2012 Annual Report

Pallid Sturgeon Population Assessment and Associated Fish Community Monitoring for the Missouri River: Segments 5 and 6

Prepared for the U.S. Army Corps of Engineers – Missouri River Recovery Program

By:
Dane A. Shuman, Robert A. Klumb, Daniel A. James, and Kristen L. Grohs

United States Fish and Wildlife Service
Great Plains Fish and Wildlife Conservation Office
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EXECUTIVE SUMMARY

Pallid sturgeon *Scaphirhynchus albus* and the Missouri River fish community were sampled in the unchannelized Missouri River downstream of Fort Randall Dam to the headwaters of Lewis and Clark Lake (Recovery Priority Management Area 3; [RPMA 3]) using standardized gears and protocols during 2012. Ten randomly selected bends were sampled with a minimum of 8 deployments of each standard gear (i.e., gill net, trot line, otter trawl, and, trammel net, minifyke net) in each bend. The confluence of a major tributary, the Niobrara River, delineates Segment 5 (upstream of the confluence) from Segment 6 (downstream of the confluence to the headwaters of Lewis and Clark Lake); however, both segments were pooled for this report. Water conditions within Segments 5 and 6 were dramatically different than the previous year (2011), when record discharges exceeded 4,248 cubic meters per second (m^3s^{-1}; 150,000 cfs) for 37 consecutive days starting on 25 June. Discharge was > 2,123 m^3s^{-1} (75,000 cfs) for a total of 115 days (May 31-September 22).

Captured pallid sturgeon in 2012 represented all years classes stocked (1997-1999 and 2001-2010) as part of population supplementation efforts, except for the 1999 year class. Ninety-five pallid sturgeon were captured in 2012; 97% were of known hatchery origin. Passive integrated transponder (PIT) tags were detected in 75% of captured fish that had PIT tags implanted at stocking while no PIT tags were detected in 32 pallid sturgeon, however status (i.e., hatchery, wild, or unknown) was obtained for 29 of those fish based on the presence of secondary marks (i.e. elastomer tag presence, scute removal, or genetics). Genetic analysis (n = 19) of unmarked fish identified one hatchery-origin fish from the 1997 year class, two from the 2001 year class, one from the 2002 year class, three from the 2005

year class, three from the 2007 year class, seven from the 2008 year class, and two from the 2009 year class. Forty-two percent of the genetically-confirmed unmarked, hatchery-propagated fish were from the 2008 year class, of which only 7% of the total 4,047 fish had PIT tags inserted prior to release. Additionally, eight fish from the 2006 year class captured during sampling did not have a PIT tag implanted at stocking but were identified by a removed scute or elastomer tag.

For standardized random gear deployments, 21 pallid sturgeon were captured with gill nets, 27 with trotlines, 16 with trammel nets, and eight with otter trawls. In 2012, the relative abundance of hatchery-reared pallid sturgeon captured in gill nets was 3.5 times higher than 2009 and 2010 and increased 186% compared to the overall running average (2003-2011). Hatchery-reared pallid sturgeon relative abundance in 2012, indexed by drifted trammel nets, decreased 6% from the fall through spring (i.e. the sturgeon season) and increased 30% in the summer (i.e. fish community season), when compared to the overall running averages (2003-2010). Additionally, the mean relative abundance of hatchery-reared pallid sturgeon caught by otter trawls slightly increased (2%) in the sturgeon season while it decreased (49%) in the fish community season compared to the overall means (2005-2010) of each respective season. Similarly, mean CPUE of all pallid sturgeon (i.e., hatchery, wild, and unknown origin) captured in the fish community season increased 26% for trammel nets and decreased 50% for otter trawls, when compared to the long-term averages. Using seasonally-pooled data, annual CPUE increased for all pallid sturgeon (i.e., fish of known hatchery origin and unknown origin combined) captured in trammel nets (5%) and decreased for those caught in otter trawls (22%) compared to the long-term averages.

Spatially, pallid sturgeon were captured throughout most of Segments 5 and 6 but 55% of recaptures were downstream of the confluence in Segment 6. Twenty-three percent of pallid sturgeon were caught in the same location where an active gear initially captured a pallid sturgeon (i.e., non-random duplicate samples). A total of 19 pallid sturgeon were captured with a combination of gears (trammel net, gill net, otter trawl, and trot line) from bend 16 in Segment 5. Additionally, 34 pallid sturgeon were captured at three bends within Segment 6: bend 4 (n = 14), bend 7 (n = 10), and bend 11 (n = 10). Pallid sturgeon were captured in the channel border mesohabitat of braided channels (55%), outside bends (29%), channel crossovers (14%), inside bends (1%), and confluence (1%) macrohabitat types.

The 19 pallid sturgeon caught in Segment 5 were from eight year classes (2001-2003 and 2005-2009) based on identifiable tags or marks, had a wide range of fork lengths (467-755 mm), and weighed300-1,560 g. The 34 fish caught in Segment 6 were from 11 year classes (1997, 1998, 2001-2003, and 2005-2010), had fork lengths ranging from 389-1,055 mm and weighed170 to 4,200 g. Mean relative condition (K_n) of pallid sturgeon by year class ranged from 0.82 to 1.00, which was similar to previous years. Age-2 and age-3 pallid sturgeon grew between 0.33-0.44 mm/d while those age 5-11 grew between 0.22-0.14 mm/d. The mean growth rate of age-14 pallid sturgeon was 0.08 mm/d, while the mean growth rate for the 1997 year class (age-15) was 0.12 mm/d (±2SE =0.02). Mean weight gain was > 0.31 g/d for all year classes and was highest for the 1997 year class (0.81 g/d).

A total of 113 shovelnose sturgeon *S. platorynchus* were captured in standard gears during 2012 (38 with gill nets, 46 with trammel nets, 15 with otter trawls, and 14 with trot lines). All shovelnose sturgeon were floy-tagged as part of a U.S. Geological Survey study to estimate population size and survival. During 2012, no young-of-year *Scaphirhynchus*

spp. were captured and the ratio of pallid sturgeon to shovelnose sturgeon in random deployments of standard gears (0.64 pallid sturgeon: 1 shovelnose sturgeon) has been decreasing since 2006.

In addition to sturgeon, eight native Missouri River species were targeted for assessment. These include shoal chub *Macrhybopsis aestivalis*, sturgeon chub *M. gelida*, sicklefin chub *M. meeki*, western silvery minnow *Hybognathus argyritis*, plains minnow *H. placitus*, sand shiner *Notropis stramineus*, blue sucker *Cycleptus elongatus*, and sauger *Sander canadense*. A total of two sturgeon chubs were collected during 2012 in the otter trawl. Each specimen was collected approximately seven river kilometers downstream of Fort Randall Dam on separate sampling occasions. These are the first observation of sturgeon chub in Segment 5 since monitoring began in 2003. None have been observed in Segment 6. Sicklefin chub or shoal chub were not captured in 2012, similar to the previous nine years. Sand shiners were captured with mini-fyke nets (n = 106) during the fish community season. A single *Hybognathus spp*. (brassy minnow *H. hankinsoni*) was captured in a mini-fyke net during the fish community season. A single blue sucker was captured in a trammel net during the sturgeon season. During 2012, a total of 81 sauger were caught in standard gears (29 in trammel nets, 27 in otter trawls, 19 in gill nets, and 6 in mini-fyke nets). Sauger were captured (n = 54; 67%) primarily during the sturgeon season. A total of 47 fish species and one hybrid were caught in Segments 5 and 6 of the Missouri River during 2012. None of the four exotic Asian carps, bighead carp *Hypophthalmichthys noblis*, silver carp *H. molitrix*, grass carp *Ctenopharyngodon idella*, or black carp *Mylopharyngodon piceus* were captured or observed.

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Introduction

A team of biologists representing State and Federal resource management agencies was assembled in 2002 to develop and implement a standardized long-term resource monitoring program for the Missouri River. This team is now known as the "Pallid Sturgeon Population Assessment Team" (Welker and Drobish 2010). The primary goal of this monitoring program is to assess the status and recovery of endangered pallid sturgeon *Scaphirhynchus albus* (Dryer and Sandoval 1993). However, the monitoring program is also directed towards the native riverine fish community (Appendix A). This team developed standardized protocols for habitat classification (Appendix B), gear types and deployment methods (Appendix C), as well as data reporting (Welker and Drobish 2010). Four pallid sturgeon Recovery Priority Management Areas (RPMAs), were identified in the recovery plan (Dryer and Sandoval 1993), which encompass nearly 1,775 km (1,100 miles) of the Missouri River system. The Pallid Sturgeon Population Assessment Team delineated 14 sampling segments within these RPMAs to implement the monitoring program. Each sampling segment was selected based on a variety of characteristics such as water temperature, turbidity, tributary influence, presence of degrading or aggrading stream beds, stream gradient, natural hydrograph, spillway releases, and flow fluctuations (Berry and Young 2001; Welker and Drobish 2010). Sampling within these segments allows biologists to monitor trends in pallid sturgeon and native Missouri River fish abundance in relation to flow modification, mitigation efforts, and shallow water habitat restoration projects. Standardized monitoring throughout the Missouri River Basin facilitates comparison of fish relative abundance and size structure in disparate habitats (e.g. Upper vs. Middle basins or unchannelized vs. channelized river banks).

The pallid sturgeon population downstream of Fort Randall Dam (RPMA 3) in South Dakota and Nebraska (Figure 1), has been supplemented through stocking since 2000 (Appendices D and E). From June 2000 through May 2011, a total of 11,589 juvenile pallid sturgeon were released from 13 year classes: 1997-1999 and 2001-2010. Additionally, 12 adult fish, which were former broodstock or rehabilitated fish were translocated to RPMA 3 from Lake Sharpe, South Dakota (Appendix E). Most hatchery-reared fish were stocked at age-1; however during September of 2008 the first stocking of age-0 fingerlings occurred. Four stocking sites were locationed downstream of Fort Randall Dam: the most upstream site was Sunshine Bottoms at the Boyd County, Nebraska boat ramp, the middle site was at the Verdel, Nebraska boat ramp, and the two downstream sites were at the Running Water boat ramp on the South Dakota side and Chief Standing Bear Bridge on the Nebraska side (Figure 1). This long-term monitoring program serves to assess the success of hatchery propagated fish and guide future stocking efforts. On October 29, 2010, 12 age-6 pallid sturgeon, outfitted with internal sonic telemetry tags, were stocked at Verdel for a new study of detection probability and catchability for standard fishing gear used in this long-term monitoring program. These age-6 pallid sturgeon were surplus captive broodstock from the U.S. Fish and Wildlife Service Gavins Point National Fish Hatchery in Yankton, South Dakota.

Because current pallid sturgeon abundance is extremely low, data collection that solely targets pallid sturgeon likely would not provide adequate information to evaluate restoration projects and flow modifications to the Missouri River. An ecologically based long-term population assessment approach was adopted to address this concern and evaluate the entire warm water benthic fish community in the Missouri River as required by the U. S. Fish and Wildlife Service's (USFWS) 2000 Biological Opinion on operations of the main-stem Missouri

River dams (USFWS 2000). Additionally, evaluating responses of other native, short-lived Missouri River fishes to changes in habitat or flow modifications may be a more sensitive indicator of habitat change in the near term compared with the rare, long-lived pallid sturgeon. A representative group of nine native Missouri River fishes was selected as indicator species for detecting improvement in the warm water benthic fish community. The species selected were: shovelnose sturgeon *S. platorynchus,* western silvery minnow *Hybognathus argyritis,* plains minnow *H. placitus*, shoal chub *Macrhybopsis aestivalis,* sturgeon chub *M. gelida*, sicklefin chub *M. meeki,* sand shiner *Notropis stramineus*, blue sucker *Cycleptus elongatus,* and sauger *Sander canadense.* Counts and lengths of all fish collected during population assessment activities are recorded; however, weight data are only collected from pallid sturgeon and the representative group of nine native Missouri River species. Information derived from this project will be vital for developing sound management recommendations for recovering the native Missouri River fish fauna

Goals

Although the Pallid Sturgeon Population Assessment Program (PSPAP) itself will not aid in the direct recovery of pallid sturgeon, information derived from this program will be used to evaluate the progress of current and proposed management actions, a key component of implementing an adaptive management approach (Walters and Holling 1990). Restoration of pallid sturgeon in the Missouri River can be divided into three broad categories: population supplementation with hatchery-reared pallid sturgeon, habitat restoration, and changes in current operations of the main-stem dams (i.e., natural hydrograph or "spring rise"). These three actions are all directed towards the ultimate goal of recovery of pallid sturgeon and require monitoring to

ascertain success within an adaptive management framework. Therefore, the specific overall goals of this population assessment program for the Missouri River are:

1. Provide needed information to detect change in pallid sturgeon and nine native targeted species populations and

2. Determine habitat preferences over time for pallid sturgeon and nine selected native species.

Objectives

Six objectives have been identified for the monitoring program. Detailed hypotheses for each objective can be found in Welker and Drobish (2010).

1. Document annual results and long-term trends in pallid sturgeon population abundance and geographic distribution throughout the Missouri River system.
2. Document annual results and long-term trends of habitat use of wild pallid sturgeon and hatchery-stocked pallid sturgeon by season and life stage.
3. Document population structure and dynamics of pallid sturgeon in the Missouri River system (i.e., size structure, condition, growth, and survival).
4. Evaluate annual results and long-term trends in population abundance and geographic distribution throughout the Missouri River system of nine targeted native species.
5. Document annual results and long-term trends of habitat usage of nine targeted native species by season and life stage.
6. Document annual results and long-term trends population abundance and geographic distribution throughout the Missouri River system of all other non-target species where sample size is greater than fifty individuals.

Success Criteria

Evaluation of success will be tied directly to the results of the PSPAP and the resulting information that these assessments provide. The following four statements may be used to determine program success:

1. The program has the ability to detect population changes.
2. The program has the ability to measure survival of hatchery-reared and stocked pallid sturgeon in the river.
3. The program has the ability to detect reproduction of pallid sturgeon in the Missouri River.
4. The program has the ability to detect recruitment of wild pallid sturgeon in the Missouri River.

Study Area

Lewis and Clark Lake, the most downstream reservoir of the Missouri River, was formed by the closure of Gavins Point Dam in 1955 and is bounded upstream by Fort Randall Dam (Figure 1). Both dams are operated by the U. S. Army Corps of Engineers (USACE). The primary function of Gavins Point Dam is to stabilize release fluctuations from upstream dams to serve downstream purposes such as navigation, flood control, and municipal water supply. The riverine section of Lewis and Clark Lake extends approximately 89 river kilometers (rkm) from Fort Randall Dam to Springfield, South Dakota (Figure 1). Maximum depth of the riverine section of Lewis and Clark Lake is about 12 m and channel width ranges from 45-90 m. Downstream of Springfield, South Dakota, Lewis and Clark Lake becomes more lacustral. However, sediment from the Niobrara River has formed a large braided delta, which starts near rkm 1,358 and ends near rkm 1331. This delta has progressively expanded downriver into the

reservoir. The riverine section of Lewis and Clark Lake was selected in the Pallid Sturgeon Recovery Plan (Dryer and Sandoval 1993) as 1 of 4 RPMAs in the Missouri River for potential recovery of the species and was designated as RPMA 3.

The riverine section of Lewis and Clark Lake retains many natural characteristics such as sandbars, sandbar pools, side channels, backwater areas, islands, old growth riparian forest, and year round flows. However the historical temperature and flow (i.e., the hydrograph) in the riverine section has been altered due to operation of Fort Randall Dam (Pegg et al. 2003). Water levels substantially fluctuate daily and seasonally (Troelstrup and Hergenrader 1990). Diel water levels can change almost 1 m. Lowest daily flows generally occur at 0600 hours with peak flows occurring between 1200 to 1900 hours for power generation demands (USACE 1994). The USACE Missouri River Main Stem Reservoirs 2000 - 2001 Annual Operating Plan (http://www.nwd-mr.usace.army.mil/rcc/reports/aop.html) reported highest seasonal releases from Fort Randall Dam during August through November to support navigation on the Missouri River downstream of Sioux City, Iowa. Lowest releases were during December through April to prevent flooding due to ice jams.

Based on the presence of a major tributary, the Niobrara River in Nebraska, the riverine section of Lewis and Clark Lake (RPMA 3) was divided into two sampling segments by the Population Assessment Team. Segment 5 (rkm 1416-1358, river mile [rm] 880-844) encompassed the riverine section downstream of Fort Randall Dam to the Niobrara River confluence. In this segment, water temperatures are depressed by hypolimnetic discharges from Fort Randall Dam and turbidity is low. Segment 6 (rkm 1358-1331, rm 844-827) encompassed the riverine section downstream of the confluence of the Missouri and Niobrara rivers to the headwaters of Lewis and Clark Lake (Figure 1). This segment has higher water temperature and

turbidity due to inflows from the Niobrara River and includes the large braided delta formed in the former headwaters of Lewis and Clark Lake.

Methods

Our sampling protocol followed the detailed guidelines identified in the "Pallid Sturgeon Population Assessment Project and the Missouri River Standard Operating Procedures for Fish Sampling and Data Collection" developed by the Pallid Sturgeon Population Assessment Team (Welker and Drobish 2010). A general summary of those guidelines follows.

Habitat Classification

The basic habitat classification system used in the Benthic Fishes Study (Berry and Young 2001) was adopted by this program (Appendix B). The Benthic Fishes Study was conducted in the late 1990's by the U. S. Geological Survey Cooperative Fish and Wildlife Research Units located at universities throughout the Missouri River Basin. This basic habitat classification system was further modified to address both broad and specific habitats using a hierarchical classification system (e.g., macrohabitat, mesohabitat, and microhabitat) to aid in consistent and comparable data collection across all segments of the Missouri River. Three continuous macrohabitats are present in nearly every bend: outside bends, inside bends, and channel crossovers. An additional 10 discrete macrohabitats have been identified that may not be present in each bend: large tributary mouths, small tributary mouths, confluence areas, large and small secondary connected channels, secondary non-connected channels, deranged channels, braided channels, dendritic channels, and dam tailwaters. Mesohabitats and microhabitats have been defined to further describe fish habitat use. This hierarchal approach provides continuity with previous studies (e.g., Benthic Fish Study) while providing a more detailed and flexible

habitat classification system for future work. All habitats were classified based on the conditions at the time of sampling.

The bend served as the basic hydrologic unit sampled within each river segment. A bend was comprised of three continuous macrohabitats: an outside bend (main channel), an inside bend (main channel) and a channel crossover (main channel). Bends were determined by the hydrologic nature of the river and extended from the upstream crossover to just upstream of the next downstream crossover and also encompassed any islands and secondary channels (i.e., discrete habitats) between these two crossovers. Typically, the river channel parallels the adjacent geographic landforms in the channelized river. However, in the unchannelized portions of the Missouri River, bends do not necessarily follow the general form of the landscape; multiple meanders occur within what appears as one large bend based on the shape of the entire river channel. Also, in unchannelized sections, the location of bends and the number of bends within a segment may change over time. The habitat classification scheme allows for bend comparisons between the channelized and unchannelized river despite changes in scale.

Sampling effort

All bends within each segment were sequentially numbered, from upstream to downstream, and then 10 bends (five per segment) were randomly selected for sampling (Appendix I). In past years (2003 and 2004) eight bends were randomly selected and two bends, one upstream and one downstream of the confluence of the Niobrara and Missouri rivers, were non-randomly selected. Following the 2004 sample season, no non-random bends were sampled (i.e., all five bends in each segment were randomly selected). Additional randomly selected bends were sampled to increase sample size as time allowed. Each mesohabitat within a macrohabitat was sampled using standard gears (Appendices B and C). A minimum of two

subsamples were required for each standard gear type for each macrohabitat within that bend where a particular gear can effectively be deployed. Habitat data (velocity and turbidity) were collected at each pallid sturgeon capture site and in each bend for one of the two sub-samples from each mesohabitat sampled. Sample location (degrees latitude and longitude), time of day, depth (m) and temperature (°C) were recorded for all subsamples. Detailed habitat data collection methods are found in Welker and Drobish (2010).

A minimum number of gear deployments for each standard gear was used, 10 for gill nets and eight for all other gears in each bend, to ensure sufficient sample size for comparisons between segments (Table 1). The standard gears were selected to sample specific habitats, fish species, and seasons. Some gears were selected to maximize capture of pallid sturgeon, while others targeted the fish community. However, all gears sampled multiple species despite targeting pallid sturgeon. All species captured were enumerated and measured to the nearest mm as total length (TL) except sturgeons were measured to fork length (FL) while paddlefish *Polyodon spathula* were measured eye to FL. Wet weight (0.1 g) was only measured for pallid sturgeon and the nine targeted native Missouri River fishes.

The sampling year was divided into two seasons: sturgeon season and fish community season. The sturgeon season encompassed the fall through spring while the fish community season occurred during summer. The sturgeon season focused on the assessment of sturgeon species while collections in the fish community season continued to assess sturgeon but placed additional emphasis and effort towards description of the native fish community. Sampling during the fish community season targeted young-of-the-year (YOY) fishes to provide evidence of recruitment. Delineation between the sturgeon and fish community seasons is primarily based on water temperature. Based on the pallid sturgeon collection and handling protocols (USFWS

2005) pallid sturgeon can only be collected with gill nets at water temperatures < 12.5 °C (< 55 °F). Due to the diversity of habitats and longitudinal changes in climate along the Missouri River, a wide time frame was necessary to facilitate comparable sampling effort among the 14 segments. For example, gill netting downstream of Fork Randall and Gavins Point dam in Nebraska and South Dakota (Segments 5-9) is typically not feasible throughout winter because of ice. However, lack of ice in the lower reaches of the Missouri River permit gill netting during most of the winter. Additional gears were deployed during the fish community season to assess the main channel and shallow water habitats (< 1.2 m) and their associated fish communities. The fish community season ran between July 1 and October 30 and the intensive sturgeon sampling occurred when possible for the remainder of the year. Data in this report covers the time period from November 1, 2011 through October 30, 2012 and herein is referred to as the 2012 sampling season. Focused studies have been previously initiated in conjunction with the population assessments program to fulfill unique biological information gaps (e.g., food habits, sturgeon hormone and disease studies, shovelnose sturgeon population estimates, gear evaluations, telemetry, and geographic information system [GIS] projects).

Sampling Gear

Multiple standard gears were deployed to sample deep and shallow water habitats of the Missouri River (Appendix C). Gill nets, trammel nets, and otter trawls were fished in deep waters (≥ 1.2 m) of the main channel, large secondary connected channels, and large tributaries during the sturgeon season. In the fish community season, trammel nets and otter trawls were again used in addition to mini-fyke nets to sample shallow water (< 1.2 m) habitats (i.e. bars). Multi-filament gill nets (1.8 m deep x 38 m length) consisted of five 8-m long panels with bar mesh sizes of 2.5, 3.8, 5.1, 7.6, and 10.2 cm. A standard gill net consisted of four panels (3.8-

10.2 cm); the smallest mesh (1 inch: 2.5 cm) was coded wild and not included in abundance calculations in this report; however, the 2.5 cm mesh was no longer used following the 2010 sampling season. Trammel nets were 1.8 m deep x 38 m length with outside wall panels of 15.2 cm bar mesh and an inside wall panel of 2.5 cm (1 inch) bar mesh and herein is referred to as the "1-inch trammel net". All gill and trammel nets were dyed green during 2003 - 2006 to reduce net avoidance in Segments 5 and 6 due to low turbidity levels (< 10 nephelometric turbidity units [ntu]). However, a comparison study with white mesh nets found little difference in catch rates of sauger and shovelnose sturgeon (Wanner et al. 2010a) and now only white nets are used. The otter trawl (0.5 m deep x 9.1 m wide) had an outer chafing mesh of 64 mm bar mesh, inner bar mesh of 32 mm constructed of Sapphire®, and a 2-m long cod end. Mini-fyke nets consisted of a lead set at the bankline (4.5 m long x 0.6 m high) with two 1.2 m wide x 0.6 m high rectangular steel frames (cab) and two 0.6 m diameter circular hoops with 3 mm "ACE" type nylon mesh. Mini-fyke nets were set with part of the cab above the waterline to prevent drowning turtles. All captured turtles were enumerated (Appendix A, F4, and G). Gill nets and mini-fyke nets were set overnight for a maximum of 18 h and catch per unit effort (CPUE) was calculated as the number of fish per net night. Trammel nets were drifted and otter trawls were pulled downstream on the river bottom for a minimum distance of 75 m and a maximum distance of 300 m. A global positioning system (GPS) was used to quantify distance sampled for trammel nets and otter trawls with CPUE measured as numbers of fish per 100 m of distance deployed. All gear deployments followed the detailed standard operating procedures (SOP) outlined in Welker and Drobish (2010).

The stratified-random study design of the population assessment program shifts to targeted sampling whenever a pallid sturgeon is captured in the initial random deployment of an

active gear (i.e., otter trawls and drifted trammel nets). Successive passes (i.e., duplicate passes) over the same location are done until two deployments fail to collect additional pallid sturgeon up to a maximum of nine deployments. These non-random deployments are excluded from CPUE calculations for annual relative abundance assessments but provide additional recaptures for determination of survival, growth, condition, and size structure.

Data Collection and Analysis

The fundamental sampling unit (i.e., replicate) for the population assessment program was the bend. Therefore, our effective sample size was the number of bends sampled with each gear deployed in each season collectively for Segments 5 and 6 (Table 1). Data were pooled for Segments 5 and 6 because of the short length (in river miles) and low number of bends sampled in each segment (n = 5). Annual CPUE was calculated for each species captured in each gear for the entire year. Mean CPUE was also separately calculated for each species caught in each gear during each sampling season. First, the average CPUE for all sub-samples within a bend was calculated by year and season and then these bend means were averaged to calculate the overall mean CPUE for year and season, respectively. The overall CPUE was also calculated for each habitat effectively sampled by a particular gear in each season (Appendix F). Variability of mean CPUE was presented as two standard errors (±2SE) which approximate a 95% confidence interval.

Indices of fish condition(fitness) were calculated for pallid sturgeon and two native Missouri River species: shovelnose sturgeon (Quist et al. 1998) and sauger (Guy et al. 1990). Relative condition factor (K_n) was calculated to assess the condition of pallid sturgeon and used the weight-length relation for the Missouri River presented in Shuman et al. (2011). Relative weight (W_r) calculations require a length-specific standard weight derived from an overall

standard weight-length relation encompassing multiple populations across a species' range. Standard weight relations have been derived for shovelnose sturgeon (Quist et al. 1998) and sauger (Guy et al. 1990). Detailed equations for calculating K_n, and W_r are found in (Anderson and Newman 1996).

Incremental proportional size distribution (PSD) was calculated to describe the population size-structure of pallid sturgeon and shovelnose sturgeon using methods proposed by Gabelhouse (1984). Length categories proposed by Shuman et al. (2006a) for pallid sturgeon, Quist et al. (1998) for shovelnose sturgeon, and Anderson and Newman (1996) for sauger were used to determine proportional size distributions (PSD). For pallid sturgeon fork length categories are stock–quality (330-629 mm), quality–preferred (630-839 mm), preferred–memorable (840-1,039 mm), memorable–trophy (1,040-1,269 mm), and trophy (≥ 1,270 mm). Sturgeon were calculated as a percentage of < stock, stock, and > stock sized fish captured in each macrohabitat and mesohabitat type. The sub-stock size category was further divided into fish < 250 mm FL for pallid sturgeon and into fish < 150 mm FL for shovelnose sturgeon, to provide greater resolution of recruitment by YOY sturgeon.

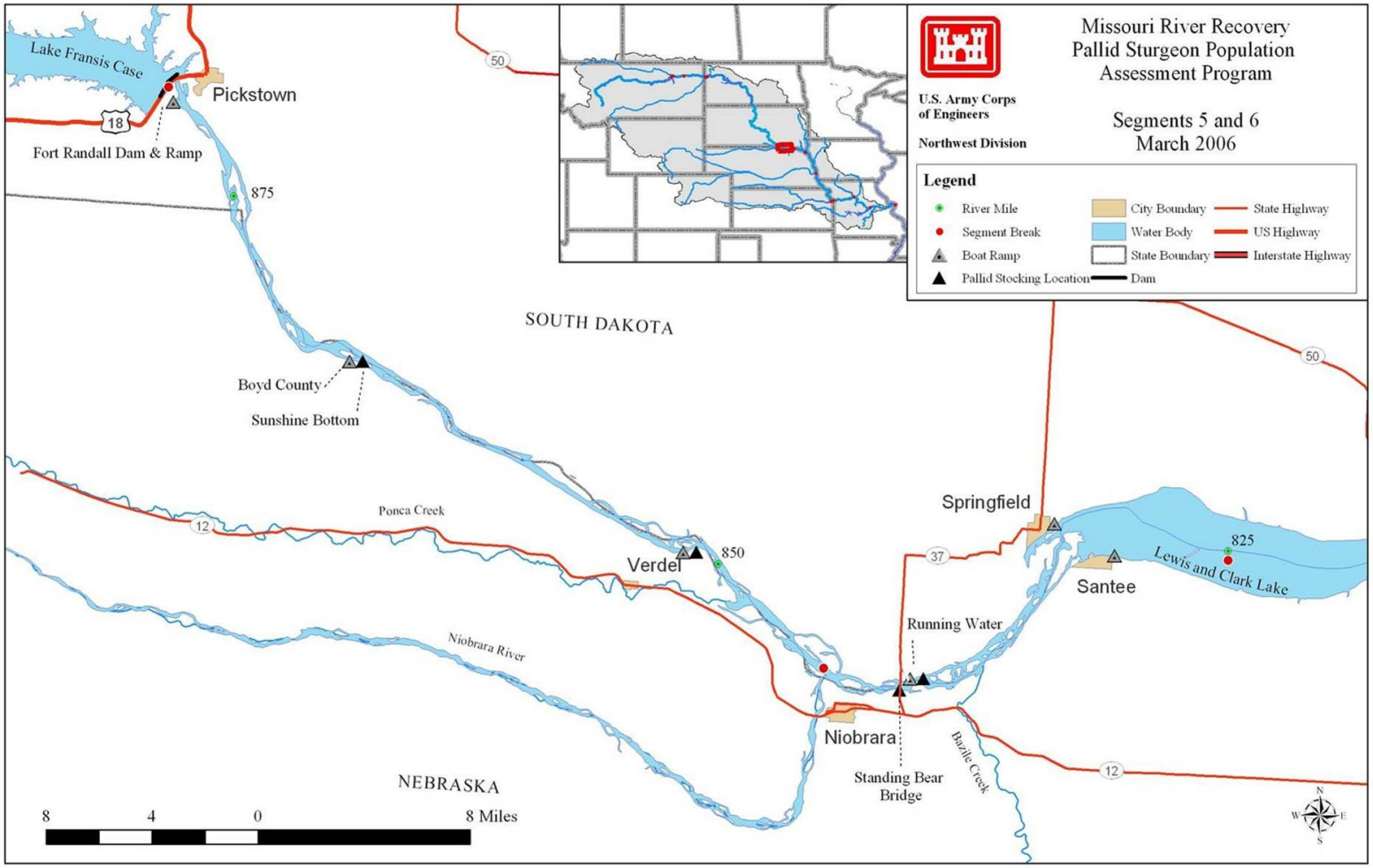

Figure 1. Map of Segments 5 and 6 of the Missouri River with major tributaries, common landmarks, and historic stocking locations for pallid sturgeon. Segments 5 and 6 encompass the Missouri River downstream from Fort Randall Dam (river mile 802) to the headwaters of Lewis and Clark Lake (river mile 827.5).

Results

In 2012, ten randomly selected bends (Appendix I) were sampled (Table 1). Water conditions within Segments 5 and 6 during 2012 were dramatically different when compared to the previous sampling year. During the previous year, record flooding occurred with discharge exceeding 2,123 m^3s^{-1} (75,000 cfs) for 115 days during May 31-September 22. No major river-wide changes in habitat occurred but local changes in depth, velocity, and substrate did occur (D. Shuman, personal observation) following the 2011 flooding.

Table 1. Number of bends sampled, mean number of deployments, and total number of deployments by macrohabitat for Segments 5 and 6 on the Missouri River during the sturgeon and fish community season in 2012. Habitat abbreviations and definitions presented in Appendix B.

Gear	Number of Bends	Mean deployments	Macrohabitat								
			BRAD	CHXO	CONF	ISB	OSB	SCCL	SCCS	SCN	TRMS
Sturgeon Season											
1-inch Trammel Net	10	8.0	32	14	4	11	15	4	0	0	0
Gill Net	10	10.0	50	17	0	16	17	0	0	0	0
Otter Trawl	10	8.0	32	11	4	13	16	4	0	0	0
Trot Lines	10	8.0	32	14	4	10	16	4	0	0	0
Fish Community Season											
1-inch Trammel Net	10	8.0	32	14	4	11	15	4	0	0	0
Mini-Fyke Net	10	8.0	32	11	4	11	12	3	3	2	2
Otter Trawl	10	7.9	31	13	4	13	14	4	0	0	0

Pallid Sturgeon

Objective 1. Document annual results and long-term trends in pallid sturgeon population abundance and geographic distribution throughout the Missouri River System.

Objective 2. Document annual results and long-term trends of habitat usage of wild pallid sturgeon and hatchery stocked pallid sturgeon by season and life stage.

Objective 3. Document population structure and dynamics of pallid sturgeon in the Missouri River system.

A total of 95 pallid sturgeon were captured during the 2012 season; 72 fish were caught in standard random deployments: trot lines (n = 27), gill nets (n = 21), drifted trammel nets (n = 16), and16-ft otter trawl (n = 8). A total of 63 duplicate passes were conducted with active gears. Duplicate passes caught 23 additional pallid sturgeon: 19 fish in the trammel nets and four fish with the 16-ft otter trawls. Additionally, one pallid sturgeon fell from the net while gill netting in the spring.

Pallid sturgeon were captured throughout Segments 5 and 6 as 43 fish were captured upstream and 52 downstream of the Niobrara and Missouri river confluence (Figure 2). On nine separate sampling occasions with active gears, four or more duplicate samples were deployed and, on a single occasion, eight deployment passes was achieved providing evidence that pallid sturgeon aggregate in certain areas. Thirty-seven duplicate passes in Segment 5 occurred in outside bend (n = 23), channel crossover (n = 12), and inside bend (n = 2) macrohabitats. The 26 duplicates passes in Segment 6 were all within the braided channel macrohabitat.

Ten pallid sturgeon were captured with drifted trammel nets from one location on 9 August, 2012 in Bend 4 of Segment 6. The sizes of these ten fish ranged from 439-608 mm FL, 270-810 g weight, and had a total mass of 5,265 g from this single location. In Bend 7 of

Segment 6, nine pallid sturgeon were captured on 18 March, 2012 with trot lines; lengths ranged from 526-1,005 mm FL, weight ranged from 460-4,005 g, and total mass was 12,950 g.

Overall, macrohabitats where pallid sturgeon were captured included braided channels, outside bends, inside bends, channel crossovers, and confluence areas. All fish were captured in the channel border mesohabitat (Table 2). Pallid sturgeon were primarily captured in the braided channel border habitat (n = 53) at depths ranging from 1.2-5.8 m, bottom velocities ranging from 0.03-0.90 m/s, and turbidity ranging from 9-129 nephelometric turbidity units (NTU). Nearly 55% of the pallid sturgeon were captured in the braided, channel border habitat of Segment 6 at a mean depth of 3.2 m, mean bottom velocity of 0.46 m/s, and mean turbidity of 45 NTU. The second most common macrohabitats where pallid sturgeon were collected were in outside bends (n = 28) and channel crossovers (n = 13). In outside bends, pallid sturgeon were captured at a mean depth of 7.3 m, mean bottom velocity of 0.44 m/s, and mean turbidity of eight NTU. In channel crossovers, fish were captured at a mean depth of 4.4 m, mean bottom velocity of 0.50 m/s, and mean turbidity of nine NTU.

Pallid sturgeon from all 13 year classes stocked in RPMA 3 (Appendix E) were captured in Segments 5 and 6 during 2012 with the exception of the 1999 year class (Table 3). Ninety-six percent of the pallid sturgeon captured were identified as hatchery origin based on genetics or presence of a tag. Passive integrated transponder (PIT) tag detection was 75% excluding the 2006 year class (N caught during 2012 sampling season = 8) that did not have PIT tags implanted prior to stocking. A PIT tag was not detected in 32 pallid sturgeon captured, but status (i.e., hatchery, wild, or unknown) was obtained for 29 fish based on the presence of secondary marks (i.e., elastomers present, scute removal): scute removal (n = 2), elastomers present (n = 2), scute removal and elastomers present (n = 10), genetics (n = 5), scute removal and genetics (n

= 3), elastomers present and genetics (n = 6), and elastomers present, scute removal, and genetics (n = 1). Three fish were of unknown status due to lack of any secondary mark (i.e., scute removal, elastomer tag) or collection of genetic confirmation. Genetic analysis was conducted for 19 fish without PIT tags and confirmed fish from the 1997 (N=1), 2001 (N = 2), 2002 (N = 1), 2005 (N = 3), 2007 (N = 3), 2008 (N = 7), and 2009 (N = 2) year classes to be of hatchery origin. Thirty-seven percent of our non-PIT tagged genetically confirmed hatchery propagated fish were from the 2008 year class, of which only 7% of the total 4,047 fish had PIT tags inserted prior to release. Additionally, eight fish from the 2006 year class that did not have a PIT tag implanted at stocking were identified by a removed scute and elastomer tag(s). In 2012, the 2010 year class was the smallest size class present in RPMA 3 and only one fish was captured.

All pallid sturgeon year classes continued to increase in length and weight since stocking in RPMA 3 (Table 3). Growth rates in terms of length (mm/d) were highest for the youngest year classes. Pallid sturgeon ages 2 and 3 grew > 0.32 mm/d while ages 5 - 11 grew > 0.13 mm/d. Age-12 pallid sturgeon, grew at a mean rate of 0.08 mm/d, while the 1997 year class (age-13) grew at a mean rate of 0.12 mm/d. Mean weight gain was > 0.31 g/d for all year classes and was highest for the 1997 year class (0.81 g/d). The four largest fish captured (FL = 940, 990, 1005, and 1055 mm, weight = 3,750, 4,600, 4,005, and 4,200 g, respectively) were from the 1997 year class and were collected in the downstream portion of Segment 6 during the early spring of 2012.

Relative condition of all pallid sturgeon year classes declined since stocking with the exception of the 1998 year class (Table 3). From 2004-2010, mean relative condition of sub-stock fish increased from 1.02 to 1.3, with no sub-stock fish captured in 2011 and 2012 (Figure 4). In contrast, relative condition of stock-sized pallid sturgeon remained fairly constant ranging

from 0.86-0.96 from 2004-2012 and condition in 2012 was 4.8% below the long-term average. Compared to the long-term average, relative condition of quality-sized pallid sturgeon was similar to 2012. Preferred-sized pallid sturgeon relative condition in 2012 increased 9% compared to the long-term average. Mean relative condition of memorable length fish (n = 2; mean = 0.84) was lower than the only other memorable length pallid sturgeon (K_n = 0.93) captured in 2009. No trophy length fish were captured in 2012.

Less than half of the pallid sturgeon captured in 2012 were stock–quality length (n = 43) with 44 quality–preferred length, six preferred–memorable length, two memorable – trophy length and no sub–stock length fish (Tables 4-6; Figure 3). During the sturgeon season the proportion of fish within the quality–preferred length category or larger was 2 times greater than that of the fish community season (Figure 3). During 2012, the greatest proportion of quality and larger sized pallid sturgeon was captured during the sturgeon season.

Overall (i.e., both seasons combined), annual mean CPUE of hatchery-reared pallid sturgeon captured in 2012 was generally larger compared to the long term averages. During 2011, the lack of trammel net deployments during the fish community season and otter trawl deployments during both the fish community and sturgeon season precluded the addition of this data to annual long-term averages. Mean annual CPUE of juvenile pallid sturgeon captured with gill nets increased 186% compared to the long term average (2003-2011) and was 3.5 times higher than the two previous years (2010 and 2011; Figure 5). Mean annual CPUE of hatchery-reared juvenile pallid sturgeon captured with gill nets was similar to 2009, the highest levels recorded. Similarly, mean annual CPUE of hatchery-reared juvenile pallid sturgeon captured with trammel nets increased 11% compared to the long term average (2003-2010) and was similar to 2010 (Figure 6). However, mean annual CPUE of hatchery-reared juvenile pallid

sturgeon captured with otter trawls and trot lines decreased 28% and 68% (Figures 7 and 8), respectively, when compared to the long term averages and were lower than previous years, when a last full complement of deployments occurred. Similarly, mean annual (i.e., both season combined) relative abundance of all pallid sturgeon (i.e., hatchery, wild, and unknown origin) increased 149% for gill nets and 5% for trammel nets, and decreased for otter trawls (22%) and trot lines (60%) compared to the long-term averages.

Mean CPUE for all pallid sturgeon (i.e., hatchery, wild, and unknown origin) varied by season with trammel nets and otter trawls. Seasonally, CPUE of hatchery reared pallid sturgeon in 2012 for otter trawls was 1.9 X higher during sturgeon season (i.e. spring) compared to fish community season (i.e., summer) while CPUE in trammel nets was 1.3 X higher in summer. Seasonal trends in mean CPUE for hatchery-reared pallid sturgeon were similar to that of all pallid sturgeon (Figures 6 and 7) during 2012.

Relative abundance of hatchery-reared pallid sturgeon captured during the fish community season in Segments 5 and 6 with trammel nets and otter trawls in 2012 varied among gears. Mean CPUE of hatchery reared pallid sturgeon captured with trammel nets during the fish community season increased 30% compared to the long-term average (2003-2010), however, mean relative abundance of fish captured by otter trawls decreased 49% compared to the long-term average (2005-2010). Similarly, mean CPUE of all pallid sturgeon (i.e., hatchery, wild, and unknown origin) captured in the fish community season increased 26% for trammel nets and decreased 50% for otter trawls when compared to the long-term average. During the fish community season, pallid sturgeon of unknown origin were not caught with the otter trawl or trammel net.

Relative abundance of hatchery-reared pallid sturgeon captured during sturgeon season in Segments 5 and 6 with trammel nets and otter trawls in 2012 was generally higher or similar to the previous sampling year. Mean CPUE of hatchery reared pallid sturgeon captured with trammel nets and otter trawls was similar to the long term average only decreasing 6% and increasing 2%, respectively. Similarly, mean CPUE of all pallid sturgeon (i.e., hatchery, wild, and unknown origin) captured during the sturgeon season increased 17% for otter trawls and decreased 14% for trammel nets, when compared to the long-term averages. During the sturgeon season, a single pallid sturgeon of unknown origin was collected with the otter trawl while pallid sturgeon of unknown origin were not caught with a trammel net.

Because few wild pallid sturgeon and few fish of unknown origin were captured in 2012, seasonal changes for each gear for all categories of pallid sturgeon were generally similar to that for hatchery-reared fish (Figures 5-8). Nearly 67% of all pallid sturgeon were captured during the sturgeon season (n = 64) compared to the fish community season (n = 31) in 2012. Pallid sturgeon were not captured in 2012 with mini-fyke nets set in the fish community season (Tables 4-6); none have been captured in this gear since monitoring began in 2003. Additionally, following the 2011 sampling season gill nets are no longer deployed during the fall.

The primary mode in the size distribution of pallid sturgeon during 2012 was from 550-600 mm FL, with smaller modes representing recently stocked fish and the oldest year classes stocked (Figure 9). Fork lengths of pallid sturgeon ranged from 389-1125 mm in Segments 5 and 6 during 2012. Mean length of pallid sturgeon captured in 2012 was 617 mm for trammel nets (range = 439-1,125 mm), 710 mm gill net for (range = 530-990 mm), 599 mm for otter trawl (range = 492-662 mm), and 695 mm for trot lines (range = 389-1,005 mm).

Pallid sturgeon are continuing to show growth and progressively recruiting to larger length categories from previous years (Figure 3). Total catch of pallid sturgeon in 2012 was similar to 2007 and 2008 but lower than 2009 and 2010 (Figure 10). Before 2004, only 1,854 stocked juvenile pallid sturgeon were at large in Segments 5 and 6. After 2003, 5,642 yearlings and 3,410 age-0 fingerlings have been stocked into RPMA 3 (Appendix E). Annual captures of pallid sturgeon increased during 2004-2009, but is biased due to variable effort among years and implementation of new gears such as the otter trawl in 2005 and the trotline in 2009 (Figure 8). Additionally, less than half the standard effort was deployed during 2011 due to record discharge from Fort Randall Dam. The ratio of pallid sturgeon to shovelnose sturgeon captured in standard random deployments in 2012 (0.64 pallid sturgeon: 1 shovelnose sturgeon) has been decreasing since 2006.

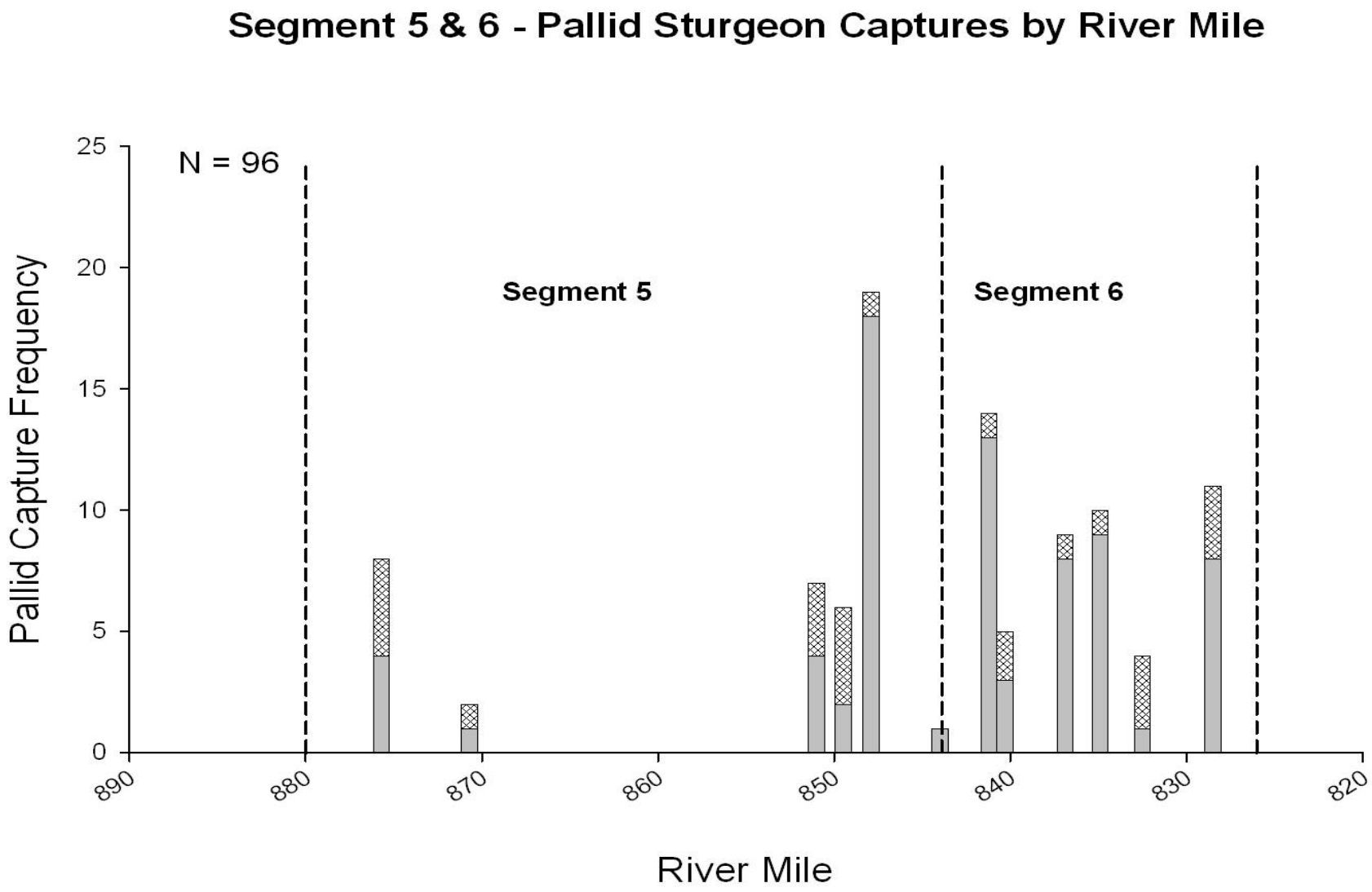

Figure 2. Distribution of pallid sturgeon captures by river mile for Segments 5 and 6 of the Missouri River during 2012. Gray bars represent random pallid sturgeon captures and cross-hatched bars represent non-random pallid sturgeon captures. Dashed line identifies upstream and downstream boundaries for Segments 5 and 6.

Table 2. Pallid sturgeon capture summaries for all gears relative to habitat type and environmental variables on the Missouri River during 2012. Means (minimum and maximum) are presented. Habitat definitions and codes presented in Appendix B. Table includes all pallid sturgeon captures including non-random samples.

Habitat		Depth (m)		Bottom Velocity (m/s)		Temperature (°C)		Turbidity (ntu)		Total pallids caught
Macro-	Meso-	Effort	Catch	Effort	Catch	Effort	Catch	Effort	Catch	
BRAD	BARS	0.4 (0.2-0.5)		0.06 (0.00-0.20)		23.8 (22.2-26.0)		15 (11-18)		
	CHNB	3.5 (1.2-12.1)	3.2 (1.2-5.8)	0.50 (0.03-1.15)	0.46 (0.03-0.90)	15.3 (6.8-26.0)	14.1 (7.0-25.2)	34 (6-129)	45 (9-129)	53
CHXO	BARS	0.4 (0.3-0.5)		0.02 (0.00-0.04)		25.3 (22.6-27.2)		5 (4-7)		
	CHNB	4.2 (1.6-7.8)	4.4 (2.7-6.8)	0.47 (0.05-0.80)	0.50 (0.32-0.78)	14.9 (5.0-26.2)	14.9 (7.1-25.6)	8 (3-22)	9 (6-22)	13
CONF	BARS	0.4 (0.3-0.5)		0.01 (0.01-0.01)		26.3 (26.2-26.4)		29 (29-29)		
	CHNB	4.5 (1.4-9.4)	2.4 (2.4-2.4)	0.79 (0.57-1.13)	0.57 (0.57-0.57)	17.9 (9.6-26.2)	10.2 (10.2-10.2)	33 (8-92)	92 (92-92)	1
ISB	BARS	0.4 (0.3-0.5)		0.04 (0.00-0.07)		25.2 (22.4-26.9)		7 (5-8)		
	CHNB	3.6 (1.2-6.9)	3.0 (3.0-3.0)	0.45 (0.15-0.71)	0.45 (0.45-0.45)	14.5 (5.0-26.0)	14.3 (14.3-14.3)	8 (3-12)	11 (11-11)	1
OSB	BARS	0.4 (0.3-0.5)		0.05 (0.00-0.10)		25.6 (22.6-27.3)		7 (5-8)		
	CHNB	5.7 (1.7-15.4)	7.3 (3.0-15.1)	0.50 (0.18-0.78)	0.44 (0.20-0.64)	15.8 (4.9-28.5)	17.3 (7.0-26.5)	8 (3-14)	8 (6-11)	28
SCCL	BARS	0.4 (0.3-0.4)		0.02 (0.02-0.02)		26.6 (26.2-26.9)		6 (6-6)		
	CHNB	4.3 (2.8-6.1)		0.50 (0.42-0.62)		17.7 (9.6-26.0)		12 (10-15)		
SCCS	BARS	0.4 (0.3-0.4)		0.05 (0.00-0.10)		26.6 (26.6-26.6)		5 (4-6)		
SCN	BARS	0.4 (0.3-0.5)		0.01 (0.01-0.01)		23.7 (23.0-24.4)		8 (8-8)		
TRMS	BARS	0.4 (0.4-0.4)				24.9 (23.7-26.1)				

Table 3. Mean (± 2 SE) fork length, weight, relative condition factor (K_n) and absolute growth rates for hatchery-reared pallid sturgeon year classes at the time of stocking and capture during 2012 from Segments 5 and 6 of the Missouri River. Table includes all hatchery-reared pallid sturgeon captures including non-random and wild samples.

		Stock Data			Capture Data			Growth Data	
Year Class	**N**	**Length (mm)**	**Weight (g)**	**K_n**	**Length (mm)**	**Weight (g)**	**K_n**	**Length (mm/d)**	**Weight (g/d)**
1997	4	493	613.0	1.46	998	4138.8	1.000	0.116	0.814
		(60)	(211.5)	(0.21)	(47)	(358.5)	(0.14)	(0.015)	(0.107)
1998	3	436	229	0.83	770	1695	0.92	0.079	0.347
		(21)	(57.1)	(0.06)	(122)	(857.6)	(0.05)	(0.032)	(0.210)
2001	12	203			724	1340.4	0.91	0.142	
		(10)			(31)	(182.6)	(0.02)	(0.010)	
2002	8	263	71.6	1.36	692	1233.1	0.94	0.135	0.376
		(17)	(16.1)	(0.09)	(50)	(358.7)	(0.05)	(0.020)	(0.128)
2003	6	300	98.7	1.21	676	1071.7	0.89	0.135	0.349
		(18)	(21.7)	(0.07)	(56)	(299.9)	(0.03)	(0.016)	(0.101)
2004	5	320	138.6	1.37	679	1057	0.89	0.148	0.378
		(27)	(42.7)	(0.07)	(23)	(151)	(0.04)	(0.020)	(0.080)
2005	12	317	132	1.36	606	777.5	0.94	0.138	0.311
		(17)	(24.2)	(0.10)	(25)	(106.8)	(0.03)	(0.100)	(0.059)
2006*	8	189	26.7	1.54	624	786.3	0.89		
		(5)	(2.7)	(0.29)	(27)	(84.4)	(0.10)		
2007	7	231	46.3	1.29	581	644.6	0.90	0.224	0.364
		(47)	(23.3)	(0.18)	(34)	(121.3)	(0.03)	(0.028)	(0.067)
2008	9				586	600.8	0.82		
					(19)	(61.3)	(0.17)		
2009	11	272	77.3	1.28	530	432.3	0.82	0.327	0.467
		(24)	(22.7)	(0.05)	(25)	(77.7)	(0.11)	(0.039)	(0.110)
2010	3	241	46.5	1.19	431	250	0.93	0.435	0.502
		(36)	(19)	(0.09)	(45)	(83.3)	(0.04)	(0.021)	(0.043)

*Mean length and weight at stocking derived from subsample of fish measured at tagging. All other year classes had passive integrated transponder (PIT) tags enabling growth rate calculations for individual fish. The 2006, 2008, and 2009 year classes had 0%, 8%, and 75% of the fish inserted with PIT tags respectively when stocked (Appendix E).

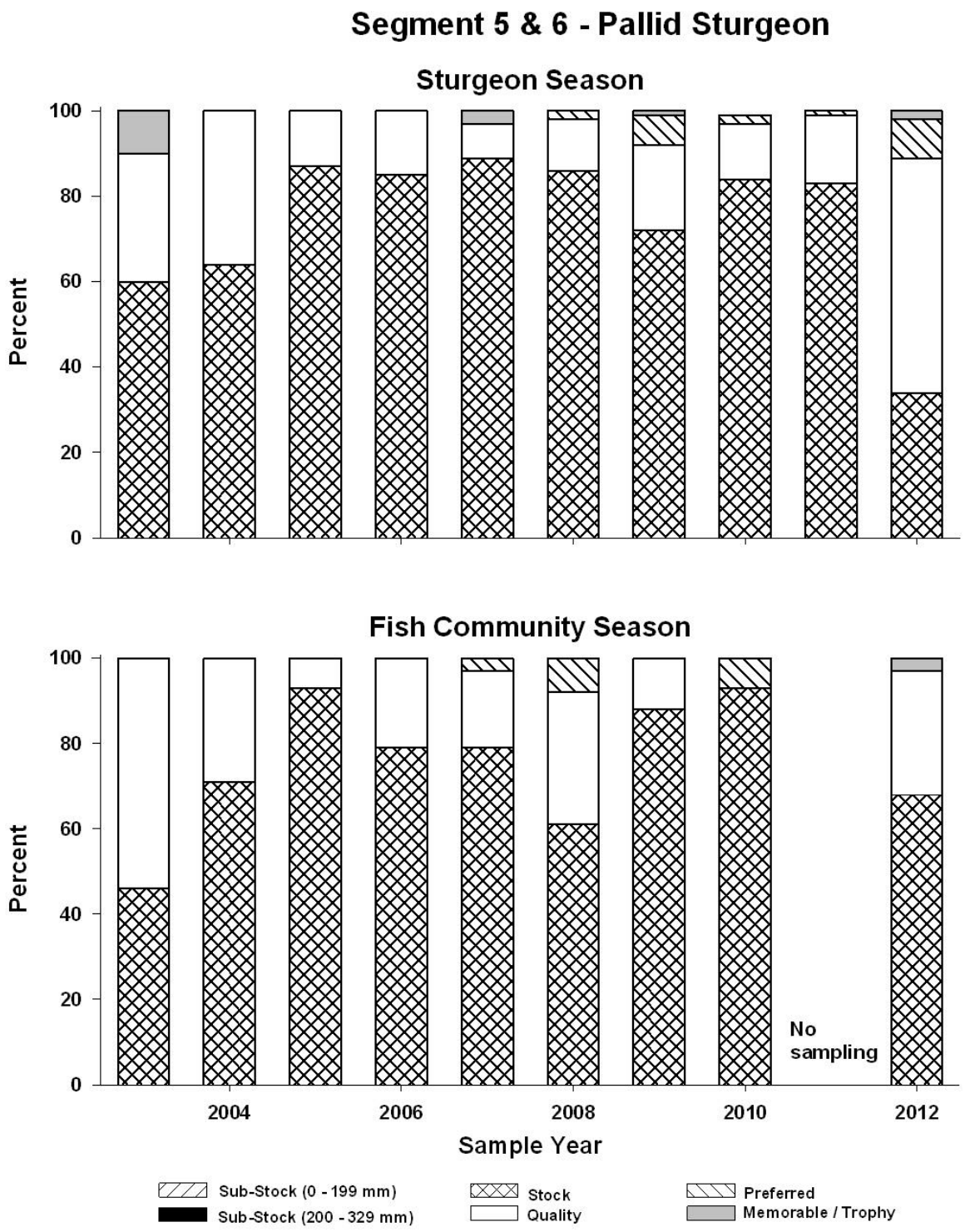

Figure 3. Proportion by length group for all pallid sturgeon captured with all gears by incremental proportional size distribution length category from 2003-2012 in Segments 5 and 6 in the Missouri River. .

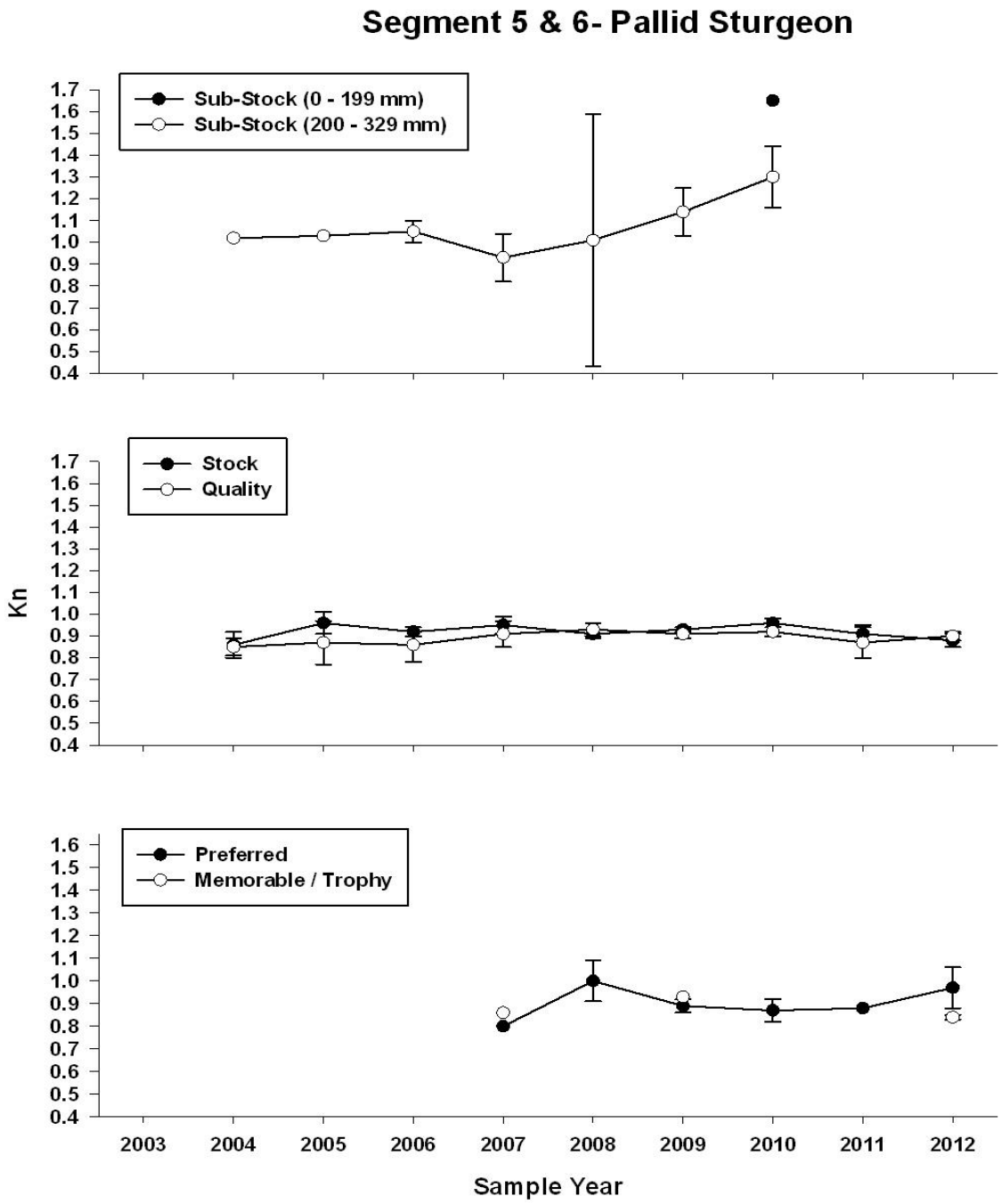

Figure 4. Relative condition factor (K_n) for all pallid sturgeon captured with all gear by incremental proportional size distribution (PSD) length category from 2003-2011 in Segments 5 and 6 in the Missouri River.

Table 4. Total number of stock (330-629 mm) pallid sturgeon randomly captured for each gear during each season and the percent caught within each macrohabitat type in Segments 5 and 6 of the Missouri River during 2012. The percent of total effort for each gear in each habitat is presented in parentheses. Habitat abbreviations and definitions presented in Appendix B.

Gear	N	Macrohabitat								
		BRAD	CHXO	CONF	ISB	OSB	SCCL	SCCS	SCN	TRMS
Sturgeon Season										
1-inch Trammel Net	3	0 (44)	33 (18)	0 (4)	0 (14)	67 (17)	0 (4)	0 (0)	0 (0)	0 (0)
Gill Net	4	0 (50)	25 (17)	0 (0)	0 (16)	75 (17)	0 (0)	0 (0)	0 (0)	0 (0)
Otter Trawl	3	33 (38)	0 (14)	0 (5)	33 (17)	33 (20)	0 (5)	0 (0)	0 (0)	0 (0)
Trot Lines	10	80 (40)	0 (18)	10 (5)	0 (13)	10 (20)	0 (5)	0 (0)	0 (0)	0 (0)
Fish Community Season										
1-inch Trammel Net	8	38 (43)	25 (17)	0 (4)	0 (14)	38 (17)	0 (5)	0 (0)	0 (0)	0 (0)
Mini-Fyke Net	0	0 (40)	0 (14)	0 (5)	0 (14)	0 (15)	0 (4)	0 (4)	0 (3)	0 (3)
Otter Trawl	2	0 (41)	50 (16)	0 (5)	0 (16)	50 (17)	0 (5)	0 (0)	0 (0)	0 (0)

Table 5. Total number of quality size and greater (≥ 630 mm) pallid sturgeon randomly captured for each gear during each season and the percent caught within each macrohabitat type in Segments 5 and 6 of the Missouri River during 2012. The percent of total effort for each gear in each habitat is presented in parentheses. Habitat abbreviations and definitions presented in Appendix B.

Gear	N	Macrohabitat								
		BRAD	CHXO	CONF	ISB	OSB	SCCL	SCCS	SCN	TRMS
Sturgeon Season										
1-inch Trammel Net	3	67 (44)	0 (18)	0 (4)	0 (14)	33 (17)	0 (4)	0 (0)	0 (0)	0 (0)
Gill Net	17	59 (50)	18 (17)	0 (0)	0 (16)	24 (17)	0 (0)	0 (0)	0 (0)	0 (0)
Otter Trawl	3	33 (38)	33 (14)	0 (5)	0 (17)	33 (20)	0 (5)	0 (0)	0 (0)	0 (0)
Trot Lines	17	76 (40)	18 (18)	0 (5)	0 (13)	6 (20)	0 (5)	0 (0)	0 (0)	0 (0)
Fish Community Season										
1-inch Trammel Net	2	100 (43)	0 (17)	0 (4)	0 (14)	0 (17)	0 (5)	0 (0)	0 (0)	0 (0)
Mini-Fyke Net	0	0 (40)	0 (14)	0 (5)	0 (14)	0 (15)	0 (4)	0 (4)	0 (3)	0 (3)
Otter Trawl	0	0 (41)	0 (16)	0 (5)	0 (16)	0 (17)	0 (5)	0 (0)	0 (0)	0 (0)

Table 6. Total number of pallid sturgeon captured in random gear deployments during each season and the percent caught within each macrohabitat type in Segments 5 and 6 of the Missouri River during 2012. The percent of total effort for each gear in each habitat is presented in parentheses. Habitat abbreviations and definitions presented in Appendix B.

Gear	N	Macrohabitat								
		BRAD	CHXO	CONF	ISB	OSB	SCCL	SCCS	SCN	TRMS
Sturgeon Season										
1-inch Trammel Net	6	33 (44)	17 (18)	0 (4)	0 (14)	50 (17)	0 (4)	0 (0)	0 (0)	0 (0)
Gill Net	21	50 (50)	18 (17)	0 (0)	0 (16)	32 (17)	0 (0)	0 (0)	0 (0)	0 (0)
Otter Trawl	6	33 (38)	17 (14)	0 (5)	17 (17)	33 (20)	0 (5)	0 (0)	0 (0)	0 (0)
Trot Lines	27	78 (40)	11 (18)	4 (5)	0 (13)	7 (20)	0 (5)	0 (0)	0 (0)	0 (0)
Fish Community Season										
1-inch Trammel Net	10	50 (43)	20 (17)	0 (4)	0 (14)	30 (17)	0 (5)	0 (0)	0 (0)	0 (0)
Mini-Fyke Net	0	0 (40)	0 (14)	0 (5)	0 (14)	0 (15)	0 (4)	0 (4)	0 (3)	0 (3)
Otter Trawl	2	0 (41)	50 (16)	0 (5)	0 (16)	50 (17)	0 (5)	0 (0)	0 (0)	0 (0)

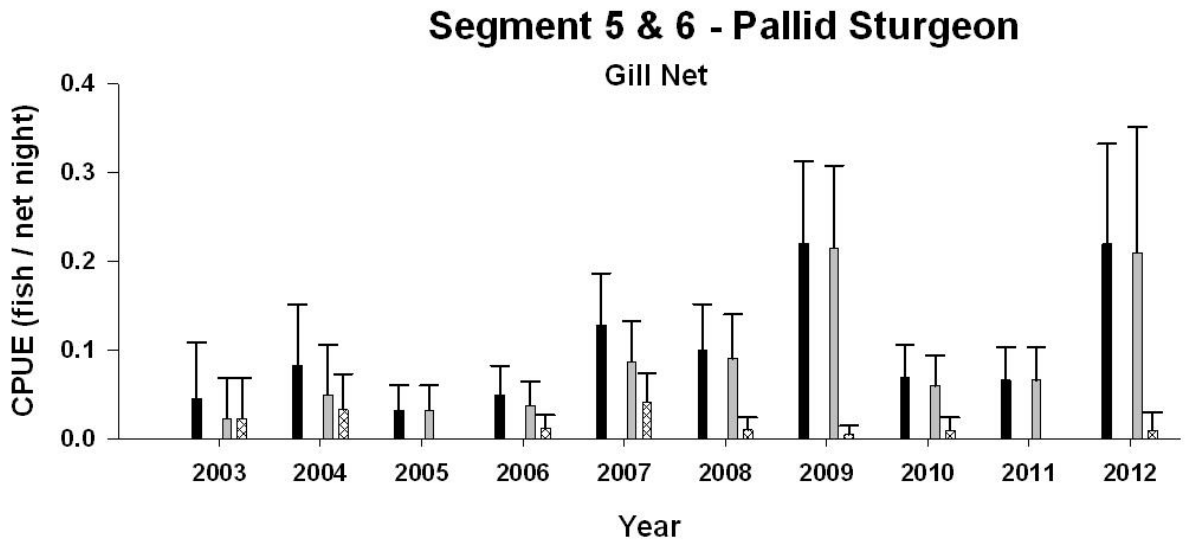

Figure 5. Mean annual catch per unit effort (± 2 SE) of all (black bars), wild (white bars), hatchery-reared (gray bars), and unknown origin (cross-hatched bars) pallid sturgeon caught by gill nets in Segments 5 and 6 of the Missouri River from 2003-2011. Gill nets were set in fall and spring during 2003-2010 and only in spring in 2011-2012.

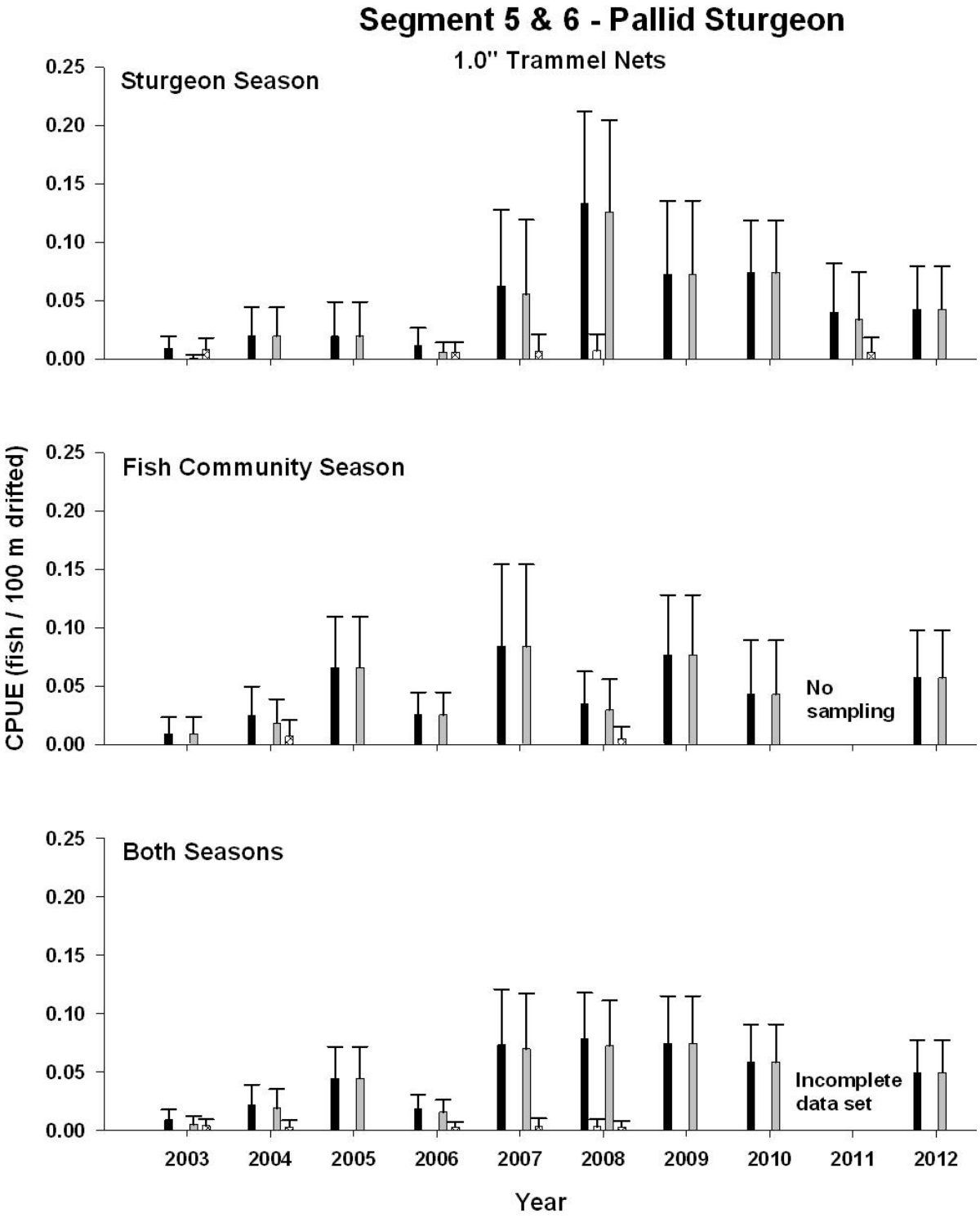

Figure 6. Mean annual catch per unit effort (± 2 SE) of all (black bars), wild (white bars), hatchery-reared (gray bars), and unknown origin (cross-hatched bars) pallid sturgeon caught by 1.0-inch trammel nets in Segments 5 and 6 of the Missouri River from 2003-2012.

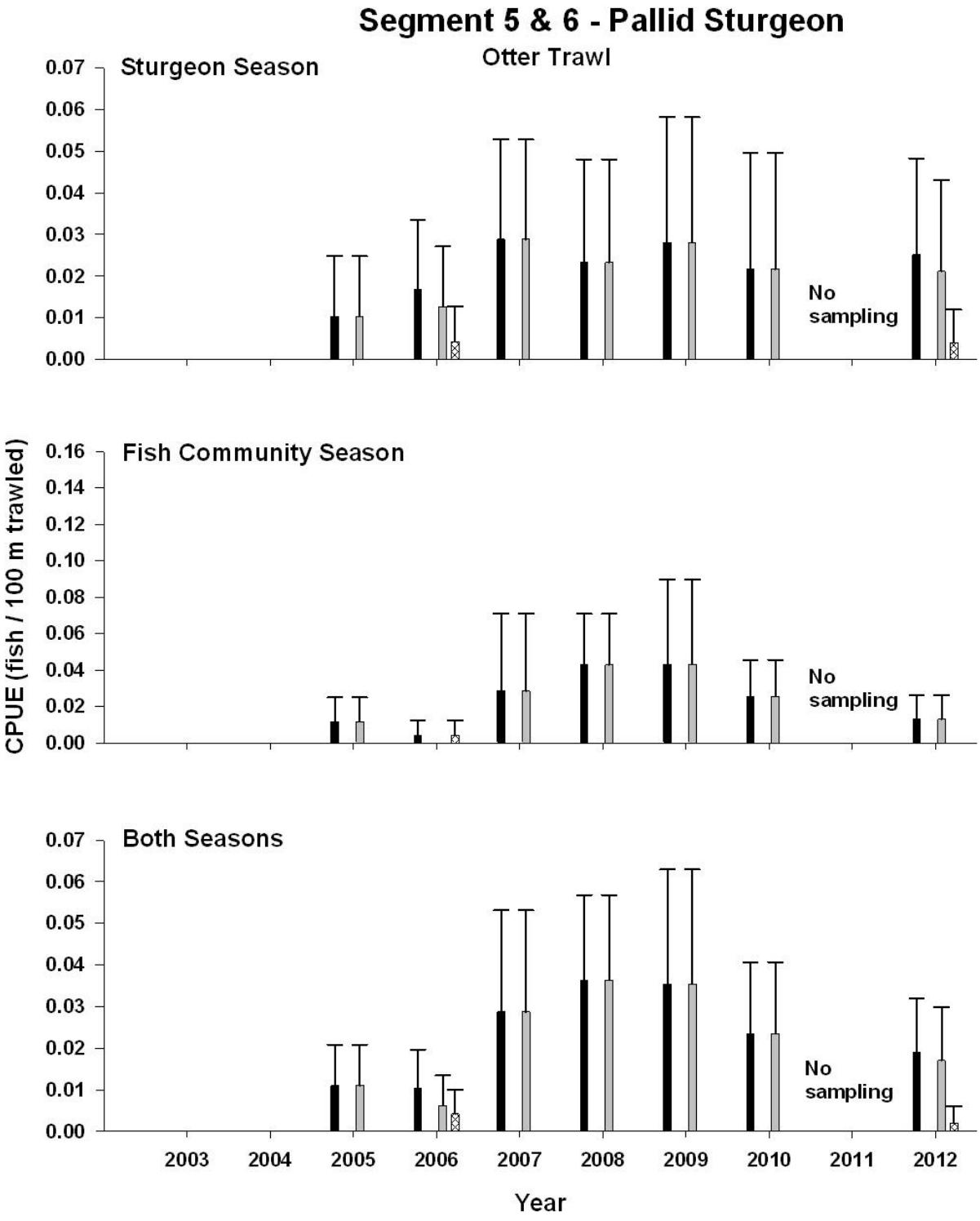

Figure 7. Mean annual catch per unit effort (± 2 SE) of all (black bars), wild (white bars), hatchery-reared (gray bars), and unknown origin (cross-hatched bars) pallid sturgeon caught by otter trawls in Segments 5 and 6 of the Missouri River from 2003-2012.

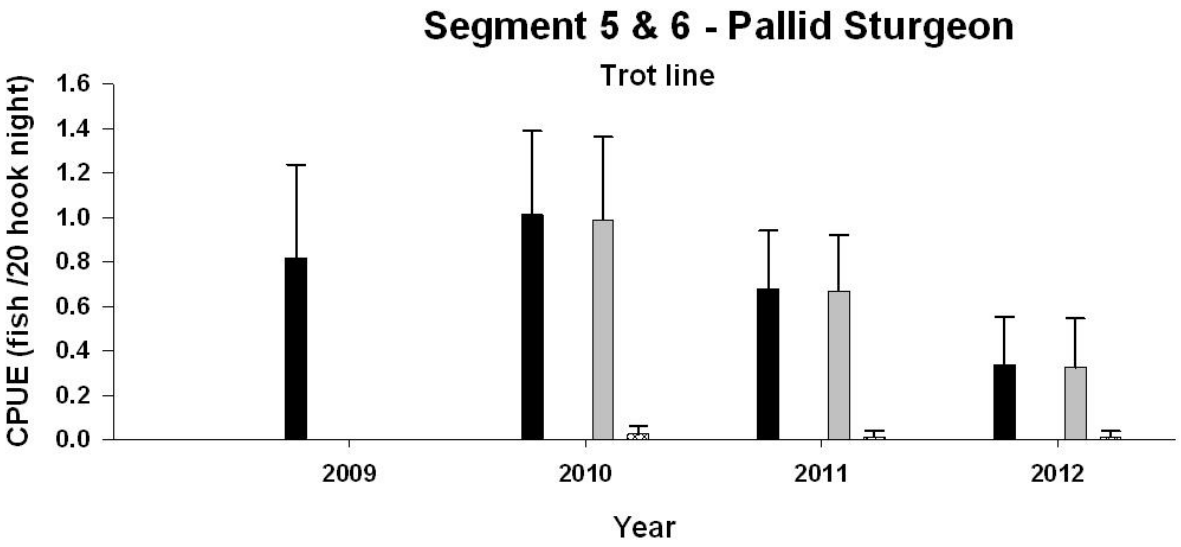

Figure 8. Mean annual catch per unit effort (± 2 SE) of all (black bars), wild (white bars), hatchery-reared (gray bars), and unknown origin (cross-hatched bars) pallid sturgeon caught by trot lines in Segments 5 and 6 of the Missouri River from 2009-2012.

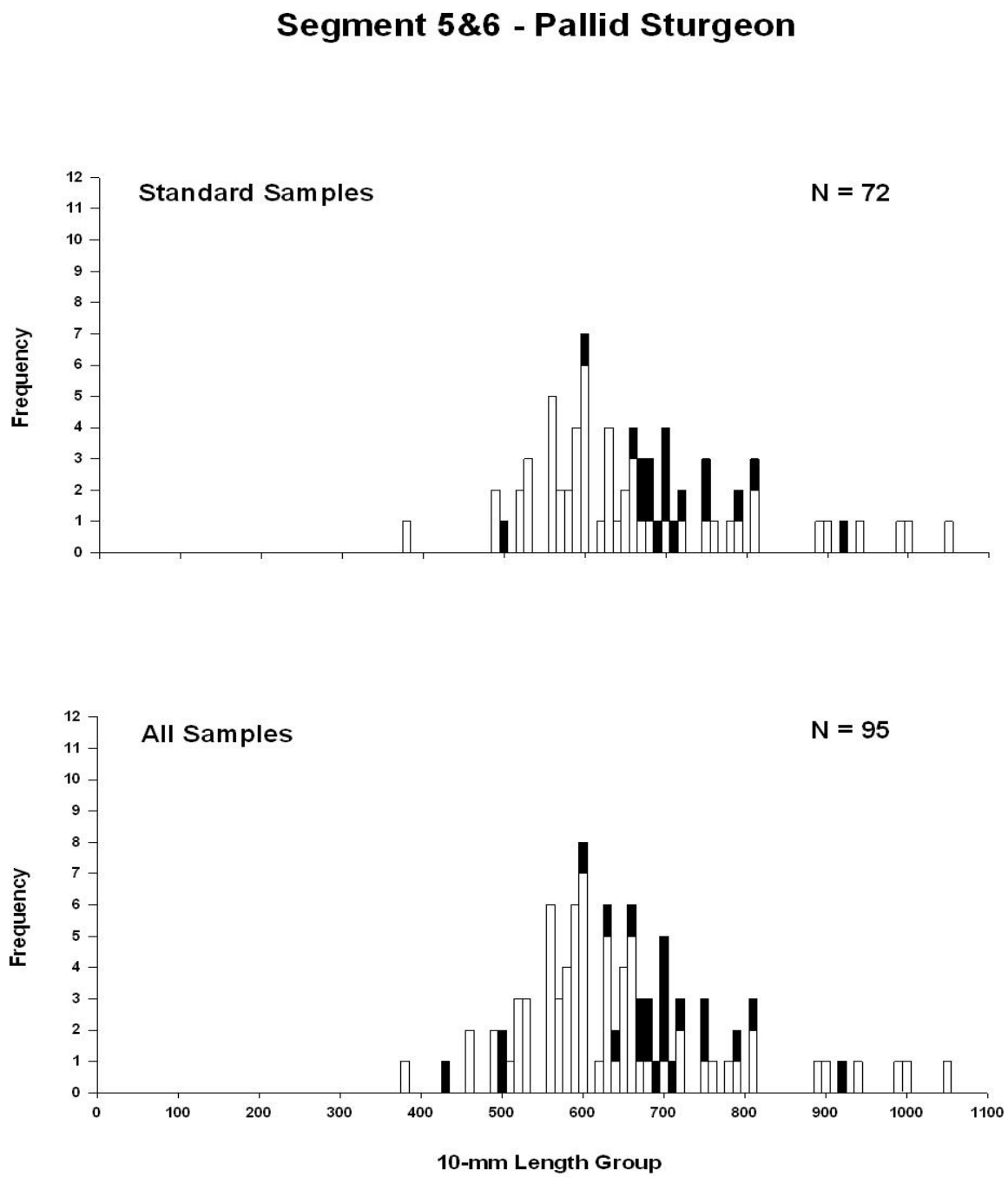

Figure 9. Length frequency of pallid sturgeon captured in Segments 5 and 6 of the Missouri River during 2012. White bars represent hatchery-reared pallid sturgeon, cross-hatched bars represent wild pallid sturgeon captures, and black bars represent unknown pallid sturgeon. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2012.

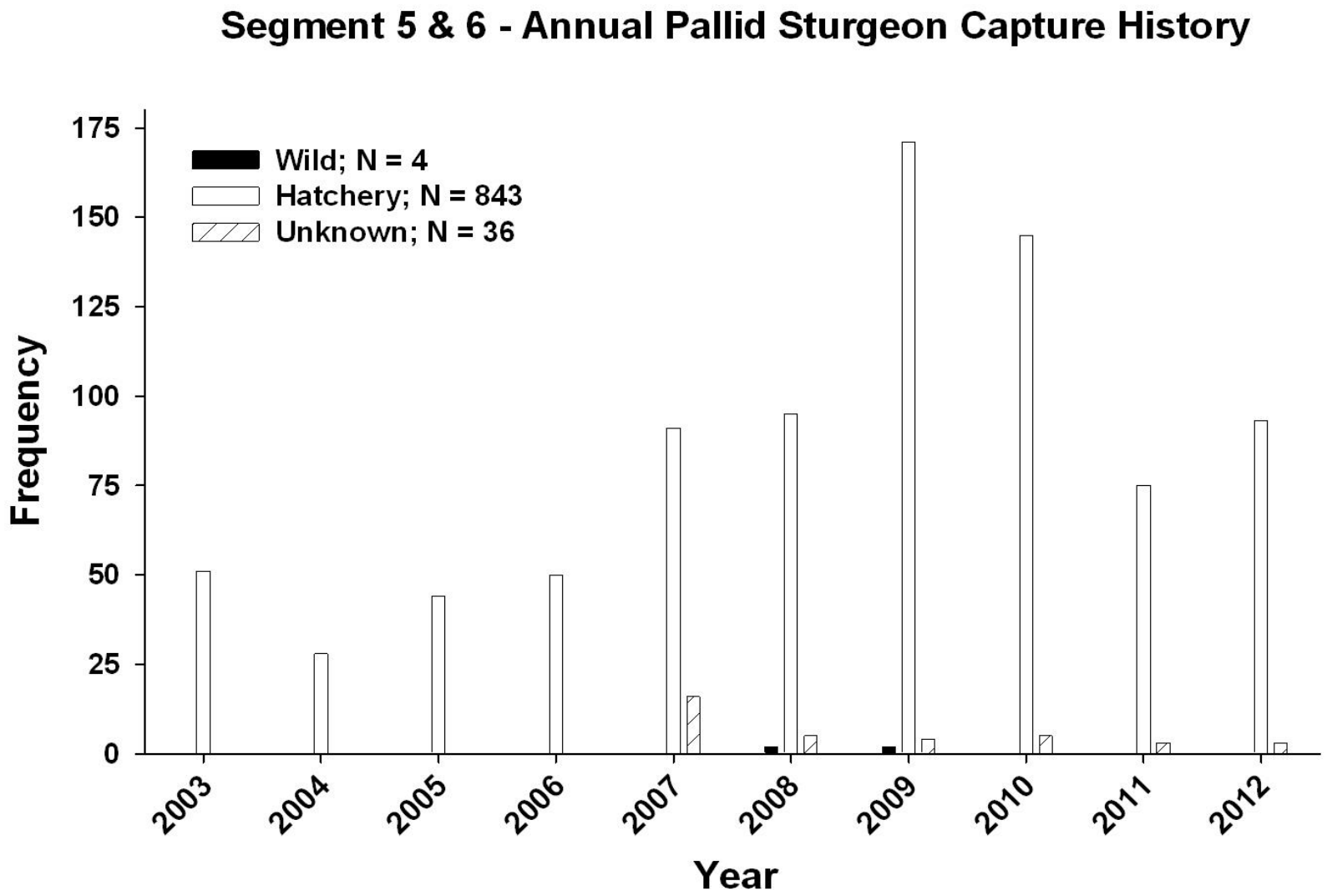

Figure 10. Annual capture history of wild (black bars), hatchery reared (white bars), and unknown origin (cross-hatched bars) pallid sturgeon caught in Segments 5 and 6 of the Missouri River from 2003-2012. Figure is designed to compare overall pallid sturgeon captures from year to year and is biased by variable effort among years. Figure includes all pallid sturgeon captures including non-random and wild samples.

Shovelnose X Pallid Sturgeon Hybrids

No shovelnose X pallid sturgeon hybrids were captured in Segments 5 and 6 during 2012. Furthermore, no hybrid sturgeon have been captured in Segments 5 and 6 since monitoring began in 2003.

Targeted Native River Species

Objective 4. Document annual results and long-term trends in native target species population abundance and geographic distribution throughout the Missouri River system.

Objective 5. Document annual results and long-term trends of habitat usage of the target native species by season.

Shovelnose Sturgeon

A total of 113 shovelnose sturgeon were sampled with standard effort and an additional nine fish were captured in duplicate passes for active gears. Gears that collected shovelnose sturgeon included trammel nets (n = 55), gill nets (n = 38), otter trawls (n = 15) and trot line (n = 14).

During 2012, mean annual (i.e., both seasons pooled) relative abundance of shovelnose sturgeon > stock length decreased for all gears when compared to the long term averages: 63% in trotlines, 37% in gill nets, 21% in trammel nets, and 12% in otter trawls (Figures 11-14). Annual CPUE of shovelnose sturgeon increased 64 % for gill nets and decreased 29% for trotlines when compared to 2011; whereas relative abundance increased 36% for trammel nets and 77% for

otter trawls when compared to 2010, the last year when full complements of these gears were deployed. Shovelnose sturgeon were not captured in mini-fyke nets in 2012 or in any previous sampling year.

A total of 86 shovelnose sturgeon were captured in standard random samples during the sturgeon season while 27 fish were captured during the fish community season. Compared to long-term averages, trammel net mean CPUE during both the sturgeon and fish community season of 2012 decreased 15% and 23%, respectively (Figure 12). The mean CPUE of shovelnose sturgeon in trammel nets in the sturgeon season (0.12 fish/100 m) was similar to the fish community season. Mean CPUE of shovelnose sturgeon captured in the otter trawl was nearly 3x greater during the spring (sturgeon season; 0.05 fish/100 m) compared to the summer (fish community season; 0.02 fish/100 m) during 2012 (Figure 13). In 2012, mean CPUE of shovelnose sturgeon captured in otter trawls increased 38% during the sturgeon season but decreased 57% during the fish community season compared to the 2005-2010 running average.

Shovelnose sturgeon were found in all macrohabitats sampled in 2012, with the exception of small secondary connected channel, non-connected secondary channels, and small tributary mouths where only mini-fyke nets were deployed (Tables 7 and 8). For all gears pooled, macrohabitats where shovelnose sturgeon were captured include braided channels (52%), outside bends (19%), channel crossovers (14%), inside bends (7%), large secondary connected channels (5%), and confluence (3%) during the sturgeon season. During the fish community season, 58% of shovelnose sturgeon were captured in braided channels, 10% in large secondary connected channels, 10% in channel crossovers, 10% at confluences, 6% in inside bends, and 6% in outside bends. For the trammel net, the proportion of shovelnose sturgeon captured greater than stock size was greater than the proportion of effort expended in the braided and secondary non-

connected channel macrohabitats during both seasons. A greater proportion of shovelnose sturgeon were caught compared to effort expended with otter trawl in the confluence macrohabitat during the both seasons and the braided, outside bend, and large secondary connected channel macrohabitats during the sturgeon season. During the sturgeon season with gill nets the proportion of the total shovelnose sturgeon caught was greater than the proportion of effort expended in the channel crossover and outside bend macrohabitat, while for trot lines catch exceeded effort in the braided and outside bend macrohabitats. All shovelnose sturgeon were caught in the channel border mesohabitat and 61% of fish were captured in the Niobrara River delta of the Missouri River in Segment 6.

Fork lengths of shovelnose sturgeon ranged from 542-767 mm, with 75% of the fish between 600-700 mm (Figure 15). Incremental PSD for shovelnose sturgeon during the sturgeon season demonstrates a current population of older large fish with limited or zero recruitment in Segments 5 and 6 (Figure 16). However, memorable and trophy sized shovelnose sturgeon have comprised 40-60% of the size distribution since 2003.

Shovelnose sturgeon captured during the sturgeon (n = 91) and fish community seasons (n = 31) exhibited a similar mean W_r of 108 and 107, respectively. The pooled shovelnose sturgeon relative weight ranged from 78-158 with a mean of 108 (± 2 SE = 2.07). Relative weight of shovelnose sturgeon for preferred– memorable and ≥ memorable length size groups have trended upward since 2008 from 97 to 112 and 88 to 106, respectively (Figure 17). No trophy, sub-stock, stock, or quality length fish were collected in 2012.

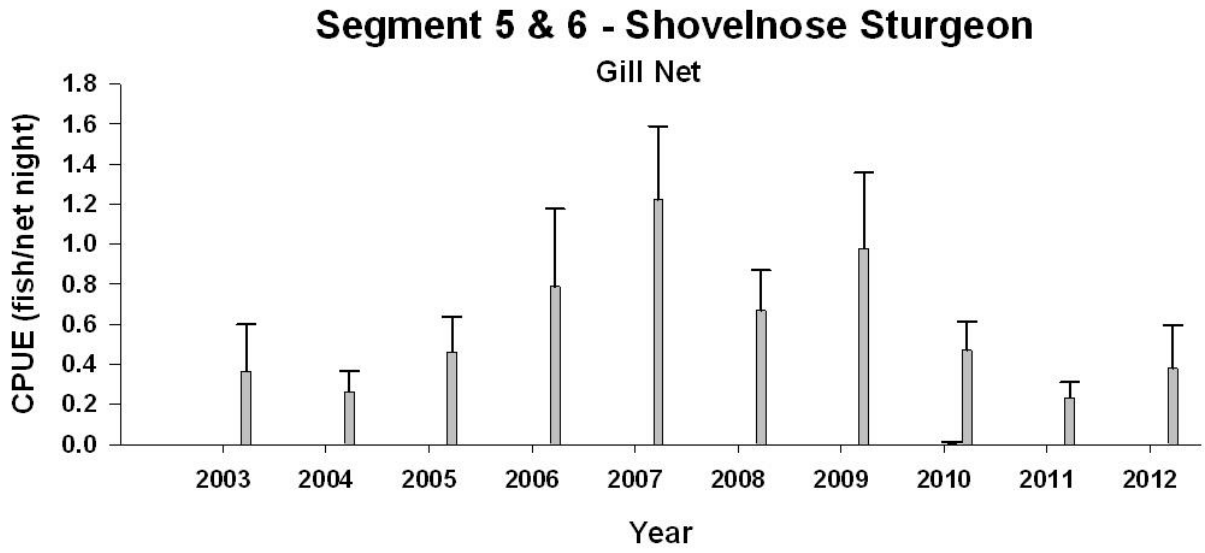

Figure 11. Mean annual catch per unit effort (± 2 SE) of sub-stock size (0-149 mm; cross-hatched bars), sub-stock size (150-249 mm; black bars), stock size (250-379 mm; white bars), and > quality size (> 380 mm; gray bars) shovelnose sturgeon caught by gill nets in Segments 5 and 6 of the Missouri River from 2003-2012. Gill nets were set in fall and spring during 2003-2010 and only in spring in 2011-2012.

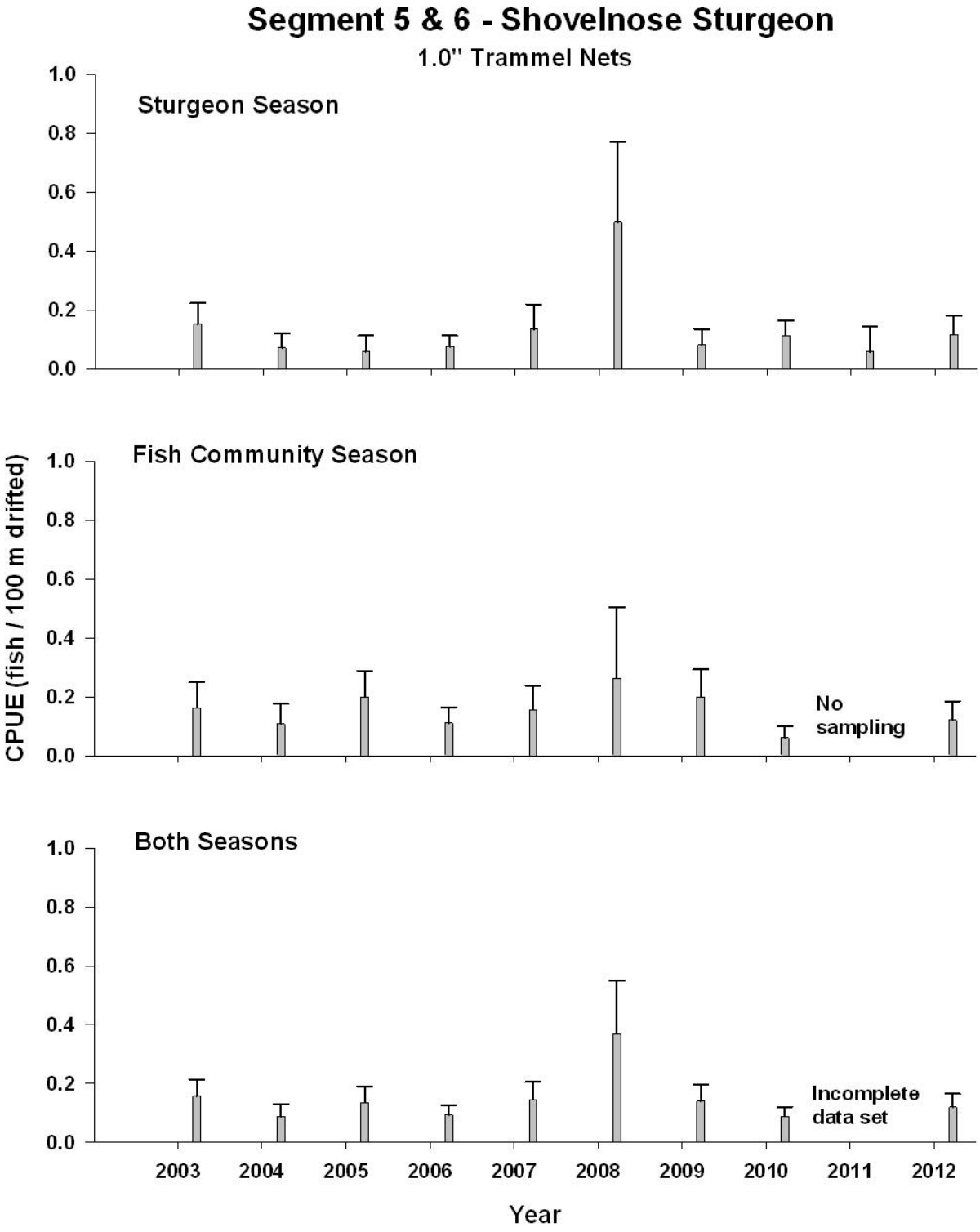

Figure 12. Mean annual catch per unit effort (± 2 SE) of sub-stock size (0-149 mm; cross-hatched bars), sub-stock size (150-249 mm; black bars), stock size (250-379 mm; white bars), and > quality size (> 380 mm; gray bars) shovelnose sturgeon caught by 1-inch trammel nets in Segments 5 and 6 of the Missouri River from 2003-2012.

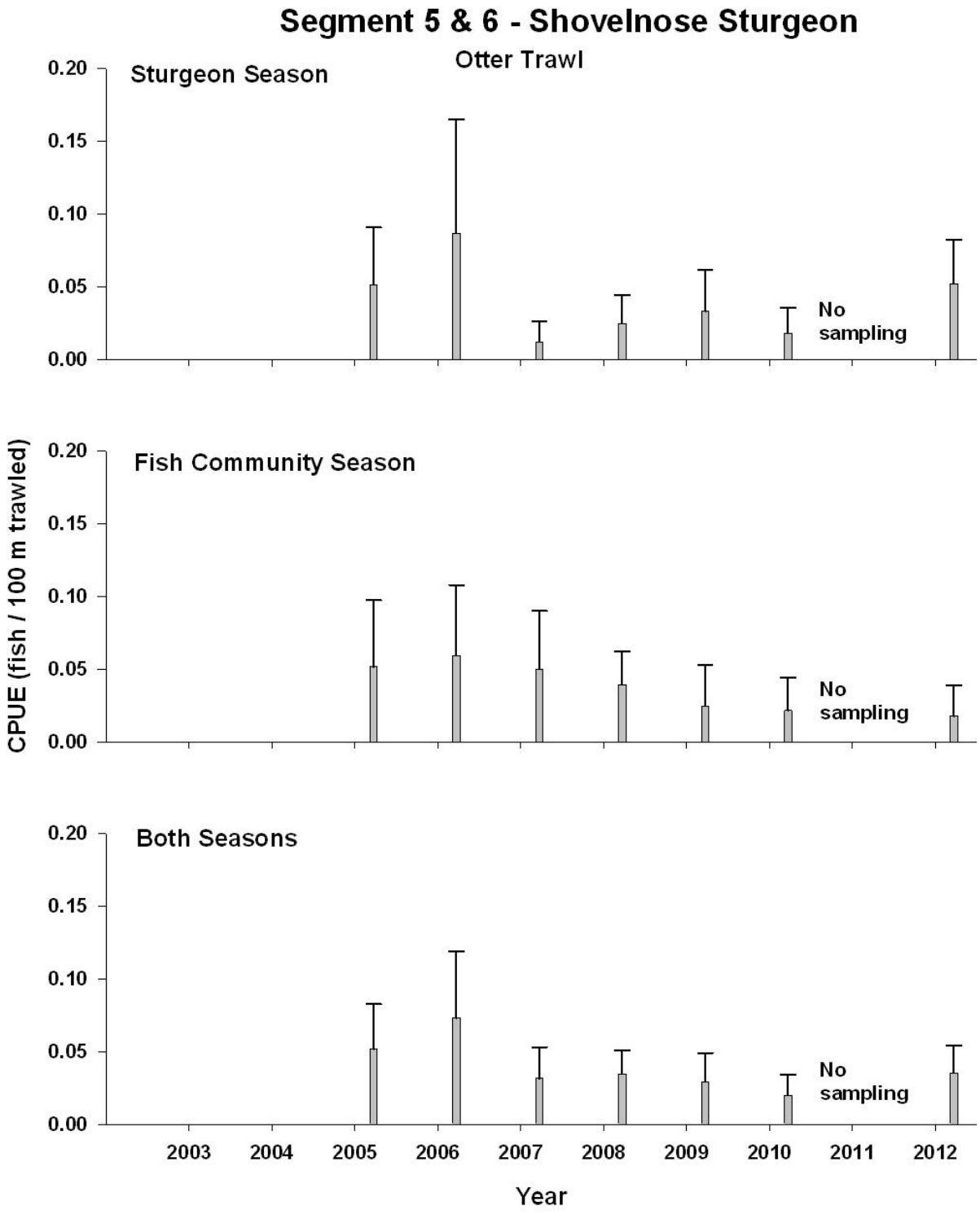

Figure 13. Mean annual catch per unit effort (± 2 SE) of sub-stock size (0-149 mm; cross-hatched bars), sub-stock size (150-249 mm; black bars), stock size (250-379 mm; white bars), and > quality size (> 380 mm; gray bars) shovelnose sturgeon caught by otter trawls in Segments 5 and 6 of the Missouri River from 2003-2012.

Figure 14. Mean annual catch per unit effort (±2 SE) of sub-stock size (0-149 mm; cross-hatched bars), sub-stock size (150-249 mm; black bars), stock size (250-379 mm; white bars), and > quality size (> 380 mm; gray bars) shovelnose sturgeon caught by trot lines in Segments 5 and 6 of the Missouri River from 2009-2012.

Table 7. Total number of quality size and greater (≥ 380 mm) shovelnose sturgeon captured for each gear during each season and the percent caught within each macrohabitat type in Segments 5 and 6 of the Missouri River during 2012. The percent of total effort for each gear in each habitat is presented in parentheses. Habitat abbreviations and definitions presented in Appendix B.

Gear	N	Macrohabitat								
		BRAD	CHXO	CONF	ISB	OSB	SCCL	SCCS	SCN	TRMS
Sturgeon Season										
1-inch Trammel Net	22	82 (44)	0 (18)	0 (4)	0 (14)	9 (17)	9 (4)	0 (0)	0 (0)	0 (0)
Gill Net	38	29 (50)	37 (17)	0 (0)	11 (16)	24 (17)	0 (0)	0 (0)	0 (0)	0 (0)
Otter Trawl	12	42 (38)	0 (14)	8 (5)	8 (17)	33 (20)	8 (5)	0 (0)	0 (0)	0 (0)
Trot Lines	14	64 (40)	0 (18)	0 (5)	7 (13)	29 (20)	0 (5)	0 (0)	0 (0)	0 (0)
Fish Community Season										
1-inch Trammel Net	24	58 (43)	13 (17)	4 (4)	8 (14)	4 (17)	13 (5)	0 (0)	0 (0)	0 (0)
Mini-Fyke Net	0	0 (40)	0 (14)	0 (5)	0 (14)	0 (15)	0 (4)	0 (4)	0 (3)	0 (3)
Otter Trawl	3	33 (41)	0 (16)	67 (5)	0 (16)	0 (17)	0 (5)	0 (0)	0 (0)	0 (0)

Table 8. Total number of shovelnose sturgeon captured for each gear during each season and the percent caught within each macrohabitat type in Segments 5 and 6 of the Missouri River during 2012. The percent of total effort for each gear in each habitat is presented in parentheses. Habitat abbreviations and definitions presented in Appendix B.

Gear	N	Macrohabitat								
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Gill Net	38	29 (50)	37 (17)	0 (0)	11 (16)	24 (17)	0 (0)	0 (0)	0 (0)	0 (0)
Otter Trawl	12	42 (38)	0 (14)	8 (5)	8 (17)	33 (20)	8 (5)	0 (0)	0 (0)	0 (0)
Trot Lines	14	64 (40)	0 (18)	0 (5)	7 (13)	29 (20)	0 (5)	0 (0)	0 (0)	0 (0)
Fish Community Season										
1-inch Trammel Net	24	58 (43)	13 (17)	4 (4)	8 (14)	4 (17)	13 (5)	0 (0)	0 (0)	0 (0)
Mini-Fyke Net	0	0 (40)	0 (14)	0 (5)	0 (14)	0 (15)	0 (4)	0 (4)	0 (3)	0 (3)
Otter Trawl	3	33 (41)	0 (16)	67 (5)	0 (16)	0 (17)	0 (5)	0 (0)	0 (0)	0 (0)

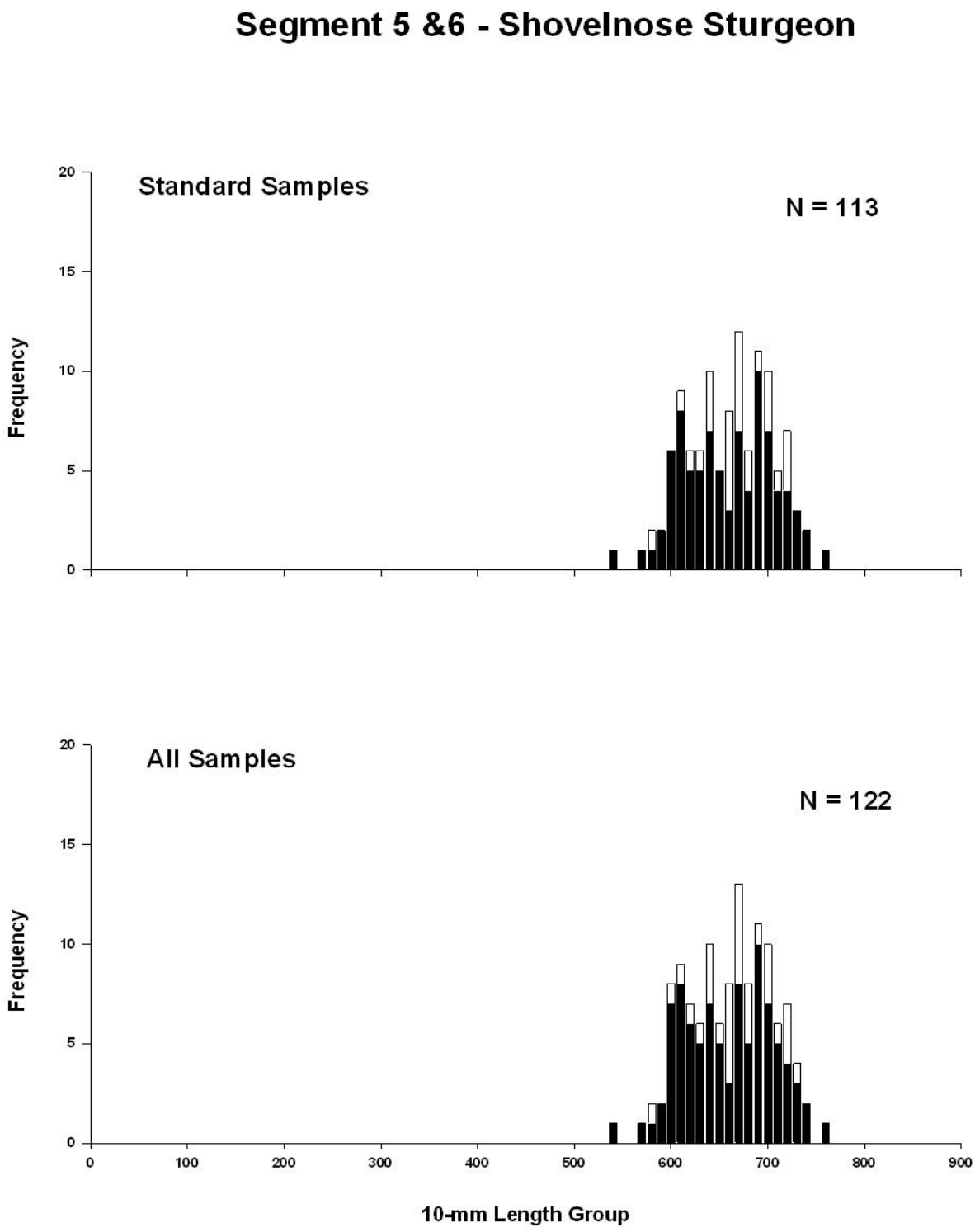

Figure 15. Length frequency histograms of shovelnose sturgeon caught during the sturgeon season (black bars) and fish community season (white bars) in Segments 5 and 6 of the Missouri River during 2012. Standard samples include standard gears, random bends, and random subsamples. All samples include duplicate sampling conducted during 2012.

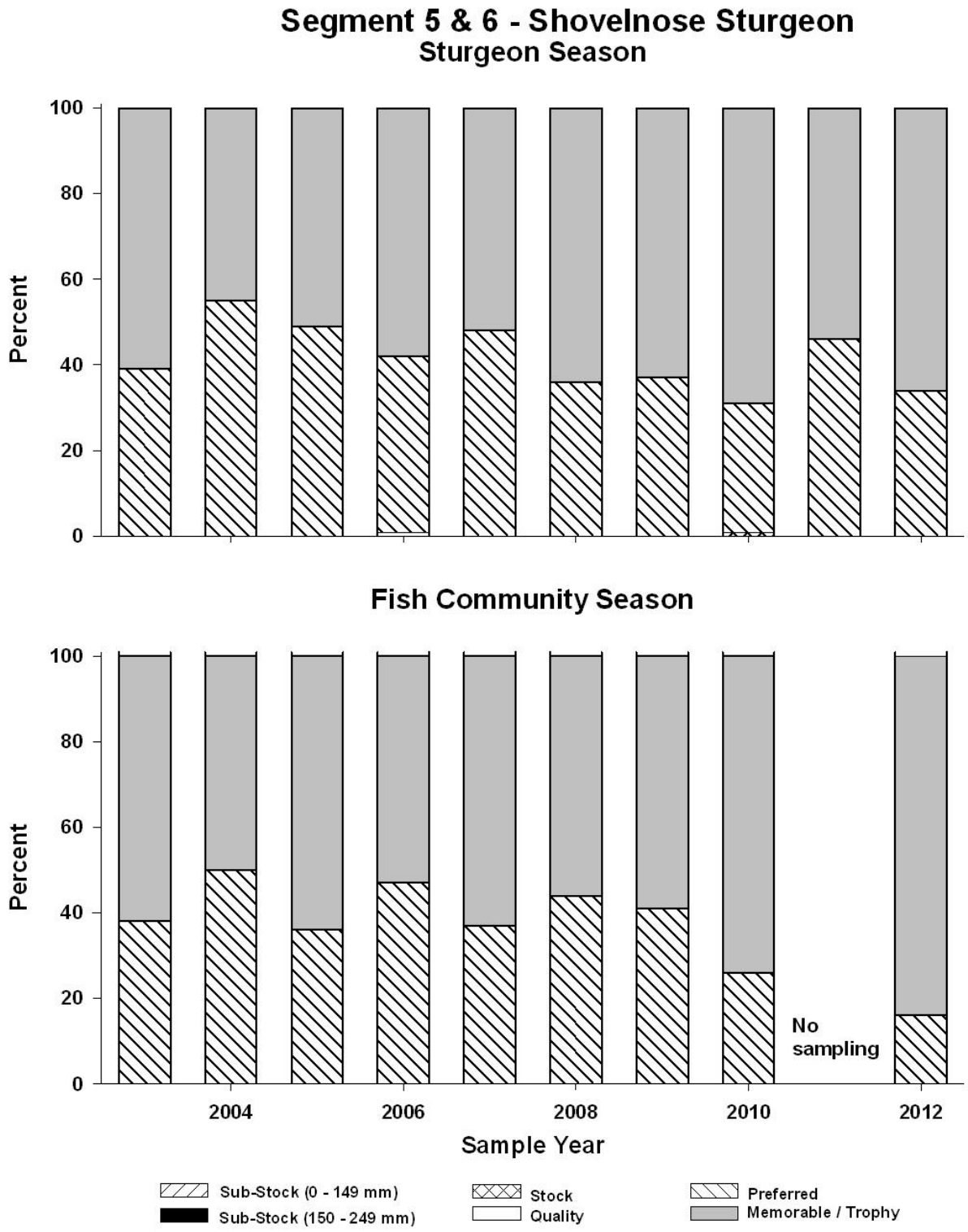

Figure 16. Percent by length group for all shovelnose sturgeon captured with all gear by incremental proportional size distribution (PSD) length category from 2003 to 2012 in Segments 5 and 6 in the Missouri River. .

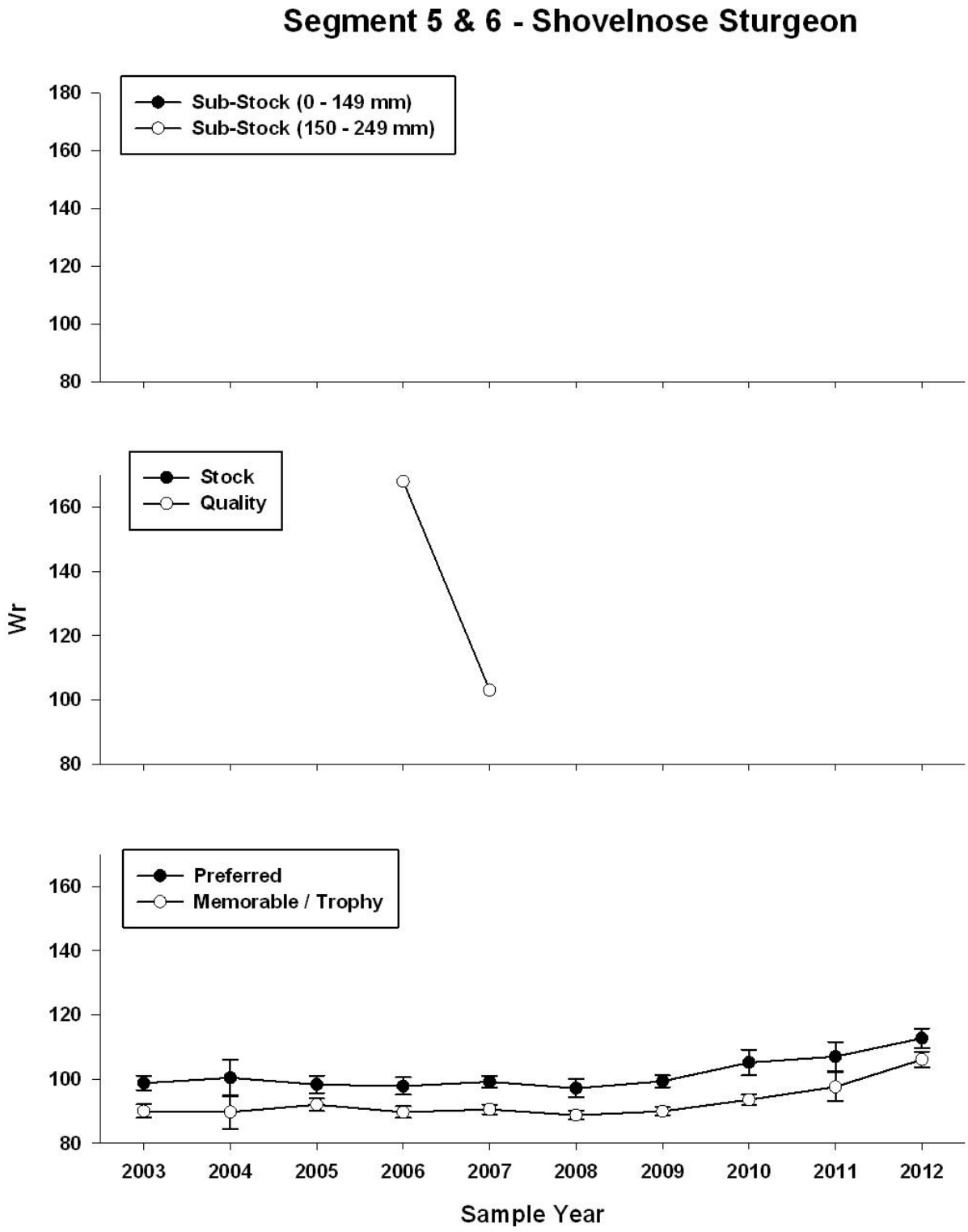

Figure 17. Relative weight (Wr) for all shovelnose sturgeon captured with all gears by incremental proportional size distribution (PSD) length category from 2003-2012 in Segments 5 and 6 in the Missouri River. .

Sturgeon Chub

A total of two sturgeon chubs were collected during 2012 in the otter trawl. Both specimens were collected from Segment 6 Bend 3 on two separate sampling occasions. A single fish was collected during the sturgeon season in a duplicate, non-random pass, and the second fish was collected during the fish community season in a random subsample. These represent the first observations of sturgeon chubs in Segments 6 since monitoring began in 2003 (none have ever been documented from Segment 5), suggesting relative abundance is extremely low in RPMA 3 (Figure 18). On 18 June 2012 a single fish was collected from the channel border mesohabitat of the channel crossover macrohabitat in a duplicate pass at a mean trawl depth of 3.8 m. Temperature and turbidity was 14.4 °C and 6 ntu, respectively, with a bottom velocity of 0.45 m/s. The second fish was collected from the channel border mesohabitat of the inside bend macrohabitat on 17 September 2012 in a non-random deployment. Water temperature was 18.9 °C and turbidity was 7 ntu at the site of capture. Mean depth of the trawl deployment was 3.2 m and bottom velocity was 0.47 m/s. Lengths of the two specimens collected were 52 and 69 mm (Figure 19).

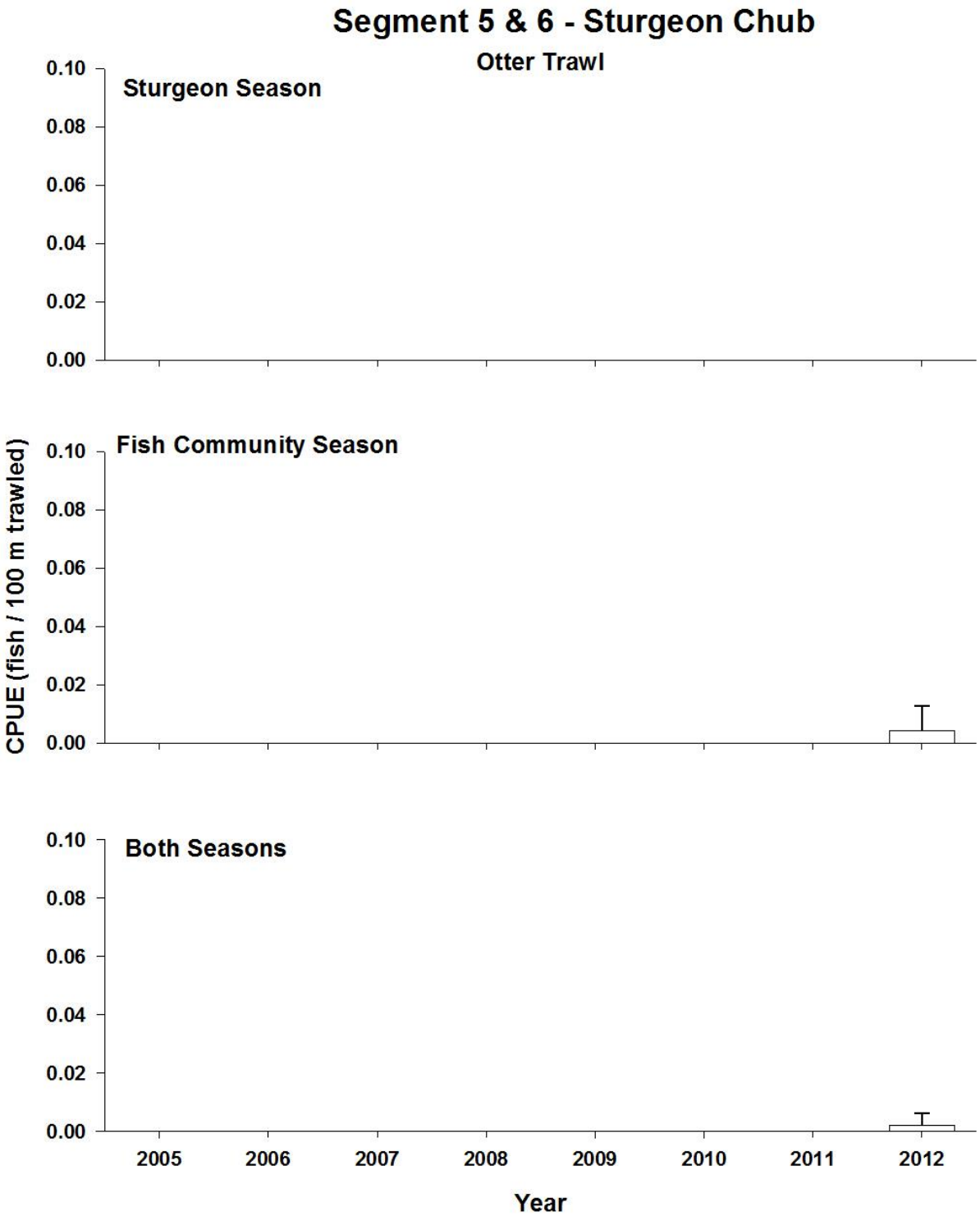

Figure 18. Mean annual catch per unit effort (± 2 SE) of sturgeon chub using otter trawls in Segments 5 and 6 of the Missouri River from 2003-2012.

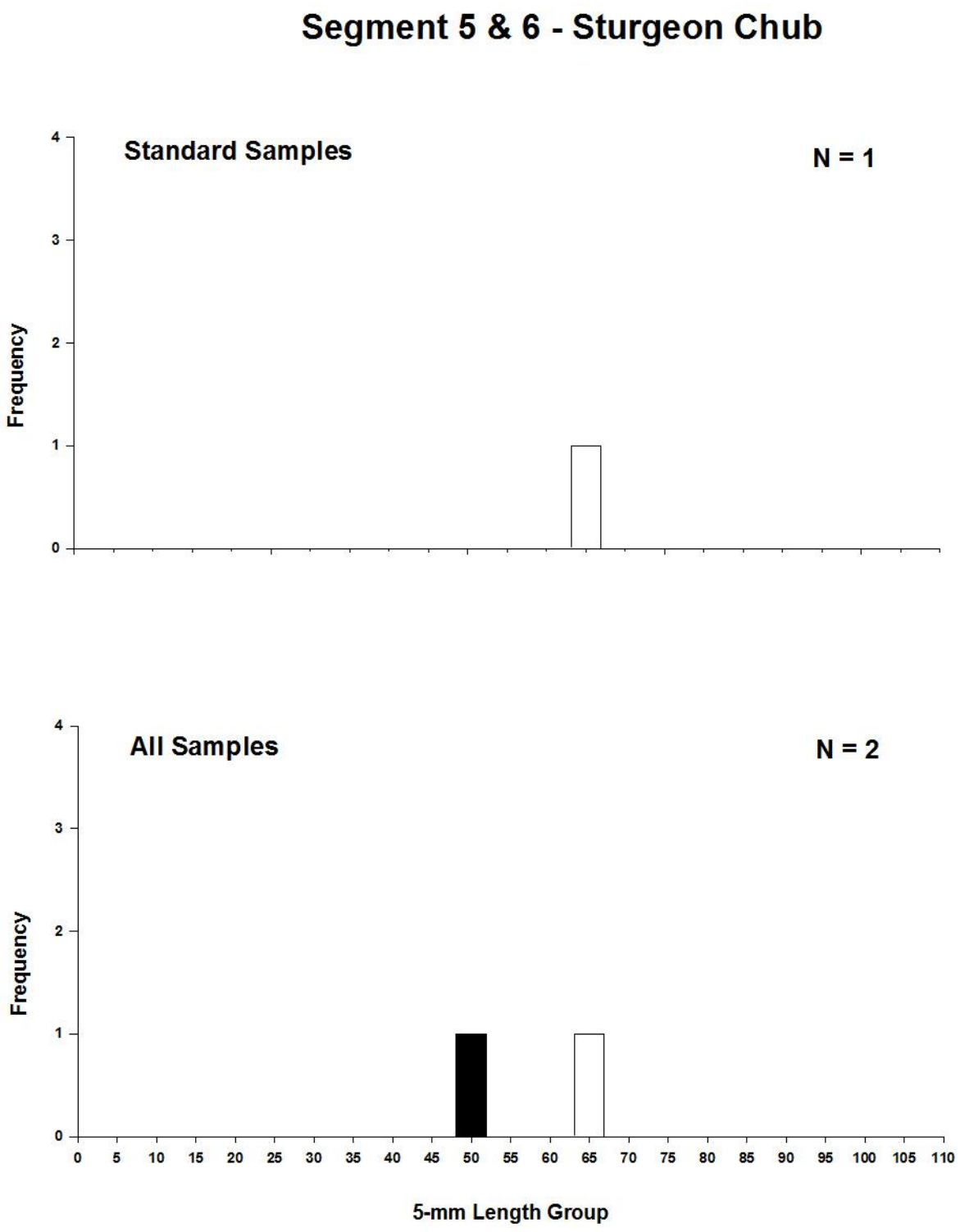

Figure 19. Length frequency of sturgeon chub during the sturgeon season (black bars) and the fish community season (white bars) in Segments 5 and 6 of the Missouri River during 2012. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2012.

Sicklefin Chub

Sicklefin chubs were not captured during the 2012 sampling season. This is the tenth consecutive year (2003-2012) without capturing sicklefin chubs in Segments 5 and 6.

Shoal Chub

Shoal chubs were not captured during the 2012 sampling season. This is the tenth consecutive year (2003-2012) without capturing shoal chubs in Segments 5 and 6.

Sand Shiner

The relative abundance of sand shiners dramatically increased (>1,100%) in 2012 compared to the two previous years of standardized sampling (i.e., 2009 and 2010; no standardized PSPAP monitoring occurred in 2011), when collectively 12 sand shiners were captured. A total of 106 sand shiners were captured in mini-fyke nets during the fish community season. During 2012, sand shiner annual catch per unit effort in mini-fyke nets was the third highest since monitoring began in 2003 and increased 48% compared to the eight year mean of standardized sampling (2003-2010; Figure 20). Sand shiners captured were collected from braided (n = 90), channel crossover (n = 5), tributary mouth small (n = 5), confluence (n = 4), inside bend (n = 1), and large secondary connected channel (n = 1) macrohabitats. Mini-fyke nets were only set in the bar mesohabitat. Eighty-four percent of the sand shiners captured were between 30 - 40 mm (Figure 21).

Spatial distribution of sand shiners in Segments 5 and 6 has been variable. In 2012, nearly 90% of the sand shiners captured were collected in Segment 6 and 10% were captured in Segment 5. In 2005, 2006, 2008, and 2012 the majority of sand shiners were captured downstream of the Niobrara River confluence with the exception of nine fish 2005, five fish in 2008 and 11 fish in 2012. In 2009, a fairly equal number of sand shiners were collect in Segments 5 and 6. However, in 2004, 2007, and 2010 the majority of sand shiners were captured upstream of the Niobrara River confluence.

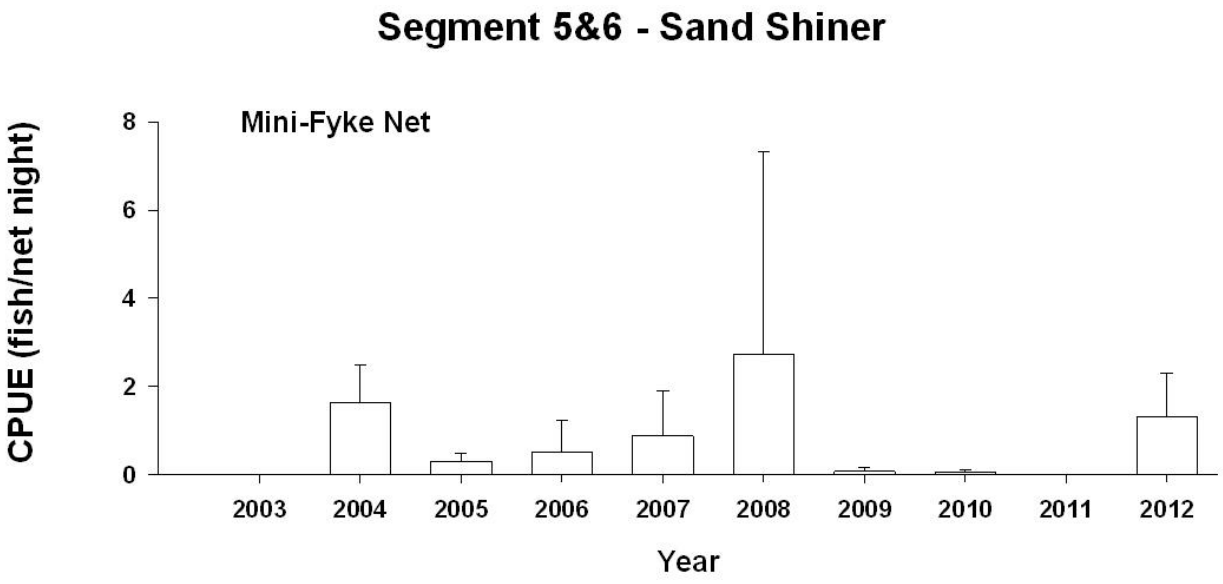

Figure 10. Mean annual catch per unit effort (± 2 SE) of sand shiner with mini-fyke nets in Segments 5 and 6 of the Missouri River during fish community season 2003-2012.

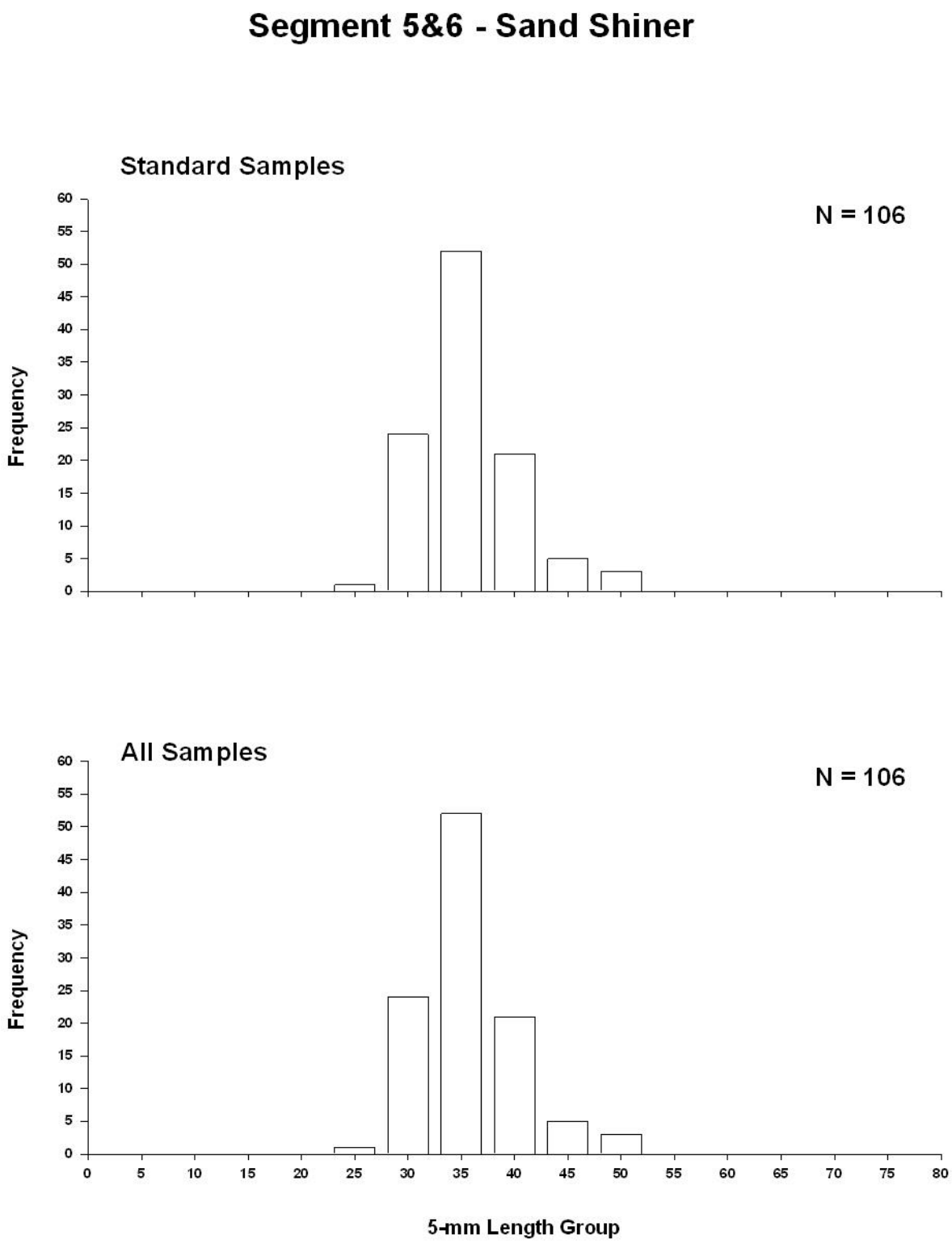

Figure 11. Length frequency of sand shiner during the sturgeon season (black bars) and the fish community season (white bars) in Segments 5 and 6 of the Missouri River during 2012. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2012.

Hybognathus spp.

The abundance of *Hybognathus* spp. in Segments 5 and 6 is at its lowest since 2006 with a single brassy minnow captured during the 2012 sampling season (Figure 22). The single brassy minnow (55 mm TL; Figure 23) was collected from a mini-fyke net deployed in the braided macrohabitat of Segment 6 Bend 6 during the fish community season. Mini-fyke net catches from 2003-2010 included one *Hybognathus* spp. collected in 2005 (unidentified), eight fish collected in 2007 (six plains minnow and two western silvery minnows), 43 fish collected in 2008 (all brassy minnows except six that were too small to identify to species), 10 brassy minnows collected in 2009, and 125 brassy minnows collected in 2010.

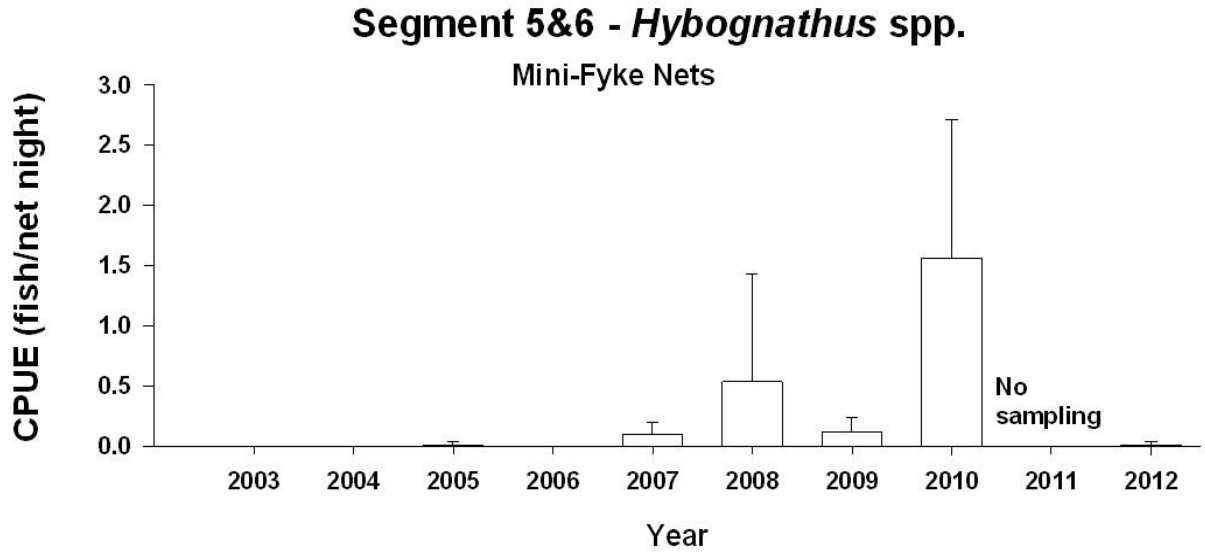

Figure 12. Mean annual catch per unit effort (± 2 SE) of *Hybognathus* spp. with mini-fyke nets in Segments 5 and 6 of the Missouri River during fish community season 2003-2012.

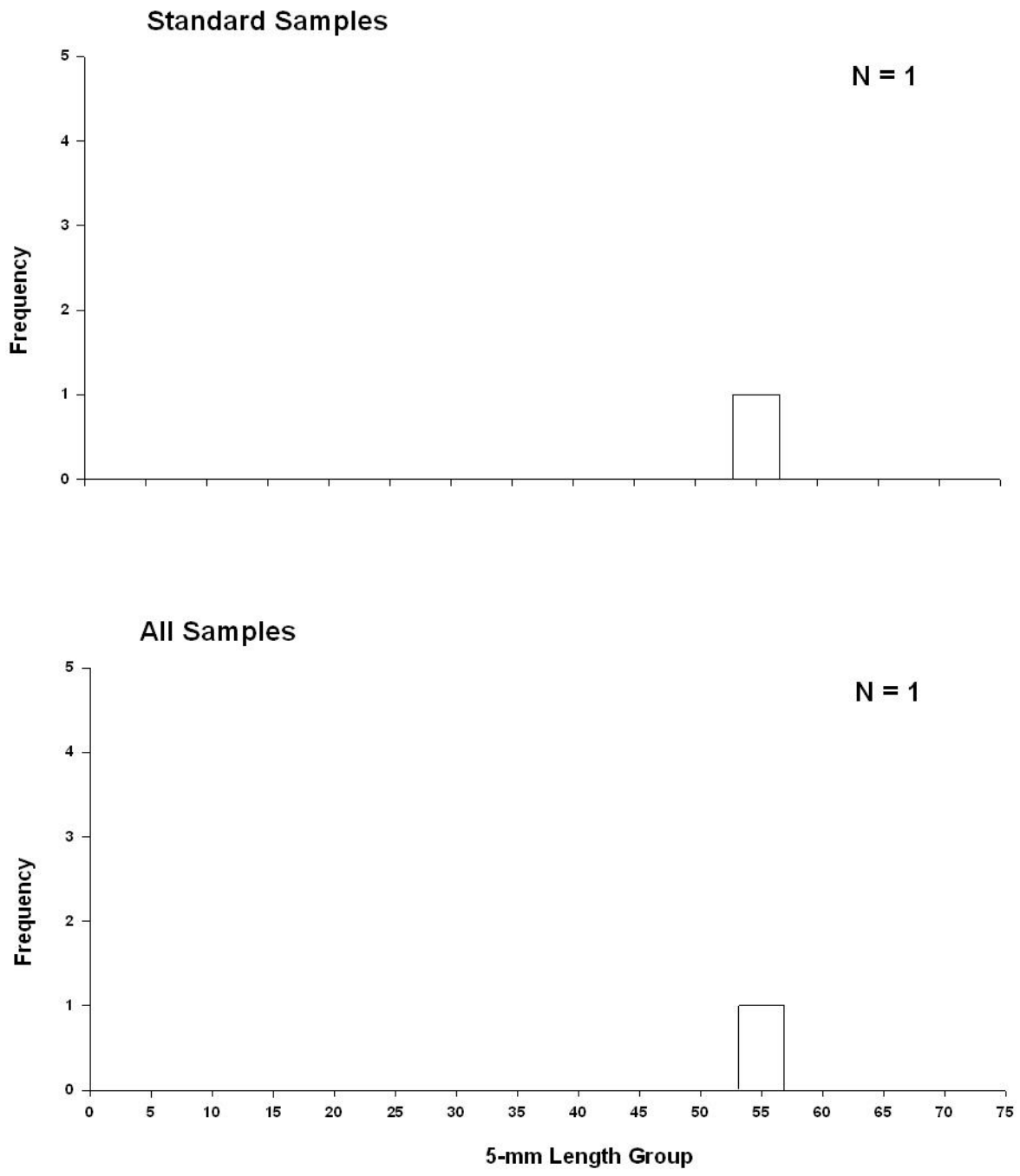

Figure 13. Length frequency of *Hybognathus* spp. caught during the sturgeon season (black bars) and the fish community season (white bars) in Segments 5 and 6 of the Missouri River during 2012. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2012.

Blue Sucker

The relative abundance of blue suckers in Segments 5 and 6 remained low in 2012. Relative abundance measured with gill nets, trammel nets, and otter trawls was low in 2012 in both seasons and ranged from 0 to < 0.01 fish/100 m (Figures 24-26). Mean relative abundance of blue suckers captured with gill nets during 2003-2011 was 0.024 fish/net night (±2 SE = 0.016), but none were captured during 2012. A single blue sucker was collected from a standard trammel net drift during the fish community season in 2012 (Figure 25). Relative abundance of blue suckers increased 211% during the fish community season, and 74% overall (i.e., both seasons combined) in trammel nets during 2012 compared to the mean of 2003-2010. Additionally, blue suckers were not caught in gill nets or otter trawls during 2012. The one blue sucker caught in 2012 was from the channel border mesohabitat of an outside bend macrohabitat (Table 9) in Segment 5 Bend 6. Since inception of this monitoring program, blue suckers have not been captured with mini-fyke nets (2003-2012). Total length of the blue sucker captured during 2012 was 786 mm TL (Figure 27). Since 2003 a total of 110 blue suckers ≥ 600 mm TL (mean 771 mm TL, ± 2 SE = 10.5) have been caught with all gears combined (except for mini-fyke nets), indicating an ageing population lacking consistent recruitment. However, on June 5, 2007, a single 203 mm TL blue sucker was captured with the otter trawl in Segment 6 Bend 6, providing the first evidence of limited recruitment within Segments 5 and 6 of the Missouri River.

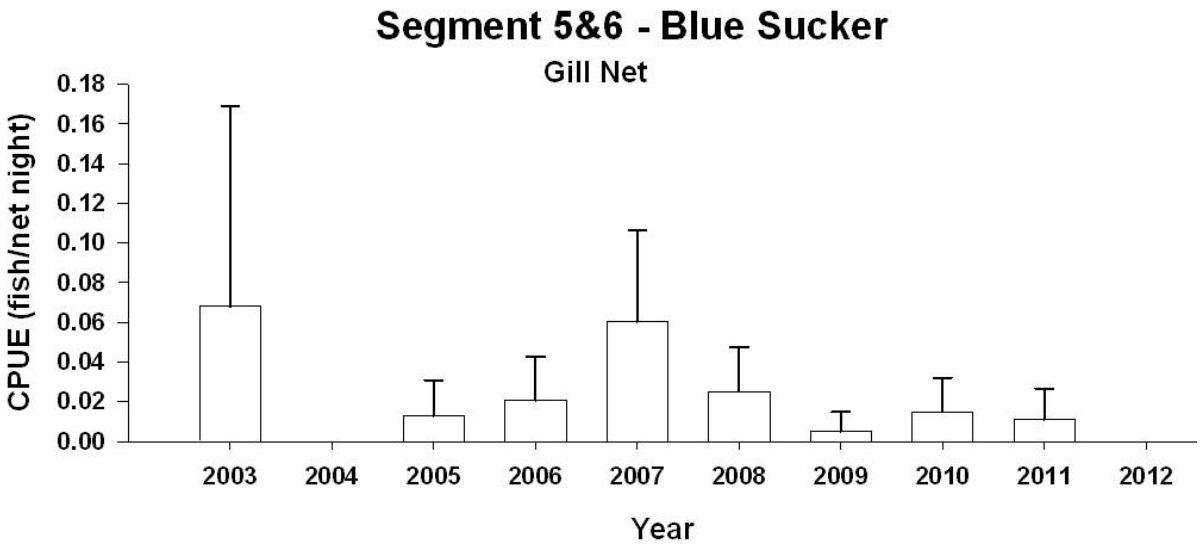

Figure 14. Mean annual catch per unit effort (± 2 SE) of blue suckers caught by gill nets in Segments 5 and 6 of the Missouri River from 2003-2012. Gill nets were set in fall and spring from 2003-2010 and only in spring in 2011 and 2012.

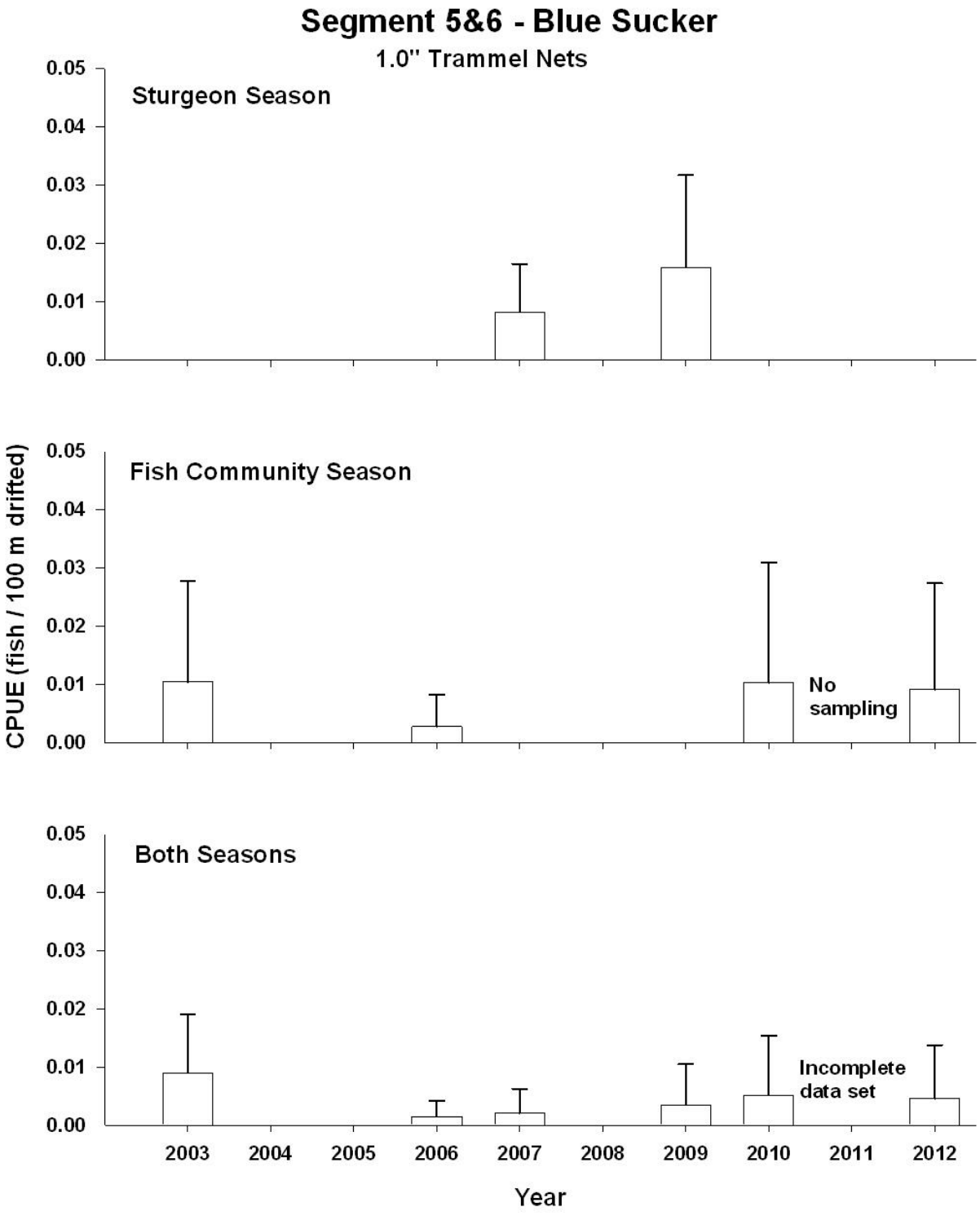

Figure 15. Mean annual catch per unit effort (± 2 SE) of blue sucker caught by 1-inch trammel nets in Segments 5 and 6 of the Missouri River from 2003-2012.

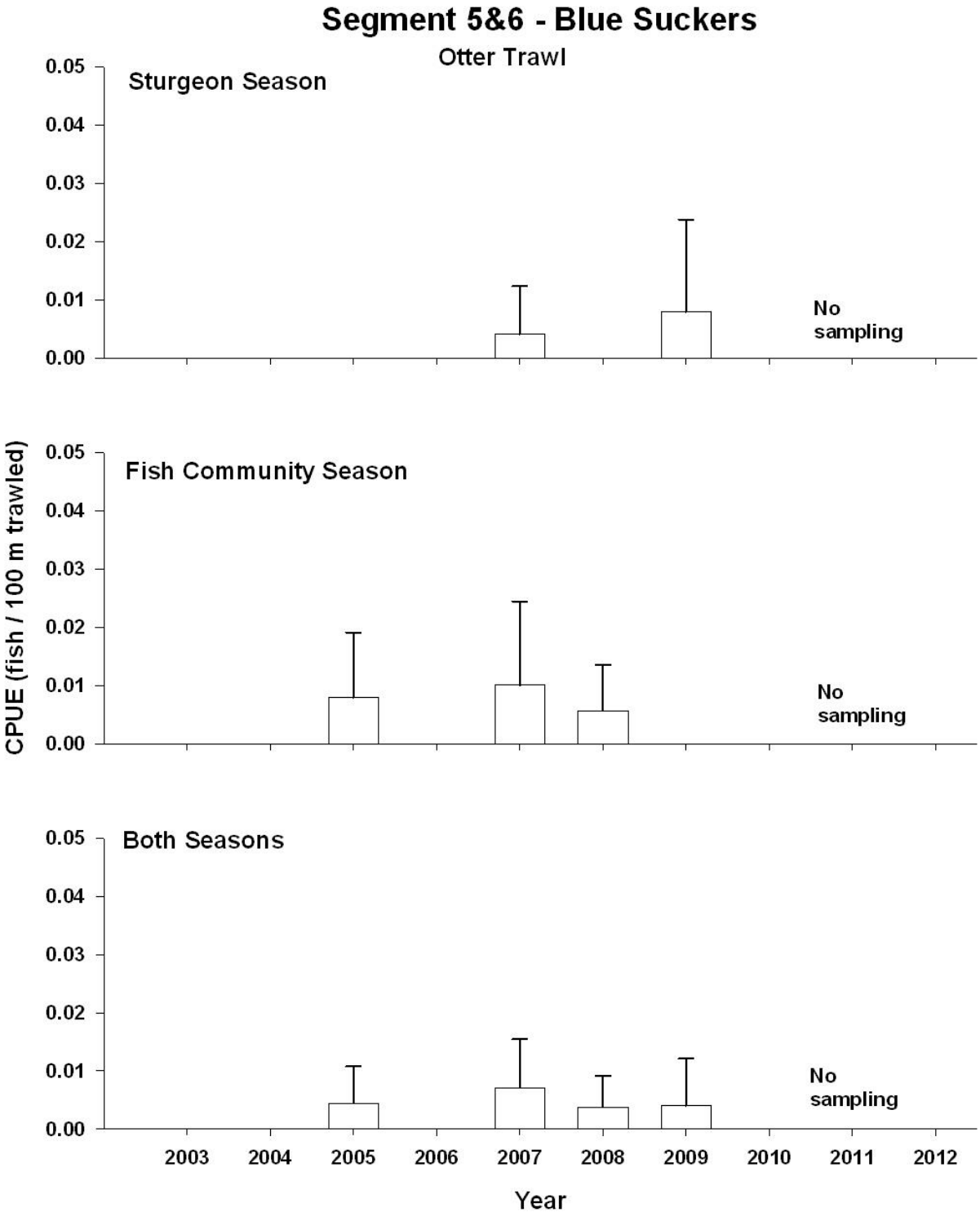

Figure 16. Mean annual catch per unit effort (± 2 SE) of blue sucker caught by otter trawls in Segments 5 and 6 of the Missouri River from 2003-2012.

Table 9. Total number of blue suckers captured for each gear during each season and the percent caught within each macrohabitat type in Segments 5 and 6 of the Missouri River during 2012. The percent of total effort for each gear in each habitat is presented in parentheses. Habitat abbreviations and definitions presented in Appendix B.

Gear	N	Macrohabitat								
		BRAD	CHXO	CONF	ISB	OSB	SCCL	SCCS	SCN	TRMS
Sturgeon Season										
1-inch Trammel Net	0	0 (44)	0 (18)	0 (4)	0 (14)	0 (17)	0 (4)	0 (0)	0 (0)	0 (0)
Gill Net	0	0 (50)	0 (17)	0 (0)	0 (16)	0 (17)	0 (0)	0 (0)	0 (0)	0 (0)
Otter Trawl	0	0 (38)	0 (14)	0 (5)	0 (17)	0 (20)	0 (5)	0 (0)	0 (0)	0 (0)
Trot Lines	0	0 (40)	0 (18)	0 (5)	0 (13)	0 (20)	0 (5)	0 (0)	0 (0)	0 (0)
Fish Community Season										
1-inch Trammel Net	1	0 (43)	0 (17)	0 (4)	0 (14)	100 (17)	0 (5)	0 (0)	0 (0)	0 (0)
Mini-Fyke Net	0	0 (40)	0 (14)	0 (5)	0 (14)	0 (15)	0 (4)	0 (4)	0 (3)	0 (3)
Otter Trawl	0	0 (41)	0 (16)	0 (5)	0 (16)	0 (17)	0 (5)	0 (0)	0 (0)	0 (0)

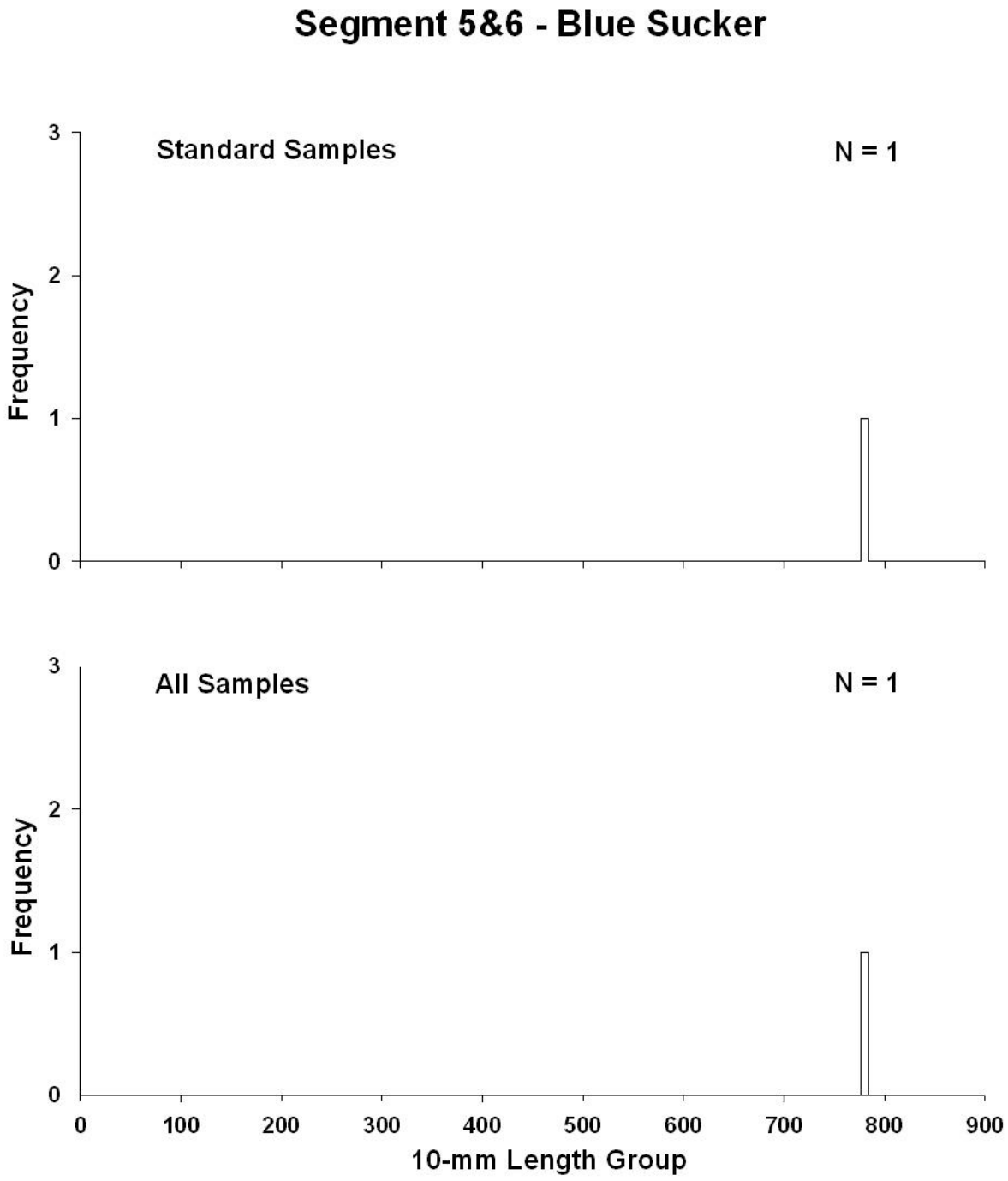

Figure 17. Length frequency of blue sucker during the sturgeon season (black bars) and the fish community season (white bars) in Segments 5 and 6 of the Missouri River during 2012. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2012.

Sauger

In 2012, 81 saugers were sampled with standard effort in Segments 5 and 6. Most fish were caught with trammel nets (n = 29) and otter trawls (n = 27). Remainder of the sauger catch was with gill nets (n = 19) and mini-fyke nets (n = 6). Duplicate passes conducted with trammel nets and otter trawls collected an additional 36 saugers. Gill net mean CPUE in 2012 (0.20 fish/net night) was the lowest since 2007 (0.15 fish/net night) but remained 64% higher than the lowest abundance observed in 2005 (0.12 fish/net night). Relative abundance of sauger caught in gill nets in 2012 decreased 26% compared to the nine year running average of 0.27 fish/net night and was nearly 97% lower than the all-time high observed in 2003 (Figure 28). Catch per unit effort of saugers from gill nets has continued to decrease yearly since 2008 (0.32 fish/ net night). Seasonal trends in sauger CPUE with trammel nets declined in both the sturgeon (13%) and fish community seasons (55%) compared to the long term running average (0.06 fish/100 m for the fish community season and 0.14 fish/100m for the sturgeon season; Figure 31). Relative abundance of saugers in the otter trawl increased during both the sturgeon season (65%) and fish community season (197%) compared to the 2010. Additionally, sauger catches in otter trawls decreased 23% during the sturgeon season but increased (31%) during the fish community season compared to the long-term average (2005-2010). During 2012 mean annual relative abundance (i.e., both seasons pooled) of saugers decreased for trammel nets (24%) but increased for otter trawls (10%) when compared to the long-term averages. Compared to 2010, mean annual CPUE of saugers increased 72% for trammel nets and 125% for otter trawls. Similar to gill nets, mini-fyke net catches of saugers has continued to decline since 2008, an all-time high of 0.21 fish/net night (Figure 31).

In Segments 5 and 6 saugers were generally spatially distributed in proximity to the confluence of the Niobrara and Missouri rivers. The majority of saugers (94%) were captured in

the channel border mesohabitat with the remainder (6%) captured in bar mesohabitat. A total of 94 saugers (80%) were captured in the delta downstream of the Niobrara and Missouri river confluence in Segment 6. In Segment 5, an additional 19 fish were captured from bends 14, 15, and 16, immediately downstream of the Verdel, Nebraska boat landing, and only 4 saugers were captured upstream of boat landing (54% of the river length in Segment 5). Saugers were captured in the braided channel (79%), outside bend (11%), channel crossover (3%), inside bend (3%), large secondary connected channel (3%), and secondary non-connected channels (< 1%) macrohabitats during 2012 for both seasons collectively (Table 10).

During 2012, the population structure and physical condition of saugers indicated successful spawning and recruitment has occurred in Segments 5 and 6. Over 65% of saugers caught in Segments 5 and 6 of the Missouri River during 2012 were between the 300-455 mm TL; however, 9% of fish were ≤ 120 mm TL (Figure 32). Multiple modes (5-7) in the length frequency histogram indicated suitable conditions for spawning and recruitment still exist in Segments 5 and 6. Incremental proportional size distribution (PSD) values for each category during the sturgeon season were: stock–quality = 3, quality–preferred = 33, preferred–memorable = 60, memorable–trophy = 4 and trophy = 0. While the PSD values shifted during the fish community season to: stock–quality = 8, quality–preferred = 46, preferred–memorable = 38, memorable–trophy = 8, with no change in the trophy size class. Incremental PSD during the sturgeon season had higher proportions of preferred–memorable sized saugers compared to the fish community season, while 19 sub-stock sized fish captured in the summer indicated some limited recruitment in 2012. Nearly all sub-stock sized saugers were caught with the otter trawl (n = 15). Excluding sub-stock sized fish, mean relative weights during the sturgeon season differed from that of the fish community season; the mean relative weights during the sturgeon

season and the fish community season were 80 (n = 72; ± 2SE = 2.33) and 72 (n = 23; ± 2SE = 2.11), respectively. The mean condition of sauger by length category declined during 2012 for stock and quality sized fish, while preferred sized fish showed no change, compared to 2011 (Figure 33).

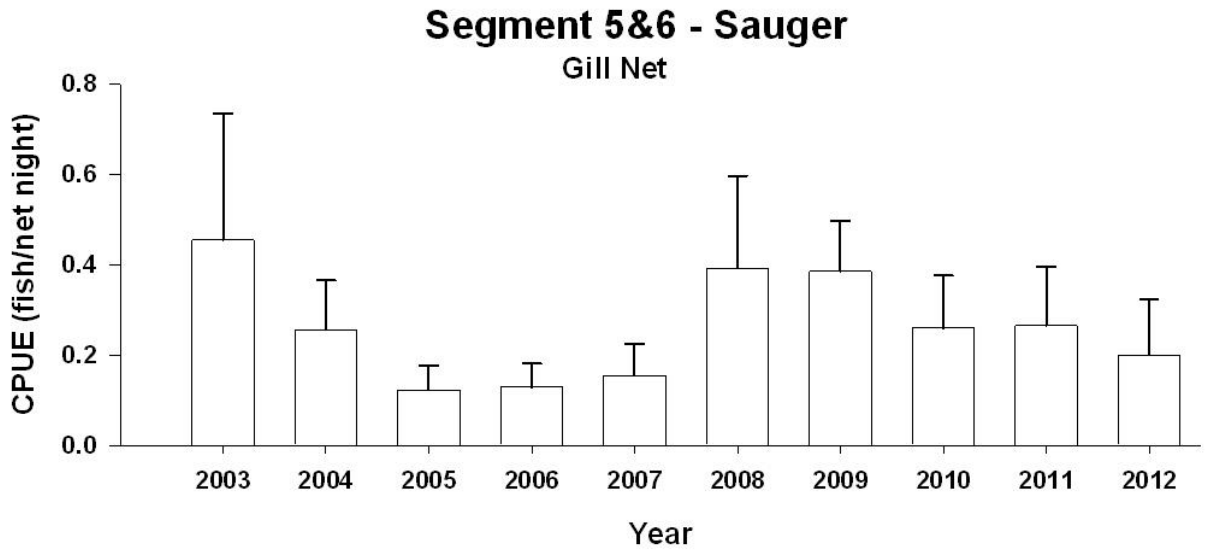

Figure 18. Mean annual catch per unit effort (± 2 SE) of sauger using gill nets and in Segments 5 and 6 of the Missouri River from 2003-2012. Gill nets were set in fall and spring during 2003-2010 and only in spring in 2011-2012.

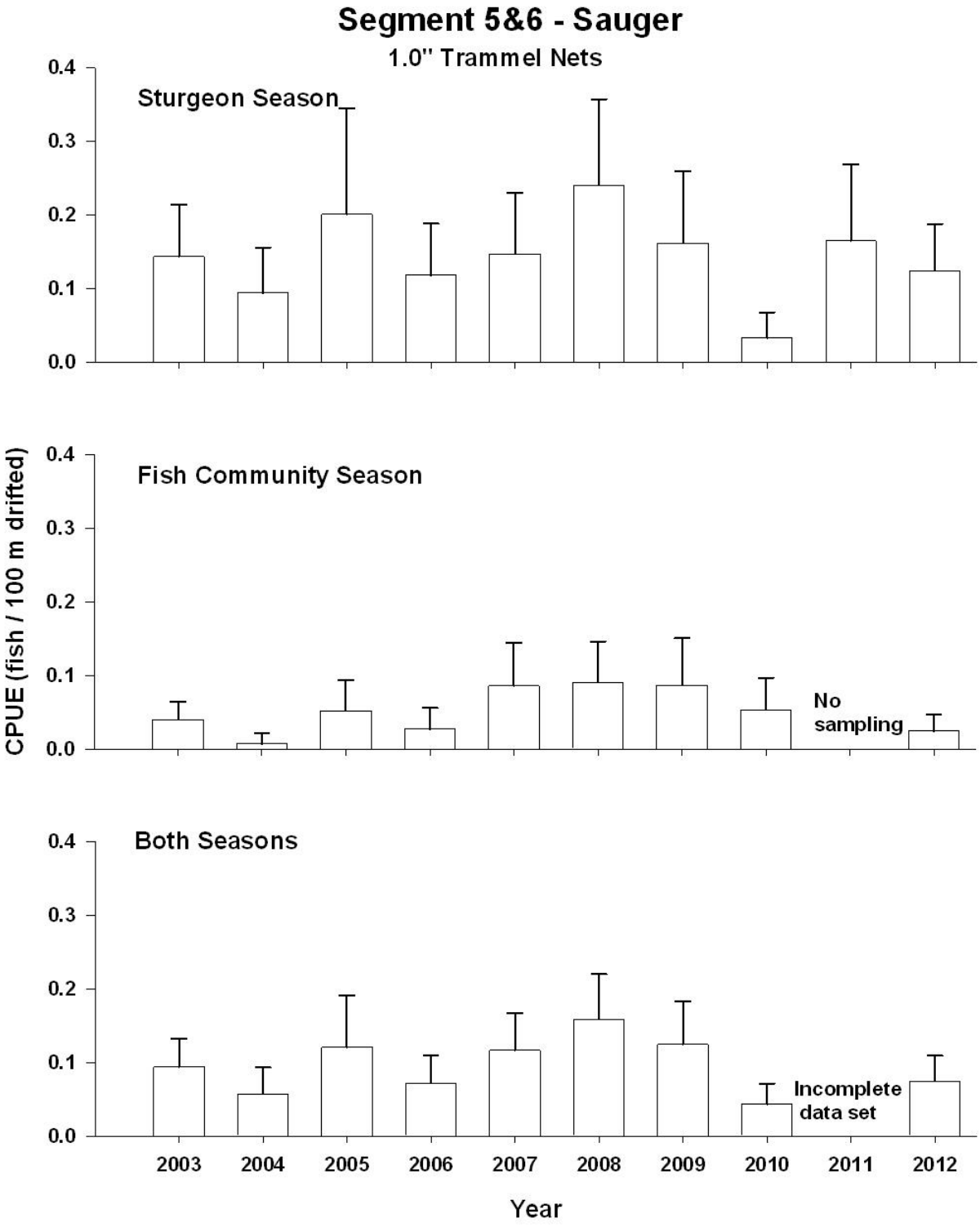

Figure 19. Mean annual catch per unit effort (± 2 SE) of sauger using 1-inch trammel nets in Segments 5 and 6 of the Missouri River from 2003-2012.

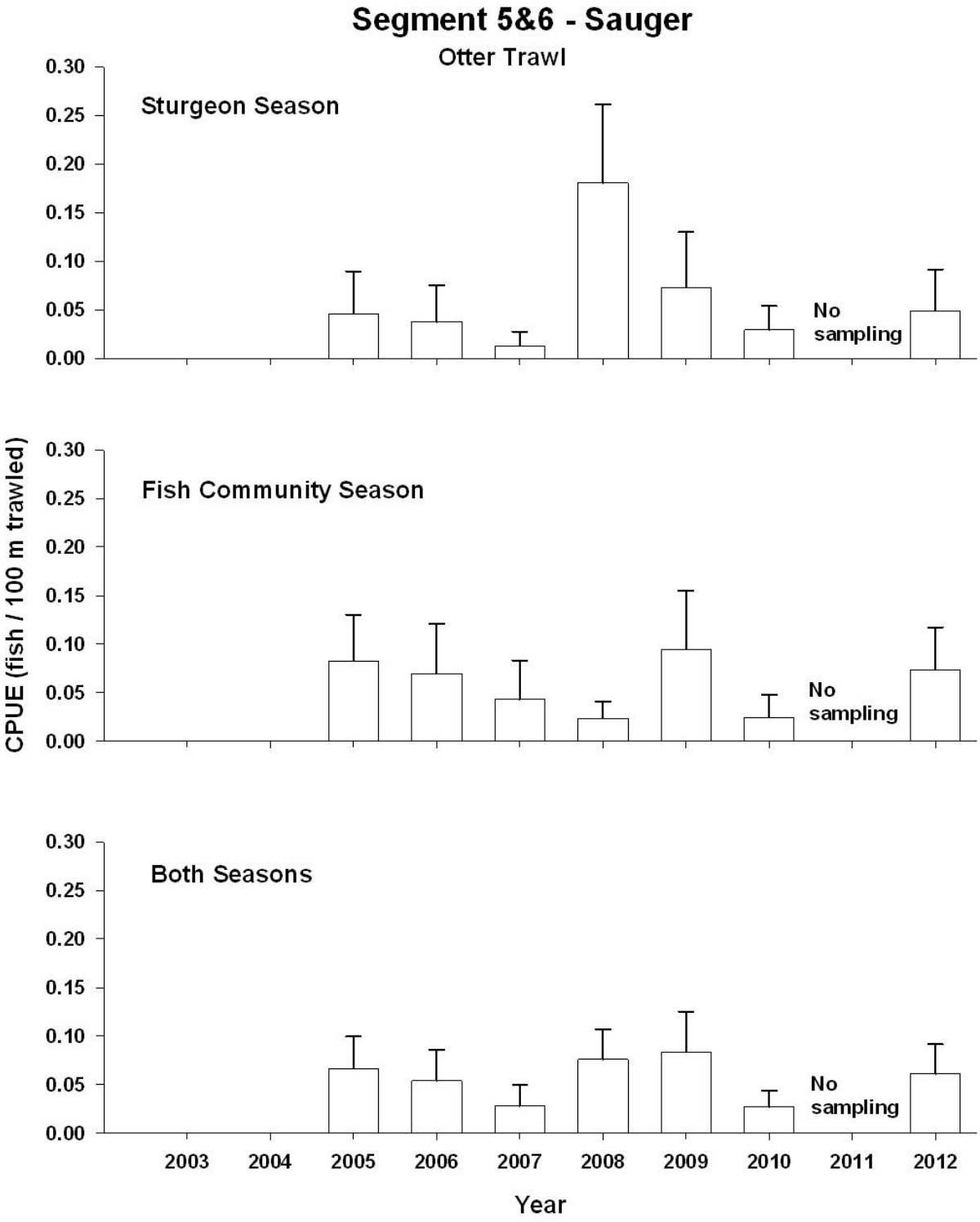

Figure 20. Mean annual catch per unit effort (± 2 SE) of sauger using otter trawls in Segments 5 and 6 of the Missouri River from 2003-2012.

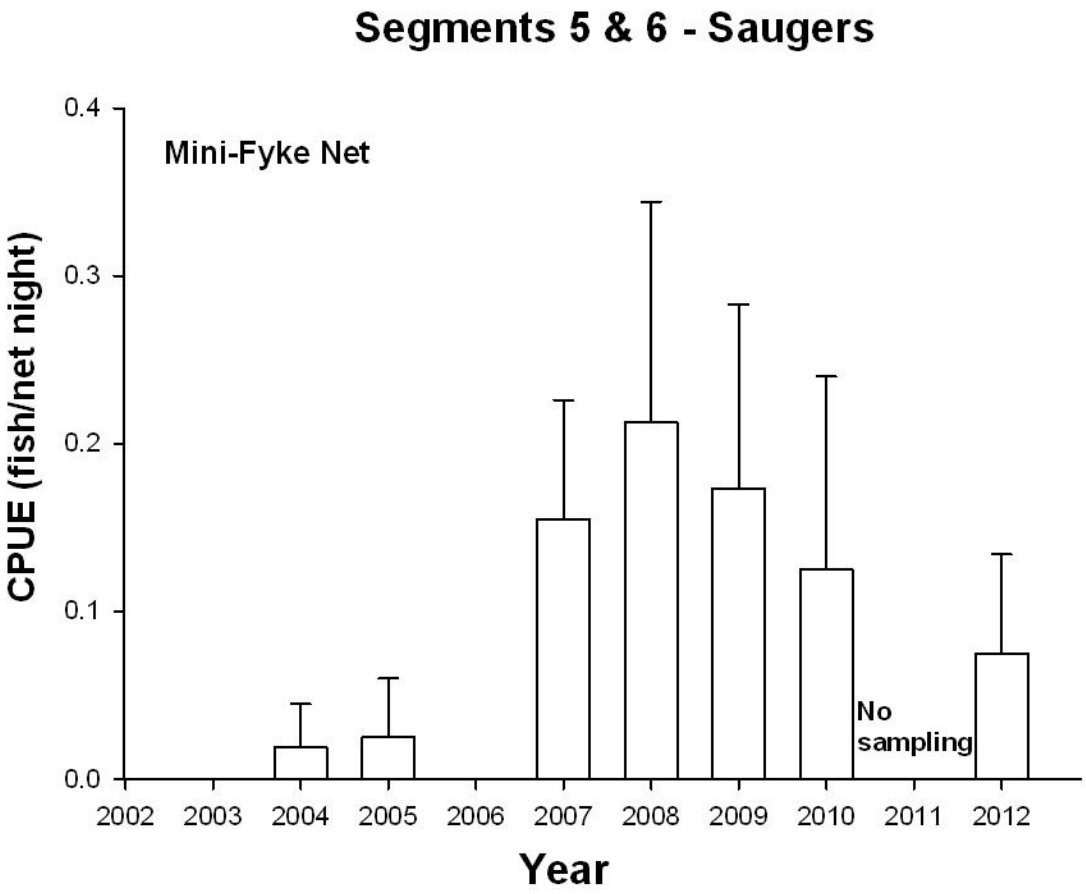

Figure 31. Mean annual catch per unit effort (± 2 SE) of saugers using mini-fyke nets in Segments 5 and 6 of the Missouri River during fish community season from 2003-2012.

Table 10. Total number of saugers captured for each gear during each season and the percent caught within each macrohabitat type in Segments 5 and 6 of the Missouri River during 2012. The percent of total effort for each gear in each habitat is presented in parentheses. Habitat abbreviations and definitions presented in Appendix B.

Gear	N	Macrohabitat								
		BRAD	CHXO	CONF	ISB	OSB	SCCL	SCCS	SCN	TRMS
Sturgeon Season										
1-inch Trammel Net	24	92 (44)	0 (18)	0 (4)	4 (14)	0 (17)	4 (4)	0 (0)	0 (0)	0 (0)
Gill Net	20	75 (50)	5 (17)	0 (0)	5 (16)	15 (17)	0 (0)	0 (0)	0 (0)	0 (0)
Otter Trawl	10	20 (38)	10 (14)	10 (5)	0 (17)	50 (20)	10 (5)	0 (0)	0 (0)	0 (0)
Trot Lines	0	0 (40)	0 (18)	0 (5)	0 (13)	0 (20)	0 (5)	0 (0)	0 (0)	0 (0)
Fish Community Season										
1-inch Trammel Net	5	100 (43)	0 (17)	0 (4)	0 (14)	0 (17)	0 (5)	0 (0)	0 (0)	0 (0)
Mini-Fyke Net	6	67 (40)	0 (14)	0 (5)	0 (14)	0 (15)	0 (4)	17 (4)	17 (3)	0 (3)
Otter Trawl	17	71 (41)	12 (16)	0 (5)	12 (16)	6 (17)	0 (5)	0 (0)	0 (0)	0 (0)

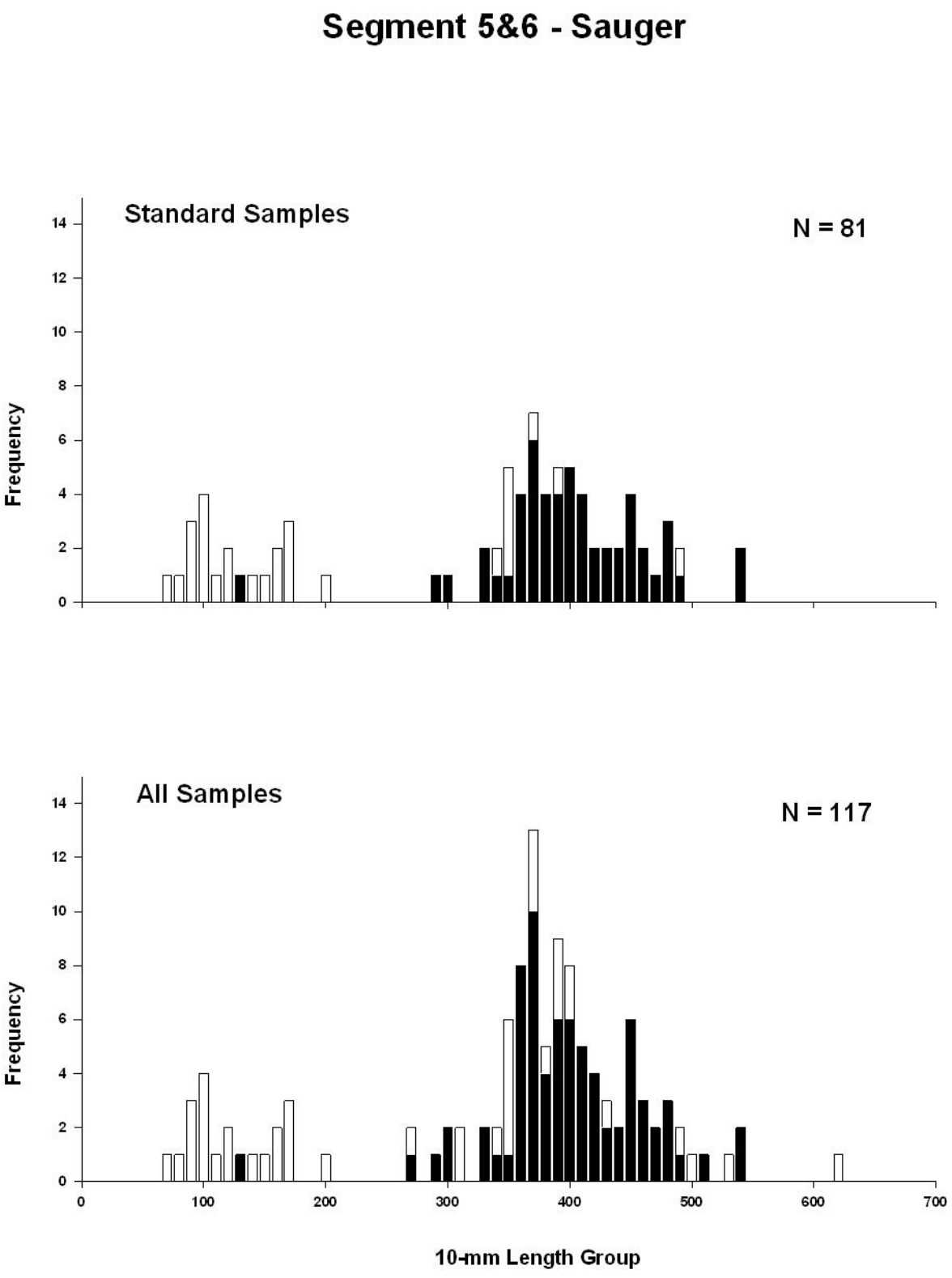

Figure 321. Length frequency of sauger during the sturgeon season (black bars) and the fish community season (white bars) in Segments 5 and 6 of the Missouri River during 2012. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2012.

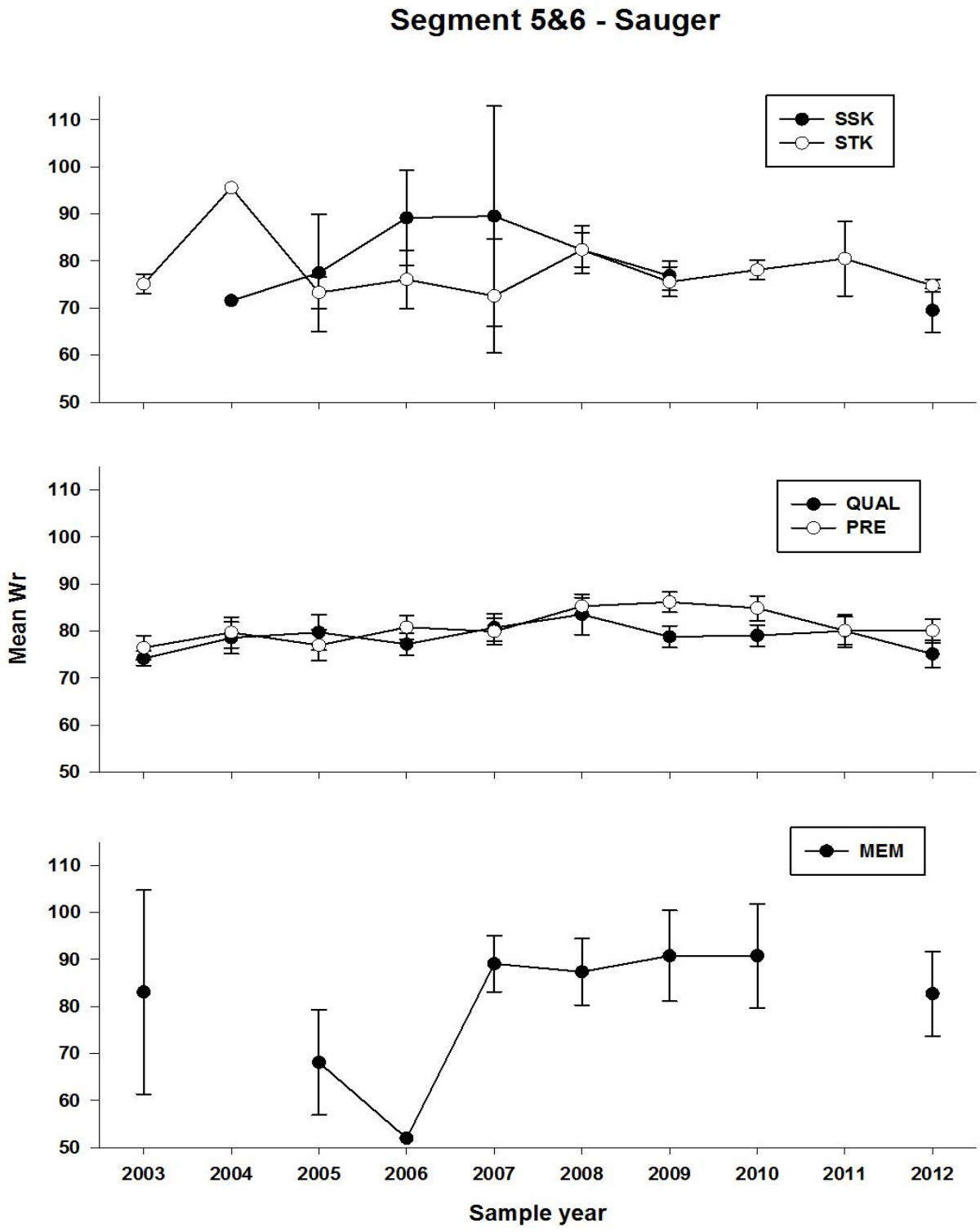

Figure 33. Relative weight (W_r) for all sauger captured with all gears by incremental proportional size distribution (PSD) length category from 2003-2011 in Segments 5 and 6 in the Missouri River. Length categories determined using the methods proposed by Gabelhouse (1984) with the exception of sub-stock categories. Relative condition factor was calculated using the equation in Anderson and Neumann (1996).

Missouri River Fish Community

Objective 6. Document annual results and long-term trends of all non-target species population abundance and geographic distribution throughout the Missouri River system, where sample size is greater than fifty individuals.

A total of 5,135 fish comprised of 47 species and one hybrid, sauger x walleye *S. canadese X S. vitreus,* were captured in standard effort and 290 fish were collected in non-random deployments during the 2012 sampling season in Segments 5 and 6 of the Missouri River (Appendices F1-F5). Additionally, 76 fish of unknown species were also collected consisting of unknown *Lempois* (ULP, n = 71), unknown *Sander* (UST, n = 3), unknown Carpoides (UCS, n = 1), and unknown Cyprinidae (UCY, n = 1). A total of 132 of the total 580 random gear deployments contained no fish: gill nets (n = 36: 36%), trammel nets (n = 50: 31%), otter trawls (n = 31: 19%), and trot lines (n = 15: 19%), whereas mini-fyke nets captured fish on each deployment. For non-random deployments, 14% of trammel nets and 15% of otter trawl deployments contained no fish. We captured four species during the 2012 season that were not seen during 2010 (the last year a full complement of standard effort was deployed): flathead chub *Platygobio gracilis* (n = 2), goldeye *Hiodon alosoides* (n = 3), golden shiner *Notemigonus crysoleucas* (n = 1), and sturgeon chub (n = 2). Five species captured in 2010 not observed in 2012 were central stoneroller *Campostoma anomalum*, pumpkinseed sunfish *Lepomis gibbosus*, longnose dace *R. cataractae*, grass pickerel *Esox americanus vermiculatus*, and white crappie *Pomoxis annularis*. Greatest numbers of fishes (n = 4,016) were captured during the summer with mini-fyke nets and catches consisted mainly of small bodied cyprinids (Appendix F4). Standard gear deployments with the greatest percentage of their total catch comprised of pallid sturgeon and the nine targeted native fish species were: gill nets (39%), trot lines (29%), trammel

nets (24%), otter trawls (9%), and mini-fyke nets (3%). Target species comprised 3% of the catch in mini-fyke nets in 2012, which was similar to the catch in 2006 and 2007 and larger than from 2009 (2%), however this was smaller than in 2010 (6%).

Of the 47 species and one hybrid captured with standard gears, 42% had > 50 individuals collectively caught. These species included: emerald shiner *N. atherinoides* (n = 1,117), spotfin shiner *Cyprinella spiloptera* (n = 709), river carpsucker *Carpiodes carpio* (n = 607), channel catfish *Ictalurus punctatus* (n = 601), black crappie *Poxomis nigromaculatus* (n = 290), bluegill *L. macrochirus* (n = 252), shorthead redhorse *Moxostoma macrolepidotum* (n = 187), smallmouth bass *Micropterus dolomieu* (n = 184), common carp *Cyprinus carpio* (n = 132), shovelnose sturgeon (n = 122), sauger (n = 118), yellow perch *Perca flavescens* (n = 117), sand shiner (n = 106), silver chub *M. storeriana* (n = 97), walleye *S. vitreum* (n = 96), pallid sturgeon (n = 96), rock bass *Ambloplites rupestris* (n = 92), bluntnose minnow *Pimephales notatus* (n = 67), largemouth bass *M. salmoides* (n = 66), and freshwater drum *Aplodinotus grunniens* (n = 58). Ten species were represented in the collective catch by ≤ 2 specimens: flathead chub, sturgeon chub, creek chub, sauger x walleye hybrid, blue sucker, rainbow smelt, fathead minnow, brassy minnow, golden shiner, and bigmouth shiner. All but six species represented by a cumulative catch of ≥ 50 fish in 2010 were also represented by ≥ 50 individuals in 2012; these species included: brassy minnow, bigmouth buffalo *Ictiobus cyprinellus*, creek chub *Semotilus atromaculatus*, rainbow smelt *Osmerus mordax*, sauger, and white bass *Morone chrysops*.

For gears targeting large fish in deep water habitats (≥ 1.2 m), channel catfish were the most common non-targeted species in 2012, which was similar to all other years except 2006 and 2009 where walleyes were the most common. Five species including sauger, shorthead redhorse, shovelnose sturgeon, channel catfish, and pallid sturgeon had an overall gill net mean CPUE ≥ 0.2 fish/net night during 2012 (Appendix F1). During the 2012 sturgeon season, the trammel net

mean CPUE for channel catfish was 0.47 fish/100 m, followed by shovelnose sturgeon (0.14 fish/100 m), sauger (0.12 fish/100 m) shovelnose sturgeon (0.12 fish/100 m), and walleye (0.11 fish/100 m; Appendix G). In contrast, during 2011 channel catfish and sauger were the only species with a mean trammel net CPUE > 0.10 fish/100 m during the sturgeon season. During 2005 and 2011 channel catfish consistently had the highest mean trammel net CPUE during the sturgeon season, excluding 2005 and 2008 where shovelnose sturgeon had the highest mean relative abundance. Channel catfish (mean CPUE 0.32 fish/100 m) and shovelnose sturgeon (mean CPUE 0.12 fish/100 m) were the species most abundantly captured with trammel nets during the fish community season (Appendix G), followed by shorthead redhorse and pallid sturgeon (0.06 fish/100 m). During both seasons, mean relative abundance with the otter trawl was highest for channel catfish (sturgeon season; fish community season), followed by silver chubs (sturgeon season; fish community season). Channel catfish and silver chubs were the two most abundant species captured in the otter trawl during both the sturgeon season (CPUE ≥ 0.59 fish/100 m; ≥ 0.14 fish/100 m) and fish community season (CPUE ≥ 0.42 fish/100 m; ≥ 0.20 fish/100 m).

The greatest numbers of fish species (n = 37) were captured in shallow water habitats with mini-fyke nets (Appendix F4). The five most abundant species captured in mini-fyke nets were emerald shiners (13.9 fish/net night), spotfin shiners (8.9 fish/net night), river carpsuckers (7.4 fish/net night), black crappie (3.6 fish/net night), and bluegill (3.1 fish/net night). Additionally, smallmouth bass, yellow perch, and sand shiner had mean CPUE > 1.3 fish/net night and the following 5 species had a mean CPUE > 0.05 fish/net night: common carp, bluntnose minnow, largemouth bass, Johnny darter, and shorthead redhorse.

Additional benefits of this long-term monitoring program are continued determination of the absence of aquatic invasive species in vulnerable waters (e.g., Lewis and Clark Lake) or their

early detection if introduced (Conover et al. 2007). Seven exotic fish species were captured in Segments 5 and 6 during 2012 which are sport and bait fishes that were intentionally introduced: common carp *Cyprinus carpio*, rainbow smelt, bluegill, black crappie, spottail shiner *Notropis hudsonius*, largemouth bass, and smallmouth bass (Berry and Young 2004). Additionally, Hoagstrom et al. (2007) considered rock bass *Ambloplites rupestris*, northern pike *Esox lucius*, spotfin shiner, and white bass as non-native species of the Missouri Valley in South Dakota (i.e., the main river channel). Based on high mean CPUE in mini-fyke nets (8.85 fish/net night), spotfin shiners were the most abundant non-native fish species captured in Segments 5 and 6 during 2012 followed by black crappie (3.63 fish/net night), bluegill (3.14 fish/net night), and smallmouth bass (2.24 fish/net night). None of the four exotic Asian carps, bighead carp *Hypophthalmichthys noblis*, silver carp *H. molitrix*, grass carp *Ctenopharyngodon idella*, or black carp *Mylopharyngodon piceus*, were captured or seen within Segments 5 and 6 from 2003-2012. However, bighead carp, silver carp, and grass carp are present in the Missouri River just downstream of Gavins Point Dam in Segment 7 (Conover et al. 2007; Stukel et al. 2010; Wanner and Klumb 2009). Because YOY Asian carps look similar to YOY gizzard shad *Dorosoma cepedianum*, there exists the potential for introduction above Gavins Point Dam by anglers mistakenly using YOY Asian carps as bait.

No zebra mussels *Dreissena polymorpha* were observed while working in Segments 5 and 6 during 2003-2012 despite the identification of larval zebra mussels (veligers) collected near the Verdel, Nebraska boat ramp (Figure 1) in 2003 (Lawrence Hesse, River Ecosystems Inc., personal communication). In 2009, Asian clams *Corbicula fluminea* were found in Lewis and Clark Lake which serves as a water source for the USFWS Gavins Point National Fish Hatchery (NFH) in Yankton, South Dakota (USFWS 2010). Asian clams were subsequently found in rearing ponds at Gavins Point Dam NFH in fall of 2009 (USFWS 2010). As part of

macroinvertebrate survey, Grohs (2008) captured adult Asian clams in the Missouri River downstream of Fort Randall Dam at Sunshine Bottoms, near the Verdel, Nebraska boat launch, and within the Niobrara Delta in 2006 and 2007. Veligers of Asian clams could have been mistaken for zebra mussels in 2003.

The long-term monitoring program also provides distribution data for turtles. Seventy-seven turtles were captured in mini-fyke nets in 2012 consisting of five species including false map *Graptemys pseudogeographica* (FSMT, n = 60), western painted *Chrysemys picta bellii* (PATT, n = 8), snapping *Chelydra serpentina* (SNPT, n = 6), smooth softshell *Apalone mutica* (SMST, n = 4), and spiny softshell *Apalone spinifera* (SNST, n = 3; Appendix F4). Additionally, two western painted and five false map turtles were collected in gill nets and two smooth softshell turtles were collected in the otter trawl (Appendix F1 and F3).

Discussion

Prior to 2012, general trends of increasing pallid sturgeon annual relative abundance in gill nets, trammel nets, and otter trawls have mirrored increasing stocking numbers, evidence that the population assessment program is meeting its first objective and can effectively describe general changes in the population (Welker and Drobish 2010). Since April 2011, 635 additional age-1 hatchery-reared pallid sturgeon were stocked into Segments 5 and 6 which was an increase of total numbers of 6% (Appendix E).

Relative abundance for all pallid sturgeon (i.e., hatchery, wild, and unknown origin) was highly variable among gears and between seasons. Gill net CPUE for all pallid sturgeon was at the all-time high (0.22 fish/net night; similar to 2009) increasing 232% compared to 2011 and 149% compared to the nine year average (2003-2011), whereas trot line relative abundance decreased 50% compared to 2011 and 57% compared to the two year average (2010-2011). Trammel net relative abundance for all pallid sturgeon decreased 13% during the sturgeon season and increased 25% during the fish community season, while the overall annual CPUE (i.e., both seasons combined) increased 5% compared to the long term average (2003-2010). Otter trawl relative abundance for all pallid sturgeon increased 16% during the sturgeon season and decreased 50% during the fish community season, while the overall annual CPUE (i.e., both seasons combined) decreased 21% compared to the long term average (2005-2010). Data was not collected during both seasons (i.e., sturgeon and fish community) with the otter trawl during 2011 and no data was collected with the trammel net during the fish community season. Long-term averages for otter trawl and trammel net were not included.

Multiple years of monitoring have found areas of high pallid sturgeon captures within the Niobrara River Delta formed in Segment 6, illustrating achievement of the second part of

Objective One for the population assessment program in RPMA 3, documentation of pallid sturgeon spatial distribution. Although pallid sturgeon were captured in all bends sampled as part of the standard monitoring effort during 2012, there was evidence of fish clustering within three areas (Figure 2). During 2012, 19 pallid sturgeon were captured between rkm 1,361.5-1,364.7 (rm 846- 848; Segment 5, bend 16), 3.2 miles upstream of the Missouri and Niobrara river confluence; an additional 13 fish were caught between rkm 1,364.7-1,369.2 (rm 848- 850.8; Segment 5, bends 14 and 15) near the Ponca Creek confluence. Clusters of age-3 to age-5 pallid sturgeon were also seen in a telemetry study in Segments 5 and 6 during 2000 to 2002 (Jordan et al. 2006) with most aggregations found at rkm 1,363 (rm 847). River kilometer 1,363 contains one of the deepest habitats (11 m) within Segments 5 and 6 (known as the "pump hole") and is located downstream of the Ponca Creek confluence on the South Dakota side of the main channel. The pump hole, located in bend 16 of Segment 5, was randomly selected for sampling in 2005, 2007 and 2008; with multiple fish (N = >2) captured each year (Shuman et al. 2006b; Shuman et al. 2008; Shuman et al. 2009). Habitat conditions within and near the pump hole have and continue to change since 2008 due to the erosion of the hard point, shifting the main channel towards the Nebraska (south) side of the river. Fourteen fish were also caught between rkm 1,352.3-1,353.8 (rm 840.3-841.2; Segment 6, bend 4) near the Running Water, South Dakota boat landing. In Segment 6 an additional 30 pallid sturgeon were collected from Bend 6 (n=9), 7 (n=10), and 11 (n=11). Synthesizing data for all gears deployed in the Missouri River downstream of Fort Randall Dam from 2003-2005 using spatial scan analysis, Spindler et al. (2009) detected three significant clusters of pallid sturgeon presence and two significant clusters of consistent absence. One significant cluster of pallid sturgeon presence was at rkm 1,357 (rm 843) one mile downstream of the Niobrara River confluence. The other locations of significant pallid sturgeon captures found by Spindler et al. (2009) were two locations in different braided

channels within the Niobrara River Delta near rkm 1,336 (rm 830) an area where clusters of pallid sturgeon were also captured in 2006-2011 (Shuman et al. 2007, Shuman et al. 2008; Shuman et al. 2009; Shuman et al. 2010; Shuman et al. 2011; Shuman et al. 2012).

As in past years, pallid sturgeon were captured in all three continuous macrohabitats and in two discrete macrohabitats (braided channels and tributary confluence) with the greatest numbers captured in braided channels. Braided channels were first distinguished as a macrohabitat type in 2004. Since the 2004 sampling season, nearly the entire Missouri River downstream of the Niobrara River was considered a braided channel macrohabitat with the exception of a large secondary connected channel and confluence macrohabitats in Segment 6, bend 1. Since 2003, 58% of all pallid sturgeon were captured in the Niobrara River Delta in Segment 6. Ninety-nine percent of pallid sturgeon captured were within channel border mesohabitats (depth > 1.2 m). Pallid sturgeon captured in 2007-2010 and 2012 corresponded with habitats where fish were located during a telemetry study in Segments 5 and 6 during 2000-2002 (Jordan et al. 2006). Most sonic-tagged age-3 to age-5 pallid sturgeon were located in the main channel (91%) with few fish found in secondary connected channels (4%). In 2009, Wanner et al. (2010b) collected a single age-1 hatchery propagated pallid sturgeon (FL=388 mm, 109 g) in a trammel net on August 12, 2009 near rkm 7 of the Niobrara River. Additionally, age-3 and age-6 pallid sturgeon were collected in the Niobrara River in 2008 indicating pallid sturgeon use of the lower reaches of the largest tributary in RPMA 3 (Wanner et al. 2009).

Population Assessment Program data has been used to successfully derive juvenile pallid sturgeon survival rates (i.e., Objective 3) for the upper (Hadley and Rotella 2009; Rotella 2010) and middle basins (Steffensen et al. 2010) of the Missouri River. Survival rates two years after release in each basin were generally similar (> 90%), although updated apparent survival for spring and summer yearlings stocked in RPMA 3 was 0.62 and 0.86 respectively (Rotella 2010).

First year annual survival rates of pallid sturgeon stocked into RPMA 3 as yearlings were low (0.22-0.58) and highly variable but after the second year often exceeded 0.90 with increased precision (Hadley and Rotella 2009). Survival of stocked age-3 pallid sturgeon from 2000-2003 was 68% during a telemetry study in RPMA 3 (Jordan et al. 2006). In 2012, pallid sturgeon representing all year classes previously stocked were captured (Table 3), with the exception of the 1999 year class. With the exception of the 1998 year class during 2006 and the 1999 and 2006 year classes during 2008, all other year classes of pallid sturgeon present have been recaptured annually during the Population Assessment Monitoring Program providing further evidence of good survival in RPMA 3 (Table 3; Appendix J).

During the sturgeon season, gill nets and trot lines were effective gears capturing 21 and 27 pallid sturgeon, respectively. Annual relative abundance of hatchery-reared pallid sturgeon captured in gill nets generally increased with the increased numbers of fish stocked into Segments 5 and 6 the previous year. Exceptions include decreases in pallid sturgeon relative abundance of 42% from 2004 to 2005, 41% from 2007 to 2008, and 68% from 2009 to 2010. The most substantial increases (> 120%) in all pallid sturgeon (i.e., hatchery, wild and unknown origin) CPUE occurred during the 2007 and 2009 sampling years (Figure 5) after large numbers of fish were stocked the previous year (2006; n = 1,008; 2008; n = 4,579) and during 2012 following the historic Missouri River flood of 2011. The one year lag for changes in relative abundance observed in 2007 and 2009 is likely due to the fact that gill net sampling occurs prior to most stocking events; therefore, stocked juvenile pallid sturgeon take at least one year to be detected by gill nets. Variability (±2 SE) in gill net CPUE each year was high, often as large or larger than the mean, which likely precludes detecting statistically significant changes in pallid sturgeon abundance within Segments 5 and 6. Under current gill net sampling effort, statistical power (β) to detect a 5% annual decline in pallid sturgeon abundance over 20 years within

Segments 5 and 6 of the Missouri River was approximately 0.2 (Bryan et al. 2009). However, this power analysis only use data from 2003-2005, when collectively few pallid sturgeon were stocked (Appendix E) and recaptured (n = 123) compared to annual captures > 78 the past five years (Figure 10). Also the high frequency of zeros in the data violated normality (for parametric statistical analyses) thus providing a conservative estimate of power (Bryan et al. 2009). Trot line CPUE has continued to decline from 1.0 fish /20 hook nights during 2010. Variability (±2 SE) in trot lines was similar to that of gill nets, often as large as the mean.

The trammel net was an effective gear and captured 16 pallid sturgeon in Segments 5 and 6 during 2012 in standard drifts, while non-random duplicate passes captured an additional 19 fish. Relative abundance of all pallid sturgeon (i.e., hatchery, wild and unknown origin) in trammel nets during the fish community season decreased 32% compared to the all-time high in 2007 (0.084 fish/100 m), but increased 33% in 2012 compared to 2010 and 26% compared to the 2003 to 2010 running average. This trend in relative abundance during the fish community was similar for hatchery-reared pallid sturgeon during summer. Relative abundance of all pallid sturgeon (i.e., hatchery, wild and unknown origin) caught in trammel nets during the sturgeon season of 2012 decreased 68% compared to the all-time high in 2008 (0.133 fish/100 m) and 14 % in 2012 compared to the 2003 to 2010 running average, but increased 5% compared to 2011. Again, this trend in relative abundance during the sturgeon season was similar for hatchery-reared pallid sturgeon during summer. Seasonal differences were also found in trammel net mean CPUE for all pallid sturgeon (i.e., hatchery, wild and unknown origin) with higher catch rates during the summer (fish community season) compared to the fall through spring (sturgeon season) in 2004-2012, with 2008 and 2010 being exceptions, while 2003 relative abundance was similar and no trammel nets were deployed during the summer of 2011. Guy et al. (2009) reported that trammel nets were relatively efficient at capturing *Scaphirhynchus* spp. and

conditional capture probability varied from 0.37 and 0.51 for the first and second attempts, respectively. Wanner et al. (2007b) reported that trammel net mean CPUE was highest and coefficient of variation was lowest during August in Segments 5 and 6. In addition, Schloesser (2008) found detection probabilities with trammel nets for large-bodies fishes in the lower Missouri River were higher in summer compared to fall through spring. With current sampling effort, statistical power to detect a 3-5% annual decline in pallid sturgeon abundance over 20 years with trammel nets ranged from 0.2-0.4 (Bryan et al. 2009).

The 16-ft otter trawl was an effective active gear for capturing pallid sturgeon. Eight pallid sturgeon were captured in standard tows with an additional 4 fish captured in duplicate passes during 2012. The CPUE trend in seasonal differences for all pallid sturgeon captured in the otter trawl was generally similar to that of the trammel net CPUE; seasonal mean CPUE for all pallid sturgeon was generally highest during the summer (fish community season) in 2005-2010, with 2006 being the exception and 2007 being similar. Wanner et al. (2007b) found otter trawls in October had the highest mean CPUE of pallid sturgeon with the lowest variability and suggested that collectively, trammel nets, gill nets, and otter trawls likely captured the true size structure of the population of pallid sturgeon in Segments 5 and 6. In the Mississippi River, Phelps et al. (2009) found generally highest CPUE for shovelnose sturgeon with benthic otter trawls during summer. Current statistical power to detect a 5% annual decline in pallid sturgeon abundance over 20 years with the otter trawl is low ($\beta < 0.2$) based on the analysis by Bryan et al. (2009). However, only one year of trawling data for Segments 5 and 6 (2005) was included in the power analysis. Only 8 pallid sturgeon were caught with the otter trawl in 2012 (Shuman et al. 2006b) with 11-23 fish captured annually from 2005-2012 (Shuman et al. 2007, 2008, 2009, 2010, 2011), while no otter trawls were deployed in 2011 due to flooding.

River discharge can affect catchability, lowering relative abundance independent of actual population size. During 2003-2011 higher releases from Ft. Randall Dam were observed during the spring compared to the fall, with 2007 being the only exception. Pallid sturgeon relative abundance indexed with gill nets demonstrated an inverse relationship to higher discharge occurring during the spring, with lower CPUE estimates observed (D. Shuman, unpublished data). During 2007, discharge from Ft. Randall Dam during late fall was higher compared to early spring resulting in higher CPUE estimates during the spring. High flows commonly result in gill nets becoming saturated with detritus and sticks or becoming buried in shifting sand, especially for the four bends in Segment 6 just downstream of the Niobrara confluence. Because of ineffective fishing, associated costs for net repair and, more commonly, replacement, as well as concern for safety of any captured pallid sturgeon, as of 2009 gill nets are no longer set in bends 1-4 Segment 6. To assess catchability of pallid sturgeon in Segments 5 and 6 with active gears used in the population assessment program a multi-year telemetry study was initiated in 2010. This mutli-year study will assess various environmental conditions and seasons on the catchability of multiple size classes of pallid sturgeon with drifted trammel nets and otter trawls.

The mean relative condition (K_n) of stocked pallid sturgeon declined after release for nearly all year classes (1997-1998, 2002-2005, and 2007-2008) except the 1998 year class during 2007-2012, the 1999 year class in 2005 and 2010, 2008 year class in 2009, and the 2009 year class in 2010. However, mean length has increased for all year classes since stocking (Table 3; Appendix J). A weight- length equation (Shuman et al. 2011) was used to recalculate relative condition for sample years 2003-2008 (Appendix K) which was previously calculated using a different weight-length equation (Keenlyne and Evenson 1993), with 2009-2011 added for

consistency. Shuman et al. (2011) compared the two equations and found weight was overestimated 5- 21 % for fish 175-1,550 mm by the Keenlyne and Evenson (1993) equation.

Condition of most pallid sturgeon was > 1.0 at the time of stocking (Table 3; Appendix J) which may have provided excess energy reserves to better enable the transition from the hatchery to a natural environment, thereby increasing survival. The decrease in condition of hatchery-reared pallid sturgeon may reflect a lack of sufficient prey resources or a stream-lined body form may be more advantageous in the natural lotic environment and hatchery-reared fish were unnaturally fat. Juvenile pallid sturgeon diets in Montana as percent wet weight were 90% fish (Gerrity et al. 2006), while the diets of juvenile pallid sturgeon downstream of Fort Randall Dam were 66% fish and 24% ephemeropterans by dry weight (Grohs et al. 2009). Spindler (2008) found the abundance of ephemeropterans and dipterans in the drift were significantly higher (1.6-1.8 fold) in areas where juvenile pallid sturgeon were captured compared to areas where fish were not captured. Shuman et al. (2011) found basin wide K_n of juvenile pallid sturgeon declined since stocking but stabilized around 0.9 within two years. Consistency of pallid sturgeon K_n from 2003-2011 for stock–quality and quality–preferred sized fish indicates availability of sufficient prey resources within in Segments 5 and 6 (Figure 4). Consistent high relative condition of juvenile pallid sturgeon also indicates the historic annual stocking rate of 75 fish/family cross appears adequate. However, relative condition of preferred-memorable sized pallid sturgeon declined from 2008-2010 then increased from 2010-2012 potentially indicating the onset of sexual maturity for the oldest year classes (1997-1999) aged 13-15 years.

Gill nets, trammel nets, and otter trawls were all effective at capturing shovelnose sturgeon. Gill net mean CPUE for shovelnose sturgeon greater than stock length increased 39% from 2011, but was substantially lower (>43%) compared to 2006-2009 (Figure 11). Yearly relative abundance (i.e., seasons pooled) of shovelnose sturgeon in trammel nets continues to

remain below the all-time high in 2008, but was similar to 2005, 2007 and 2009, which continues to indicate a stable population with high survival of adults with low spawning success and/or recruitment. Generally trammel net mean CPUE was the highest during the summer fish community season for shovelnose sturgeon during 2003-2012 with the exception of 2008 and 2010, which corresponded with pallid sturgeon seasonal catch rates, while similar rates were observed during 2012. Shovelnose sturgeon relative abundance in otter trawls increased during the sturgeon season compared to the previous four years (2007-2010), while CPUE during the fish community decreased to its lowest level since the gear was deployed (i.e., 2005). Yearly relative abundance increased compared to the previous four years, but remained lower that 2005 and 2006 estimates possibly indicating a stable to declining population. Statistical power (β) to detect a 5% annual decline in shovelnose sturgeon abundance over 20 years was ≥ 0.7 for trammel nets and otter trawls under current levels of sampling effort and ranged from 0.4-0.8 for gill nets (Bryan et al. 2009). Shovelnose sturgeon were individually marked with floy tags during 2006 (n = 161), 2007 (n = 411), 2008 (n = 273), 2009 (n = 260), 2010 (n = 176), 2011 (n = 61), and 2012 (n = 98). Except for 2010, the percent of recaptured floy-tagged shovelnose sturgeon has increased or remained stable each year since tagging began in 2006: 3, 7, 13, 16, and 16% respectively from 2007- 2012 (excluding 2010). Although recaptures declined in 2010 to 10%, this high proportion indicates that a large proportion of the total shovelnose sturgeon population has been tagged since 2006.

The low number of shovelnose sturgeon within the stock–quality (n = 2) and no fish within the quality–preferred length categories indicates low levels of recruitment have occurred within Segments 5 and 6 of the Missouri River. The catch of two stock–quality fish in 2010 provides the first indication of past recruitment in Segments 5 and 6, but transcription errors may have occurred while taking length or weight measurements. Jordan and Willis (2001) during

1998 and 1999 as well as Pierce et al. (2003) reported only capturing preferred length and larger sized shovelnose sturgeon in RPMA 3. Shovelnose sturgeon within the preferred–memorable and ≥ memorable length classes were in good relative condition in 2012, thus these fish should be physically capable of reproduction. Since 2008, Wr of shovelnose sturgeon in the preferred and memorable/trophy length categories has been trending upwards. Personal observations in 2008-2012 identified female shovelnose sturgeon in later stages of egg development within Segments 5 and 6. Standard gears (gill nets, otter trawl, and trammel nets) have captured small shovelnose sturgeon (i.e., < 249 mm FL) from the channelized and unchannelized Missouri River (Eder and Steffensen 2010; Herman et al. 2010; Horner et al. 2010; Plauck et al. 2010; Steffensen 2010; Wilson et al. 2010). These catches in other segments further indicate that shovelnose sturgeon in Segments 5 and 6 are failing to either spawn due lack of habitat or have poor larval and juvenile survival.

The collection of two sturgeon chubs in Segment 5 during the 2012 sampling year is the first documented capture since the 1950's (Bailey and Allum 1962) and were considered extirpated from this section of the Missouri River (Hesse 1994). This was the first collection of this species since monitoring began in 2003. Additionally, no sturgeon chubs were collected in 1996-1998 by Benthic Fish Study researchers (Young et al. 1998). The sicklefin chub and shoal chub have not been captured in Segments 5 and 6 since monitoring began in 2003 suggesting that these chub species are either extirpated or at such a low abundance that we were unable to detect them. In Segments 5 and 6, the otter trawl captured 130 silver chubs during 2010 with > 60 captured each year from 2005-2009. This same trawl has captured sturgeon chubs, sicklefin chubs, and shoal chubs in Segments 7-10 (Steffensen 2010; Horner et al. 2010; Eder and Steffensen 2010; Stukel et al. 2010) and 13-14 (Plauck et al. 2010; Herman et al. 2010) in 2009 in South Dakota, Iowa, Nebraska, Kansas, and Missouri downstream of Gavins Point Dam. In

Montana and North Dakota, sicklefin and sturgeon chubs were also captured with the otter trawl in Segments 2 (Haddix et al. 2010a), 3 (Haddix et al. 2010b), and 4 (Wilson et al. 2010) of the Missouri River in 2009. Additionally, this same trawl was used to collect shoal chubs from the Kanasas River during 2009 (Niswonger et al. 2010). Capture of sicklefin chubs and shoal chubs in other segments of the Missouri River and large tributaries indicated that we should capture these species if present in Segments 5 and 6. These three chub species have also not been found in the Niobrara River (Wanner et al. 2009; Wanner et al. 2010b) though flathead chubs *Platygobio gracilis* were commonly collected, a species only encountered during 2005 and 2012 in Segments 5 and 6 (Shuman et al. 2006b). Predation could also explain the low abundance or lack of presence of these three chub species in Segments 5 and 6. Additionally, entrainment and localized habitat changes, from the extreme flooding that occurred within the Missouri River reservoirs during 2011 may have enabled new populations to establish or develop.

Since 2003, all three *Hybognathus* spp. were at low abundance in Segments 5 and 6. A single brassy minnow was captured during 2012. Prior to 2012 a total of 191 *Hybognathus* spp. were captured since sampling began in 2003. Of the 191 total hybognatus collected, 110 brassy minnows and 15 brassy minnows were captured in 2010. Ten were brassy minnows collected in 2009 (Shuman et al. 2010). Prior to 2009, four *Hybognathus* spp. in 2003, one *Hybognathus* spp. in 2005, and 6 plains minnows and 2 western silvery minnows in 2007, and six *Hybognathus spp.* and 37 brassy minnows in 2008 were captured in Segments 5 and 6 (Shuman et al 2006b; Shuman et al. 2008; Shuman et al. 2009). *Hybognathus* spp. were captured primarily with mini-fyke nets throughout the Missouri River during 2009 (Haddix et al. 2010a; Haddix et al. 2010b; Wilson et al. 2010; Herman et al. 2010; Horner et al. 2010; Eder and Steffensen 2010; Plauck et al. 2010; Steffensen 2010; Stukel et al. 2010; Wilson et al. 2010).

The first record of blue sucker recruitment in Segments 5 and 6 was documented in 2007 with the capture of a 203 mm total length fish. No small blue suckers < 600 mm TL were captured in Segments 5 and 6 during 2003-2006 and 2008-2012. Five blue sucker yolk-sac larvae (approximate mean length of 10 mm) were collected in Segment 5 near Sunshine Bottoms on June 6, 2003 at a water temperatures ranging between 15.5-16 °C (R. Klumb, USFWS, unpublished data). At present, blue suckers appear to have difficulty recruiting in Segments 5 and 6. Few small (< 250 mm TL) blue suckers have been captured in other segments of the Missouri River (Eder and Steffensen 2010; Haddix et al. 2010a, 2010b; Horner et al. 2010; Niswonger et al. 2010; Steffensen 2010; Stukel et al. 2010; Wilson et al. 2010) with the exception of downstream of the Big Sioux River in Segment 8 during 2006 (Hamel and Steffensen 2007). These low catch rates of small blue suckers in the channelized and unchannelized segments of the Missouri River highlight that habitats used by early life stages are poorly known or that suitable spawning conditions in the Missouri River have been limited.

Gill nets, trammel nets, and otter trawls were effective at capturing saugers in Segments 5 and 6. Gill net mean CPUE declined during 2003-2005 during a period of drought, leveled off during 2005-2007, increased in 2007-2008, leveled off again in 2008-2009 and declined in 2009-2012. Trammel net mean CPUE during the sturgeon season is consistently higher than that of the fish community season except during 2010, while otter trawl CPUE was consistently higher during the fish community season, except during 2008 and 2010. Under current sampling effort, statistical power (β) in Segments 5 and 6 to detect a 5% annual decline in sauger abundance over 20 years with trammel nets was about 0.8 and ranged from 0.6-0.7 for gill nets (Bryan et al. 2009). Yearly trends in relative abundance for saugers in otter trawls, gill nets, trammel nets, and mini-fyke nets demonstrates a stable or slightly decreasing population since 2008 after drought conditions lessened. Decreases in CPUE for saugers may also be attributed to a decrease

in sampling efficacy during recent years (2009 and 2012) of increased discharge from Fort Randall Dam.

Multiple modes in the length frequency of saugers indicate consistent recruitment (Figure 33). Graeb (2006) found that radio-tagged ripe saugers only spawned in the delta (Segment 6) and not in the Missouri River upstream of the Niobrara River confluence. Total catch of YOY saugers (< 150 mm) in mini-fyke nets during summer in 2012 (n = 5) decreased from in 2010 (n = 8), 2009 (n = 6), and 2008 (n = 15); however, an increase was observed compared to 2004 (n = 2) and 2005 (n = 1) and decreased from. Despite a 67% decrease in total number of YOY sauger captured in 2012 compared to 2008, adequate spawning conditions and larval survival existed in Segments 5 and 6 during 2012 (Figure 33). Although saugers can spawn and recruit in Segments 5 and 6, the population's long term viability could still be at risk due to hybridization with walleye. Hybridization rates of sauger with walleye in Lewis and Clark Lake were 21%; hybrids were comprised of multiple year classes indicating hybridization occurred regularly (Graeb 2006). The delta formed in the headwaters of Lewis and Clark Lake has been found to be an increasingly important habitat for spawning by saugers in RPMA 3 compared to clear colder waters upstream of the delta (Graeb et al. 2009).

The collective total catch of all fish in Segments 5 and 6 has been highly variable from 2003 to 2012 (range: 538-14,622). These observed fluctuations among years in total catch may be attributed to disparate levels of effort with gears targeting small bodied fishes such as the use of the bag siene as a standard gear in 2004 and 2005, the evaluation of the small mesh otter trawl in 2006 and push trawl in 2007 (Appendix C). We cannot be certain that the fluctuations in total fish captures represented a decrease in overall fish relative abundance in Segments 5 and 6 during 2009, 2010, and 2012 or a decrease in sampling efficiency due to reductions in sandbar habitat available or flooded shoreline vegetation due to high water levels. The fish community

season extended from July 1st to October 31st. Because different fish species may become more abundant during different times of the year (increase in YOY), sampling during the fish community season should be systematically spread throughout the four month period. However, Klumb (2007) noted little variation in the monthly mean relative abundance of overall fish catches in mini-fyke nets from June-August within the Segments 5 and 6, but peaks for individual species were observed.

We captured 47 fish species and one hybrid (saugeye) downstream of Fort Randall Dam during 2012. During 1996-1998, Berry and Young (2004) captured 45 fish species and one hybrid (walleye x sauger). We captured six species not observed in the Fort Randall reach by Berry and Young (2004): bigmouth shiner, blue sucker, creek chub, orange-spotted sunfish, pallid sturgeon, and sturgeon chub. Four species encountered by Berry and Young (2004) but not observed during standardized monitoring in Segments 5 and 6 during 2012 included burbot *Lota lota*, mimic shiner *Notropis volucellus*, white crappie *Pomoxis annularis*, and river shiner *Notropis blennius*. River shiners and white crappies have been captured in past years of monitoring in Segments 5 and 6 but since 2003 burbots or mimic shiners have not been observed.

The pallid sturgeon population assessment program is adaptive, allowing for changes in standard gear types and experimentation with the effectiveness of new gears (Appendix C). Since the monitoring program began in 2003, the beam trawl, small mesh otter trawl, hoop net, setline, bag seine, and push trawl have been evaluated and are no longer used as standard gears due to low catch rates and similar species composition captured in comparison to current standard gears. In 2006 and 2007 a comparison of white and green mesh gill nets and trammel nets were evaluated and Wanner at al. (2010a) reported no significant differences in catch rates due to mesh color for gill nets with significance only noted for 5 of 25 species in trammel nets.

Therefore, green and white mesh gill nets and trammel nets can be pooled for future analyses. In 2009 and 2010 the trotline was initiated as an evaluation gear to determine its effectiveness in capturing pallid sturgeon (Appendix J).

Tissue samples (fin clips) collected from sturgeon during 2009 from Segments 5 and 6 indicated the presence of the pallid sturgeon iridovirus. A total of 38 tissue samples were collected from pallid (n = 9) and shovelnose (n = 29) sturgeon. One pallid sturgeon, from the 2003 year class produced at Gavins Point National Fish Hatchery and stocked in 2004 near Sunshine Bottoms tested positive for the presence of the disease while all shovelnose tested negative (Linda Vannest, USFWS Bozeman Fish Health Center, personal communication). From stocking to capture the virus positive pallid sturgeon added more weight and length compared to the mean, while relative condition decreased from above average at stocking to slightly below the mean at recapture. Fork length (300 mm) and weight (92 g) of this virus positive fish at stocking was less than the mean (324 mm, range = 277-370 mm, 113 g, range = 70-163 g, n = 17) while fork length (564 mm) and weight (560 g) at recapture was greater than the mean for this year class (518 mm, range = 465-575, 436 g, range = 290-580 g, n = 14). Also, relative condition at stocking (1.15) of the virus positive fish was greater than the mean relative condition (1.09) of the other 14 pallid sturgeon of the 2003 year class captured during 2009, while the relative condition at capture (0.88) was slightly less than the mean 0.90. Based on the information collected from this single fish, virus positive pallid sturgeon appear to increase in length and weight similar to fish from the same year class as well as exhibit similar condition.

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Appendices

Appendix A. Phylogenetic list of Missouri River fishes with corresponding letter codes used in the long-term pallid sturgeon and associated fish community sampling program. The phylogeny follows that used by the American Fisheries Society, Common and Scientific Names of Fishes from the United States and Canada, 5th edition. Asterisks and bold type denote targeted native Missouri River species.

Scientific name	Common name	Letter Code
CLASS CEPHALASPIDOMORPHI-LAMPREYS		
ORDER PETROMYZONTIFORMES		
Petromyzontidae – lampreys		
Ichthyomyzon castaneus	Chestnut lamprey	CNLP
Ichthyomyzon fossor	Northern brook lamprey	NBLP
Ichthyomyzon unicuspis	Silver lamprey	SVLP
Ichthyomyzon gagei	Southern brook lamprey	SBLR
Petromyzontidae	Unidentified lamprey	ULY
Petromyzontidae larvae	Unidentified larval lamprey	LVLP
CLASS OSTEICHTHYES – BONY FISHES		
ORDER ACIPENSERIFORMES		
Acipenseridae – sturgeons		
Acipenser fulvescens	Lake sturgeon	LKSG
Scaphirhynchus spp.	Unidentified Scaphirhynchus	USG
Scaphirhynchus albus	**Pallid sturgeon**	**PDSG***
Scaphirhynchus platorynchus	**Shovelnose sturgeon**	**SNSG***
S. albus X S. platorynchus	Pallid-shovelnose hybrid	SNPD
Polyodontidae – paddlefishes		
Polyodon spathula	Paddlefish	PDFH
ORDER LEPISOSTEIFORMES		
Lepisosteidae – gars		
Lepisosteus oculatus	Spotted gar	STGR
Lepisosteus osseus	Longnose gar	LNGR
Lepisosteus platostomus	Shortnose gar	SNGR
ORDER AMMIFORMES		
Amiidae – bowfins		
Amia calva	Bowfin	BWFN
ORDER OSTEOGLOSSIFORMES		
Hiodontidae – mooneyes		
Hiodon alosoides	Goldeye	GDEY

Scientific name	Common name	Letter Code
Hiodon tergisus	Mooneye	MNEY
	ORDER ANGUILLIFORMES	
	Anguillidae – freshwater eels	
Anguilla rostrata	American eel	AMEL
	ORDER CLUPEIFORMES	
	Clupeidae – herrings	
Alosa alabame	Alabama shad	ALSD
Alosa chrysochloris	Skipjack herring	SJHR
Alosa pseudoharengus	Alewife	ALWF
Dorosoma cepedianum	Gizzard shad	GZSD
Dorosoma petenense	Threadfin shad	TFSD
D. cepedianum X D. petenense	Gizzard-threadfin shad hybrid	GSTS
	ORDER CYPRINIFORMES	
	Cyprinidae – carps and minnows	
Campostoma anomalum	Central stoneroller	CLSR
Campostoma oligolepis	Largescale stoneroller	LSSR
Carassius auratus	Goldfish	GDFH
Carassus auratus X Cyprinius carpio	Goldfish-Common carp hybrid	GFCC
Couesius plumbens	Lake chub	LKCB
Ctenopharyngodon idella	Grass carp	GSCP
Cyprinella lutrensis	Red shiner	RDSN
Cyprinella spiloptera	Spotfin shiner	SFSN
Cyprinus carpio	Common carp	CARP
Erimystax x-punctatus	Gravel chub	GVCB
Hybognathus argyritis	**Western slivery minnow**	**WSMN***
Hybognathus hankinsoni	Brassy minnow	BSMN
Hybognathus nuchalis	Mississippi silvery minnow	SVMW
Hybognathus placitus	**Plains minnow**	**PNMW***
Hybognathus spp.	Unidentified Hybognathus	HBNS
Hypophthalmichthys molitrix	Silver carp	SVCP
Hypophthalmichthys nobilis	Bighead carp	BHCP
Luxilus chrysocephalus	Striped shiner	SPSN
Luxilus cornutus	Common shiner	CMSN
Luxilus zonatus	Bleeding shiner	BDSN
Lythrurus unbratilis	Western redfin shiner	WRFS
Macrhybopsis aestivalis	**Shoal chub**	**SKCB***
Macrhybopsis gelida	**Sturgeon chub**	**SGCB***
Macrhybopsis meeki	**Sicklefin chub**	**SFCB***
Macrhybopsis storeriana	Silver chub	SVCB
M. aestivalis X M. gelida	Shoal-Sturgeon chub hybrid	SPST
M. gelida X M. meeki	Sturgeon-Sicklefin chub hybrid	SCSC

Scientific name	Common name	Letter Code
Macrhybopsis spp.	Unidentified chub	UHY
Margariscus margarita	Pearl dace	PLDC
Mylocheilus caurinus	Peamouth	PEMT
Nocomis biguttatus	Hornyhead chub	HHCB
Notemigonus crysoleucas	Golden shiner	GDSN
Notropis atherinoides	Emerald shiner	ERSN
Notropis blennius	River shiner	RVSN
Notropis boops	Bigeye shiner	BESN
Notropis buchanani	Ghost shiner	GTSN
Notropis dorsalis	Bigmouth shiner	BMSN
Notropis greenei	Wedgespot shiner	WSSN
	Cyprinidae – carps and minnows	
Notropis heterolepsis	Blacknose shiner	BNSN
Notropis hudsonius	Spottail shiner	STSN
Notropis nubilus	Ozark minnow	OZMW
Notropis rubellus	Rosyface shiner	RYSN
Notropis shumardi	Silverband shiner	SBSN
Notropis stilbius	Silverstripe shiner	SSPS
Notropis stramineus	**Sand shiner**	**SNSN***
Notropis topeka	Topeka shiner	TPSN
Notropis volucellus	Mimic shiner	MMSN
Notropis wickliffi	Channel shiner	CNSN
Notropis spp.	Unidentified shiner	UNO
Opsopoeodus emiliae	Pugnose minnow	PGMW
Phenacobius mirabilis	Suckermouth minnow	SMMW
Phoxinus eos	Northern redbelly dace	NRBD
Phoxinus erythrogaster	Southern redbelly dace	SRBD
Phoxinus neogaeus	Finescale dace	FSDC
Pimephales notatus	Bluntnose minnow	BNMW
Pimephales promelas	Fathead minnow	FHMW
Pimephales vigilax	Bullhead minnow	BHMW
Platygobio gracilis	Flathead chub	FHCB
P. gracilis X M. meeki	Flathead-sicklefin chub hybrid	FCSC
Rhinichthys atratulus	Blacknose dace	BNDC
Rhinichthys cataractae	Longnose dace	LNDC
Richardsonius balteatus	Redside shiner	RDSS
Scardinius erythrophthalmus	Rudd	RUDD
Semotilus atromaculatus	Creek chub	CKCB
	Unidentified Cyprinidae	UCY
	Unidentified Asian Carp	UAC
	Catostomidae - suckers	
Carpiodes carpio	River carpsucker	RVCS
Carpiodes cyprinus	Quillback	QLBK

Scientific name	Common name	Letter Code
Carpiodes velifer	Highfin carpsucker	HFCS
Carpiodes spp.	Unidentified Carpiodes	UCS
Catostomus catostomus	Longnose sucker	LNSK
Catostomus commersonii	White sucker	WTSK
Catostomus platyrhynchus	Mountain sucker	MTSK
Catostomus spp.	Unidentified *Catostomus* spp.	UCA
Cycleptus elongatus	**Blue sucker**	**BUSK***
Hypentelium nigricans	Northern hog sucker	NHSK
Ictiobus bubalus	Smallmouth buffalo	SMBF
Ictiobus cyprinellus	Bigmouth buffalo	BMBF
Ictiobus niger	Black buffalo	BKBF
Ictiobus spp.	Unidentified buffalo	UBF
Minytrema melanops	Spotted sucker	SPSK
Moxostoma anisurum	Silver redhorse	SVRH
Moxostoma carinatum	River redhorse	RVRH
Moxostoma duquesnei	Black redhorse	BKRH
Moxostoma erythrurum	Golden redhorse	GDRH
Moxostoma macrolepidotum	Shorthead redhorse	SHRH
Moxostoma spp.	Unidentified redhorse	URH
Catostomidae - suckers	Unidentified Catostomidae	UCT
	ORDER SILURIFORMES	
	Ictaluridae – bullhead catfishes	
Ameiurus melas	Black bullhead	BKBH
Ameiurus natalis	Yellow bullhead	YLBH
Ameiurus nebulosus	Brown bullhead	BRBH
Ameiurus spp.	Unidentified bullhead	UBH
Ictalurus furcatus	Blue catfish	BLCF
Ictalurus punctatus	Channel catfish	CNCF
I. furcatus X I. punctatus	Blue-channel catfish hybrid	BCCC
Ictalurus spp.	Unidentified *Ictalurus* spp.	UCF
Noturus exilis	Slender madtom	SDMT
Noturus flavus	Stonecat	STCT
Noturus gyrinus	Tadpole madtom	TPMT
Noturus nocturnus	Freckled madtom	FKMT
Pylodictis olivaris	Flathead catfish	FHCF
	ORDER SALMONIFORMES	
	Esocidae - pikes	
Esox americanus vermiculatus	Grass pickerel	GSPK
Esox lucius	Northern pike	NTPK
Esox masquinongy	Muskellunge	MSKG
E. lucius X E. masquinongy	Tiger Muskellunge	TGMG
	Umbridae - mudminnows	

Scientific name	Common name	Letter Code
Umbra limi	Central mudminnow	MDMN
	Osmeridae - smelts	
Osmerus mordax	Rainbow smelt	RBST
	Salmonidae - trouts	
Coregonus artedi	Lake herring or cisco	CSCO
Coregonus clupeaformis	Lake whitefish	LKWF
Oncorhynchus aguabonita	Golden trout	GDTT
Oncorhynchus clarkii	Cutthroat trout	CTTT
Oncorhynchus kisutch	Coho salmon	CHSM
Oncorhynchus mykiss	Rainbow trout	RBTT
Oncorhynchus nerka	Sockeye salmon	SESM
Oncorhynchus tshawytscha	Chinook salmon	CNSM
Prosopium cylindraceum	Bonneville cisco	BVSC
Prosopium williamsoni	Mountain whitefish	MTWF
Salmo trutta	Brown trout	BNTT
Salvelinus fontinalis	Brook trout	BKTT
Salvelinus namaycush	Lake trout	LKTT
Thymallus arcticus	Arctic grayling	AMGL
	ORDER PERCOPSIFORMES	
	Percopsidae – trout-perches	
Percopsis omiscomaycus	Trout-perch	TTPH
	ORDER GADIFORMES	
	Gadidae - cods	
Lota lota	Burbot	BRBT
	ORDER ATHERINIFORMES	
	Cyprinodontidae - killifishes	
Fundulus catenatus	Northern studfish	NTSF
Fundulus diaphanus	Banded killifish	BDKF
Fundulus notatus	Blackstripe topminnow	BSTM
Fundulus olivaceus	Blackspotted topminnow	BPTM
Fundulus sciadicus	Plains topminnow	PTMW
Fundulus zebrinus	Plains killifish	PKLF
	Poeciliidae - livebearers	
Gambusia affinis	Western mosquitofish	MQTF
	Atherinidae - silversides	
Labidesthes sicculus	Brook silverside	BKSS
	ORDER GASTEROSTEIFORMES	

Scientific name	Common name	Letter Code
	Gasterosteidae - sticklebacks	
Culaea inconstans	Brook stickleback	BKSB
	ORDER SCORPAENIFORMES	
	Cottidae - sculpins	
Cottus bairdi	Mottled sculpin	MDSP
Cottus carolinae	Banded sculpin	BDSP
	ORDER PERCIFORMES	
	Percichthyidae – temperate basses	
Morone Americana	White perch	WTPH
Morone chrysops	White bass	WTBS
Morone mississippiensis	Yellow bass	YWBS
Morone saxatilis	Striped bass	SDBS
M. saxatilis X M. chrysops	Striped-white bass hybrid	SBWB
	Centrarchidae - sunfishes	
Ambloplites rupestris	Rock bass	RKBS
Archoplites interruptus	Sacramento perch	SOPH
Lepomis cyanellus	Green sunfish	GNSF
Lepomis gibbosus	Pumpkinseed	PNSD
Lepomis gulosus	Warmouth	WRMH
Lepomis humilis	Orangespotted sunfish	OSSF
Lepomis macrochirus	Bluegill	BLGL
Lepomis megalotis	Longear sunfish	LESF
Lepomis microlophus	Redear sunfish	RESF
L. cyanellus X L. macrochirus	Green sunfish-bluegill hybrid	GSBG
	Centrarchidae - sunfishes	
L. cyanellus X L. humilis	Green-orangespotted sunfish hybrid	GSOS
L. macrochirus X L. microlophus	Bluegill-redear sunfish hybrid	BGRE
Lepomis spp.	Unidentified *Lepomis*	ULP
Micropterus dolomieu	Smallmouth bass	SMBS
Micropterus punctulatus	Spotted sunfish	STBS
Micropterus salmoides	Largemouth bass	LMBS
Micropterus spp.	Unidentified *Micropterus* spp.	UMC
Pomoxis annularis	White crappie	WTCP
Pomoxis nigromaculatus	Black crappie	BKCP
Pomoxis spp.	Unidentified crappie	UCP
P. annularis X P. nigromaculatus	White-black crappie hybrid	WCBC
Centrarchidae	Unidentified Centrarchidae	UCN
	Percidae - perches	
Ammocrypta asprella	Crystal darter	CLDR

Scientific name	Common name	Letter Code
Etheostoma blennioides	Greenside darter	GSDR
Etheostoma caeruleum	Rainbow darter	RBDR
Etheostoma exile	Iowa darter	IODR
Etheostoma flabellare	Fantail darter	FTDR
Etheostoma gracile	Slough darter	SLDR
Etheostoma microperca	Least darter	LTDR
Etheostoma nigrum	Johnny darter	JYDR
Etheostoma punctulatum	Stippled darter	STPD
Etheostoma spectabile	Orange throated darter	OTDR
Etheostoma tetrazonum	Missouri saddled darter	MSDR
Etheostoma zonale	Banded darter	BDDR
Etheostoma spp.	Unidentified Etheostoma spp.	UET
Perca flavescens	Yellow perch	YWPH
Percina caprodes	Logperch	LGPH
Percina cymatotaenia	Bluestripe darter	BTDR
Percina evides	Gilt darter	GLDR
Percina maculata	Blackside darter	BSDR
Percina phoxocephala	Slenderhead darter	SHDR
Percina shumardi	River darter	RRDR
Percina spp.	Unidentified Percina spp.	UPN
	Unidentified darter	UDR
Sander canadense	**Sauger**	**SGER***
Sander vitreus	Walleye	WLYE
S. canadense X S. vitreus	Sauger-walleye hybrid/Saugeye	SGWE
Sander spp.	Unidentified *Sander* (formerly *Stizostedion*) spp.	UST
	Unidentified Percidae	UPC
	Sciaenidae - drums	
Aplodinotus grunniens	Freshwater drum	FWDM
	NON-TAXONOMIC CATEGORIES	
	Age-0/Young-of-year fish	YOYF
	No fish caught	NFSH
	Unidentified larval fish	LVFS
	Unidentified	UNID
	Net Malfunction (Did Not Fish)	NDNF
	Turtles	
Chelydra serpentine	Common Snapping Turtle	SNPT
Chrysemys picta bellii	Western Painted Turtle	PATT
Emydoidea blandingii	Blanding's Turtle	BLDT
Graptemys pseudogeographica	False Map Turtle	FSMT
Trachemys scripta	Red-Eared Slider Turtle	REST

Scientific name	Common name	Letter Code
Apalone mutica	Smooth Softshell Turtle	SMST
Apalone spinifera	Spiny Softshell Turtle	SNST
Terrapene ornata ornata	Ornate Box Turtle	ORBT
Sternotherus odoratus	Stinkpot Turtle	SPOT
Graptemys geographica	Map Turtle	MAPT
Graptemys kohnii	Mississippi Map Turtle	MRMT
Graptemys ouachitensis	Ouachita Map Turtle	OUMT
Pseudemys concinna metteri	Missouri River Cooter Turtle	MRCT
Terrapene carolina triunguis	Three-toed Box Turtle	TTBT

Appendix B. Definitions and codes used to classify standard Missouri River habitats in the long-term pallid sturgeon and associated fish community sampling program. Three habitat scales were used in the hierarchical habitat classification system: Macrohabitats, Mesohabitats, and Microhabitats.

Habitat	Scale	Definition	Code
Braided channel	Macro	An area of the river that contains multiple smaller channels and is lacking a readily identifiable main channel (typically associated with unchannelized sections)	BRAD
Main channel cross over	Macro	The inflection point of the thalweg where the thalweg crosses from one concave side of the river to the other concave side of the river, (i.e., transition zone from one-bend to the next bend). The upstream CHXO for a respective bend is the one sampled.	CHXO
Tributary confluence	Macro	Area immediately downstream, extending up to one bend in length, from a junction of a large tributary and the main river where this tributary has influence on the physical features of the main river	CONF
Dendritic	Macro	An area of the river where the river transitions from meandering or braided channel to more of a treelike pattern with multiple channels (typically associated with unchannelized sections)	DEND
Deranged	Macro	An area of the river where the river transitions from a series of multiple channels into a meandering or braided channel (typically associated with unchannelized sections)	DRNG
Main channel inside bend	Macro	The convex side of a river bend	ISB
Main channel outside bend	Macro	The concave side of a river bend	OSB
Secondary channel-connected large	Macro	A side channel, open on upstream and downstream ends, with less flow than the main channel, large indicates this habitat can be sampled with trammel nets and trawls based on width and/or depths > 1.2 m	SCCL
Secondary channel-connected small	Macro	A side channel, open on upstream and downstream ends, with less flow than the main channel, small indicates this habitat cannot be sampled with trammel nets and trawls based on width and/or on depths < 1.2 m	SCCS
Secondary channel-non-connected	Macro	A side channel that is blocked at one end	SCCN
Tributary	Macro	Any river or stream flowing in the Missouri River	TRIB
Tributary large mouth	Macro	Mouth of entering tributary whose mean annual discharge is > 20 m^3/s, and the sample area extends 300 m into the tributary	TRML
Tributary small mouth	Macro	Mouth of entering tributary whose mean annual discharge is < 20 m^3/s, mouth width is > 6 m wide and the sample area extends 300 m into the tributary	TRMS
Wild	Macro	All habitats not covered in the previous habitat descriptions	WILD
Bars	Meso	Sandbar or shallow bank-line areas with depth < 1.2 m	BARS
Pools	Meso	Areas immediately downstream from sandbars, dikes, snags, or other obstructions with a formed scour hole > 1.2 m	POOL
Channel border	Meso	Area in the channelized river between the toe and the thalweg, area in the unchannelized river between the toe and the maximum depth	CHNB
Thalweg	Meso	Main channel between the channel borders conveying the majority of the flow	TLWG
Island tip	Meso	Area immediately downstream of a bar or island where two channels converge with water depths > 1.2 m	ITIP

Appendix C. List of standard and wild gears (type), their corresponding codes in the database, seasons deployed, years used, and catch per unit effort units for collection of Missouri River fishes in Segments 5 and 6 for the long-term pallid sturgeon and associated fish community sampling program. Long-term monitoring began in 2003 for Segments 5 and 6. Two seasons are sampled: 1) the sturgeon season (ST) extends from fall through spring (October 1-June 30) and 2) fish community season (FC) in summer (July 1 – September 30). Detailed gear descriptions and specifications provided in Welker and Drobish (2010).

Gear	Code	Type	Season	Years	CPUE units
Gill Net – 4 meshes, small mesh set upstream	GN14	Standard	Sturgeon	2003 - Present	Fish / net night
Gill Net – 4 meshes, large mesh set upstream	GN41	Standard	Sturgeon	2003 - Present	Fish / net night
Trammel Net – 1-inchinner mesh	TN	Standard	Both Seasons	2003 - Present	Fish / 100 m drift
Otter Trawl – 16 ft head rope	OT16	Standard	Both Seasons	2003 - Present	Fish / 100 m trawled
Mini-Fyke Net	MF	Standard	Fish Comm.	2003 - Present	Fish / net night
Beam Trawl	BT	Standard	Both Seasons	2003 - 2004	Fish / 100 m trawled
Hoop Net – 4 ft.	HN	Standard	Both Seasons	2003 - 2004	Fish / net night
Trammel Net – 2.5” inner mesh	TN25	Standard	Sturgeon	2005 – 2006	Fish / 100 m drift
Bag Seine – quarter arc method pulled upstream	BSQU	Standard	Fish Comm.	2003 – 2005	Fish / 100 m^2
Bag Seine – quarter arc method pulled downstream	BSQD	Standard	Fish Comm.	2003 - 2005	Fish / 100 m^2
Bag Seine – half arc method pulled upstream	BSHU	Standard	Fish Comm.	2003 - 2005	Fish / 100 m^2
Bag Seine – half arc method pulled downstream	BSHD	Standard	Fish Comm.	2003 - 2005	Fish / 100 m^2
Bag seine – rectangular method pulled upstream	BSRU	Standard	Fish Comm.	2003 - 2005	Fish / 100 m^2
Bag seine – rectangular method pulled downstream	BSRD	Standard	Fish Comm.	2003 - 2005	Fish / 100 m^2
Otter trawl – 16 ft SKT 4mm x 4mm HB2 MOR	OT01	Evaluation	Fish Comm.	2005 - 2006	Fish / 100 m trawled
Push Trawl – 8 ft 4mm x 4mm	POT02	Evaluation	Fish Comm.	2006 - 2007	Fish / m trawled
Trot Line[d]	TL	Standard	Both Seasons	2010 - Present	Fish / hook night

[a]Beam trawls were a standard gear from 2003 - 2004 and dropped as a standard gear in 2005.
[b]Bag seines were a standard gear from 2003 – 2005 and dropped as a standard gear in 2006.
[c]Hoop nets were a standard gear from 2003 – 2004 and dropped as a standard gear in 2005 but still used in Segments 5 and 6.
[d]Trot lines were an experimental gear during 2009.

Appendix D. Stocking locations and codes for pallid sturgeon by Recovery Priority Management Area (RPMA) in the Missouri River Basin.

State(s)	RPMA	Site Name	Code	River	R.M.
MT	2	Forsyth	FOR	Yellowstone	253.2
MT	2	Cartersville	CAR	Yellowstone	235.3
MT	2	Miles City	MIC	Yellowstone	181.8
MT	2	Fallon	FAL	Yellowstone	124.0
MT	2	Intake	INT	Yellowstone	70.0
MT	2	Sidney	SID	Yellowstone	31.0
MT	2	Big Sky Bend	BSB	Yellowstone	17.0
ND	2	Fairview	FRV	Yellowstone	9.0
MT	2	Milk River	MLK	Milk	11.5
MT	2	Mouth of Milk	MOM	Missouri	1761.5
MT	2	Grand Champs	GRC	Missouri	1741.0
MT	2	Wolf Point	WFP	Missouri	1701.5
MT	2	Poplar	POP	Missouri	1649.5
MT	2	Brockton	BRK	Missouri	1678.0
MT	2	Culbertson	CBS	Missouri	1621.0
MT	2	Nohly Bridge	NOB	Missouri	1590.0
ND	2	Confluence	CON	Missouri	1581.5
SD/NE	3	Sunshine Bottom	SUN	Missouri	866.2
SD/NE	3	Verdel Boat Ramp	VER	Missouri	855.0
SD/NE	3	Standing Bear Bridge	STB	Missouri	845.0
SD/NE	3	Running Water	RNW	Missouri	840.1
SD/NE	4	St. Helena	STH	Missouri	799.0
SD/NE	4	Mullberry Bend	MUL	Missouri	775.0
NE/IA	4	Ponca State Park	PSP	Missouri	753.0
NE/IA	4	Sioux City	SIO	Missouri	732.6
NE/IA	4	Sloan	SLN	Missouri	709.0
NE/IA	4	Decatur	DCT	Missouri	691.0
NE/IA	4	Boyer Chute	BYC	Missouri	637.4
NE/IA	4	Bellevue	BEL	Missouri	601.4
NE/IA	4	Rulo	RLO	Missouri	497.9
MO/KS	4	Kansas River	KSR	Missouri	367.5
NE	4	Platte River	PLR	Platte	5.0
KS/MO	4	Leavenworth	LVW	Missouri	397.0
MO	4	Parkville	PKV	Missouri	377.5
MO	4	Kansas City	KAC	Missouri	342.0
MO	4	Miami	MIA	Missouri	262.8
MO	4	Grand River	GDR	Missouri	250.0
MO	4	Boonville	BOO	Missouri	195.1
MO	4	Overton	OVT	Missouri	185.1
MO	4	Hartsburg	HAR	Missouri	160.0
MO	4	Jefferson City	JEF	Missouri	143.9
MO	4	Mokane	MOK	Missouri	124.7
MO	4	Hermann	HER	Missouri	97.6
MO	4	Washington	WAS	Missouri	68.5
MO	4	St. Charles	STC	Missouri	28.5

Appendix E. Juvenile and adult pallid sturgeon stocking summary for Segments 5 and 6 of the Missouri River (RPMA 3).

Year	Stocking site[a]	Number stocked	Year class	Stocking date	Age at stocking	Primary mark	Secondary mark
2000	VER	416	1997	6/6/2000	Age - 3	PIT	Elastomer / Dangler
2000	VER	22	1997	8/2/2000	Age - 3	Sonic tag[b]	PIT
2000	VER	98	1998	9/20/2000	Age - 2	PIT	
2000	VER	4	Adults[c,]	7/6/00	Unknown - Adult	Sonic tag[d]	PIT
2000	VER	3	Adults[c,]	9/20/00	Unknown - Adult	2 w/ sonic tags[d]	PIT
2000	RNW	2	Adults[c]	7/6/00	Unknown - Adult	PIT	
2002	VER	558	2001	4/21/2002	Age - 1	PIT	Elastomer
2002	SUN	181	1999	4/27/2002	Age - 3	PIT	Elastomer
2003	STB	300	2002	7/26/2003	Age - 1	PIT	Elastomer
2003	SUN	301	2002	7/26/2003	Age - 1	PIT	Elastomer
2004	SUN	244	2003	10/7/2004	Age - 1	PIT	Elastomer
2004	STB	271	2003	10/7/2004	Age - 1	PIT	Elastomer
2005	RNW	868	2004	8/30/2005	Age - 1	PIT	Elastomer
2006	STB	1,005	2005	8/25/2006	Age - 1	PIT	Elastomer
2006	Sand Creek	3	Adults[c]	12/8/2006	Unknown - Adult	PIT	
2007	STB	600	2006	5/9/2007	Age - 1	3rd right scute	Elastomer
2008	STB	600	2007	4/17/2008	Age - 1	PIT	4th left scute
2008	SUN	569	2007	5/8/2008	Age - 1	PIT	3rd and 4th left scute[e]
2008	STB	3,410	2008	9/14/2008	Age - 0	Elastomer[f]	
2009	STB	340	2008	4/13/2009	Age - 1	4th right scute	Elastomer
2009	VER	297	2008	5/28/2009	Age - 1	PIT	4th right scute
2010	VER	491	2009	4/15/2010	Age - 1	PIT	5th Left scute
2010	VER	3	2009	4/15/2010	Age - 1	5th left scute	

2010	VER	144	2009	4/22/2010	Age - 1	PIT	5th left scute
Year	Stocking sitea	Number stocked	Year class	Stocking date	Age at stocking	Primary mark	Secondary mark
2010	VER	210	2009	4/22/2010	Age - 1	5th left scute	Elastomer
2010	VER	12	2004	10/29/2010	Age - 6	Sonic tagg	PIT
2010	VER	1	2004	10/29/2010	Age - 6	PIT	
2010	RNW	12	2004	10/29/2010	Age - 6	Sonic tagg	PIT
2010	RNW	1	2004	10/29/2010	Age - 6	PIT	
2011	VER	220	2010	4/12/2011	Age-1	5th right scute	
2011	VER	75	2010	4/12/2011	Age-1	Elastomer	
2011	RNW	152	2010	4/12/2011	Age-1	5th right scute	
2011	RNW	152	2010	4/12/2011	Age-1	Elastomer	
2011	VER	27	2010	5/13/2011	Age - 1	Sonic tag[g]	PIT
2011	VER	9	2010	5/13/2011	Age - 1	PIT	

[a]Stocking site abbreviation presented in Appendix D.
[b]Stocked for telemetry study by Jordan et al. (2006).
[c] Translocated fish from Lake Sharpe, South Dakota.
[d]Stocked for telemetry study by Wanner et al. (2007c).
[e]Only about 100 fish had wrong scute removed (3rd left) and had correct scute (4th left) also removed.
[f]2008 year class had approximately 300 fish (< 10%) incorrectly tagged with purple elastomer on left and yellow on right.
Yellow last used as year class designation in 2005.
[g]Stocked for catchability/detectability study (Klumb et al. 2011).

Appendix F

Total catch, overall mean catch per unit effort (± 2 SE), and mean CPUE (fish/100 m) by mesohabitat within a macrohabitat for all species caught with each gear type combining the sturgeon (fall through spring) and fish community (summer) seasons for Segments 5 and 6 of the Missouri River during 2012. Species captured are listed alphabetically and their codes are presented in Appendix A. Bold type indicates targeted native Missouri River species and habitat abbreviations and definitions are presented in Appendix B. Standard Error was not calculated when N < 2.

Appendix F1. Gill net catch, relative abundance (CPUE as fish/net night) with variation (± 2 SE in parentheses) river wide and for habitats sampled in Segments 5 and 6 of the Missouri River during 2012.

Species	Total Catch	Overall CPUE	BRAD	CHXO	ISB	OSB
			CHNB	CHNB	CHNB	CHNB
BKBH	1	0.01 (0.02)	0.02 (0.04)	0 (0)	0 (0)	0 (0)
CARP	3	0.03 (0.045)	0 (0)	0 (0)	0.063 (0.125)	0.118 (0.235)
CNCF	22	0.22 (0.202)	0.06 (0.068)	0.647 (1.056)	0.25 (0.387)	0.235 (0.365)
FHCF	2	0.02 (0.028)	0 (0)	0 (0)	0 (0)	0.118 (0.161)
FSMT	5	0.05 (0.059)	0 (0)	0.118 (0.235)	0 (0)	0.176 (0.256)
NTPK	18	0.18 (0.108)	0.14 (0.14)	0.294 (0.374)	0.188 (0.202)	0.176 (0.256)
PATT	2	0.02 (0.028)	0 (0)	0 (0)	0 (0)	0.118 (0.161)
PDFH	1	0.01 (0.02)	0 (0)	0.059 (0.118)	0 (0)	0 (0)
PDSG	**22**	**0.22 (0.112)**	**0.22 (0.131)**	**0.235 (0.365)**	**0 (0)**	**0.412 (0.386)**
QLBK	1	0.01 (0.02)	0 (0)	0 (0)	0 (0)	0.059 (0.118)
RKBS	14	0.14 (0.085)	0.22 (0.154)	0.118 (0.161)	0.063 (0.125)	0 (0)
SGER	**20**	**0.2 (0.124)**	**0.3 (0.223)**	**0.059 (0.118)**	**0.063 (0.125)**	**0.176 (0.256)**
SHRH	38	0.38 (0.155)	0.3 (0.183)	0.294 (0.374)	0.75 (0.428)	0.353 (0.483)
SNGR	2	0.02 (0.028)	0 (0)	0 (0)	0 (0)	0.118 (0.161)
SNSG	**38**	**0.38 (0.216)**	**0.22 (0.208)**	**0.824 (0.771)**	**0.25 (0.387)**	**0.529 (0.71)**
WLYE	16	0.16 (0.12)	0.26 (0.227)	0 (0)	0 (0)	0.176 (0.191)

Species	Total Catch	Overall CPUE	BRAD	CHXO	ISB	OSB
			CHNB	CHNB	CHNB	CHNB
WTBS	1	0.01 (0.02)	0 (0)	0 (0)	0 (0)	0.059 (0.118)

Appendix F2. 1-inch trammel net catch and relative abundance (CPUE as fish/100 m) with variation (± 2 SE in parentheses) river wide and for habitats sampled in Segments 5 and 6 of the Missouri River during 2012.

Species	Total Catch	Overall CPUE	BRAD	CHXO	CONF	ISB	OSB	SCCL
			CHNB	CHNB	CHNB	CHNB	CHNB	CHNB
BUSK	**1**	**0.005 (0.009)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0.024 (0.049)**	**0 (0)**
CARP	22	0.06 (0.038)	0.057 (0.053)	0.167 (0.17)	0.058 (0.116)	0.023 (0.045)	0.013 (0.026)	0 (0)
CNCF	142	0.394 (0.16)	0.391 (0.252)	0.365 (0.202)	0.602 (1.077)	0.15 (0.143)	0.392 (0.424)	0.985 (1.452)
FHCF	8	0.03 (0.026)	0.011 (0.023)	0.016 (0.032)	0 (0)	0 (0)	0.099 (0.122)	0.073 (0.146)
FWDM	3	0.007 (0.01)	0.018 (0.025)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
GDEY	2	0.005 (0.006)	0.005 (0.01)	0 (0)	0 (0)	0.018 (0.036)	0 (0)	0 (0)
GZSD	5	0.015 (0.019)	0.022 (0.035)	0 (0)	0 (0)	0 (0)	0.033 (0.066)	0 (0)
NTPK	9	0.032 (0.022)	0 (0)	0.016 (0.032)	0 (0)	0.088 (0.085)	0.09 (0.094)	0 (0)
PDFH	1	0.004 (0.007)	0 (0)	0 (0)	0 (0)	0.026 (0.052)	0 (0)	0 (0)
PDSG	**16**	**0.05 (0.027)**	**0.046 (0.04)**	**0.04 (0.044)**	**0 (0)**	**0 (0)**	**0.13 (0.109)**	**0 (0)**
QLBK	3	0.008 (0.009)	0.006 (0.012)	0.017 (0.033)	0.058 (0.116)	0 (0)	0 (0)	0 (0)
RKBS	15	0.049 (0.035)	0.081 (0.054)	0 (0)	0 (0)	0 (0)	0.071 (0.143)	0.069 (0.139)
RVCS	10	0.033 (0.023)	0.018 (0.026)	0.111 (0.102)	0 (0)	0.015 (0.03)	0.021 (0.042)	0 (0)
SGER	**29**	**0.074 (0.034)**	**0.168 (0.077)**	**0 (0)**	**0 (0)**	**0.028 (0.057)**	**0 (0)**	**0.069 (0.139)**
SGWE	1	0.003 (0.005)	0 (0)	0 (0)	0 (0)	0 (0)	0.013 (0.027)	0 (0)
SHRH	31	0.099 (0.064)	0.072 (0.056)	0.094 (0.07)	0.068 (0.135)	0.103 (0.118)	0.181 (0.301)	0.053 (0.106)
SMBF	5	0.016 (0.014)	0.023 (0.028)	0.016 (0.031)	0.071 (0.143)	0 (0)	0 (0)	0 (0)

Species	Total Catch	Overall CPUE	BRAD	CHXO	CONF	ISB	OSB	SCCL
			CHNB	CHNB	CHNB	CHNB	CHNB	CHNB
SNGR	6	0.019 (0.02)	0 (0)	0.042 (0.06)	0 (0)	0 (0)	0.042 (0.084)	0.069 (0.139)
SNSG	**46**	**0.12 (0.045)**	**0.197 (0.095)**	**0.06 (0.075)**	**0.109 (0.217)**	**0.031 (0.043)**	**0.037 (0.042)**	**0.281 (0.222)**
WLYE	24	0.066 (0.035)	0.107 (0.076)	0.043 (0.048)	0 (0)	0.063 (0.071)	0 (0)	0.143 (0.187)
WTBS	1	0.004 (0.007)	0.009 (0.018)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Appendix F3. Otter trawl catch and relative abundance (CPUE as fish/100 m) with variation (± 2 SE in parentheses) river wide and for habitats sampled in Segments 5 and 6 of the Missouri River during 2012.

Species	Total Catch	Overall CPUE	BRAD	CHXO	CONF	ISB	OSB	SCCL
			CHNB	CHNB	CHNB	CHNB	CHNB	CHNB
BLGL	1	0.002 (0.004)	0.005 (0.011)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
CARP	19	0.042 (0.023)	0 (0)	0.014 (0.029)	0.129 (0.258)	0.039 (0.043)	0.085 (0.067)	0.212 (0.219)
CNCF	227	0.511 (0.142)	0.579 (0.242)	0.39 (0.201)	0.536 (0.439)	0.143 (0.1)	0.724 (0.487)	0.719 (0.468)
ERSN	2	0.005 (0.007)	0.012 (0.017)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
FHCF	3	0.008 (0.01)	0.015 (0.022)	0 (0)	0 (0)	0.013 (0.026)	0 (0)	0 (0)
FWDM	28	0.06 (0.042)	0.113 (0.09)	0 (0)	0 (0)	0.013 (0.026)	0.056 (0.111)	0.043 (0.085)
GDEY	1	0.002 (0.004)	0 (0)	0 (0)	0 (0)	0 (0)	0.011 (0.022)	0 (0)
JYDR	1	0.002 (0.004)	0.006 (0.011)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NTPK	3	0.006 (0.007)	0 (0)	0 (0)	0 (0)	0.013 (0.026)	0.023 (0.031)	0 (0)
PDSG	**8**	**0.017 (0.013)**	**0.011 (0.021)**	**0.029 (0.041)**	**0 (0)**	**0.013 (0.026)**	**0.033 (0.037)**	**0 (0)**
QLBK	1	0.002 (0.004)	0.005 (0.011)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
RBST	1	0.002 (0.004)	0 (0)	0.014 (0.027)	0 (0)	0 (0)	0 (0)	0 (0)
RKBS	27	0.067 (0.053)	0.146 (0.13)	0 (0)	0 (0)	0.013 (0.026)	0.028 (0.039)	0.042 (0.085)
RVCS	7	0.015 (0.016)	0.033 (0.04)	0 (0)	0 (0)	0 (0)	0.011 (0.022)	0 (0)
SFSN	1	0.002 (0.005)	0.006 (0.012)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Species	Total Catch	Overall CPUE	BRAD	CHXO	CONF	ISB	OSB	SCCL
			CHNB	CHNB	CHNB	CHNB	CHNB	CHNB
SGCB	**1**	**0.002 (0.004)**	**0 (0)**	**0 (0)**	**0 (0)**	**0.013 (0.026)**	**0 (0)**	**0 (0)**
SGER	**27**	**0.061 (0.03)**	**0.076 (0.049)**	**0.042 (0.046)**	**0.043 (0.086)**	**0.026 (0.052)**	**0.086 (0.106)**	**0.042 (0.084)**
SGWE	1	0.002 (0.004)	0.005 (0.011)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SHRH	48	0.104 (0.043)	0.06 (0.043)	0.131 (0.129)	0.055 (0.11)	0.08 (0.087)	0.158 (0.11)	0.31 (0.461)
SMBF	1	0.002 (0.004)	0.005 (0.011)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SMBS	4	0.009 (0.009)	0 (0)	0 (0)	0 (0)	0.039 (0.043)	0.014 (0.029)	0 (0)
SMST	2	0.004 (0.006)	0.005 (0.011)	0.014 (0.028)	0 (0)	0 (0)	0 (0)	0 (0)
SNSG	**15**	**0.035 (0.019)**	**0.033 (0.03)**	**0 (0)**	**0.186 (0.187)**	**0.013 (0.026)**	**0.044 (0.042)**	**0.042 (0.085)**
STCT	3	0.007 (0.008)	0.006 (0.013)	0 (0)	0 (0)	0 (0)	0.023 (0.031)	0 (0)
STSN	1	0.002 (0.004)	0 (0)	0.012 (0.024)	0 (0)	0 (0)	0 (0)	0 (0)
SVCB	79	0.17 (0.082)	0.059 (0.047)	0.249 (0.274)	0 (0)	0.185 (0.123)	0.157 (0.12)	0.975 (1.128)
WLYE	34	0.074 (0.032)	0.022 (0.022)	0.081 (0.068)	0 (0)	0.052 (0.072)	0.18 (0.114)	0.209 (0.28)
WTSK	2	0.004 (0.009)	0 (0)	0 (0)	0 (0)	0.026 (0.053)	0 (0)	0 (0)
YWPH	3	0.006 (0.007)	0 (0)	0.028 (0.039)	0 (0)	0.013 (0.026)	0 (0)	0 (0)

Appendix F4. Mini-fyke net catch and relative abundance (CPUE as fish/net night) with variation (± 2 SE in parentheses) river wide and for habitats sampled in Segments 5 and 6 of the Missouri River during 2012.

Species	Total Catch	Overall CPUE	BRAD	CHXO	CONF	ISB	OSB	SCCL	SCCS	SCN	TRMS
			BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS
BKBH	7	0.088 (0.081)	0.094 (0.138)	0 (0)	0 (0)	0.091 (0.182)	0.083 (0.167)	0 (0)	0 (0)	0 (0)	1 (2)
BKCP	290	3.625 (2.813)	3.844 (3.377)	11 (17.766)	1 (2)	0.909 (0.989)	0.5 (0.522)	5 (7.024)	1 (1.155)	2 (4)	2 (2)
BLGL	251	3.138 (1.758)	2.594 (3.286)	6.273 (7.136)	2 (3.367)	0.273 (0.282)	1.75 (1.877)	8.333 (10.914)	8.333 (3.712)	4.5 (9)	4 (4)
BMBF	7	0.088 0.095)	0.219 (0.233)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
BMSN	1	0.013 (0.025)	0.031 (0.063)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
BNMW	67	0.838 (1.204)	1.75 (2.993)	0.364 (0.557)	0 (0)	0 (0)	0.167 (0.225)	0 (0)	0 (0)	1.5 (3)	1 (2)
BSMW	**1**	**0.013 (0.025)**	**0.031 (0.063)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**
CARP	79	0.988 (0.471)	2.094 (1.049)	0.273 (0.282)	0.5 0.577	0.182 (0.364)	0.083 (0.167)	0.333 (0.667)	0.667 (1.333)	0 (0)	0.5 (1)
CKCB	1	0.013 (0.025)	0.031 (0.063)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
CNCF	3	0.038 (0.043)	0.031 (0.063)	0 (0)	0.25 0.5	0 (0)	0 (0)	0 (0)	0 (0)	0.5 (1)	0 (0)
ERSN	1115	13.938 (12.294)	2.625 (4.994)	16.455 (19.378)	119.5 217.129	21.545 30.285	2.083 3.325	27.667 (42.526)	9 (8.083)	0 (0)	0 (0)
FHCB	2	0.025 (0.05)	0.063 (0.125)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
FHMW	2	0.025 (0.035)	0.063 (0.087)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
FSMT	55	0.688 (0.402)	0.281 (0.224)	2.636 (1.987)	0 (0)	0 (0)	0.5 (0.461)	0 (0)	0.333 (0.667)	4.5 (9)	0.5 (1)
FWDM	16	0.2 (0.262)	0.156 (0.203)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.333 (0.667)	5 (10)	0 (0)
GDSN	1	0.013 (0.025)	0 (0)	0 (0)	0 (0)	0 (0)	0.083 (0.167)	0 (0)	0 (0)	0 (0)	0 (0)

Species	Total Catch	Overall CPUE	BRAD	CHXO	CONF	ISB	OSB	SCCL	SCCS	SCN	TRMS
			BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS	BARS
GNSF	16	0.2 (0.199)	0.469 (0.483)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.5 (1)
GZSD	3	0.038 (0.043)	0.031 (0.063)	0.091 (0.182)	0.25 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
JYDR	48	0.6 (0.42)	1.094 (0.952)	0.727 (1.115)	0 (0)	0.091 (0.182)	0.25 (0.261)	0 (0)	0 (0)	0 (0)	0.5 (1)
LMBS	66	0.825 (0.306)	1.125 (0.529)	0.364 (0.304)	0.25 (0.5)	0.455 (0.625)	0.333 (0.512)	1.667 (2.404)	2.667 (3.333)	1.5 (3)	0 (0)
NTPK	5	0.063 (0.082)	0.094 (0.188)	0.091 (0.182)	0 (0)	0.091 (0.182)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
OSSF	3	0.038 (0.056)	0.094 (0.138)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
PATT	6	0.075 (0.069)	0.156 (0.158)	0.091 (0.182)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
RDSN	10	0.125 (0.135)	0.25 (0.324)	0 (0)	0.25 (0.5)	0.091 (0.182)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
RKBS	25	0.313 (0.136)	0.219 (0.174)	0.545 (0.495)	0 (0)	0.364 (0.488)	0.417 (0.386)	0.667 (0.667)	0 (0)	0.5 (1)	0 (0)
RVCS	588	7.35 (3.591)	12.281 (6.622)	1.364 (1.624)	7.5 (8.699)	5.545 (9.721)	0.333 (0.376)	2.333 (0.667)	25.667 (48.364)	0 0	0.5 (1)
SFSN	708	8.85 (4.61)	14.281 (10.26)	2.182 (1.568)	6.25 (11.177)	2.182 (2.137)	4.25 (4.425)	23.667 (41.349)	18 (14)	0.5 (1)	0.5 (1)
SGER	**6**	**0.075 (0.059)**	**0.125 (0.119)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0.333 (0.667)**	**0.5 (1)**	**0 (0)**
SHRH	44	0.55 (0.436)	0.281 (0.185)	1.545 (2.715)	0.5 (1)	0.273 (0.39)	0.167 (0.225)	1 (2)	0 (0)	0 (0)	4 (8)
SMBF	25	0.313 (0.243)	0.563 (0.499)	0.455 (0.909)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2)
SMBS	179	2.238 (0.585)	1.563 (0.837)	3.091 (1.896)	0.75 (0.957)	3.727 (1.708)	2.333 (1.189)	1.667 (2.404)	3 (5.033)	1 (2)	3.5 (7)
SMST	2	0.025 (0.035)	0.031 (0.063)	0 (0)	0 (0)	0.091 (0.182)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SNGR	32	0.4 (0.215)	0.406 (0.38)	0.182 (0.244)	2.25 (1.708)	0.182 (0.244)	0.083 (0.167)	0.333 (0.667)	0.333 (0.667)	1.5 (3)	0 (0)
SNPT	6	0.075 (0.078)	0.094 (0.138)	0 (0)	0 (0)	0 (0)	0.167 (0.333)	0 (0)	0 (0)	0.5 (1)	0 (0)
SNSN	**106**	**1.325 (0.978)**	**2.813 (2.322)**	**0.455 (0.909)**	**1 (1.414)**	**0.091 (0.182)**	**0 (0)**	**0.333 (0.667)**	**0 (0)**	**0 (0)**	**2.5 (5)**

Species	Total Catch	Overall CPUE	BRAD BARS	CHXO BARS	CONF BARS	ISB BARS	OSB BARS	SCCL BARS	SCCS BARS	SCN BARS	TRMS BARS
SNST	3	0.038 (0.043)	0.031 (0.063)	0.091 (0.182)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.5 (1)	0 (0)
STCT	7	0.088 (0.089)	0.219 (0.215)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
STSN	18	0.225 (0.128)	0.219 (0.233)	0.455 (0.415)	0 (0)	0.455 (0.415)	0.083 (0.167)	0 (0)	0 (0)	0 (0)	0 (0)
UCS	1	0.013 (0.025)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.5 (1)
UCY	1	0.013 (0.025)	0 (0)	0 (0)	0 (0)	0 (0)	0.083 (0.167)	0 (0)	0 (0)	0 (0)	0 (0)
ULP	71	0.888 (1.775)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	35.5 (71)
UST	3	0.038 (0.043)	0.094 (0.105)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
WLYE	1	0.013 (0.025)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.5 (1)	0 (0)
WTBS	16	0.2 (0.199)	0.156 (0.203)	0 (0)	0.75 (0.957)	0 (0)	0.667 (1.163)	0 (0)	0 (0)	0 (0)	0 (0)
WTSK	5	0.063 (0.065)	0 (0)	0.091 (0.182)	0 (0)	0.091 (0.182)	0.167 (0.333)	0 (0)	0 (0)	0 (0)	0.5 (1)
YWPH	114	1.425 (1.722)	2.156 (3.929)	3 (5.215)	0.5 (1)	0.182 (0.244)	0.417 (0.575)	0.333 (0.667)	0.333 (0.667)	0 (0)	0.5 (1)

Appendix F5. Trot line catch and relative abundance (CPUE as fish/20 hook nights) with variation (± 2 SE in parentheses) river wide and for habitats sampled in Segments 5 and 6 of the Missouri River during 2012.

Species	Total Catch	Overall CPUE	BRAD	CHXO	CONF	ISB	OSB	SCCL
			CHNB	CHNB	CHNB	CHNB	CHNB	CHNB
BKBH	1	0.013 (0.025)	0.031 (0.063)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
CARP	1	0.013 (0.025)	0 (0)	0.071 (0.143)	0 (0)	0 (0)	0 (0)	0 (0)
CNCF	72	0.9 (0.253)	0.563 (0.335)	1.143 (0.354)	1.25 (1.893)	0.9 (0.554)	1.125 (0.655)	1.5 (2.38)
FHCF	1	0.013 (0.025)	0.031 (0.063)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
FWDM	10	0.125 (0.109)	0.219 (0.233)	0.071 (0.143)	0 (0)	0 (0)	0 (0)	0.5 (1)
PDSG	**27**	**0.338 (0.174)**	**0.656 (0.377)**	**0.214 (0.309)**	**0.25 (0.5)**	**0 0**	**0.125 (0.171)**	**0 (0)**
RKBS	1	0.013 (0.025)	0.031 (0.063)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SHRH	6	0.075 (0.059)	0.031 (0.063)	0.143 (0.194)	0.25 (0.5)	0.2 (0.267)	0 (0)	0 (0)
SNSG	**14**	**0.175 (0.099)**	**0.281 (0.205)**	**0 (0)**	**0 (0)**	**0.1 (0.2)**	**0.25 (0.224)**	**0 (0)**
STCT	3	0.038 (0.043)	0.094 (0.105)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SVCB	1	0.013 (0.025)	0.031 (0.063)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
WLYE	2	0.025 (0.035)	0.031 (0.063)	0 (0)	0 (0)	0.1 (0.2)	0 (0)	0 (0)

Appendix G. Hatchery names, locations and abbreviations.

Hatchery	State	Abbreviation
Blind Pony State Fish Hatchery	MO	BYP
Neosho National Fish Hatchery	MO	NEO
Gavins Point National Fish Hatchery	SD	GAV
Garrison Dam National Fish Hatchery	ND	GAR
Miles City State Fish Hatchery	MT	MCH
Blue Water State Fish Hatchery	MT	BLU
Bozeman Fish Technology Center	MT	BFT
Fort Peck State Fish Hatchery	MT	FPH

Appendix H. Alphabetic list of Missouri River fishes with total catch per unit effort by gear type for the sturgeon (fall through spring) and the fish community (summer) seasons during 2012 for Segments 5 and 6 of the Missouri River. Species codes are located in Appendix A. Bold type denotes targeted native Missouri River species.

Species Code	Sturgeon Season				Fish Community Season		
	1-inch trammel net	Gill net	Otter trawl	Trot lines	1-inch trammel net	Mini-Fyke Net	Otter trawl
BKBH	0	0.010	0	0.013	0	0.088	0
BKCP	0	0	0	0	0	3.625	0
BLGL	0	0	0	0	0	3.138	0.004
BMBF	0	0	0	0	0	0.088	0
BMSN	0	0	0	0	0	0.013	0
BNMW	0	0	0	0	0	0.838	0
BSMW	**0**	**0**	**0**	**0**	**0**	**0.013**	**0**
BUSK	**0**	**0**	**0**	**0**	**0.009**	**0**	**0**
CARP	0.074	0.030	0.079	0.013	0.047	0.988	0.004
CKCB	0	0	0	0	0	0.013	0
CNCF	0.470	0.220	0.599	0.900	0.317	0.038	0.422
ERSN	0	0	0.009	0	0	13.938	0
FHCB	0	0	0	0	0	0.025	0
FHCF	0.050	0.020	0.016	0.013	0.009	0	0
FHMW	0	0	0	0	0	0.025	0
FSMT	0	0.050	0	0	0	0.688	0
FWDM	0.006	0	0	0.125	0.008	0.200	0.120
GDEY	0.005	0	0.004	0	0.004	0	0
GDSN	0	0	0	0	0	0.013	0
GNSF	0	0	0	0	0	0.200	0
GZSD	0	0	0	0	0.030	0.038	0
JYDR	0	0	0.004	0	0	0.600	0
LMBS	0	0	0	0	0	0.825	0
NTPK	0.064	0.180	0.013	0	0	0.063	0
OSSF	0	0	0	0	0	0.038	0

Species Code	Sturgeon Season				Fish Community Season		
	1-inch trammel net	Gill net	Otter trawl	Trot lines	1-inch trammel net	Mini-Fyke Net	Otter trawl
PATT	0	0.020	0	0	0	0.075	0
PDFH	0	0.010	0	0	0.007	0	0
PDSG	**0.043**	**0.220**	**0.025**	**0.338**	**0.057**	**0**	**0.009**
QLBK	0.016	0.010	0	0	0	0	0.004
RBST	0	0	0.004	0	0	0	0
RDSN	0	0	0	0	0	0.125	0
RKBS	0.094	0.140	0.134	0.013	0.005	0.313	0
RVCS	0.065	0	0.004	0	0	7.350	0.026
SFSN	0	0	0.005	0	0	8.850	0
SGCB	**0**	**0**	**0**	**0**	**0**	**0**	**0.004**
SGER	**0.124**	**0.200**	**0.049**	**0**	**0.025**	**0.075**	**0.074**
SGWE	0	0	0	0	0.005	0	0.004
SHRH	0.138	0.380	0.126	0.075	0.061	0.550	0.083
SMBF	0.022	0	0	0	0.009	0.313	0.004
SMBS	0	0	0	0	0	2.238	0.018
SMST	0	0	0	0	0	0.025	0.009
SNGR	0.038	0.020	0	0	0	0.400	0
SNPT	0	0	0	0	0	0.075	0
SNSG	**0.118**	**0.380**	**0.052**	**0.175**	**0.122**	**0**	**0.018**
SNSN	**0**	**0**	**0**	**0**	**0**	**1.325**	**0**
SNST	0	0	0	0	0	0.038	0
STCT	0	0	0.014	0.038	0	0.088	0
STSN	0	0	0	0	0	0.225	0.004
SVCB	0	0	0.144	0.013	0	0	0.196
UCS	0	0	0	0	0	0.013	0
UCY	0	0	0	0	0	0.013	0
ULP	0	0	0	0	0	0.888	0
UST	0	0	0	0	0	0.038	0
WLYE	0.114	0.160	0.028	0.025	0.019	0.013	0.121
WTBS	0.007	0.010	0	0	0	0.200	0

Species Code	Sturgeon Season				Fish Community Season		
	1-inch trammel net	Gill net	Otter trawl	Trot lines	1-inch trammel net	Mini-Fyke Net	Otter trawl
WTSK	0	0	0.009	0	0	0.063	0
YWPH	0	0	0	0	0	1.425	0.013

Appendix I. Comprehensive list of bend numbers (randomly selected) and corresponding bend river miles for Segments 5 and 6 of the Missouri River sampled from 2003-2012 during the sturgeon (ST) and fish community (FC) seasons.

Segment-bend number	Bend river mile	Year									
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
5 - 1	880.0										
5 - 2	878.9						ST, FC				
5 - 3	875.7			FC				ST, FC			ST, FC
5 - 4	873.2		ST				ST, FC				
5 - 5	871.9		ST			ST	ST, FC				
5 - 6	870.7	ST, FC	FC		ST, FC	ST, FC			ST, FC		ST, FC
5 - 7	869.2	ST, FC	ST, FC	ST, FC	ST, FC	ST, FC					
5 - 8	865.7				ST, FC				ST, FC		
5 - 9	864.4								ST, FC		
5 - 10	863.2	ST, FC	ST	ST		ST, FC		ST, FC			
5 - 11	861.5	ST (W)		FC	ST, FC	ST, FC					
5 - 12	853.0		ST, FC	ST,FC				ST, FC	ST, FC		
5 - 13	851.7	ST (W)	FC								
5 - 14	851.0				ST, FC		ST, FC				ST, FC
5 - 15	849.5	ST, FC	ST	ST				ST, FC	ST, FC		ST, FC
5 - 16	847.9	ST (W)	ST	FC	(W)	ST, FC	ST, FC				ST, FC
5 - 17	845.5	ST, FC	FC	ST				ST, FC			
6 - 1	844.0		ST, FC	ST	ST,FC	ST, FC		ST, FC			ST, FC
6 - 2	843.2	ST, FC	ST	ST		ST					
6 - 3	842.5	ST (W)	FC				ST, FC				
6 - 4	841.2	ST, FC	ST,FC	ST, FC	ST, FC				ST, FC		ST, FC
6 - 5	840.3	ST, FC	ST,FC	ST					ST, FC		
6 - 6	836.9	ST, FC	ST		ST, FC	ST, FC		ST, FC			ST, FC
6 - 7	834.9	ST (W)	ST	ST, FC	ST, FC	ST, FC	ST, FC		ST, FC		ST, FC
6 - 8	832.5	ST, FC		FC	ST, FC	ST, FC		ST, FC	ST, FC		

Segment-bend number	Bend river mile	Year									
		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
6 - 9	830.5	ST (W)	ST,FC	FC			ST, FC		ST, FC		
6 - 10	829.5	ST (W)		FC			ST, FC	ST, FC			
6 - 11	828.5	ST (W)				ST, FC	ST, FC	ST, FC			ST, FC

Appendix J. Amended pallid sturgeon length and weights at stocking and recapture, with recalculated growth rates and relative condition factors ($K_{n,}$) for 2003-2008 reports in Segments 5 and 6 of the Missouri River. Additional report (2009-2010) data provided for reference and continuity. Condition was recalculated using a new weight-length relation specific for the Missouri River presented in Shuman et al. (2011); whereas, previous reports used the equation from Keenlyne and Evenson (1993).

		Stocking data			Recapture data			Growth	
Year class	N	Length (mm)	Weight (g)	K_n	Length (mm)	Weight (g)	K_n	Length (mm/d)	Weight (g/d)
					2003				
1997	26	532	654.2	1.249	647	810.5	0.804	0.099	0.134
		(12)	(52.3)	(0.094)	(13)	(53.9)	(0.024)	(0.013)	(0.040)
1998	3	499	459.7	1.029	566	530.3	0.794	0.062	0.066
		(69)	(222.3)	(0.101)	(75)	(256.6)	(0.083)	(0.027)	(0.094)
1999	6	465	426.0	1.213	514	429.2	0.866	0.108	0.023
		(40)	(126.5)	(0.248)	(64)	(151.3)	(0.033)	(0.077)	(0.207)
2001	6	210			392	187.0	0.958	0.374	
		(16)			(25)	(37.7)	(0.042)	(0.065)	
2002	1	294	91.0	1.220	385	143.0	0.789	1.000	0.571
					2004				
1997	8	554	705.0	1.158	656	857.0	0.803	0.075	0.114
		(17)	(118.7)	(0.107)	(21)	(156.3)	(0.090)	(0.016)	(0.122)
1998	1	487	491.0	1.249	546	420.0	0.733	0.045	-0.054
1999	6	477	518.5	1.293	540	477.7	0.851	0.101	-0.080
		(52)	(173.2)	(0.199)	(45)	(102.5)	(0.052)	(0.026)	(0.122)
2001	3	213			402	204.3	0.926	0.238	
		(7)			(58)	(121.7)	(0.144)	(0.067)	
2002	3	234	51.7	1.421	350	132.9	0.992	0.318	0.219
		(24)	(18.7)	(0.082)	(27)	(31.9)	(0.060)	(0.103)	(0.057)
					2005				
1997	3	558	806.7	1.296	664	1034.0	0.932	0.058	0.125
		(30)	(183.3)	(0.059)	(70)	(349.5)	(0.074)	(0.025)	(0.096)
1998	2	508	484.5	1.076	580	530.0	0.759	0.043	0.028
		(3)	(7.0)	(0.005)	(10)	(20.0)	(0.072)	(0.001)	(0.135)
1999	2	426	266.5	1.023	470	385.0	1.026	0.045	0.127
		(64)	(147.0)	(0.072)	(79)	(330.0)	(0.366)	(0.021)	(0.203)
2001	8	182			465	349.4	0.932	0.202	
		(10)			(59)	(171.8)	(0.073)	(0.016)	

Year class	N	Stocking data			Recapture data			Growth	
		Length (mm)	Weight (g)	K_n	Length (mm)	Weight (g)	K_n	Length (mm/d)	Weight (g/d)
					2005				
2002	7	235	52.0	1.424	449	325.0	1.021	0.289	0.364
		(16)	(12.2)	(0.058)	(63)	(23.7)	(0.126)	(0.056)	(0.148)
2003	10	332	157.8	1.322	415	222.5	0.910	0.252	0.187
		(32)	(43.5)	(0.099)	(39)	(66.8)	(0.088)	(0.058)	(0.137)
2004	7	302	111.1	1.362	351	145.0	1.082	1.249	0.871
		(11)	(13.3)	(0.055)	(11)	(18.3)	(0.090)	(0.086)	(0.389)
					2006				
1997	7	498	532.7	1.176	688	1095.7	0.889	0.088	0.262
		(55)	(185.4)	(0.161)	(19)	(112.8)	(0.050)	(0.024)	(0.098)
1999	1	393	200.0	1.03	606	710.0	0.879	0.140	0.335
2001	11	210			542	516.4	0.916	0.224	
		(15)			(20)	(58.8)	(0.033)	(0.023)	
2002	8	253	68.4	1.49	498	401.0	0.933	0.226	0.306
		(19)	(13.0)	(0.21)	(34)	(72.1)	(0.056)	(0.030)	(0.060)
2003	4	308	121.5	1.30	413	215.0	0.933	0.206	0.182
		(52)	(62.3)	(0.17)	(26)	(38.7)	(0.052)	(0.022)	(0.057)
2004	8	278	89.4	1.41	348	126.9	0.978	0.321	0.158
		(16)	(16.1)	(0.09)	(19)	(17.7)	(0.074)	(0.133)	(0.089)
					2007				
1997	9	543	681.7	1.19	755	1526.1	0.897	0.084	0.333
		(38)	(134.2)	(0.11)	(49)	(310.1)	(0.070)	(0.022)	(0.133)
1998	2	472	331.0	0.88	554	765.0	1.377	0.033	0.174
		(90)	(254.0)	(0.16)	(87)	(200.0)	(1.024)	(0.000)	(0.177)
1999	1	453	328.0	1.06	593	725.0	0.964	0.084	0.239
2001	10	224			521	458.0	0.915	0.169	
		(14)			(29)	(79.3)	(0.043)	(0.021)	
2002	17	243	57.6	1.38	501	432.4	0.970	0.185	0.272
		(12)	(10.2)	(0.10)	(24)	(71.1)	(0.043)	(0.017)	(0.051)
2003	17	319	127.2	1.26	490	386.5	0.939	0.179	0.269
		(19)	(21.7)	(0.06)	(23)	(51.7)	(0.044)	(0.013)	(0.041)
2004	20	294	103.3	1.33	435	255.5	0.891	0.212	0.223
		(15)	(15.8)	(0.09)	(23)	(49.3)	(0.091)	(0.035)	(0.058)
2005	12	322	147.1	1.45	396	209.5	1.024	0.230	0.180

Year class	N	Stocking data			Recapture data			Growth	
		Length (mm)	Weight (g)	K_n	Length (mm)	Weight (g)	K_n	Length (mm/d)	Weight (g/d)
		(23)	(33.6)	(0.11)	(26)	(49.7)	(0.074)	(0.044)	(0.102)
					2007				
2006	8	189	26.7	1.54	321	94.4	0.94	0.854	0.437
		(5)	(2.7)	(0.29)	(10)	(16.0)	(0.110)	(0.068)	(0.103)
					2008				
1997	12	534	630.1	1.169	792	1959.6	0.975	0.089	0.458
		(21)	(86.4)	(0.119)	(42)	(360.4)	(0.045)	(0.010)	(0.108)
1998	1	427	212.0	0.832	677	1000.0	0.86	0.087	0.275
		.	.		.	.	.	.	.
2001	19	194	.	.	616	803.4	0.935	0.184	.
		(12)		.	(23)	(80.3)	(0.041)	(0.018)	.
2002	21	251	60.2	1.333	540	522.1	0.913	0.159	0.250
		(12)	(8.0)	(0.052)	(21)	(79.8)	(0.046)	(0.013)	(0.043)
2003	10	318	126.0	1.232	523	452.5	0.908	0.163	0.257
		(30)	(34.0)	(0.051)	(20)	(55.5)	(0.063)	(0.016)	(0.033)
2004	12	322	136.3	1.326	480	342.8	0.893	0.150	0.198
		(18)	(26.1)	(0.094)	(24)	(57.7)	(0.040)	(0.025)	(0.060)
2005	11	313	126.3	1.349	446	259.5	0.869	0.216	0.217
		(20)	(25.5)	(0.098)	(21)	(46.7)	(0.101)	(0.057)	(0.104)
2006	1				392	190	0.988		
2007	5	262	61.0	1.130	305	106.4	0.985	0.132	-.279
		(26)	(29.7)	(0.186)	(84)	(104.2)	(0.451)	(0.053)	(1.053)
					2009				
1997	16	541	684.9	1.203	816	1978.4	0.894	0.086	0.405
		(18)	(107.3)	(0.129)	(38)	(274.4)	(0.022)	(0.012)	(0.084)
1998	3	460	309.3	0.915	540	515.0	0.932	0.026	0.065
		(37)	(150.7))	(0.179)	(30)	(50.0)	(0.077)	(0.001)	(0.030)
1999	4	426	258.3	0.98	653	933.3	0.888	0.090	0.267
		(41)	(101)	(0.127)	(44)	(228.6)	(0.070)	(0.015)	(0.059)
2001	27	203	.	.	608	784.0	0.927	0.155	.
		(11)	.	.	(23)	(92.0)	(0.023)	(0.017)	.
2002	21	252	62.2	1.361	588	687.9	0.918	0.166	0.311
		(10)	(7.7)	(0.053)	(23)	(88.5)	(0.027)	(0.011)	(0.042)
2003	18	322	126.6	1.232	521	443.1	0.896	0.124	0.198
		(12)	(14.9)	(0.033)	(16)	(39.6)	(0.022)	(0.014)	(0.029)
2004	31	296	106.8	1.409	487	373.7	0.934	0.136	0.188

Year class	N	Stocking data			Recapture data			Growth	
		Length (mm)	Weight (g)	K_n	Length (mm)	Weight (g)	K_n	Length (mm/d)	Weight (g/d)
		(10)	(7.1)	(0.075)	(14)	(35.8)	(0.027)	(0.013)	(0.025)
					2009				
2005	22	315	132.8	1.358	457	305.4	0.947	0.143	0.175
		(14)	(22.1)	(0.080)	(16)	(31.8)	(0.031)	(0.020)	(0.034)
2006	8	189	26.7	1.54	454	297.1	0.933	0.334	0.339
		(5)	(2.7)	(0.29)	(23)	(54.6)	(0.067)	(0.024)	(0.061)
2007	5	231	40.0	1.075	402	199.0	0.949	0.465	0.441
		(25)	(22.3)	(0.311)	(14)	(22.7)	(0.025)	(0.148)	(0.167)
2008	3	263	55.0	1.059	299	87.3	1.058	0.473	0.193
		(22)	(14.0)	(0.021)	(42)	(41.3)	(0.122)	(0.176)	(0.540)
					2010				
1997	6	560	699.4	1.120	858	2304.2	0.893	0.089	0.487
		(5)	(71.9)	(0.096)	(68)	(500.6)	(0.049)	(0.015)	(0.121)
1998	2	425	200.5	0.799	654	1020.0	0.957	0.066	0.235
		(4)	(7.0)	(0.003)	(179)	(710.0)	(0.173)	(0.047)	(0.190)
1999	2	388	147	0.790	595	665.0	0.875	0.070	0.176
		(0)	(0)	(0)	(0)	(30.0)	(0.039)	(0.001)	(0.007)
2001	19	206			597	747.1	0.946	0.132	
		(19)			(33)	(120.8)	(0.063)	(0.017)	
2002	17	247	62.3	1.428	566	621.5	0.945	0.125	0.211
		(13)	(10.6)	(0.069)	(22)	(81.1)	(0.024)	(0.008)	(0.027)
2003	10	337	154.5	1.281	544	532.7	0.926	0.102	0.185
		(27)	(35.7)	(0.121)	(28)	(86.6)	(0.030)	(0.012)	(0.040)
2004	24	298	112.1	1.413	505	431.5	0.969	0.120	0.184
		(9)	(12.2)	(0.062)	(9)	(26.1)	(0.031)	(0.006)	(0.015)
2005	28	312	130.1	1.404	496	401.6	0.950	0.135	0.202
		(14)	(17.9)	(0.065)	(14)	(32.8)	(0.031)	(0.014)	(0.027)
2006	8	189	26.7	1.54	500	430.6	1.001	0.236	0.305
		(5)	(2.7)	(0.29)	(12)	(42.9)	(0.067)	(0.005)	(0.026)
2007	8	245	55.6	1.299	461	328.1	0.953	0.274	0.339
		(34)	(18.5)	(0.191)	(49)	(89.5)	(0.058)	(0.032)	(0.104)
2008	7	330	112.0	1.026	415	220.0	0.927	0.286	0.393
					(28)	(46.4)	(0.030)		
2009	7	294	96.8	1.283	273	84.0	1.304	0.448	0.348
		(13)	(21.5)	(0.120)	(54)	(39.3)	(0.175)	(0.142)	(0.122)
					2011				
1997	3	561	703	1.122	837	2170.0	0.904	0.081	0.453

Year class	N	Stocking data			Recapture data			Growth	
		Length (mm)	Weight (g)	K_n	Length (mm)	Weight (g)	K_n	Length (mm/d)	Weight (g/d)
		(11)	(160.0)	(0.184)	(118)	(927.1)	(0.054)	(0.130)	(0.319)
					2011				
1998	1	427	212	0.832	736	1575	0.913	0.087	0.352
2001	12	203			630	900.4	0.955	0.136	
		(37)			(35.8)	(166.3)	(0.027)	(0.029)	
2002	13	233	46.3	1.309	611	768.2	0.925	0.134	0.257
		(11)	(6.8)	(0.082)	(30)	(111.8)	(0.087)	(0.012)	(0.042)
2003	4	301	107.8	1.339	534	528.0	0.986	0.097	0.176
		(13)	(5.7)	(0.120)	(41)	(114.7)	(0.084)	(0.014)	(0.047)
2004	8	293	109.1	1.458	551	556.3	0.954	0.126	0.218
		(17.5)	(20.3)	(0.111)	(32)	(70.2)	(0.122)	(0.016)	(0.035)
2005	10	330	151.1	1.393	540	506.7	0.923	0.125	0.212
		(14)	(15.8)	(0.156)	(25)	(48.6)	(0.076)	(0.017)	(0.032)
2006	4	189	26.7	1.54	558	532.5	0.866		
		(5)	(2.7)	(0.29)	(20)	(86.6)	(0.121)		
2007	9	246	53.5	1.257	537	463.9	0.867	0.257	0.370
		(13)	(11.5)	(0.109)	(36)	(62.1)	(0.113)	(0.038)	(0.069)
2008	4				492	300.5	0.744		
					(38)	(72.4)	(0.163)		
2009	4	283	84.5	1.232	379	158.8	0.910	0.342	0.263
		(30)	(35.0)	(0.121)	(23)	(36.1)	(0.074)	(0.225)	(0.174)

* Mean length and weight at stocking derived from subsample of fish measured at tagging. All other year classes had passive integrated transponder (PIT) tags enabling growth rate calculations for individual fish. The 2006, 2008, and 2009 year classes had 0%, 8%, and 75% of the fish inserted with PIT tags respectively when stocked (Appendix E).

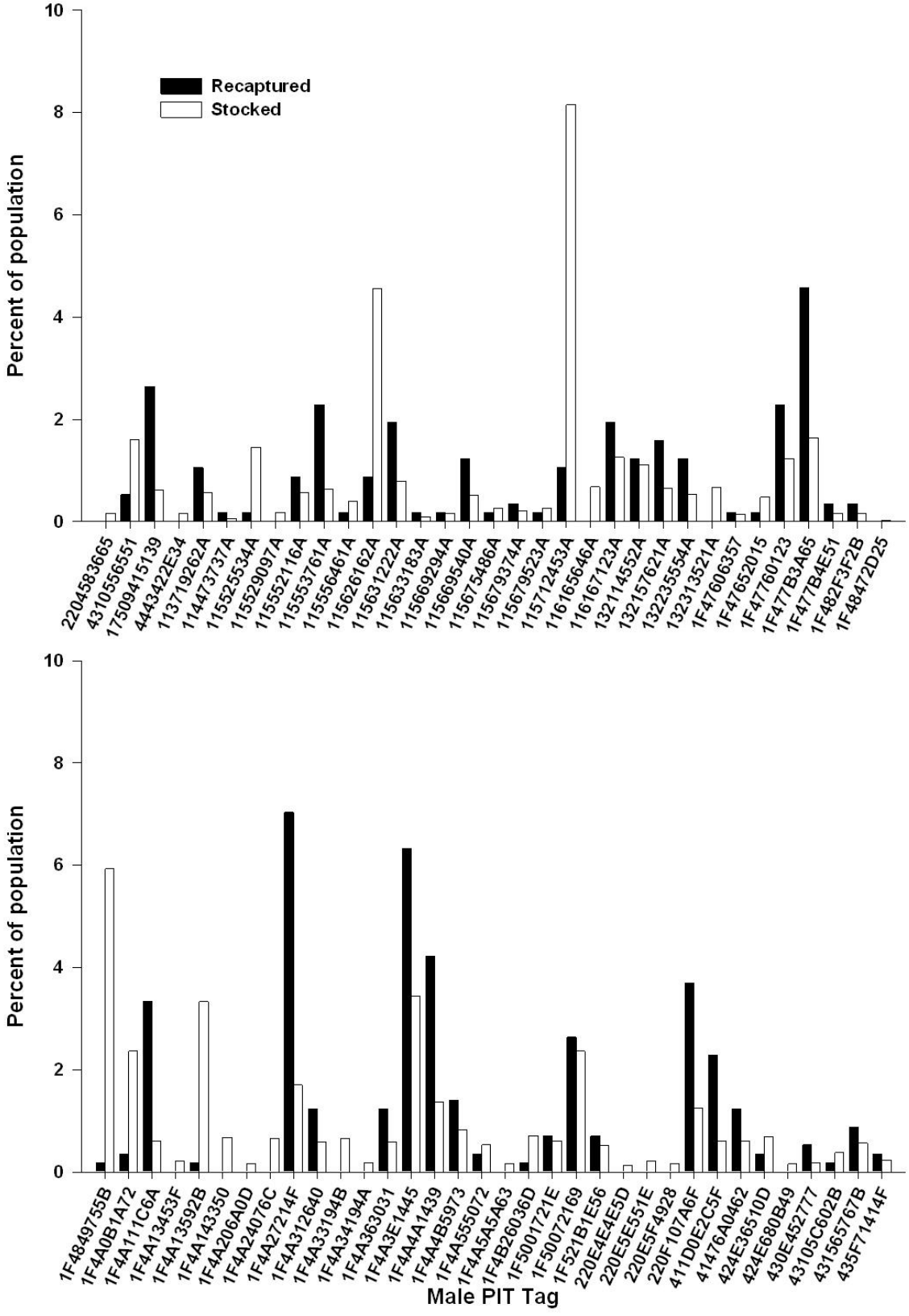
Appendix K. Total number individual fish stocked and recaptured and percent of stocked fish recaptured from each parental male in RPMA 3 during 2003-2012. Duplicate captures of individual fish were removed.

MALE	Year Class	Total number Stocked	Total number recaptured	Percent of stocked recaptured
2204583665	2007	19		0.0
4310556551	2006	158	3	1.9
4310556551	2008	26		0.0
17509415139	2001	70	15	21.4
4443422E34	2007	19		0.0
113719262A	1999	65	6	9.2
114473737A	2004	6	1	16.7
115525534A	2007	72		0.0
115525534A	2009	95	1	1.1
115529097A	2007	20		0.0
115552116A	2004	26	3	11.5
115552116A	2007	39	2	5.1
115553761A	2005	73	13	17.8
115556461A	2007	45	1	2.2
115626162A	2008	500	5	1.0
115626162A	2009	22		0.0
115631222A	2001	71	11	15.5
115631222A	2007	20		0.0
115633183A	2005	10	1	10.0
115669294A	2007	19		0.0
115669540A	2003	59	7	11.9
115675486A	2003	30	1	3.3
115679374A	2004	24	2	8.3
115679523A	2009	29	1	3.4
115712453A	2007	19		0.0
115712453A	2008	916	6	0.7
116165646A	2010	78		0.0
116167123A	2002	121	10	8.3
116167123A	2004	23	1	4.3
132114552A	2003	55	6	10.9
132114552A	2007	73	1	1.4
132157621A	2003	55	7	12.7
132157621A	2007	19	2	10.5
132235554A	2004	61	7	11.5
132313521A	2010	76		0.0
1F47606357	2004	17	1	5.9
1F47652015	2007	55	1	1.8
1F47760123	1998	49	5	10.2
1F47760123	2003	92	8	8.7
1F477B3A65	2002	120	17	14.2

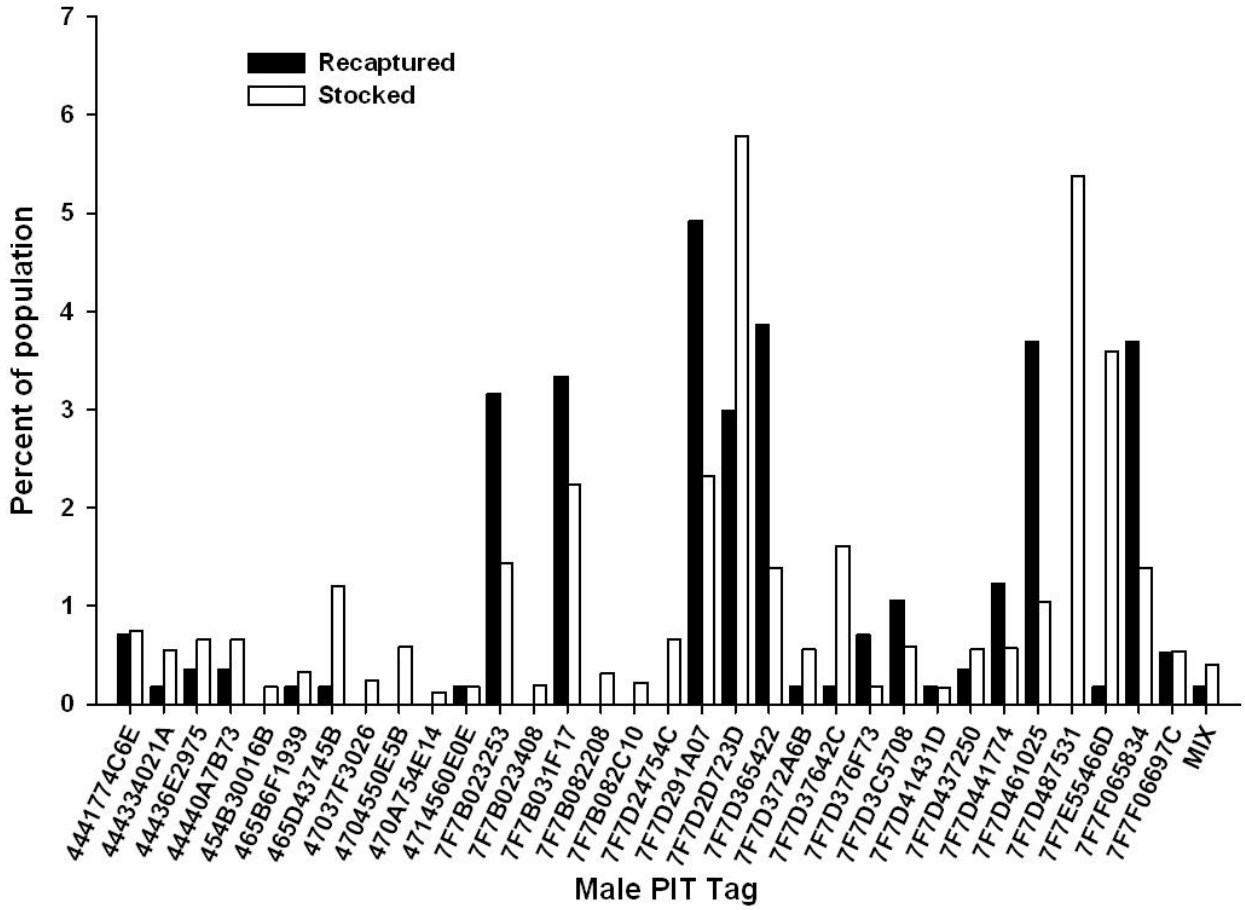
MALE	Year Class	Total number Stocked	Total number recaptured	Percent of stocked recaptured
1F477B3A65	2004	26	6	23.1
1F477B3A65	2009	42	3	7.1
1F477B4E51	2007	19	2	10.5
1F482F3F2B	2005	19	2	10.5
1F48472D25	2009	3		0.0
1F4849755B	2008	680	1	0.1
1F4A0B1A72	2006	271	2	0.7
1F4A111C6A	2001	70	19	27.1
1F4A13453F	2009	25		0.0
1F4A13592B	2008	382	1	0.3
1F4A143350	2010	77		0.0
1F4A206A0D	2007	19		0.0
1F4A24076C	2010	75		0.0
1F4A27214F	2001	70	18	25.7
1F4A27214F	2002	120	21	17.5
1F4A27214F	2004	5	1	20.0
1F4A312640	2004	67	7	10.4
1F4A33194B	2010	75		0.0
1F4A34194A	2007	20		0.0
1F4A363031	1998	49	7	14.3
1F4A363031	2007	19		0.0
1F4A3E1445	2004	394	36	9.1
1F4A4A1439	1997	156	24	15.4
1F4A4B5973	2001	70	8	11.4
1F4A4B5973	2004	25		0.0
1F4A555072	2009	61	2	3.3
1F4A5A5A63	2007	19		0.0
1F4B26036D	2007	81	1	1.2
1F5001721E	2007	69	4	5.8
1F50072169	2005	271	15	5.5
1F521B1E56	2003	60	4	6.7
220E4E4E5D	2009	15		0.0
220E5E551E	2008	25		0.0
220E5F4928	2007	19		0.0
220F107A6F	2002	120	18	15.0
220F107A6F	2004	24	3	12.5
411D0E2C5F	2001	70	13	18.6
41476A0462	2001	70	7	10.0
424E36510D	2007	79	2	2.5
424E680B49	2009	18		0.0
430E452777	2004	20	3	15.0
43105C602B	2009	43	1	2.3
431565767B	2004	26	3	11.5
431565767B	2007	39	2	5.1

MALE	Year Class	Total number Stocked	Total number recaptured	Percent of stocked recaptured
435F71414F	2009	27	2	7.4
4441774C6E	2007	86	4	4.7
444334021A	2005	10	1	10.0
444334021A	2008	53		0.0
44436E2975	2010	75	2	2.7
44440A7B73	2007	50	2	4.0
44440A7B73	2009	26	1	3.8
454B30016B	2007	20		0.0
465B6F1939	2009	37		0.0
465D43745B	2006	138	1	0.7
47037F3026	2009	27		0.0
4704550E5B	2010	67		0.0
470A754E14	2009	14		0.0
4714560E0E	2007	20	1	5.0
7F7B023253	2005	165	18	10.9
7F7B023408	2009	22		0.0
7F7B031F17	2005	257	19	7.4
7F7B082208	2009	36		0.0
7F7B082C10	2009	25		0.0
7F7D24754C	2010	76		0.0
7F7D291A07	1997	180	23	12.8
7F7D291A07	2003	33	3	9.1
7F7D291A07	2006	33		0.0
7F7D291A07	2007	20	1	5.0
7F7D2D723D	2005	200	16	8.0
7F7D2D723D	2008	463	1	0.2
7F7D365422	2003	131	22	16.8
7F7D365422	2009	28		0.0
7F7D372A6B	2007	64	1	1.6
7F7D37642C	2009	185	1	0.5
7F7D376F73	2004	20	4	20.0
7F7D3C5708	2001	67	5	7.5
7F7D41431D	2007	19	1	5.3
7F7D437250	2004	18	2	11.1
7F7D437250	2008	46		0.0
7F7D441774	1999	66	7	10.6
7F7D461025	2002	120	21	17.5
7F7D487531	2004	22		0.0
7F7D487531	2007	63		0.0
7F7D487531	2008	532	1	0.2
7F7E55466D	2004	16	1	6.3
7F7E55466D	2008	396		0.0
7F7F065834	1997	79	11	13.9
7F7F065834	1999	50	4	8.0

MALE	Year Class	Total number Stocked	Total number recaptured	Percent of stocked recaptured
7F7F065834	2004	30	6	20.0
7F7F06697C	2009	62	3	4.8
MIX	2004	18	1	5.6
MIX	2008	28		0.0
Grand Total		11473	569	5.0



Appendix K-1. Percent of population stocked (white bars) and recaptured (black bars) per wild broodstook male used in the propagation program.

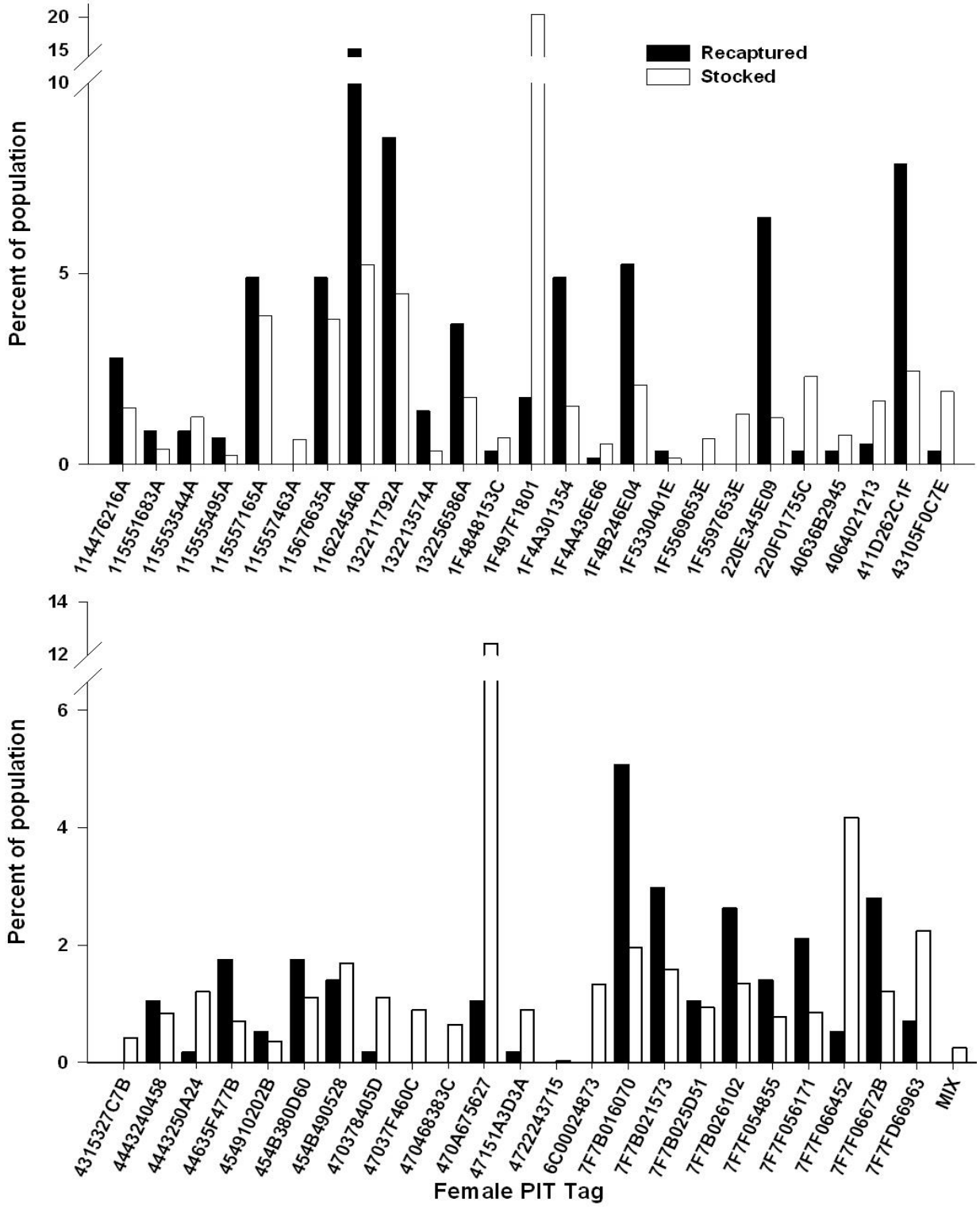


Appendix K-2. Percent of population stocked (white bars) and recaptured (black bars) per wild broodstook male used in the propagation program.

Appendix L. Total number individual fish stocked and recaptured and percent of stocked fish recaptured from each parental female in RPMA 3 during 2003-2012. Duplicate captures of individual fish were removed.

FEMALE	Year Class	Total number Stocked	Total number recaptured	Percent of stocked recaptured
4064021213	2006	191	3	1.6
4443240458	2005	20	2	10.0
4443240458	2007	76	4	5.3
4722243715	2009	3		0.0
114476216A	2004	170	16	9.4
115551683A	2004	44	5	11.4
115553544A	2007	142	5	3.5
115555495A	2004	26	4	15.4
115557165A	2005	275	22	8.0
115557165A	2007	40	2	5.0
115557165A	2009	133	4	3.0
115557463A	2008	75		0.0
115676635A	2005	436	28	6.4
116224546A	2002	601	87	14.5
132211792A	2004	513	49	9.6
132213574A	2005	39	8	20.5
132256586A	2003	202	21	10.4
1F4848153C	2009	79	2	2.5
1F497F1801	2006	271	2	0.7
1F497F1801	2008	2063	8	0.4
1F4A301354	1997	176	28	15.9
1F4A436E66	2007	60	1	1.7
1F4B246E04	1997	239	30	12.6
1F5330401E	2004	18	2	11.1
1F5569653E	2010	76		0.0
1F5597653E	2010	151		0.0
220E345E09	2001	140	37	26.4
220F01755C	2009	264	2	0.8
40636B2945	2007	88	2	2.3
411D262C1F	2001	280	45	16.1
43105F0C7E	2010	219	2	0.9
4315327C7B	2009	47		0.0
4443250A24	2006	138	1	0.7
44635F477B	2005	80	10	12.5
454910202B	2004	41	3	7.3
454B380D60	2004	35	9	25.7
454B380D60	2007	92	1	1.1
454B490528	2007	99	3	3.0
454B490528	2009	95	5	5.3

FEMALE	Year Class	Total number Stocked	Total number recaptured	Percent of stocked recaptured
470378405D	2007	126	1	0.8
47037F460C	2007	102		0.0
470468383C	2009	74		0.0
470A675627	2008	1424	6	0.4
47151A3D3A	2007	102	1	1.0
6C00024873	2010	153		0.0
7F7B016070	2003	224	29	12.9
7F7B021573	1999	181	17	9.4
7F7B025D51	2007	107	6	5.6
7F7B026102	2005	155	15	9.7
7F7F054855	2003	89	8	9.0
7F7F056171	1998	98	12	12.2
7F7F066452	2004	21	2	9.5
7F7F066452	2008	457	1	0.2
7F7F06672B	2001	138	16	11.6
7F7FD66963	2007	110	2	1.8
7F7FD66963	2009	147	2	1.4
MIX	2008	28		0.0
Grand Total		11473	571	5.0



Appendix L-1. Percent of population stocked (white bars) and recaptured (black bars) per wild broodstook female used in the propagation program.

Appendix M. Total number, mean length (FL mm), weight (g), and relative weight (Wr) of marked and recaptured shovelnose sturgeon in segments 5 and 6 of the Missouri River during 2006-2012. Two standard errors are presented in parentheses.

			Marked Fish			Recaptured Fish		
SY	Marked	Recaptured	Mean Length	Mean Weight	Wr	Mean Length	Mean Weight	Wr
2006	161		645 (7)	1120.1 (39.5)	94.55 (1.83)			
2007	396	12	645 (4)	1110.9 (22.6)	94.44 (1.3)	637 (26)	1091.7 (98.3)	97.31 (5.66)
2008	271	22	656 (6)	1143.6 (29.5)	92 (1.55)	651 (18)	1122 (121.5)	91.52 (4.25)
2009	259	39	657 (6)	1166.3 (29.4)	92.83 (1.27)	635 (13)	1087.2 (64.2)	97.54 (3.2)
2010	176	20	658 (7)	1219.7 (36.9)	97.17 (1.96)	685 (18)	1370.8 (95.6)	95.68 (4.41)
2011	61	10	656 (13)	1267 (73.4)	101.47 (3.61)	646 (31)	1230.5 (114.2)	105.33 (10.1)
2012	98	18	662 (8)	1394.7 (63.7)	108.03 (2.44)	687 (16)	1546.1 (111.4)	106.51 (3.04)