SHOVELNOSE STURGEON POPULATION MONITORING, BROODSTOCK COLLECTION, AND RESEARCH EXTENSION PROJECTS, WABASH RIVER, INDIANA, 2008

Progress Report 2008

Nathan J. Nye
Big Rivers Assistant Biologist

Fisheries Section
Indiana Department of Natural Resources
Division of Fish and Wildlife
I.G.C.-South, Room W273
402 W. Washington Street
Indianapolis, IN 46204

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EXECUTIVE SUMMARY

- This report summarizes population, VHS monitoring, broodstock, and research extension data for shovelnose sturgeon (*Scaphirhynchus platorynchus*) collected in 2008.

- The objectives of this study were to: 1) sample index stations (RM 298.8 to 316.4) to analyze trends of SNS abundance and size; 2) sample new reaches (RM 0 to 100.0, 100.1 to 200.0) to analyze SNS population demographics outside the spawning period; 3) monitor SNS and other fish species in the Wabash River for VHS; 4) assist the Ohio Department of Natural Resources (ODNR) and the West Virginia Division of Natural Resources (WVDNR) in collecting SNS broodstock for their reintroduction programs; and 5) aid regional researchers in collecting tissue samples to determine SNS spawning readiness (US Geological Survey).

- Shovelnose sturgeon were processed by Indiana DNR (IDNR) personnel in 2008 (N = 853). Of these, 698 were tagged and released into the Wabash River.

- The median FL value for SNS was 27.2 inches in the upper Wabash River and 27.4 inches in the lower Wabash River in 2008.

- The IDNR collected SNS broodstock for West Virginia during 2008 ($N \sim 110$). The ODNR's SNS 2008 reintroduction program was dropped due to lack of funding.

- IDNR personnel collected tissue (blood plasma and eggs) samples from gravid female SNS (N = 28 blood plasma, N = 35 egg) for USGS researchers in 2008.

- IDNR personnel did not assist USACE in detecting SNS sonic communication signals in 2008 due to USACE scheduling conflicts. Collaboration may continue during 2009.

- It is recommended that IDNR biologists continue to: 1) closely monitor changes in SNS abundance and size; 2) closely monitor SNS and other fish species for the presence of VHS; 3) assist the ODNR and WVDNR broodstock collections for their reintroduction programs; and 4) collaborate on research extension projects with USGS, USACE, and Purdue University scientists to gain collective insights on SNS population demographics and reproduction that could not be accomplished by any one agency alone.

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INTRODUCTION

This report covers shovelnose sturgeon data collected by the IDNR in 2008. The species description, along with general descriptions of the Wabash River, specific descriptions of index monitoring sites, fish processing methodology, and referenced 2005 to 2007 SNS data were adapted from the report covering shovelnose sturgeon data collected from 2005 to 2007 (Donabauer 2008).

The shovelnose sturgeon (*Scaphirhynchus platorynchus*) is one of nine species of sturgeon of the order Acipensiformes native to North America. Also in the genus *Scaphirhynchus*, the pallid sturgeon (*S. albus*) and the Alabama sturgeon (*S. suttkusi*) are the closest relatives of the shovelnose sturgeon (SNS) and exhibit similar morphological characteristics (e.g., three rows of bony scutes, a shovel-like snout, a protrusible mouth, and a long filament on the caudal fin). Sturgeon populations world-wide have been largely threatened by two forms of anthropogenic activity: habitat alteration and over-harvest. Most of the large rivers in the United States have been modified (e.g., dams, channel dredging, bank stabilization) for the purposes of flood control, navigation, and hydropower. The Wabash River is one exception, and as the twelfth longest river in the United States it has the longest free-flowing stretch of river (411 mi) east of the Mississippi River. This relatively unaltered system is the eastern most stronghold of SNS. Consequently, there is a substantial commercial caviar and recreational sport fishery for this species.

Shovelnose sturgeon take many years to reach sexual maturity (7 to 9 years), have received increasing fishing pressure over the last decade (international caviar trade), and are vulnerable to over-harvest (Colombo et al. 2007). Subsequently, the Indiana DNR implemented harvest regulations as of February 2, 2007. Commercial and recreational anglers may only harvest SNS ≥ 25 inches fork-length (FL). In addition, commercial anglers may only harvest SNS from October 1 through May 31. Due to the unique life history of SNS, Kennedy (2005) recommended the 25 in FL minimum length limit (recently implemented) for SNS in the Wabash River, and suggested that a long-term program designed to monitor population changes should be considered. Thus, we have taken measures to act on these recommendations and have attempted to build upon previous work by sampling index stations originally proposed by Kennedy (2005)

with the intention to collect long-term data that will allow us to monitor SNS population trends in the Wabash River.

Restoration programs for SNS have been initiated by the Ohio Department of Natural Resources (ODNR) and the West Virginia Division of Natural Resources (WVDNR) as of 2005. Both agencies have acquired sexually mature SNS from the Wabash River with the aid of the Indiana Department of Natural Resources (IDNR) and Purdue University (PU) annually from 2005 through 2007. The goals of these programs are to create self-reproducing SNS populations in the Scioto River (Ohio) and the Kanawha River (West Virginia) through the stocking of post-spawn adults and cultured fingerlings derived from the Wabash River.

The Indiana DNR has also been part of several research extension projects with federal agencies interested in SNS reproduction. The US Geological Survey (USGS) has asked for assistance to collect blood plasma and egg samples from gravid female SNS. Plasma obtained allows for biomarkers (e.g., reproductive steroids) to be quantified so that reproductive status and health can be evaluated. Egg collection allows for a polarization index (PI) to be determined and indicates SNS spawning readiness. The USGS anticipates that these data can be used as a surrogate for the federally endangered pallid sturgeon for which data is exceptionally difficult to acquire. In addition, the US Army Corps of Engineers (USACE) is using technology designed to locate SNS via acoustic communications. The objective is to identify the origin of sound waves produced by SNS and use this information to determine relationships between spawning behavior and habitat. Since the upper Wabash River hosts a concentrated population of SNS during the spawning season, the USACE found these circumstances offered an ideal opportunity to test their equipment in May 2007. Many of the complexities associated with SNS reproduction remain to be discovered, and the technical expertise other regional biologists can offer will greatly increase our understanding of SNS life history characteristics in the Wabash River.

The objectives of our research are threefold: 1) sample fixed index stations to analyze long-term trends of SNS abundance and growth; 2) assist the Ohio DNR and the West Virginia DNR collect SNS broodstock for their reintroduction programs; and 3) aid regional researchers collect tissue samples (USGS), sonic communication signals (USACE) to determine SNS spawning readiness and behavior and to monitor fish health (Purdue University).

METHODS

Study Area

The upper Wabash River (Figure 1) was the primary area of investigation for this study during the spring, as Purdue University researchers (Kennedy 2005) identified probable SNS spawning areas near Lafayette, Indiana. The study shifted to the lower 200 mi stretch of the Wabash River during the months of July through December, when efforts were focused on studying shovelnose sturgeon outside this spawning area.

From its origin near the town of St. Henry, Ohio, the Wabash River meanders 276 mi across northern and western Indiana before it forms the 200 mi border between Indiana and Illinois prior to its confluence with the Ohio River near Uniontown, Kentucky. The Wabash River drains 73 counties in Indiana and a total land area of 32,821 mi^2, ranking as the second largest sub-basin of the Ohio River valley (Tennessee River sub-basin = 40,893 mi^2). The headwater elevation of the Wabash River is 876 ft from which the river descends 2.3 ft/mi to Logansport, Indiana and 0.6 ft/mi thereafter to its mouth. J. Edward Roush Lake (formerly Huntington Reservoir), near Huntington, Indiana is the only impoundment along the entire stretch of the Wabash River.

For the purposes of our research, the Wabash River is divided into four reaches of interest, corresponding to 100-mi sections of river. Reach one begins at river mile 0 (the confluence of the Wabash and Ohio Rivers) and continues to river mile 100.0 (RM 0 to 100.0). River mile 100 is approximately 4.5 mi upstream of the confluence of the White and Wabash Rivers which occurs at Mt. Carmel, IL. Reach two extends from river mile 100.1 to river mile 200 (RM 100.1 to 200.0). River mile 200 is approximately 0.5 mi upstream from the Illinois state line and approximately 13 mi downstream of Terre Haute, IN. Reach three extends from river mile 200.1 through 300 (RM 200.1 to 300.0). River mile 300 is approximately 9 mi downstream of Lafayette, IN. Reach four extends from RM 300.1 through 400 (RM 300.1 to 400.0). River mile 400 is approximately two mi downstream of Andrews, IN (Huntington County). Reaches one and two are classified as the lower Wabash River and reaches three and four are classified as the upper Wabash River.

Upper Wabash River Population Monitoring (RM 200.1 to 400.0)

Index Monitoring

The spring population monitoring protocol was to sample shovelnose sturgeon using boom-mount pulsed-DC electrofishing boats at four index stations twice during the spring on the upper Wabash River, with each index station being sampled three times (e.g., 1/4, 1/2, and 3/4-stream width) for 20 min each in the downstream direction. Index stations included Collier's Island (CI; RM 298.8 to 299.4), Goose Island (GI; RM 300.8 to 301.4), Mascouten Park (MP; RM 312.7 to 313.4), and Heron Island (HI; RM 315.4 to 316.4). All index sites were located in Reach 4 except CI which is located at the uppermost end of Reach 3. All SNS collected were assigned a serial number and measured (± 0.1 in) from the tip of the rostrum to the fork of the caudal fin (fork length; FL). Wet weight was measured with a top-loading mechanical dial scale (Douglas Homs Corporation, Belmont, California) for fish up to 2.2 lbs (± 0.1 oz). A linear spring scale (Pesola ©, Barr, Switzerland) was used to measure the wet weight of SNS up to 11 lbs (± 2 oz). All SNS were fitted with a T-bar anchor tag (Floy Tag Inc., Seattle, Washington) in the musculature at the base of the left pectoral fin. The left pectoral ray was clipped from all sturgeon, stored in scale envelopes, and archived in the laboratory for historical record of population age structure. If the sturgeon was a recapture, the Floy-tag number was recorded and the right pectoral fin ray was clipped.

The number of males was determined by the presence of milt after pressure was applied to the ventral surface. Gravid females were identified in 2008 with a 10-gauge spice injector (Delux Marinade Injector, New Iberta, LA) used to puncture suspect females (e.g., swollen abdomens). All other stages of maturity (e.g., immature females, immature males, mature non-gravid females, mature non-gravid males, mature non-functional females, mature non-functional males, inter-sex fish, and unverified mature gravid females) were not verified because this would have required invasive surgical techniques. Before sturgeon were released downstream of the index station from which they were collected, they were also examined for egg-check marks. Catch-per-unit-effort (CPUE) was summarized as the number of fish captured per-hour of electrofishing.

Experimental Sampling

Non-electrofishing gear was used during June and July at the sites around Lafayette including drift nets (DN), hoop nets (HN), and trawls (T). These gear types were used for a variety of purposes. Drift nets and hoop nets were used in order to try to catch SNS during high water (June 11 to 12) when electrofishing was not feasible. The IDNR primarily (exclusively on the upper Wabash) drifted unanchored nets with the current composed of three inch bar mesh, with 6 ft panels which were 150 ft long (3 in x 6 ft x 150 ft). Also used were an experimental gill net (0.5 to 2.5 in x 10 ft x 250 ft) and a paddlefish net (4 in x 10 ft x 150 ft); these additional drift nets were used on the lower Wabash River post-spawn. There were hoop nets of two different mesh sizes (1 in and 1.5 in) used by the IDNR on the Wabash River (upper and lower) in 2008.

In an effort to document larval (spawning success) and juvenile (year class strength) SNS in the Wabash River in 2008, the IDNR used a mini-Missouri trawl (Herzog et al. 2005, Tripp 2007). The mini-Missouri trawl is a two-layer balloon trawl with a cover of 0.25 in delta style mesh and an inner trawl body of 0.7 in bar mesh. The trawl narrows from 8 ft at the head rope to 1.5 ft at the mid-section and the cod end (Herzog 2005). The head rope with floats and a chained foot rope are tied to otter boards [16 in x 9 in, weighing 18 lbs] (Tripp 2007). The trawl is towed (in reverse) along the bottom contours of the river with 75 ft tow lines tied to each side of the bow of the boat (Tripp 2007). Trawls were 3 to 10 minutes in duration. Trawling was performed on the upper Wabash River at Lafayette on June 25, 2008 to help IDNR personnel gain experience using the gear which they had not done previously, and also to attempt to capture larval SNS. Trawling took place later in the year on the lower Wabash River.

Viral Hemorrhagic Septicemia (VHS) Monitoring

In 2008, the IDNR participated in monitoring of SNS and other fish species in the Wabash River for the presence of viral hemorrhagic septicemia (VHS). This was necessary amid growing concerns over transportation of VHS across state boundaries to uncontaminated areas via contaminated fish and/or water. The shovelnose sturgeon is not listed by the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS) as a VHS susceptible species. However, several fish species found in the Wabash River are listed by APHIS as VHS susceptible. Additionally, Indiana is currently listed by APHIS as a VHS-

regulated area. The transportation of untested SNS broodstock and water from the Wabash River could have provided an opportunity for VHS transmission to West Virginia, a VHS non-regulated area. The result was unprecedented VHS monitoring of the Wabash River and the fish populations located there.

On April 8 and April 16, 2008 IDNR personnel collected composite samples of catostomids (various suckers), gizzard shad, and shovelnose sturgeon using boom-mount pulsed-DC electrofishing boats. Biological data including fork length (in), wet weight (lbs), sex (male, female, unknown), egg-check mark (Y/N), and Floy® tag number were recorded from SNS by IDNR personnel. All fish were transported to the Indiana Animal Disease Diagnostic Laboratory (ADDL) at Purdue University where they were sacrificed and tested for VHS.

Broodstock Collection

All 2008 SNS broodstock were collected from the Wabash River near the Mascouten Park (MP) index site at Lafayette, Indiana. The agencies (e.g., IDNR and WVDNR), and universities (PU) involved met at the MP ramp on May 5, 2008 to coordinate sampling effort. Shovelnose sturgeon were collected by boom-mount pulsed-DC electrofishing boats. Captured SNS were hauled to the MP ramp where part of the crew monitored two collection cages and segregated fish by sex while remaining crew members continued to collect SNS. Females were typically rotund with an obvious blue band running the entire anterior-posterior length of the ventral surface. Males were relatively slender and could be verified by the presence of milt or spawning tubercles. Personnel from IDNR recorded a variety of biological data including fork length (in), wet weight (lbs), sex (male, female, unknown), egg-check mark (Y/N), and Floy® tag number. Broodstock were then placed into WVDNR (PI: Chris O'Bara) hatchery-transport trucks and shipped to a hatchery in West Virginia. Ohio (ODNR) did not participate in SNS broodstock collection in 2008 due to a lack of funding.

Research Extension Projects (Upper Wabash River)

USGS

Indiana DNR personnel again collaborated with USGS (PI: Dr. Diana M. Papoulias) in 2008 to collect blood plasma and egg samples from gravid female SNS. The USGS supplied an instructional DVD, field centrifuge, dry ice cooler, data sheets, large storage container including

small field and laboratory supplies, and dry ice shipping containers. Blood and egg samples were taken from gravid female SNS in 2008 after they were identified from population monitoring and broodstock collection (e.g., gravid females not taken by WVDNR). Sturgeon were held at the rostrum upside down while an 18-gauge needle was inserted between the anal and caudal fin to make an entry point between the scutes. A 20-gauge needle was used to draw a small volume of heparin (clot preventative) into the syringe to coat the length of the cylinder. Then the remaining heparin was expelled back into the heparin vial and stored on ice for reuse. The 20-gauge needle was then slowly inserted straight through the hole made by the 18-gauge needle until the backbone was identified. The needle was carefully pulled one millimeter from the backbone while gently pulling on the plunger until the syringe was filled with 4 mL of blood. The blood was transferred from the syringe to a labeled vaccutainer and put on ice to limit clotting and the degradation of proteins. Pressure was then applied to the needle entry point to stop the bleeding. After all blood samples were collected, the vaccutainers were placed in the field centrifuge at 3500 RPM for 10 min. The resulting plasma was removed with a disposable pipet and evenly distributed with 1 mL of plasma among four labeled cryovials. The labeled cryovials were placed in a cryo-box and put on dry ice until shipment. USGS extracted steroids from plasma samples and used radioimmunoassay (RIA) to determine hormone (estradiol, 11-ketotestosterone, and testosterone) levels and evaluate reproductive state.

A 10-gauge spice injector (Delux Marinade Injector, New Iberta, LA) was used to collect eggs from gravid female SNS in 2008. The abdominal surface of gravid female SNS was punctured with the spice injector midway between the edge of the ventral scutes and the midline approximately one third of the way from the pelvic fins to obtain a sample of 10 to 20 eggs. The eggs were immediately placed into labeled bottles containing 10% neutral buffered formalin and shipped to USGS at room temperature in a box separate from the plasma. The eggs were measured by USGS for polarization index (PI) values. Using a razor blade the eggs were cut down the animal-vegetal axis through the nucleus or germinal vesicle (GV). A microscope and eyepiece micrometer were used to measure the total length of the egg (e.g., along the long axis) as well as the distance from edge of the vegetal pole of the oocyte to the beginning edge of the GV (e.g., generally the shortest distance). Oocytes with a GV to cell membrane length and total length ratio 0.07 or lower were considered ready to spawn.

USACE

Collaboration between IDNR personnel and USACE researchers involving detection of SNS sonic transmission signals ("sounds") which took place in 2007, though proposed for 2008, did not occur due to fieldwork scheduling conflicts.

Purdue University

Indiana DNR personnel collaborated with researchers at Purdue University (PIs: Dr. Reuben Goforth, Dr. Maria Sepulveda). Dr. Goforth is a community ecologist interested in studying the SNS spawning (present in the spring) and resident (present year-round) SNS populations in the upper Wabash River. For Dr. Goforth's work, biological data was recorded and fin rays, otoliths, and stomachs were removed from sacrificed SNS (collected for VHS) for aging purposes and diet analysis. Dr. Goforth was interested in assessing differences in fish ages estimated from fin rays and otoliths taken from the same fish. He was also interested in studying SNS diet composition during the spawning period and diet composition for the resident SNS population in the upper Wabash River outside the spawning period. He was instrumental in providing manpower for all spring SNS sampling on the upper Wabash River. He graciously provided graduate students as well as undergraduates (both from his lab and his classes) to assist shorthanded IDNR personnel in SNS collections.

Dr. Sepulveda has several research interests including ecotoxicology, and she was specifically interested in studying SNS population health as well as determining the presence/prevalence of intersexed (hermaphroditic) SNS in the Wabash River due to the presence of pharmaceutical chemicals in the water. To this end, the 64 SNS collected (sacrificed) for VHS testing were also sampled by Dr. Sepulveda. Biological data included fork length, weight, sex, and maturity status. Gonad, liver, whole blood, and blood plasma samples were taken from each fish. Gonadosomatic index (GSI; gonad weight relative to body weight) and hepatosomatic index (HSI; liver weight relative to body weight) were calculated for each fish, and gonads were visually examined for evidence of intersex (gonads with characteristics of the opposite sex, e.g., clear eggs in male testes). Blood chemistry analyses measured hematological parameters including: 1) packed cell volume (PCV) which is a measure of total red blood cell numbers; 2) hemoglobin levels; and 3) plasma proteins. Dr. Sepulveda also graciously supplied student assistance for IDNR fish collections in 2008.

Lower Wabash River Population Monitoring (RM 0 to 200.0)

Shovelnose sturgeon population monitoring efforts were expanded to include the population outside of the spring spawning period, when the fish are presumably not concentrated in spawning areas on the upper Wabash River. We believe that spring sampling performed at index stations on the upper Wabash River may be biased in terms of sex ratios, maturity status, and size and age structure (all large mature fish, significantly more males than females). It is desirable to gain a clearer understanding of these variables for the shovelnose sturgeon population throughout the Wabash River to supplement what may be learned solely from studying spawning concentrations of fish. Population monitoring during the summer and fall of 2008 occurred on the lower Wabash River (Reaches 1 and 2). Beginning in July, periodic sampling was performed near Crawleyville, IN (Reach 1; RM 82 to 89), near St. Francisville, IL (Reach 2; RM 116.5 to 118.7), near the confluence of the Embarras and Wabash Rivers (Reach 2; RM 122.1), and near Vincennes, IN (Reach 2; RM 130). The objective of this sampling was to enhance our understanding of SNS movement within the Wabash River and habitat types utilized post-spawn with the ultimate goal of sacrificing 20 SNS monthly in each of the four reaches. Sacrificing these fish will enable us to collect empirical age, size, sex, and maturity data for SNS throughout the year including spawning and non-spawning periods. This will allow us to more effectively manage this increasingly exploited species.

Varying river conditions and habitat types allowed us to utilize several different gear types, including electrofishing (EF), drift nets (DN), set gill nets (GN), hoop nets (HN) and trawls (T). Electrofishing was performed using boom-mount pulsed-DC electrofishing boats as on the upper Wabash River. Drift nets, hoop nets, and trawls used on the lower Wabash were the same as those described for the upper Wabash. Drift and hoop nets were useful for fishing during high water and for fishing deep holes; situations where electrofishing gear is ineffective. Set gill nets (GN) were simply 3 in x 6 ft x 150 ft drift nets with an orange bullet float attached to the upstream float line and a hoop net anchor attached to the upstream lead line, while the downstream end of the net remained unanchored. A two liter soda bottle was attached to the downstream end of the float line; this was to mark the end of the net, rather than for flotation purposes.

Fish processing methods largely followed those used on the upper Wabash River. One difference was that non-invasive sex and maturity determination was difficult, because this sampling was performed outside the spawning season. Sex and maturity status were not recorded for these fish unless evidence of maturity status was obvious upon observation.

RESULTS

Upper Wabash River Population Monitoring

Index Monitoring

Shovelnose sturgeon were sampled at index stations in 2008 (*N* = 156). All index stations were sampled in 2008 (total effort = 8.1 h), which met the total effort outlined in the protocol. However, effort at individual index sites did not meet the 2 h/site effort outlined in the protocol (Table 1). More SNS were captured among left descending transects (40%) within index stations than either mid-channel (39%) or right descending transects (21%). Mean CPUE among all index stations was 19.2 fish/h and was highest at HI on 4/24/08 (70 fish/h) and lowest at CI on 7/10/08 (0 fish/h). Of the 156 SNS captured, less than 1% (*N* = 1) were IDNR recaptures and approximately 2% (*N* = 3) were PU recaptures, while the remaining 98% (*N* = 152) were tagged with a new IDNR Floy-tag and released. Egg check marks were present on 6% (*N* = 10) of the SNS collected at index stations in 2008. Fork-length (Mean ± SD) and weight (Median, IQR) among all index sites was 27.4 ± 2.0 in and 2.9, 2.4 to 3.1 lbs (Table 1, Table 2). The median FL value for 2008 SNS was 27.5 compared to 27.2, 26.4, and 27.1 in in 2005, 2006, and 2007 respectively. For 82% (*N* = 128) of the SNS collected during index monitoring in 2008, sex could not be verified; 11% (*N* = 17) were mature gravid females, and 7% (*N* = 11) were mature gravid males.

For all upper Wabash River data combined in 2008 (e.g., index stations, VHS, broodstock collection, research extension), 47 gravid female SNS were collected. One gravid female SNS was sample twice (recaptured). The minimum FL for gravid females was 24.6 in and the median FL for gravid females was 28.0 in (Figure 2); 14% of gravid females (*N* = 7) were protected by the 25 in (FL) minimum size limit (Table 3). Additionally, of the 535 total SNS sampled on the upper Wabash River in 2008, 86% (*N* = 462) were captured by electrofishing and 14% (*N* = 73) were captured by non-electrofishing (experimental) gear (Figure 3).

Experimental Sampling

There were 73 SNS captured using non-electrofishing gear on the upper Wabash River in June and July, 2008 (Table 4). Hoop nets accounted for 93% (*N* = 68) of the experimental gear catch, while drift nets accounted for 5% (*N* = 4) and trawls 1% (*N* = 1) respectively (Figure 3, Table 4). Trawling took place (total effort = 1.2 h) on June 25, 2008 at several sites near Lafayette. The only SNS captured during trawling was a large adult; there were no larval or juvenile SNS present in the catch. Biological data for fish captured with experimental gear are summarized in Table 2.

Viral Hemorrhagic Septicemia (VHS) Monitoring

On April 8 and April 16, 2008, SNS (*N* = 64) were collected with 4.3 total h of effort (CPUE=14.9 fish/h) at index sites near Lafayette, IN (HI, MP, CI, GI) (Table 5). Fork-length (Mean ± SD) and weight (Median, IQR) of SNS tested for VHS was 27.5 ± 1.9 in and 3.4, 2.8 to 4.3 lbs (Table 2). Approximately 5% (*N* = 3) of the SNS were recaptures (PU = 3 Floy) and egg check marks were present on 6% (*N* = 4) of the SNS tested for VHS. The 64 SNS were tested for VHS by the Indiana ADDL at Purdue University; all 64 SNS tested negative for VHS. All gizzard shad and various suckers tested VHS negative as well.

Broodstock Collection

On May 5, 2008, approximately 200 SNS were collected with 1.6 h of effort by IDNR, PU, and WVDNR (CPUE ~ 125 fish/h; Table 5). Of these, approximately 110 were handled as little as possible, loaded into a hatchery truck, and transported to West Virginia. The remaining fish were sampled by IDNR and are referred to as the sampled fish. Definitive gravid females represented 10% (*N* = 9) of the catch that was sampled by IDNR, and these fish were also sampled (egg and blood plasma) for USGS. Four percent (*N* = 4) of the sampled SNS were recaptures (PU = 2 Floy; IDNR = 2 Floy) and egg check marks were present on 9% (*N* = 8) of the sampled SNS. Fork-length (Mean ± SD) and weight (Median, IQR) of sampled SNS were 26.7 ± 1.8 in and 2.9, 2.4 to 3.5 lbs (Table 2). Additional data pertaining to hatchery success and resultant stocking of shovelnose sturgeon by WVDNR has not been made available to IDNR at the time of this report.

Research Extension Projects (Upper Wabash River)

USGS

Gravid female SNS (*N* = 34) were collected for USGS during April and May, 2008, and blood plasma and egg tissue samples were obtained from these fish. One fish was captured and sampled twice (4/16 and 5/5/08), for a total sample size of 35. Blood plasma samples were successfully taken from 28 of the gravid females collected, with the remaining seven plasma samples (all from 4/24/08) discarded due to concerns about possible processing errors (reddish colored plasma). Dr. Sepulveda later informed us that this was normal because plasma samples taken from females close to spawning will exhibit a higher degree of reddish coloration. Unfortunately disposal of the samples had already taken place. Egg samples were successfully taken from all 35 of the gravid females collected. The samples were shipped to USGS on November 12, 2008.

Purdue University SNS Population Health

Shovelnose sturgeon collected for VHS testing (*N* = 64) during April, 2008 were also sampled by researchers at Purdue University (P.I. Dr. Maria Sepulveda) interested in determining the presence/prevalence of intersexed SNS in the Wabash River. Of the 64 SNS collected, 12 were females and 52 were males; the sex ratio (females: males) was 0.23:1. There were mature gravid females (19%; *N* = 12), mature gravid males (80%; *N* = 51), and an immature male (1%; *N* = 1) present in the sample. Three percent (*N* = 2; both males) were possible intersex fish. Fork length (Mean ± SD) and weight (Mean ± SD) was greater for females compared to males. Gonadosomatic index (GSI) was higher in females (20.0%) than males (3.4%), and HSI was slightly higher in males (1.6) than in females (1.4). Mean plasma protein level was the same for males and females (6.3 g/dl), while PCV was higher for males (37%) compared to females (26%). Data for these fish are summarized in Table 6.

There was additional SNS electrofishing sampling conducted by IDNR and Purdue University personnel at Lafayette on May 29, 2008. There were 131 SNS collected with one hour of EF effort (CPUE = 131 fish/h; Table 5); 5% (*N* = 6) were recaptures (PU = 4 Floy; IDNR = 2 Floy), and egg check marks were present on 6% (*N* = 8) of SNS. Fork-length (Mean ± SD) and weight (Median, IQR) was 27.5 ± 1.9 in and 2.9, 2.3 to 3.3 lbs (Table 2). There were mature

gravid females (6%; *N* = 8), and unknown/other sex SNS (94%; *N* = 123) present in the sample (Table 3). As noted above, egg and blood plasma samples were taken from the gravid females and sent to USGS.

Lower Wabash River Population Monitoring (RM 0 to 200.0)

Shovelnose sturgeon were sampled near Crawleyville, IN (Reach 1) and near St. Francisville, IL, the mouth of the Embarras River, IL, and Vincennes, IN (Reach 2) during July to December, 2008 (*N* = 318). Gear types used included electrofishing (EF), drift nets (DN), set gill nets (GN), hoop nets (HN), and trawls (T). Different gear types were utilized in an effort to determine the most effective method of capturing SNS outside the spawning period when electrofishing is used almost exclusively because the fish are concentrated in areas where electrofishing may be highly effective when river conditions are favorable.

Between the two reaches sampled (Reach 1, Reach 2), Reach 1 produced 73% (*N* = 232) of the SNS catch and Reach 2 produced 27% (*N* = 86). Within reaches, there was only one sampling site for Reach 1 (Crawleyville); all SNS sampled in Reach 1 were captured there. There were three sites for Reach 2 including St. Francisville, IL (SFV), near the confluence of the Embarras and Wabash Rivers (EMB), and near Vincennes, IN (VIN). Among these sites, SFV produced 79% (*N* = 68), VIN produced 20% (*N* = 17), and EMB produced 1% (*N* = 1) of the SNS catch respectively.

Of the 318 SNS sampled on the lower Wabash River in 2008, 79% (*N* = 251) were captured by electrofishing. Mean electrofishing CPUE was 15.8 fish/h, and was highest at Crawleyville (CV) on 10/16/08 (37.1 fish/h) and lowest at CV on 8/6/08 and near the Embarras River (EMB) on 9/17/08 (0 fish/h) (Table 7). Experimental gear (DN, GN, HN, T) captured the remaining 21% (*N* = 67; Table 8) of the SNS. Drift nets contributed the highest percentage of the total SNS catch by non-electrofishing gear (20%, *N* = 65), while hoop nets (1%, *N* = 2), set gill nets (*N* = 0), and trawls (*N* = 0) were less effective (Figure 3).

Fork-length (Mean ± SD) and weight (Median, IQR) of SNS for all lower Wabash SNS was 26.9 ± 3.0 in and 3.2, 2.5 to 3.7 lbs (Table 9). A wider range of lengths were represented in the lower Wabash samples relative to the upper Wabash, illustrated by SNS length frequency distributions (Figure 4). There were 12 SNS (range 9 to 20 in) sampled on the lower Wabash

that were smaller than the smallest SNS sampled at Lafayette on the upper Wabash during the spring.

DISCUSSION

Upper Wabash River Population Monitoring (RM 200.1 to 400.0)

Overall CPUE in our 2008 index sample was lower (19 fish/h) than reported for 2005 to 2007 by IDNR (52 fish/h; Table 1). The decline in overall CPUE was not due to a major decline at any one particular index station; declines were apparent at each index site (HI, MP, GI, CI) in 2008 (Table 1). However, these declines are not necessarily related to a decline in the SNS population in the Wabash River. Declines in CPUE in 2008 stem in part from the fact that the volunteers used in 2008 were students who lacked experience dip-netting stunned SNS, while crews used in previous years (especially 2005) were experienced.

The declines were also influenced by the fact that three of the four index sampling events took place on or after June 24, 2008. Previous index sampling occurred before the end of May, when the SNS spawning period was at its peak. Late index sampling in 2008 likely occurred as the spawning period was ending (June 24) or had ended completely (July 9 to 10). The SNS most likely had vacated their spawning areas by this time. Considering that the single April index sampling event (April 24) yielded an overall CPUE (49 fish/h; Table 5) similar to the 2005 to 2007 overall CPUE (52 fish/h; Table 1), the low CPUE during the late sampling events (22, 2, 2.5 fish/h; Table 5) is most likely the driving force behind overall and individual site CPUE declines in 2008.

To date, index stations were only sampled to protocol once (IDNR, 2005). In 2008, personnel limitations continued to affect spring SNS population monitoring as IDNR relied heavily on volunteer help from Purdue University through June, when IDNR was able to hire a seasonal assistant. In December 2008, IDNR was able to hire a full time Big Rivers Assistant Biologist and plans to hire a seasonal assistant in time for the 2009 SNS spring sampling period. This will allow the IDNR to perform sampling events with a full in-house crew, reducing reliance on volunteer help and increasing the likelihood that index sites will be sampled to protocol. Future index sampling should take place during late April through early May as occurred from 2005 to 2007. Data collections must consistently follow the original protocol if comparisons across years are to be valid.

One valuable result of performing index sampling in June and July, 2008 was to lend support to the general thought that SNS congregate in the upper Wabash River near Lafayette to spawn in April and May, and then redistribute themselves elsewhere in the river post-spawn. Electrofishing catch rates at sites near Lafayette during April and May (index and non-index sampling) were similar to previous years, while electrofishing catch rates at the same sites during late June through early July declined to near zero. This was further supported by low catch rates from experimental gear (trawl; CPUE = 0.8 fish/h) used at Lafayette on June 25, 2008.

Overall, electrofishing was the most effective gear for capturing SNS on the upper Wabash River during low water conditions in 2008 while SNS were concentrated there. Electrofishing produced the largest total daily catches and highest catch rates, and SNS were consistently captured by electrofishing throughout April and May, before high water and the end of the SNS spawning season combined to cause declines in catch by both electrofishing and other gear types in late June and July.

Upper Wabash River Experimental Gear Sampling

Though electrofishing was the most effective means of capturing SNS on the upper Wabash River in 2008, it was sometimes advisable, especially in high-water conditions to utilize other gear types. The four non-electrofishing gear types used on the upper Wabash River in 2008 yielded mixed results. Of the 73 SNS collected, 93% (N = 68) were collected by hoop nets. Most (N = 60) of those fish were caught during a single overnight event on June 11 to 12, 2008 at the Heron Island index site near Lafayette. Aside from one highly successful hoop net sampling event, catch and catch rates from experimental gear on the upper Wabash River were low in 2008. These efforts were in part a learning experience, with IDNR personnel experimenting with gear that they would use more extensively on the lower Wabash River later in the year. Valuable experience using a trawl to capture larval and juvenile SNS was gained on June 25 at Lafayette. The trawl was successfully deployed eight times on runs ranging from 3 to 14 min. This was the first attempt by the fisheries section at trawling for larval and juvenile SNS, and there were no larval or juvenile SNS captured. However, the presence of bycatch (including one adult SNS) indicated that the gear was being fished correctly. Trawling will continue in 2009 on the upper Wabash River with the goal of documenting SNS spawning success signified by the presence of larval SNS.

Broodstock collection

At the time of this report, no data or report has been made available to the IDNR by the WVDNR regarding hatchery (spawning and rearing) and stocking success of SNS broodstock (adults and offspring) collected in 2008.

Research Extension Projects (Upper Wabash River)

USGS

At the time of this report, no data or report has been made available to IDNR by USGS regarding results of laboratory assays performed on egg and blood plasma samples from SNS collected in 2008.

Purdue University Population Health

Dr. Sepulveda reported that PCV (red blood cell level) was higher for males (37%) compared to females (26%). She noted that this difference may have been due to stress (males more sensitive to electrofishing than females). She also noted that a PCV > 25% is considered abnormal. Gonadosomatic index values were higher for females (20.0%) compared to males (3.4%), and GSI values for both sexes were indicative of reproductively active fish, which is not surprising because these fish were sampled during the spawning period. The sex ratio (0.23 Female: 1 Male) supports our belief that the spawning population is primarily composed of male SNS. Two males were likely intersex fish, exhibiting patches of clear eggs in their testes. This indicates that intersex SNS are likely present in the Wabash River.

Lower Wabash River Population Monitoring (RM 0 to 200.0)

Extensive sustained monitoring of SNS on the lower Wabash River had not been attempted previously by IDNR, and the current large-scale SNS monitoring efforts outside the spawning period are pioneering activities in fisheries research in Indiana. Shovelnose sturgeon sampling on the lower Wabash River in 2008 was largely an exercise in learning. A broad range of gear types were utilized at several different sites in an effort to discover where the SNS may be found and how best to catch them. Productive sites were discovered on the lower Wabash

River in 2008 (Crawleyville, Reach 1; St. Francisville, Reach 2) and sampling is planned at these locations again in 2009.

Electrofishing was the most productive method of capturing SNS on the lower Wabash River in 2008. This was true for both Reach 1 and Reach 2. Electrofishing was the sole means of capturing SNS after October 8, and catch rates remained steady from 10/9/08 through 11/5/08, after which catch rates declined through the final sampling event of the year on 12/17/08 (Table 7). The declines in catch coincided with a steady drop in water temperature from 60ºF on 11/5/08 to 38ºF on 12/17/08. The effect of water level on electrofishing success during this time is not thought to be a contributing factor to declines in catch rates because water levels were fairly stable throughout the sampling period. We believe that as water temperature declined, SNS sought the warmest water available, likely found in the deepest holes where depth would cause electrofishing to be ineffective. Declining electrofishing catch with declining water temperature (particularly in late fall) is a trend which should be monitored in the future to establish a possible threshold below which electrofishing for SNS (provided river conditions allow electrofishing) is ineffective and should be abandoned in favor of gear types more effective at sampling greater depths.

Drift netting was successful on two occasions (July 16; N = 21, July 17; N = 43 at Crawleyville), and the catch from these two events provided 96% of the total catch from non-electrofishing gear (Table 8). Success depended on deploying the net at the lower end of the sandbar on the inside of the large bend downstream of the Crawleyville access ramp. Precise placement was the key to the net being taken by the current and pulled through a fast moving chute between mid-channel and the Illinois shore; this chute was where the SNS were captured. Deployment of the net too far toward mid-channel or too close to the Illinois shore caused the net not to be pulled through the chute. Drift netting is a high-water gear which was used when water levels were too high for electrofishing. In 2009, we plan to continue learning and perfecting our drift netting technique and scouting additional locations where effective drift netting may take place at times of high water.

Hoop netting yielded little success in 2008, with a total catch of two SNS from four events (three 10-net, five hour events; one 10-net overnight event). This low success rate was probably due to net placement. Nets were set immediately below a slate riffle located upstream of the access ramp at Crawleyville (near Coffee Island; RM 89.3) on July 2, yielding zero SNS.

Shovelnose sturgeons are suction filter feeders; a hard slate substrate is not likely an optimum place for them to feed, thus they were not present there. On July 16, the river was very high and the nets were set at Crawleyville (Reach 1) along the sandbar located on the inside of the large bend downstream of the Crawleyville access ramp. These nets yielded large amounts of bycatch, but no SNS. The nets were set in the same location on September 5, again yielding large amounts of bycatch, but only one SNS. The final hoop net set of the year occurred near the confluence of the Embarras and Wabash Rivers (Reach 2) on October 8 and yielded one SNS. Falling autumn leaves were a problem because they clogged the net mesh. Aside from possibly reducing effectiveness of the gear, the large volume of leaves in the net greatly increased the difficulty of net retrieval. Hoop netting was discontinued in mid-October due to the large load of leaves in the river and low hoop net catch rates. In addition, due to improved river conditions for electrofishing (lower water levels) and resultant improved electrofishing catch rates, our efforts were focused where and how SNS were actually being caught. Hoop netting SNS remains a work in progress, with more experimental hoop net sets planned for 2009.

Trawling was attempted near the confluence of the Embarras and Wabash Rivers on October 8, and did not yield any juvenile or adult SNS. Nonetheless, valuable experience was gained as the gear was deployed successfully on seven runs ranging from 5 to 10 min each. The presence of bycatch indicated the gear was being fished correctly. Trawling is planned again in 2009 with the goal of determining the presence/prevalence of juvenile SNS in the lower Wabash River.

It must be noted that though no larval or juvenile SNS were documented in the lower Wabash River in 2008, there were 12 fish (range 9 to 20 in) sampled there which were smaller than any of the fish sampled during the spring near Lafayette. Of these, 92% (N = 11) were captured during electrofishing and 83% (N = 10) were captured at Crawleyville (Reach 1). Additionally, there were several small SNS which were observed during electrofishing but were not captured because they were small enough to pass through the mesh of the dip nets. The presence of smaller SNS lends support to the argument that the fish present at Lafayette in spring are (large) mature spawning fish, and that a more representative sample of the population as a whole may be found downriver outside the spawning season. Future monitoring of these areas on the lower Wabash River will help us to sample the sub adult portions of the population more extensively and develop a more complete profile of SNS size structure within the population. It

is hoped that eventually trawling, in particular, will help to effectively sample juvenile SNS resulting in development of estimates of year class strength.

Finally, analysis of size distributions for SNS in the Wabash River in 2008 indicates that the minimum FL (25 in) harvest limit for SNS may be an insufficient regulation to protect this fishery from recruitment over-fishing. Of the 47 gravid female SNS collected in 2008, 86% (*N* = 40) were larger than 25 in FL. Similarly, 89% gravid male and 87% of the unknown sex SNS collected in 2008 were larger than 25 in FL. Our data indicate that SNS ≤ 25 in were documented in the sample, however relatively few (14%; N = 7 gravid females, 11%; *N* = 9 gravid males, 13%; *N* = 53 unknown sex) would have been protected by the current minimum 25 in FL regulation. When expanded to include 2007 SNS data, only 9% of gravid females (*N* = 7/80), 11% of gravid males (*N* = 18/149), and 16% (*N* = 112/698) of unknown sex SNS would have been protected. In addition, median FL values of gravid female and gravid male SNS collected in 2007 were 27.3 and 27.2 in respectively (Donabauer 2008). In 2008, these values were 28.1 in for gravid females and 27.1 in for gravid males respectively.

If a 27-in minimum FL regulation were to replace the current minimum harvest regulation of 25 in FL, 30 and 49% of all gravid female and gravid male SNS sampled in 2008 would have been protected. Colombo et al. (2007) argued that a 27-in minimum length limit provided the necessary protection to curtail growth and recruitment over-fishing of SNS in the middle Mississippi River. Donabauer (2008) argued the same for the Wabash River. This report reiterates the sentiment of Donabauer (2008) that if the IDNR agrees that some degree of protection for mature SNS is a governing dynamic of long-term SNS sustainability in the Wabash River, a larger minimum FL regulation should be considered.

RECOMENDATIONS

- Index stations should continue to be sampled on an annual basis to monitor changes in abundance, growth, sex, age, and maturity schedules of shovelnose sturgeon.

- Productive sampling sites on the lower Wabash River identified in 2008 should continue to be sampled on an annual basis to enhance knowledge of shovelnose sturgeon population demographics on a river-wide scale.

- New sampling sites on the lower Wabash River should be scouted and sampled to discover additional areas where the shovelnose sturgeon may be effectively studied.

- Following Tripp (2007), trawling should continue on the upper and lower Wabash River to document shovelnose sturgeon spawning success and year class strength.

- Sampling with experimental gear should continue on the upper and lower Wabash River in 2009 to develop effective means of capturing shovelnose sturgeon during times when electrofishing is impossible or ineffective.

- Broodstock collection should continue on an as-needed basis to supply ODNR and WVDNR with gravid shovelnose sturgeon for their reintroduction programs.

- Blood plasma and egg collection, fish health assessments, and acoustic surveys should continue to aid USGS, USACE, and Purdue University in assessing shovelnose sturgeon spawning preparedness and population health in the Wabash River.

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Submitted by: Nathan J. Nye, Assistant Big Rivers Biologist
Date: March 27, 2009

Approved by: Thomas C. Stefanavage, Big Rivers Biologist

Approved by: Brian M. Schoenung, Fisheries Supervisor

Date: August 21, 2009

Table 1. Summary statistics of shovelnose sturgeon collected at Heron Island (HI), Mascouten Park (MP), Goose Island (GI), and Colliers Island (CI) index stations from the Wabash River, 2008.

Statistic	HI	MP	GI	CI	Totals
Effort (hr)					
2005-2007 Mean	1.2	1.0	0.7	0.7	3.6
2008	3.0	3.1	1.0	1.0	8.1
Overall Total[1]	6.5	6.1	3.0	3.0	18.6
No. Collected					
2005-2007 Mean	101	53	16	13	183
2008	94	57	5	0	156
Overall Total	398	215	53	39	705
CPUE (fish/hr)					
2005-2007 Average	87	53	24	20	52
2008	31	18	5	0	19
Overall Mean	61	35	18	13	38
IDNR Recaptures					
2005-2007	0	4	0	1	5
2008	0	1	0	0	1
Overall Total	0	5	0	1	6
PU Recaptures					
2005-2007	15	3	2	0	20
2008	2	1	0	0	3
Overall Total	17	4	2	0	23
No. Tagged					
2005-2007	289	151	46	38	524
2008	92	55	5	0	152
Overall Total	381	206	51	38	676
Mean FL ± SD					
2005-2007	26.9 ± 1.8	26.7 ± 2.2	27.2 ± 2.0	26.1 ± 1.5	26.8 ± 1.9
2008	27.5 ± 1.9	27.3 ± 2.2	26.8 ± 2.7	-	27.4 ± 2.0
Overall	27.1 ± 1.9	26.8 ± 2.2	26.6 ± 2.2	26.1 ± 1.5	26.9 ± 2.0

[1]Overall total and overall mean includes SNS sampled from 2005-2008.

Table 2. Summary of shovelnose sturgeon size data by sampling event on the upper Wabash River, Indiana, 2008.

Date	Purpose[1]	Location[2]	N[3]	Length Range[4]	Median Length (IQR)	Mean Length (SD)	Weight Range[4]	Median Weight (IQR)	Mean Weight (SD)
4/8/08	VHS	HI to MP	34	24.9-32.2	27.4 (26.2,28.2)	27.5 (1.7)	2.0-6.0	3.4 (2.8,4.4)	3.6 (1.0)
4/16/08	VHS,USGS	CI,GI,HI	51	23.0-31.7	27.5 (26.1,28.9)	27.5 (2.0)	1.5-5.3	3.3 (2.9,4.2)	3.5 (1.0)
4/24/08	Index,USGS	HI,MP	103	22.7-31.9	27.6 (25.8,28.6)	27.4 (2.0)	1.1-5.3	3.2 (2.5,4.0)	3.2 (0.9)
5/5/08	Broodstock	MP	90	22.8-32.3	26.7 (25.4,27.8)	26.7 (1.8)	1.5-4.7	2.9 (2.4,3.5)	2.9 (0.7)
5/29/08	Purdue,USGS	HI,MP	131	23.7-35.9	27.5 (26.2,28.6)	27.5 (1.9)	1.7-7.6	3.0 (2.3,3.3)	2.9 (0.8)
6/11/08	EXG	HI	12	22.8-29.9	26.4 (25.2,28.7)	26.7 (2.1)	1.5-4.1	2.6 (2.1,3.3)	2.7 (0.8)
6/12/08	EXG	HI	60	21.0-30.5	26.4 (25.0,27.7)	26.3 (1.8)	1.5-4.7	2.8 (2.5,3.1)	2.8 (0.6)
6/24/08	Index	HI,MP	44	22.0-31.2	27.5 (26.3,28.6)	27.5 (1.9)	1.4-4.7	2.6 (2.4,3.0)	2.8 (0.7)
6/25/08	EXG	Roadhouse	1	-	-	31.6	-	-	4.0
7/9/08	Index	HI,MP	4	23.5-29.2	27.6 (26.2,28.3)	27.0 (2.4)	1.6-3.1	2.4 (2.1,2.7)	2.4 (0.6)
7/10/08	Index	CI,GI	5	24.9-31.6	26.2 (25.0,26.4)	26.8 (2.7)	1.6-4.6	2.4 (2.4,2.5)	2.7 (1.1)
Total	Index		156	22.2-31.9	27.5 (26.1, 28.6)	27.4 (2.0)	1.1-5.3	2.9 (2.4, 3.7)	3.1 (0.9)
	All		535	21.0-35.9	27.2 (25.8, 28.4)	27.2 (1.9)	1.1-7.6	3.0 (2.4, 3.5)	3.0 (0.9)

[1]Viral Hemorrhagic Septicemia (VHS); United States Geological Survey (USGS); Experimental gear sampling (EXG)
[2]All are sampling locations near Lafayette, IN.
[3]The first 30 fish collected on 4/16/08 were used for VHS testing; the VHS total from 4/8/08 and 4/16/08 was 64 SNS. The 90 fish listed for 5/5/08 were leftover (extra) fish from broodstock collections.
[4]Lengths are reported in inches, weights are reported in pounds.

Table 3. Summary of shovelnose sturgeon sex and maturity status from fish collected during sampling events on the upper Wabash River, Indiana, 2008.

Date	Purpose[1]	Location[2]	Gear[3]	No. Gravid Females	No. Gravid Males	No. Other/Unknown	No. Gravid Females <25 in FL[4]	No. Gravid Males <25 in FL[5]	No. Other/Unknown <25 in FL[6]
4/8/08	VHS	HI to MP	EF	7	26	1	0	1	0
4/16/08	VHS, USGS	CI,GI,HI	EF	8	25	18	0	4	2
4/24/08	Index, USGS	HI,MP	EF	15	0	88	1	0	12
5/5/08	Broodstock	MP	EF	9	0	81	4	0	10
5/29/08	Purdue,USGS	HI,MP	EF	8	0	123	2	0	11
6/11/08	EXG	HI	DN,HN	1	0	11	0	0	2
6/12/08	EXG	HI	HN	0	19	41	0	4	11
6/24/08	Index	HI,MP	EF	0	9	35	0	0	5
6/25/08	EXG	Roadhouse	T	0	0	1	0	0	0
7/9/08	Index	HI,MP	EF	0	1	3	0	0	0
7/10/08	Index	CI,GI	EF	0	1	4	0	0	1
Total	All			48	81	406	7	9	54

[1]EXG (Experimental Gear) included all non-electrofishing (EF) sampling events.
[2]All are sampling locations near Lafayette, IN.
[3]Electrofishing (EF), drift net (DN), hoop net (HN) and trawl (T).
[4]Gravid females; 14% (7/47) were protected by 25 in FL minimum size limit in 2008. There were 47 gravid females, one recapture was sampled twice.
[5]Gravid males; 11% (9/81) protected by 25 in FL minimum size limit in 2008. No gravid males were sampled twice.
[6]Other/Unknown; 13% (53/403) protected by 25 in FL minimum size limit in 2008. There were 403 other/unknown SNS, three recaptures including one <25 in FL were sampled twice.

Table 4. Summary of non-electrofishing sampling events targeting shovelnose sturgeon on the upper Wabash River near Lafayette, Indiana, 2008.

Date	Gear	Location	Water Temp (°F)	River[1] Stage (ft)	Effort	Effort Unit	No. Collected	CPUE (fish/hr)	No. Tagged	No. Recaptures	No. Released
6/11/08	DN	HI	-	7.7	0.3	hours	4	13.3	4	0	4
6/11/08	HN	HI	-	7.7	55	hours	8	0.1	8	0	8
6/12/08	HN	HI	-	8.8	9	nights	60	6.7	60	0	60
6/25/08	T	Lafayette	-	4.5	1.2	hours	1	0.8	1	0	1
Total	All						73		73	0	73

[1]River stage recorded from Brown Street Overlook Gage, Lafayette, IN.

Table 5. Summary of electrofishing sampling events targeting shovelnose sturgeon on the upper Wabash River near Lafayette, Indiana, 2008.

Date	Purpose	Spawn/Post Spawn	Location	Water Temp (°F)	River[1] Stage (ft)	Effort (hrs)	No. Collected[2,3]	CPUE[4] (fish/hr)	No. Tagged	No. Recaptures	No. Released
4/8/08	VHS	Spawn	HI,MP	52	9.0	2.3	34	15.0	33	1	0
4/16/08	VHS,USGS	Spawn	CI,GI,HI	50	7.8	3.4	51	14.9	46	5	21
4/24/08	Index,USGS	Spawn	HI,MP	64	4.8	2.1	103	48.7	100	3	103
5/5/08	Brood,USGS	Spawn	MP	-	3.6	1.6	200	125.0	87	3	90
5/29/08	Purdue,USGS	Spawn	HI,MP	-	3.6	1.0	131	131.0	125	6	131
6/24/08	Index	Post Spawn	HI,MP	72	4.5	2.0	44	22.0	43	1	44
7/9/08	Index	Post Spawn	HI,MP	77	4.5	2.0	4	2.0	4	0	4
7/10/08	Index	Post Spawn	CI,GI	77	4.7	2.0	5	2.5	5	0	5
Total	All					16.4	572	34.9	443	19	398

[1]River stage recorded from Brown Street Overlook Gage, Lafayette, IN.
[2]The first 30 fish collected on 4/16/08 were used for VHS testing, the rest were sampled by IDNR and released.
[3] The 200 fish from 5/5/08 represents the approximately 110 fish sent to West Virginia which were not sampled by IDNR, and the 90 actual fish left over from broodstock collection which were sampled by IDNR; gravid females present in the 90 sampled fish were sampled for USGS as well. The 90 sampled fish were all released.
[4]The CPUE calculated for 5/5/08 is an approximation; an exact count of fish sampled this day was not made. The resultant electrofishing CPUE for the all upper Wabash River sampling (34.9 fish/hr) is also an approximation due to the 5/5/08 data.

Table 6. Summary statistics of shovelnose sturgeon fish health data from Purdue University research, 2008.

Sex	N (Immature, Mature)	Intersex	% Intersex	Mean Length (SD)	Mean Weight (SD)	GSI	HSI	Plasma Protein (g/dl)	PCV[1] (%)
M	52 (1,51)	2	4	27.2 (1.7)	3.4 (0.9)	20.0	1.6	6.3	37.4
F	12 (0, 12)	0	0	28.5 (2.4)	4.2 (1.2)	3.4	1.4	6.3	25.6
ALL	64 (1,63)	2	3	27.5 (1.9)	3.6 (1.0)	6.5	1.5	6.3	35.2

[1]Packed cell volume; measures of red blood cells.

Table 7. Summary of IDNR electrofishing sampling events on the lower Wabash River, Indiana, 2008.

Date	Location[1]	Reach[2]	Water Temp (°F)	River Stage (ft)	Gage[3]	Effort (hrs)	No. Collected	CPUE (fish/hr)	No. Tagged	No. Recaptures	No. Released[4]
8/6/08	CV	1	80	6.09	MC	0.5	0	0.0	0	0	0
9/4/08	CV	1	82	3.75	MC	0.6	1	1.8	1	0	1
9/10/08	VIN	2	76	5.56	RS	1.9	11	5.8	11	0	11
9/16/08	VIN	2	75	5.59	RS	1.3	6	4.8	6	1	6
9/17/08	EMB	2	72	6.39	RS	0.9	0	0.0	0	0	0
10/1/08	SFV	2	72	5.47	RS	1.3	12	9.0	12	0	12
10/9/08	SFV	2	68	5.17	RS	1.3	32	24.2	32	0	32
10/15/08	SFV	2	70	5.45	RS	1.7	24	14.5	23	1	24
10/16/08	CV	1	72	3.21	MC	1.7	64	37.1	63	0	63
10/23/08	CV	1	70	3.27	MC	1.7	47	27.6	46	0	47
11/5/08	CV	1	60	3.4	MC	1.0	37	36.4	36	1	37
11/13/08	CV	1	52	3.45	MC	0.9	12	14.1	12	1	12
12/17/08	CV	1	38	4.61	MC	1.2	5	4.1	5	0	5
Total	Reach	1				7.6	166	21.8	163	2	165
Total	Reach	2				8.3	85	10.2	84	2	85
Total	All					15.9	251	15.8	247	4	250

[1]Crawleyville (CV), Vincennes (VIN), Embarras (EMB), St. Francisville (SFV)
[2]Reach 1 (RM 0-100.0), Reach 2 (RM 100.1-200.0)
[3]Mount Carmel Gage at Mount Carmel, IL (MC), Red Skelton Gage at Vincennes, IN (RS)
[4]One extremely gravid looking female was sacrificed.

Table 8. Summary of IDNR non-electrofishing sampling events on the lower Wabash River, Indiana, 2008.

Date	Gear[1]	Location[2]	Reach	Water Temp (°F)	River Stage	Gage[3]	Effort	Effort Unit	No. Collected	CPUE (fish/unit effort)	No. Tagged	No. Recaptures	No. Released
7/2/08	DN	CV	1	76	11.0	MC	NA	Hours	0	0	0	0	0
7/2/08	HN	CV	1	76	11.0	MC	55	Hours	0	0	0	0	0
7/16/08	DN	CV	1	78	15.0	MC	0.9	Hours	21	23.3	21	1	21
7/16/08	HN	CV	1	81	15.0	MC	50	Hours	0	0.0	0	0	0
7/17/08	DN	CV	1	80	14.7	MC	2.7	Hours	43	16.1	43	0	43
8/6/08	DN	CV	1	82	6.5	MC	0.4	Hours	1	2.7	1	0	1
8/7/08	DN	CV	1	82	6.4	MC	1.1	Hours	0	0.0	0	0	0
9/5/08	HN	CV	1	78	3.9	MC	10	Nights	1	0.1	1	0	1
9/16/08	GN	VIN	2	75	5.6	RS	9.5	Hours	0	0.0	0	0	0
9/17/08	GN	EMB	2	74	6.4	RS	7.2	Hours	0	0.0	0	0	0
10/8/08	DN	EMB	2	68	5.3	RS	2.3	Hours	0	0.0	0	0	0
10/8/08	HN	EMB	2	68	5.3	RS	50	Hours	1	0.02	1	0	1
10/8/08	T	EMB	2	68	5.3	RS	1.0	Hours	0	0.0	0	0	0
Total	All								67		67	1	67

[1]Drift Net (DN), Hoop Net (HN), Set Gill Net (GN), Trawl (T)
[2]Crawleyville (CV), Vincennes (VIN), Embarras (EMB)
[3]Mount Carmel Gage at Mount Carmel, IL (MC), Red Skelton Gage at Vincennes, IN (RS)

Table 9. Summary of shovelnose sturgeon size data by sampling event on the lower Wabash River, Indiana, 2008.

Date	Gear[1]	Location[2]	Reach[3]	N	Length Range	Median Length (IQR)	Mean Length (SD)	Weight Range	Median Weight (IQR)	Mean Weight (SD)
7/16/2008	DN	CV	1	21	23.2-30.6	29.1 (27.5,29.7)	28.3 (1.9)	1.9-4.4	3.5 (3.1,3.7)	3.4 (0.6)
7/17/2008	DN	CV	1	43	14.5-31.3	28.2 (27.0,29.3)	27.8 (2.7)	0.3-5.5	3.3 (2.8,3.9)	3.3 (0.9)
8/6/2008	DN	CV	1	1	-	-	24.6	-	-	2.0
9/4/2008	EF	CV	1	1	-	-	26.7	-	-	3.0
9/5/2008	HN	CV	1	1	-	-	30.8	-	-	4.3
9/10/2008	EF	VIN	2	11	21.9-29.9	28.1 (26.7,28.6)	27.3 (2.3)	1.3-3.8	3.3 (2.8,3.5)	3.1 (0.8)
9/16/2008	EF	VIN	2	6	25.6-31.5	29.1 (27.4,29.8)	28.7 (2.1)	2.3-5.4	3.9 (3.2,5.0)	4.0 (1.2)
10/1/2008	EF	SFV	2	12	21.9-30.1	28.1 (26.9,29.7)	27.8 (2.5)	1.6-5.4	4.0 (3.4,4.3)	3.9 (0.9)
10/8/2008	HN	EMB	2	1	-	-	26.1	-	-	2.8
10/9/2008	EF	SFV	2	32	17.2-31.9	28.6 (27.3,29.4)	27.9 (3.2)	0.4-5.8	4.0 (3.3,4.6)	3.8 (1.2)
10/15/2008	EF	SFV	2	24	21.3-30.7	28.7 (27.3,29.4)	28.1 (2.0)	1.1-5.5	3.7 (3.4,3.9)	3.7 (0.8)
10/16/2008	EF	CV	1	64	16.6-30.6	25.6 (23.6,27.6)	25.3 (2.9)	0.4-5.0	2.4 (2.0,3.2)	2.5 (0.9)
10/23/2008	EF	CV	1	47	9.9-30.5	26.8 (25.7,28.1)	26.0 (3.8)	0.1-5.2	3.2 (2.5,3.5)	2.9 (1.1)
11/5/2008	EF	CV	1	37	18.3-29.7	26.7 (25.4,27.7)	26.2 (2.5)	0.6-3.6	2.8 (2.4,3.1)	2.6 (0.7)
11/13/2008	EF	CV	1	12	21.2-31.1	26.6 (24.9,28.1)	26.4 (2.8)	1.4-4.0	2.5 (2.0,3.4)	2.6 (0.9)
12/17/2008	EF	CV	1	5	26.2-30.0	27.5 (27.1,27.9)	27.7 (1.4)	2.7-3.8	3.3 (3.1,3.4)	3.2 (0.4)
Reach 1				232	9.9-31.3	27.0 (25.2,28.5)	26.5 (3.1)	0.1-5.5	3.0 (2.4,3.5)	2.9 (0.9)
Reach 2				86	17.2-31.9	28.4 (26.9,29.5)	27.9 (2.6)	0.4-5.8	3.7 (3.2,4.3)	3.7 (1.0)
Total	All			318	9.9-31.9	27.4 (25.8,28.9)	26.9 (3.0)	0.1-5.8	3.2 (2.5,3.7)	3.1 (1.0)

[1]Electrofising (EF), Drift Net (DN), Hoop Net (HN)
[2]Crawleyville (CV), Vincennes (VIN), St. Francisville (SFV), Embarras (EMB)
[3]Reach 1 (RM 0-100.0), Reach 2 (RM 100.1-200.0)

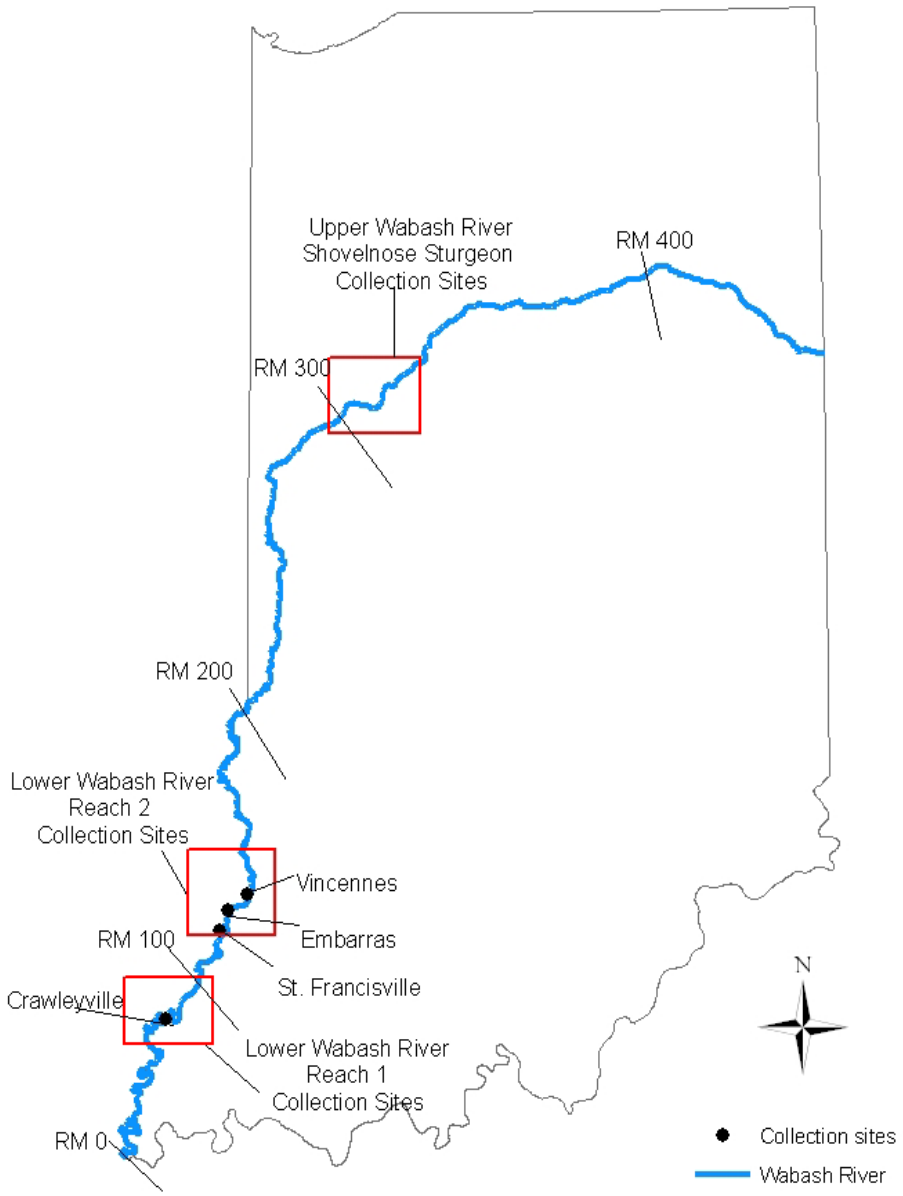

Figure 1. Shovelnose sturgeon population monitoring sites with reach delineations, Wabash River, Indiana, 2008.

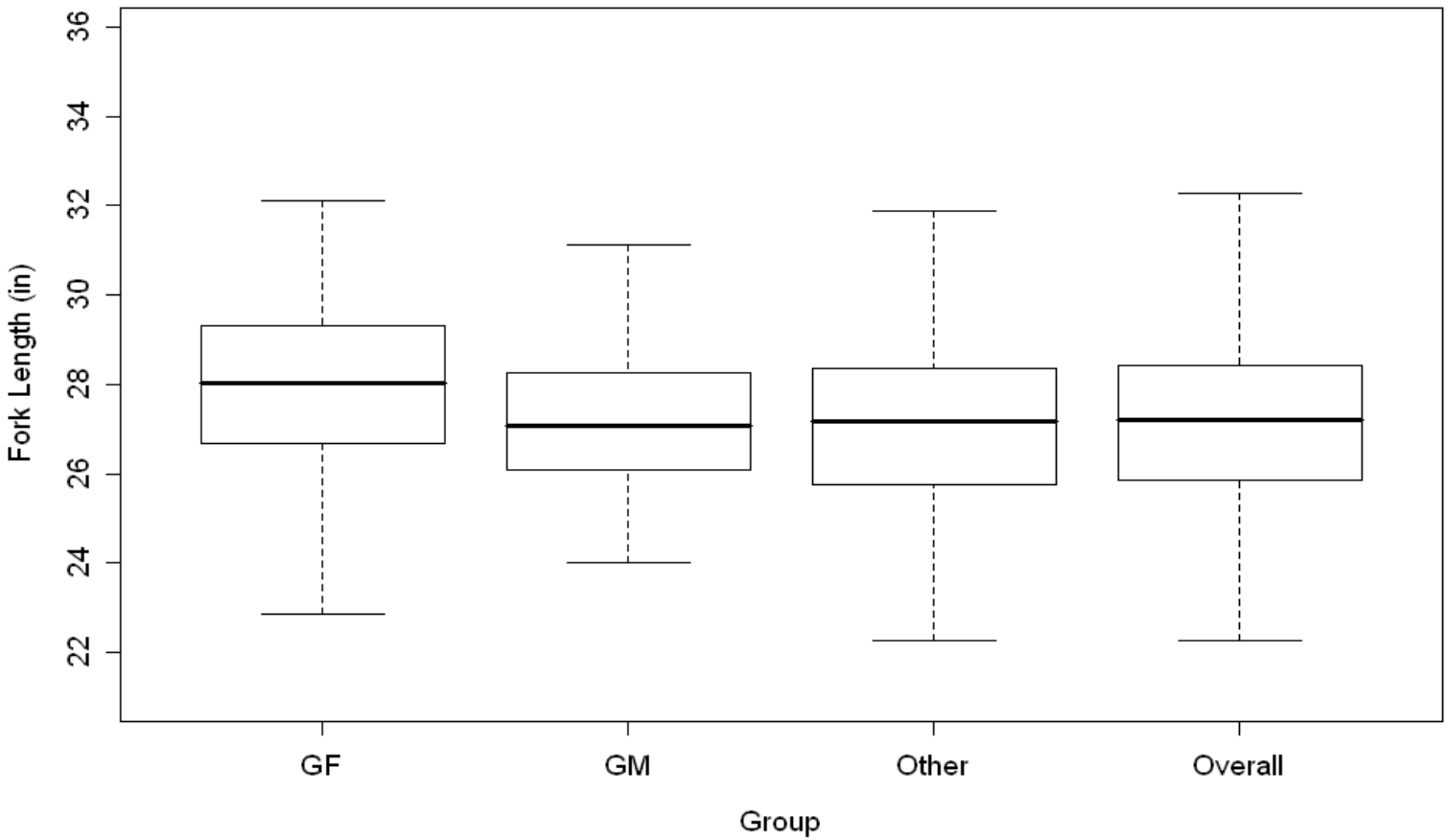

Figure 2. Box plots of fork length (FL) versus gravid female (GF; N = 47), gravid male (GM; N = 81), other/unknown (Other; N = 407), and overall (Overall; N = 535) groups for shovelnose sturgeon collected in the Wabash River, Indiana, 2008. The horizontal bar within each box represents median FL value; the upper and lower horizontal bars of the box represent 25% deviations from the median; the whiskers represent the outermost 25% deviations from the median.

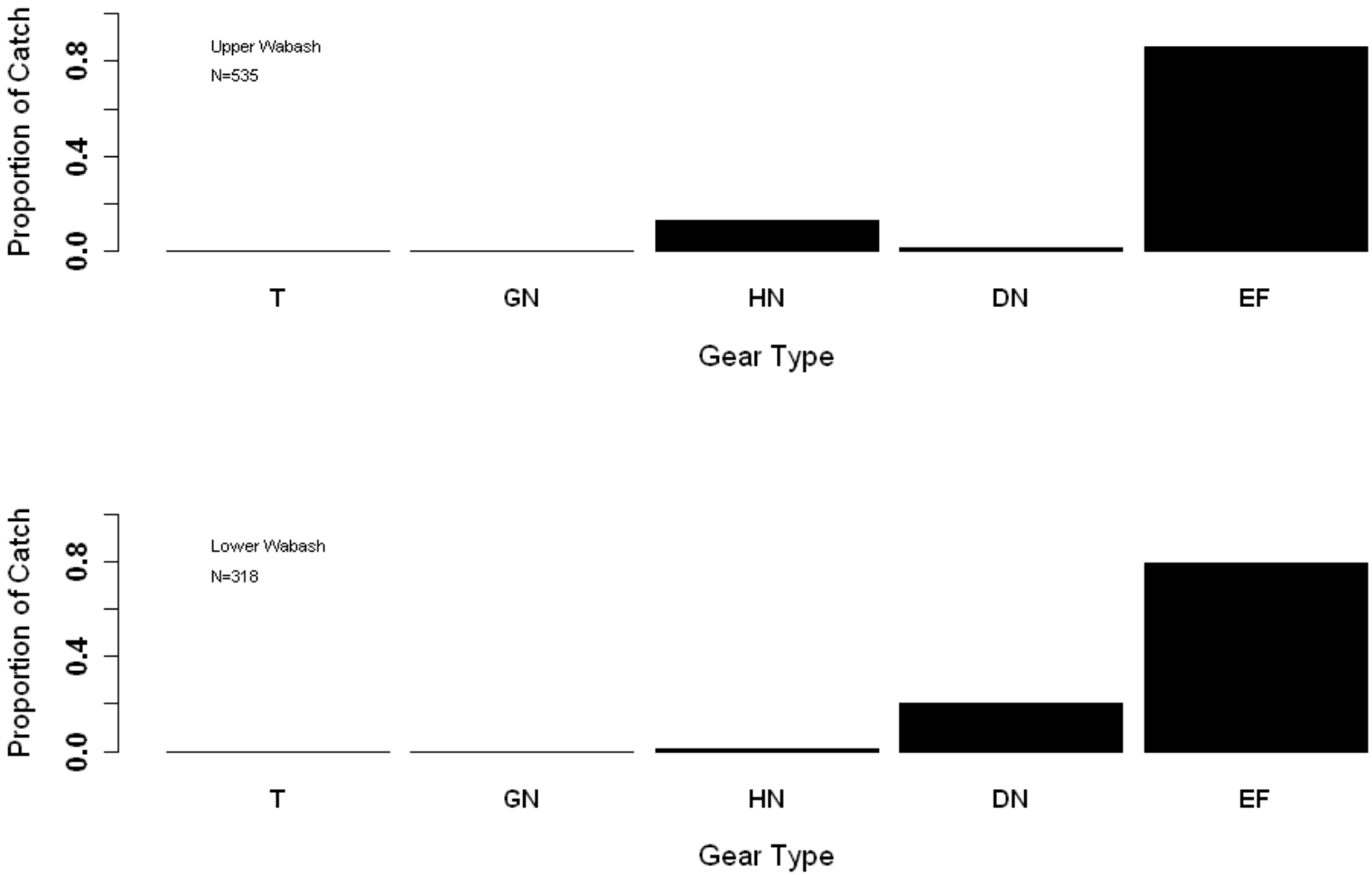

Figure 3. Proportion of SNS catch by gear type on the upper and lower Wabash River, Indiana, 2008.

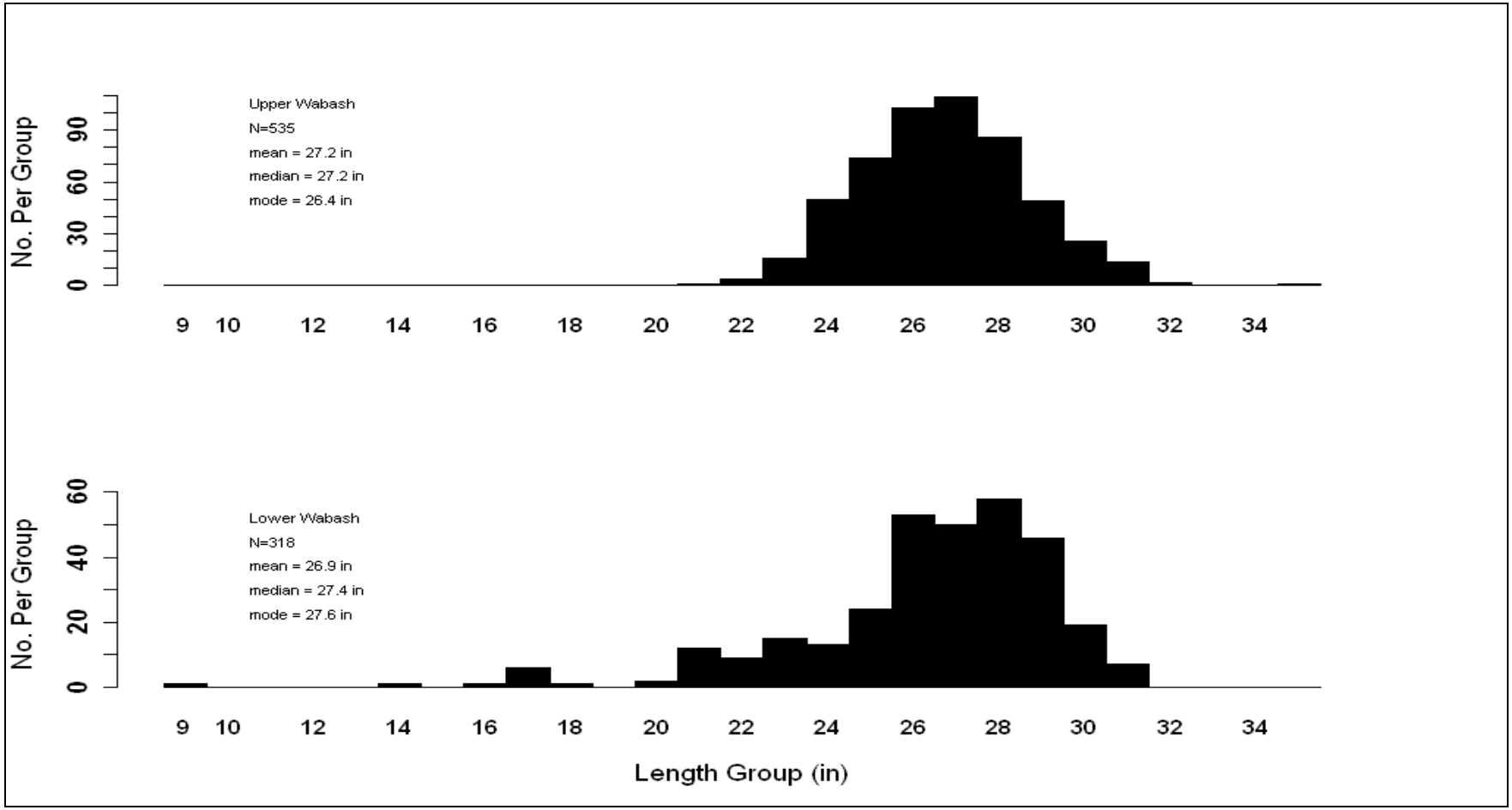

Figure 4. Length frequency distributions of the shovelnose sturgeon sampled by the IDNR in the upper and lower Wabash River, Indiana, 2008.