *Micropterus salmoides* and black crappie *Pomoxis nigromaculatus* are among a small group of fish species considered to be indicators of a healthy aquatic ecosystem (Anderson et al. 2016). Many natural resource agencies and organizations monitor populations of largemouth bass and black crappie as a priority for sportfish management. Since both species are indicators of a healthy ecosystem, researchers can use them to assess the effects of natural and anthropogenic disturbances in aquatic systems. The Illinois Department of Natural Resources (IDNR) monitors these species in lakes and reservoirs throughout the state, including The Nature Conservancy's (TNC) Emiquon Nature Preserve (Emiquon). Illinois River Biological Station (IRBS) staff, sponsored by TNC, collects data (2007-present) on these and other species through standardized annual fish community monitoring at Emiquon (Figure 1 and 2).

Much of fish and game management is conducted using population trends through time. In fisheries management, many of these trends are based on relative abundance (generally catch-per-unit-effort [CPUE]). However, the exact nature of the relationship between true population abundance and CPUE is largely unknown (Harley et al. 2001, Hubert and Fabrizio 2004). This makes pertinent analysis and management based solely on CPUE difficult. Population estimates are a more robust method for assessing population trends, often providing valuable insight that CPUE does not. Periodic (3- to 5-year intervals) population estimates also provide reference points that allow managers to interpolate CPUE data. Unfortunately, population estimates are not frequently part of fisheries management because of the intensive effort required, as most population estimation techniques require several sampling trips to a single waterbody. McInerny and Degan (1993) estimated that mark-recapture studies require 2-4 times more effort than catch rate indices require and would have greater cost associated to obtain the minimum number of recaptures to reduce biasing the study.

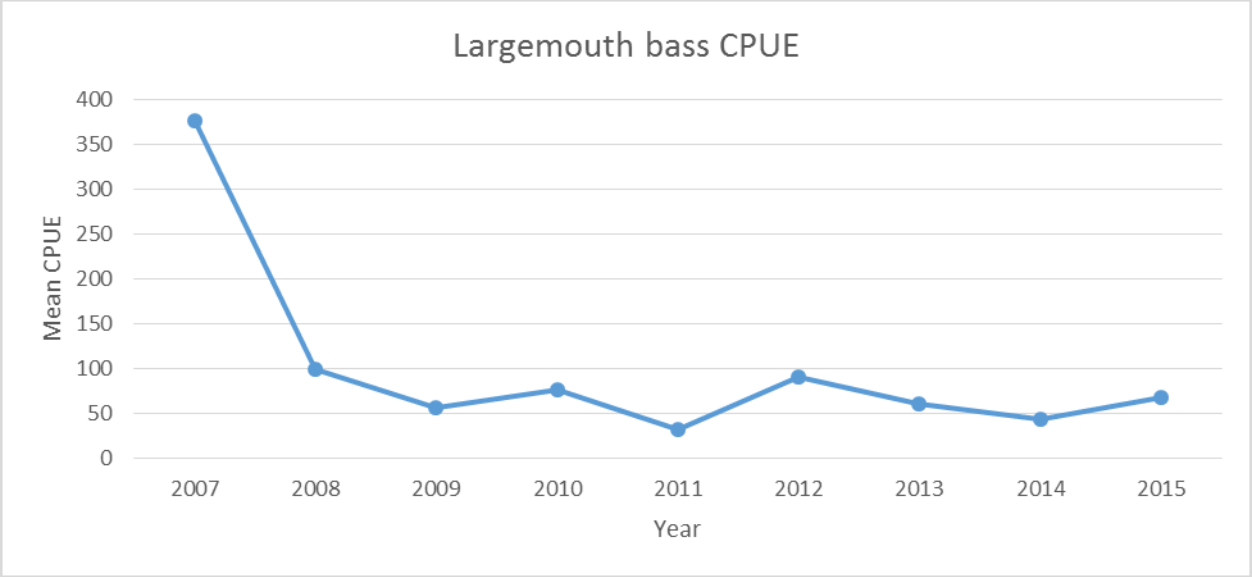

Figure 1: Catch per unit effort (CPUE) of largemouth bass using electrofishing data from standardized fish monitoring at Emiquon.

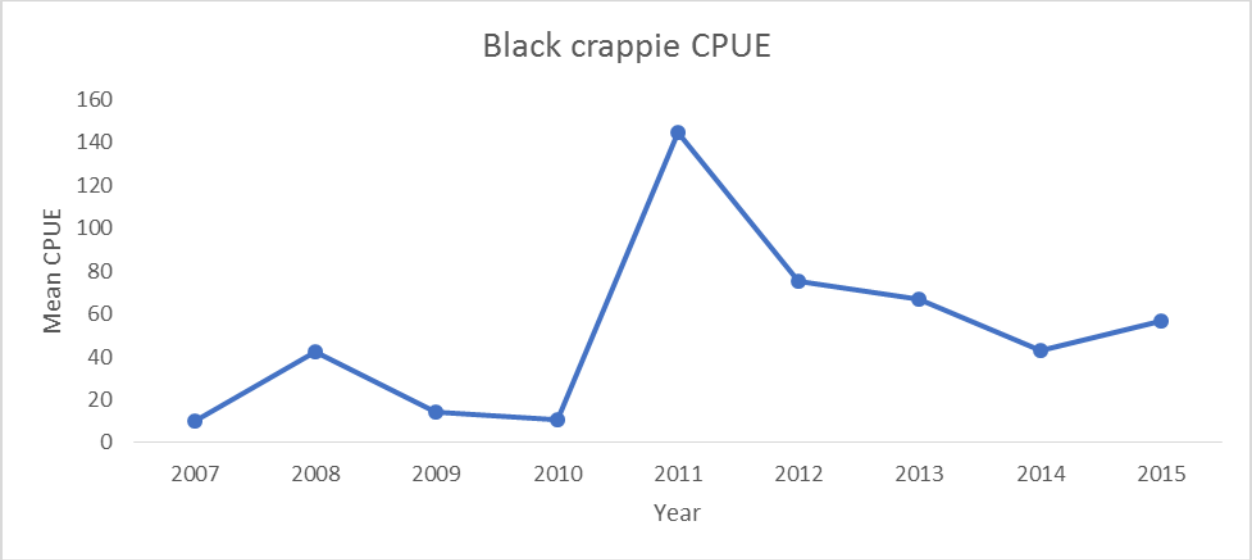

Figure 2: Catch per unit effort (CPUE) of black crappie using tandem fyke netting data from annual standardized fish monitoring at Emiquon.

The Nature Conservancy, seeking greater ability to manage water levels within Emiquon, completed initial construction of a water control structure allowing connection of Emiquon to the main channel of the Illinois River in 2016. This created a managed connection with the Illinois River to allow TNC managers to fluctuate the water level to manage fish, vegetation, waterfowl, and other abiotic and biotic factors. This managed connection will also allow for mimicking of a more-natural flood pulse to allow for exchange between a river and the associated floodplain (Junk et al. 1989). In an effort to better understand population trends of selected species of fishes pre- and post-construction of the water control structure at Emiquon, a pre-construction mark-recapture study was initiated.

The mark-recapture study was conducted in 2015 to gather pre-construction population estimates on largemouth bass and black crappie at Emiquon. Population estimates using mark-recapture techniques can be used to estimate total population as a function of water level or surface area that would allow for a post-reconnection comparison, and any new management action implemented, if desired by TNC. Information obtained from this study could also potentially be used to determine the effects of exploitation, health of the aquatic ecosystem, and health of these valuable sportfish.

Methods:

Largemouth bass and black crappie were collected from Emiquon during May-October 2015. Based on judgement of biologists and analysis of previously collected data, pulsed-DC electrofishing was used to target largemouth bass, whereas fyke nets and tandem fyke nets were used to target black crappie. However, all size-appropriate largemouth bass and black crappie were tagged regardless of which gear they were collected with. All largemouth bass greater than 150 mm and black crappie greater than 100 mm in length were marked with two clear T-bar floy tags in the musculature of the dorsal fin. The first tag was for population estimates of tagged versus non-tagged fish, the second tag was used to evaluate tag retention.

Data collection began on 27 May 2015, with an initial sampling effort to tag as many fish as possible in order to put enough tags in the system to allow for sufficient recaptures and provide the best possible population assessment. This initial effort occurred daily and lasted through 11 June 2015. Subsequently, targeted pulsed-DC electrofishing occurred bi-weekly with a goal of sampling all accessible habitat during each sampling event. Sampling bi-weekly allowed tagged fish to disperse and circulate throughout Emiquon allowing for a mixing of tagged and untagged fish. Specific habitats were only sampled once per sampling event, and one three-person crew spent approximately three days per week to electrofish all available habitats. Targeted fyke nets and tandem fyke nets were also to be deployed every other week; however, these efforts had to be suspended from July through September due to high mortality of black crappie. Targeted fyke netting and tandem fyke netting resumed in October and a total of fourteen days were spent on targeted netting. As this study was not interested in CPUE, exact effort was not recorded for time spent electrofishing or number of targeted nets deployed, however all nets were set for one net night (~24 hours).

In addition to targeted sampling, monthly standardized monitoring of Emiquon using a randomized sampling design that included electrofishing, fyke netting, tandem fyke netting, mini fyke netting and tandem mini fyke netting (outlined by Vanmiddlesworth et al. 2015) was also used to mark and recapture fish. This standardized effort was conducted using Upper Mississippi River Restoration (UMRR) Program's Long Term Resource Monitoring (LTRM) style protocols and was conducted independently of targeted sampling. More information about LTRM protocols and can be found in Ratcliff et al. (2014).

During each sampling event, untagged fish were tagged and counted. Recaptured tagged fish were counted and inspected for the number of tags each fish retained and potential tag loss (scarring or wounding in the tagging area). Data was summarized from all sampling crews and a population estimate for each species was calculated in Program R using a Schnabel model (Schnabel 1938).

Results:

A total of 1,971 largemouth bass and 1,550 black crappie were collected during this study (Table 1). We estimated a total population of largemouth bass to be 21,090 (17,110-27,484) and black crappie to be 205,042 (91,198-490,563) (Table 1). Pulsed-DC electrofishing was most effective at capturing the majority of largemouth bass with 1,924, while tandem fyke nets were most effective at capturing black crappie with a total of 1,159 (Table 2). Fyke nets only captured 11 largemouth bass and 111 black crappie. Mini-fyke nets were the least productive at capturing either species (Table 2). Largemouth bass recapture rates were higher using electrofishing, capturing 83 of the 84 fish with only one largemouth bass being caught in a tandem fyke net. Black crappie capture rates were equal using electrofishing and fyke nets, both gears only recapturing two each.

We observed excellent tag retention during this study, with no recaptured largemouth bass having lost either tag, and only one black crappie losing a single tag. In addition to observing tag retention, all individual fish were checked for tagging scars upon capture. No untagged largemouth bass or black crappie collected were noted as having tagging-related scarring. Any such scars would likely have been visible due to the short (5 month) duration of this study.

Table 1. Total number marked, total number of recaptures, tag retention, and population estimate for largemouth bass and black crappie collected at The Nature Conservancy's Emiquon Nature Preserve during 2015.

Species	Total Marked	Total Recaptures	Tag Retention	Population Estimate (95% C.I.)
Largemouth bass	1,971	84	100.0%	21,090 (17,110-27,484)
Black crappie	1,550	4	87.5%	205,042 (91,198-490,563)

Table 2. Total number of marked and recaptured largemouth bass and black crappier per gear type collected at The Nature Conservancy's Emiquon Nature Preserve in 2015.

Species per gear type	Marked fish	Re-captured fish
Largemouth bass		
Pulsed DC electrofishing	1,924	83
Fyke	11	0
Tandem Fyke	36	1
Total	1971	84
Black crappie		
Pulsed DC electrofishing	279	0
Fyke	111	2
Tandem Fyke	1,159	2
Tandem mini-fyke	1	0
Total	1,550	4

Discussion:

Our results provide valuable insight into populations of largemouth bass and black crappie at Emiquon, and provide excellent baseline data to allow for comparisons following completion of the water control structure and any subsequent management actions. A sufficient number largemouth bass were tagged and recaptured to provide a suitable population estimate for pre-construction conditions at Emiquon. Although very few black crappie were recaptured (four), leading to very high range of potential error within the 95% confidence interval, our data demonstrate that there is a very large population of black crappie within Emiquon.

Largemouth bass recapture rates were higher with electrofishing and lowest in tandem fyke nets. This was consistent with earlier analysis of monitoring data (and expert opinion) that suggested electrofishing as the most efficient means of sampling largemouth bass. The high number of recaptures of largemouth bass could potentially be attributed to homing tendencies of the species. Largemouth bass tend to be recaptured in the same area since they do not move a great distant from their home location (Mclnerny & Degan 2011). As sampling efficiency was inhibited by extensive aquatic vegetation during summer months, habitats still accessible via electrofishing boats were sampled consistently during each sampling event. This could have potentially inflated recaptures of largemouth bass, but any influence in overall results would be negligible as great care was taken to sample all available habitat in the entire system during each sampling event.

Black crappie recaptures were lower than largemouth bass which could be due to high population size, inability to set tandem nets in summer months, or the loss of tags. Despite the low numbers of recaptures and inability to set tandem fyke nets for several months, we believe that our population estimate of black crappie is representative of the true number present in Emiquon. Despite the wide range of potential error calculated, we can conclude that the black crappie are exceptionally abundant in Emiquon, and our efforts and results support this conclusion. Specific to the inability to set tandem nets: high mortality rates and highly stressed black crappie were observed beginning in July, leading to our decision to temporarily discontinue the use of this gear. This stress and mortality was likely due to overnight decreases in dissolved oxygen. Mortality in double tagged black crappie was also observed by Larson et al. (1991), who reported 40% mortality of double tagged fish when water temperatures were greater than 12.5 °C (temperatures throughout our entire study were greater than 12.5 °C). However, based on condition of the vast majority of black crappie upon capture and release, we do not feel our tagging-induced mortality rates were nearly this high.

One black crappie lost one of its tags during this study. While a sample size of four tagged fish makes it impossible to make any conclusions about tag retention, Larson et al. (1991) concluded that smaller crappie ($\leq$ 200 mm) show lower tag retention using the anchored T-bar tags. This is due to the "T" not locking between the pterygiophores and reduced musculature near the dorsal fin. Thus, the lower number of recaptured black crappie in this study could potentially be attributed to tag loss of smaller black crappie. However, when considering this factor, it is important to note that all largemouth bass and black crappie were visually inspected for tagging scars resulting from dropped tags. No obvious tagging scars were observed on untagged fish.

Exploitation by anglers was not monitored in this study, however steps were taken to account for this uncontrollable variable. Detailed signs, included photos of tagged fish, were displayed at the boat ramp asking anglers to report any harvest of tagged fish. Larson et al. (1991) and Dunning et al.

(1987) used monetary rewards for anglers to report exploited fish with tags, and using monetary rewards could be an option to increase reporting from anglers of tagged fish in future studies.

The information gathered in this study was pre-reconnection of Emiquon with the Illinois River. Since the water control structure was completed in July of 2016, a post-connection comparison of largemouth bass and black crappie populations using similar mark recapture techniques within Emiquon could be conducted. This would allow TNC managers to gauge the effect of future management actions on these recreationally valuable fishes.

References:

Anderson, A. M., A. F. Casper and K. N. S. McCain. 2016. Draft Report Upper Mississippi River Restoration Long Term Resource Monitoring Analysis Team Fish Indicators of Ecosystem Health: Upper Mississippi River System.

Dunning, D. J., Q. E. Ross, J. R. Waldman, M. T. Mattson. 1987. Tag Retention by, and Tagging Mortality of, Hudson River Striped Bass. North American Journal of Fisheries Management, 7:4, 535-538.

Hall, T. J. 1986. Electrofishing Catch per Hour as an Indicator of Largemouth Bass Density in Ohio Impoundments. North American Journal of Fisheries Management, 6:3, 397-400.

Harley, S. J., R. A. Myers, and A. Dunn. 2001. Is Catch-Per-Unit-Effort Proportional to Abundance? Canadian Journal of Fisheries and Aquatic Sciences 58: 1760–1772.

Hubert, W. A., and M. C. Fabrizio. 2007. Relative Abundance and Catch Per Unit Effort. Pages 279–325 in C. S. Guy and M. L. Brown, editors. Analysis and Interpretation of Freshwater Fisheries Data. American Fisheries Society, Bethesda, Maryland.

Junk, W. J., P. B. Bayley, and R. E. Sparks. 1989. The Flood Pulse Concept in River-Floodplain Ecosystems. Pages 110–127 in D. P. Dodge, editor. Proceedings of the International Large Rivers Symposium. Canadian Special Publication of Fisheries and Aquatic Sciences 106.

Larson, S. C., B. Saul, and S. Schleiger. 1991. Exploitation and Survival of Black Crappies in Three Georgia Reservoirs. North American Journal of Fisheries Management, 11:4, 604-613.

Mclnerny, M. C., and D. J. Degan. 2011. Electrofishing Catch Rates as an Index of Largemouth Bass Population Density in Two Large Reservoirs. North America Journal of Fisheries Management, 13:2, 223-228.

Ratcliff, E. N., E. J. Gittinger, T. M. O'Hara, and B.S. Ickes. 2014. Long Term Resource Monitoring Program Procedures: Fish Monitoring, 2nd edition. A program report submitted to the U.S. Army Corps of Engineers' Upper Mississippi River Restoration-Environmental Management Program, June 2014. Program Report LTRMP 2014-P001, 88 pp. including Appendixes A–G, http://pubs.usgs.gov/mis/ltrmp2014-p001/.

Schnabel, Z. E. (1938). The estimation of the total fish population of a lake. American Mathematical Monthly. 45, 348-352.

VanMiddlesworth, T. D., and A. F. Casper. 2015. The Nature Conservancy's Emiquon Preserve Fish and Aquatic Vegetation Monitoring Annual Report. INHS Technical Report 2015.