2018 Annual Report

Pallid Sturgeon Population Assessment and Associated Fish Community Monitoring for the Missouri River: Segment 3

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

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EXECUTIVE SUMMARY

The 2018 field season marked the 13th consecutive sampling year for Pallid Sturgeon Population Assessment crews in Segment 3 of the Missouri River. Although this was the 13th year of sampling, it was the third consecutive year with a reduction in sampling gears and effort from the historical program. Neither the otter trawl or mini-fyke net was used in sampling during the 2016 through 2018 field season. Additionally, effort was also reduced by nearly half, from 22 to 12 standard bends since 2016.

As such, a total of 12 randomly selected river bends were sampled in Segment 3 during 2018. All 12 bends were sampled once each, with trammel net, during both sturgeon and fish community seasons, respectively. Comparatively, trotlines were used to sample each bend once, with half of the bends sampled during sturgeon season, and the other half sampled during fish community season. Overall, 202 trammel nets were deployed throughout Segment 3 during the 2018 field season, which accounted for 48.0 km of river being sampled. Additionally, a total of 96 trotlines were deployed in Segment 3 during 2018.

A total of 36 pallid sturgeon were captured throughout Segment 3 during the 2018 sampling season, all of which were of hatchery origin. Seasonally, more pallid sturgeon were handled during sturgeon season (n=23) than during fish community season (n=13). Trotlines proved to be a more affective gear, catching 27 pallid sturgeon, while the remaining nine were sampled via random trammel net deployments.

Trammel net CPUE throughout Segment 3 during the 2018 sampling year was recorded at 0.05 fish/100m and 0.01 fish/100m for the sturgeon and fish community seasons, respectively. In turn, a combined-season CPUE was then tabulated at 0.03 fish/100m. While trotline CPUE was reported at 0.33 fish/20 hooks and 0.23 fish/20 hooks for the sturgeon and fish community seasons, respectively, which to a combined-season trotline CPUE of 0.28 fish/20 hooks.

The pallid sturgeon captured in Segment 3 during 2018 averaged 423 mm in fork length and 304 g in weight, with a range of 305 mm and 80 g to 980 mm to 3,960 g, with 92% of the individuals sampled falling into the stock size length category. Additionally, nothing outside of the norm was observed regarding relative condition factor.

All 36 pallid sturgeon captured throughout Segment 3 in 2018 were of known year class. Year class in order of abundance were; 2016 (n=9), 2008 and 2009 (n=6), 2010 (n=5), 2015 (n=4), 2013 and 2014 (n=2), 2001 and 2017 (n=1). In addition, 27 of the 36 pallid sturgeon observed in Segment 3 were of known stocking location, with 20 individuals originating in the Missouri River and the remaining seven originating in the Yellowstone River. Stocking origination in rank of abundance were; Wolf Point and Culbertson each with 10 individuals, Intake (n=5) and Fallon (n=2).

The sampling events throughout Segment 3 during the 2018 field season resulted in the capture of 161 shovelnose sturgeon. Temporally, more shovelnose sturgeon were observed during sturgeon season (n=107) than fish community season (n=54). In relation to gears, a greater number were witnessed via trammel net (n=87) when compared to trotline (n=74).

Trammel net sampling led to seasonal CPUE, for the quality and above size class of shovelnose sturgeon, the most frequently observed size class, of 0.20 fish/100m and 0.11 fish/100m for the sturgeon and fish community seasons, respectively. Seasonal catch rates led to a combined-season CPUE of 0.15 fish/100m. Trotline CPUE was reported at 1.13 fish/20 hooks and 0.42 fish/20 hooks for the sturgeon and fish community seasons, respectively. In turn, seasonal trotline catch rates led to a combined-season CPUE of 0.77 fish/20 hooks.

The shovelnose sturgeon observed throughout Segment 3 in 2018 averaged 443 mm in fork length and 330 g in weight, with a range of 288 mm and 90 g to 807 mm and 2,670 g. No major variations of relative weight were observed during 2018. However, with the loss of otter trawl as a sampling gear, the relative weight trends for the smaller size classes of shovelnose sturgeon becomes harder to follow due to low sample size.

Although never overly abundant, blue sucker captures were not well represented in Segment 3 sampling events during the 2018 field season. With the capture of only one individual during sturgeon season and another individual during fish community season, seasonal catch rates were very low. Although zero-catch season and years exist, it does not appear to be alarming, given that most of our blue sucker captures in any segment most likely relate to their long spawning migration movements.

A total of 73 sauger were collected within Segment 3 during the 2018 sampling season. Like those results witnessed in Segment 2, a higher proportion (78%) of Segment 3 sauger observations came during sturgeon season, when compared to fish community season (22%). In

response, sturgeon season CPUE (0.22 fish/100m) was greater that the observed CPUE during fish community season (0.08 fish/100m).

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Introduction

The U.S. Fish and Wildlife Service (USFWS) listed pallid sturgeon *Scaphirhynchus albus* as endangered in 1990. In response to listing, the USFWS issued a Biological Opinion to the U.S. Army Corps of Engineers (COE), the primary water management entity responsible for the Missouri River mainstem from Fort Peck Dam and Reservoir to its confluence with the Mississippi River. Additionally, an amendment to the 2000 Biological Opinion was issued in 2003. The Amendment listed several Reasonable and Prudent Alternatives (RPA) to address the inability of pallid sturgeon to naturally reproduce and the need to be able to detect changes in their populations and ecosystem trends.

The Pallid Sturgeon Population Assessment Program (program) is guided by the RPA's in the 2003 Amendment to the 2000 Biological Opinion. The program is a comprehensive monitoring plan designed to assess survival, movement, distribution, habitat use, and physical characteristics of these habitats used by wild and hatchery reared juvenile pallid sturgeon (Welker, Drobish and Williams 2017). The 2000 Biological Opinion divides the program area into river and reservoir segments and assigns high, moderate, or low priority management action to these segments for pallid sturgeon (Welker, Drobish and Williams 2017). The focus of the program is on the high priority management action segments. The Missouri River from Fort Peck Dam downstream to the headwaters of Lake Sakakawea, ND is listed as a high priority action segment.

The program has stratified the Missouri River from Fort Peck Dam to the headwaters of Lake Sakakawea into four study segments based on biological, hydrological and fluvial geomorphological characteristics. The COE contracted Montana Fish, Wildlife & Parks (FWP) to conduct program sampling from Fort Peck Dam downstream to the North Dakota border, which consists of study segments 1 through 3.

The objectives of this program are as follows:

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.
4. Evaluate annual results and long-term trends in native target species population abundance and geographic distribution throughout the Missouri River system.
5. Document annual results and long-term trends of habitat usage of the native target species by season and life stage.
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.

Sampling Season and Species

This program has two discrete seasons (sturgeon and fish community), which are primarily segregated by time of year and subsequently water temperatures. However, the sturgeon season is designed to sample sturgeon with gears that are temperature dependent, such as gill nets. Due to the nature of the majority of habitats in segment 1 through 3, gill nets are not an efficient gear for collecting pallid sturgeon due to debris flows and swift current and therefore they are not used in any segment situated in Montana. Trammel nets, otter trawl and trotlines are standard gears used in segments 1-4 during sturgeon season and appear to be an effective method to sample pallid sturgeon. However, due to an exercise in gear/effort reduction, otter trawls were not performed in segments 1-3 in 2016-2018.

The fish community season extends from the beginning of July until the end of September and is designed not only to monitor sturgeon, but also monitor other native Missouri River fish populations. Both trammel nets and otter trawls are used during the fish community season, however mini fyke nets are added as a standard gear to more effectively sample shallow water habitats < 1.2 m in depth. However, in accordance with the aforementioned gear reduction, neither otter trawls nor mini-fyke nets were used in 2016-2018.

Trotlines were used as an evaluation gear in 2009 to evaluate their effectiveness at capturing pallid sturgeon. Trotlines became a standard gear starting in 2010. All randomly selected river bends were sampled once with trotlines throughout the two seasons.

In addition to pallid sturgeon, the program is designed to monitor nine other native Missouri River species labeled "target" species. These include, shovelnose sturgeon *Scaphirhynchus platorynchus*, blue sucker *Cycleptus elongatus*, sauger *Sander canadense*, sturgeon chub *Macrhybopsis gelida*, sicklefin chub *M. meeki*, speckled chub *M. aestivalis*, plains minnow *Hybognathus placitus*, western silvery minnow *H. argyritis*, and sand shiner *Notropis stramineus*. This suite of species was selected for various reasons. First, some species may have similar habitat requirements as pallid sturgeon and therefore by monitoring their populations we may gain further insight into pallid sturgeon habitat and how anthropomorphic and natural changes to the Missouri River affect native fish assemblages. Secondly, it is hypothesized that various chub species and other native fishes are an important component of pallid sturgeon diet, and thereby monitoring pallid sturgeon prey will allow us to better describe their habitat. Thirdly, we wouldn't expect to see an immediate response in a long-lived species like pallid sturgeon would be difficult to measure when environmental conditions change from either favorable or detrimental conditions. Thus, by monitoring short-lived native fishes we may be able to correlate environmental conditions to changes in fish populations on a much shorter time interval and make inferences on how pallid sturgeon populations may be affected. Again, due to the reduction of gears, the smaller bodied fishes are rarely, if ever observed.

Study Area

Montana Fish, Wildlife & Parks samples three segments on the Missouri River below Fort Peck Dam to its confluence with the Yellowstone River in accordance with the Pallid Sturgeon Population Assessment Program. Study segment 3 of the Missouri River Pallid Sturgeon Population Assessment Program encompasses 119 river miles from Wolf Point, MT to the confluence of the Missouri and Yellowstone Rivers in North Dakota. In this large section, the river has completely transitioned from a cold clear cobble substrate river in segment 2 to a warm turbid prairie river, more similar to its natural characteristics (Galat et al, 2005). The aggrading streambed of segment 3 is flanked by stream deposited sediment of the Fort Union Formation (NRIS, 2007). This stretch of river is slightly less flow regulated than upstream segments due to the tributaries and runoff events. There are five major tributaries that influence this section of river, which include the Milk River, Redwater River, Poplar River, Big Muddy Creek, and Prairie Elk Creek. These sediment packed tributaries flush their warmer turbid waters into the Missouri River increasing flows and suspended sediment, which in turn enables sandbar and island formation. Turbidities in this stretch of river are greater than that of segment 2 and discharge constantly changes with precipitation events and tributary discharge. The species composition of this stretch of river is vastly different from the uppermost segment just below Fort Peck Dam. The non-native fish stocked for recreation are much less prevalent and the prevalence of native, non-sport fish is increased (Gardner and Stewart, 1987). This stretch of ever-changing river is diverse with over 36 species of fish, many of which are benthic specialists, exhibiting streamlined bodies and well-developed chemosensory organs for surviving the sometimes high flows and ever-turbid waters (Galat et al, 2005; Berry et al. 2004). This stretch of river can be highly dynamic and is more reminiscent of what the Missouri River looked like before it became one of the most regulated and impounded rivers in the United States (Galat et al, 2005).

Methods

Sampling methods for the Pallid Sturgeon Population Assessment Program were conducted in accordance with the Standard Operating Procedures (Welker and Drobish 2016), which was established by representatives from State and Federal agencies involved with pallid sturgeon recovery on the Missouri River. For a detailed description of methodologies please see Welker, Drobish and Williams (2017). A general description of sampling guidelines follows.

Sampling Site Selection and Description

Montana Fish Wildlife & Parks (FWP) was contracted to sample Segment 1 from Fort Peck Dam (RM 1771.5) to the mouth of the Milk River (RM 1761), Segment 2 from the mouth of the Milk River (RM 1761) to Wolf Point (RM 1701.5) and Segment 3 from Wolf Point (RM 1701.5) to the Montana/North Dakota border (RM 1586.5). Historically, 22 standard bends were sampled in Segment 3, however, due to the effort reduction exercise starting in 2016, 12 random bends are now sampled.

In 2016-2018, trammel nets alone were used when sampling all 12 randomly selected river bends during both seasons. Trotlines were switched from an experimental gear, in 2009, to a standard gear for 2010. Twelve random trotline bends were selected by moving upstream one river bend from the 12 bends that were randomly selected for sampling by standard gears. This was done to the minimize the possibility of an attractant effect of trotlines to our standard gears and to optimize our time spent on any particular bend, since overnight trotlines require an additional trip to each sampled bend. Trotline bends were only sampled once, as opposed to standard bends, which were sampled by standard gears in both sturgeon season and fish community season. Half (N=6) were sampled with trotline in sturgeon season and half (N=6) were sampled during fish community season.

The Population Assessment Team developed a standard set of habitat classifications for the Missouri River (Appendix B) which consists of three distinct macrohabitats found in every bend, a main channel crossover (CHXO), main channel outside bend (OSB), and main channel inside bend (ISB). Each sampling bend was comprised of these three main macrohabitats. Nine additional macrohabitats were identified that may or may not be present in every bend: large tributary mouths (TRML), small tributary mouths (TRMS), confluence areas (CONF), large and

small secondary connected channels (SCCL& SCCS), deranged channels (DRNG), braided channels (BRAD), dendritic channels (DEND) and non-connected secondary channel (SCN).

Mesohabitats were established to further define macrohabitats. Mesohabitats include bars (BARS), pools (POOL), channel border (CHNB), thalweg (TLWG) and island tip (ITIP). Channel borders are situated in areas between the deepest portions of the river up to a depth of 1.2 m. Bars are considered shallow areas (< 1.2 m) where terrestrial and aquatic habitats merge. The thalweg is the deepest portion of the river between the two channel borders where the majority of the flow is directed. Pools are directly downstream of any feature that creates scour, thus creating a habitat of deep (> 1.2 m) slower moving water. Island tips are just downstream of bars or islands where two channels meet where the water is > 1.2 m in depth.

For all analysis, the sampling unit was the river bend, where every river bend has a channel crossover, inside and outside bend. The downstream border of a river bend is the beginning of the next downstream bend's channel crossover.

Sampling Gear

For specific information pertaining to the specific habitats gears are utilized in and physical measurements taken in accordance with sampling the various gears described below, please see Welker, Drobish and Williams (2017).

Trammel Net

The standard trammel net has a length of 38.1 m, an inner mesh wall 2.4 m and two outer mesh walls 1.8 m deep. The inner mesh is made of #139 multifilament twine with a bar mesh size of 25.4 mm. The outer walls are constructed of #9 multifilament twine with a bar mesh size of 203.2 mm. The float line is a 12.7 mm diameter foam core with a lead line of 22.7 kg. Trammel nets were drifted from the bow of the boat and orientated perpendicular to the river flow for a minimum of 75 m and a maximum drift distance of 300 m.

Otter Trawl

The standard otter trawl has a length of 7.6 m, a width of 4.9 m and height of 0.9 m. The otter trawl has an inner mesh (6.35mm bar, #18 polyethylene twine) and outer mesh (38mmbar, #9 polyethylene twine) and a cod end opening of 406.4 mm. The trawl doors were made from 19.1 mm marine plywood and measured 762 mm x 381 mm. The trawl doors are used to keep the mouth of the trawl open while deployed on the riverbed. The trawl also has a 7.9 m long tickler chain attached to the bottom of the mouth of the trawl, which aids in keeping it orientated on the riverbed and protecting the mouth when snags are encountered. The otter trawl was deployed from the bow of the boat parallel to the current with two 30.5 m ropes and towed downstream slightly faster than current speed for a minimum of 75 m and a maximum distance of 300 m. The otter trawl has not been used since 2015.

Mini Fyke Nets

The standard mini-fyke net consists of two rectangular frames 1.2 m wide and 0.6 m high and two 0.6 m tempered steel hoops. A 4.5 m long and 0.6 m high lead is connected to the first frame. The fyke net was made of 3 mm "ace" style mesh. The lead has small floats attached to the top and lead weights on the bottom. Mini-fyke nets are set with a "T" stake on shore and extend into river as perpendicular to the shoreline as possible or angled slightly downstream where higher velocities existed. Mini-fyke nets were set overnight and checked the following morning. Mini fyke nets have not been used since 2015.

Trotlines

Trotlines consisted of 32 m nylon rope attached to both upstream and downstream anchors. Octopus style circle hooks were attached to the ropes using 136 kg monofilament line and commercial fishing clips. Twenty 45.7 cm leaders were used on each trotline each with a 2/0 Eagle Claw circle hook. Trotlines are set overnight and checked the next morning.

Data Collection and Analysis

A minimum of eight random subsamples were taken in macrohabitats present at each randomly selected river bend. At least two subsamples (when possible) were taken using each gear in each macro habitat within a bend. More than two subsamples were taken in a

macrohabitat for a gear when the number of discrete macrohabitats was less than four or less than four could be effectively sampled. When a pallid sturgeon was captured, we duplicated the sample in a non-random manner. No more than eight duplicates were taken and we would stop taking duplicates whenever two contiguous duplicate subsamples contain no pallid sturgeon. Although this non-random sampling, it gives us a better understanding of relative abundance and identifies habitats that pallid sturgeon may congregate in.

All fish were measured to the nearest mm. Fork length (FL) was used for pallid and shovelnose sturgeon, while other species were measured to TL, except for paddlefish *Polyodon spathula*, which were measured from the eye to the fork in the caudal fin. The first 25 fish of each species in each subsample were measured, after 25 they were counted.

Time was recorded at the beginning of each sample with all gears and an end time was always recorded when pulling mini fyke net sets. A global positioning satellite (GPS) position was taken at the beginning and end of all otter and beam trawls and trammel net drifts. One GPS location was taken for mini fyke net samples (middle of the seine). All GPS locations were taken using the internal GPS of the Xplore Technologies iX104 tablet.

Sample depth was determined at the beginning, middle and end of each trawl and drift using a Lowrance X136 sonar unit. One depth was taken for mini fyke nets at the intersection of the frame and floatline using a wading rod.

Water temperature taken near the surface was recorded at every sample using the Lowrance X136 unit for trawls and trammel net drifts and using a hand-held thermometer for mini fyke net and bag seine samples.

Habitat samples were collected randomly for 25% of each mesohabitat within each macrohabitat sampled. Velocities (mps) were taken at three depths in the water column for habitats > 1.2 m in depth (bottom, 0.8 of bottom depth and 0.2 of the bottom depth) using either a Current AA Price Meter and sounding reel or a Marsh-McBirney Flo Mate 2000. Velocities for shallow water habitats (< 1.2 m) were taken at the bottom and 0.6 of the bottom depth using the March-McBirney Flo Mate 2000.

Turbidity was recorded in nephelometeric turbidity units (NTU) using a LaMotte 2020 turbidity meter. Turbidity was taken at the midpoint of all samples, except mini fyke sets, where it was taken at the convergence of the rectangular frame and float line.

In addition to 25% of all mesohabitats, habitat measurements were taken whenever a pallid sturgeon was captured.

Genetic Verification

Genetic verification for pallid sturgeon or potential hybrids followed the methods outlined in Welker, Drobish and Williams (2017). Two fin pectoral fin clips (~ 2 cm^2) are taken from any pallid sturgeon of unknown origin. Fin samples are then preserved in 95% non-denatured alcohol for genetic analysis. All samples are sent to the U.S. Fish and Wildlife Service's Lamar Laboratory for analysis and archiving.

Relative Condition

Relative condition (Kn) for all sampled pallid sturgeon was calculated using the following formula: Kn = W / W', where W is the fork length of the specimen and W' is the length-specific mean weight predicted by the weight-length relationship equation calculated for that population. Since no weight length-relationship exists for the hatchery reared pallid sturgeon population in segment 3, we used relative condition factor calculated by Shuman et al. (2011).

Size Classes of Pallid and Shovelnose Sturgeon

We used the length categories proposed by Shuman et al. (2006) for pallid sturgeon and Quist et al. (1998) for shovelnose sturgeon when looking at the total proportion of fish captured by length. Additionally, we broke up sub-stock sizes for both pallid and shovelnose into two groups to aid in determining recruitment of young-of-the-year (YOY) sturgeon. Fork length categories for both species of sturgeon are given in all figures and tables pertaining to size classes.

Analyses

The fundamental sampling unit for the Population Assessment Program is the river bend. Therefore, sample size was equal to the number of bends sampled. Accordingly, all catch-per-unit-effort (CPUE) estimates for each species by gear were made on a bend level and the mean bend CPUE's were averaged to obtain the segment CPUE. Catch-per-unit-effort was stratified by season, depending on the analysis. In addition, stratification by macro- and mesohabitats was

performed for each species. All CPUE estimates were performed by the Missouri Department of Conservation.

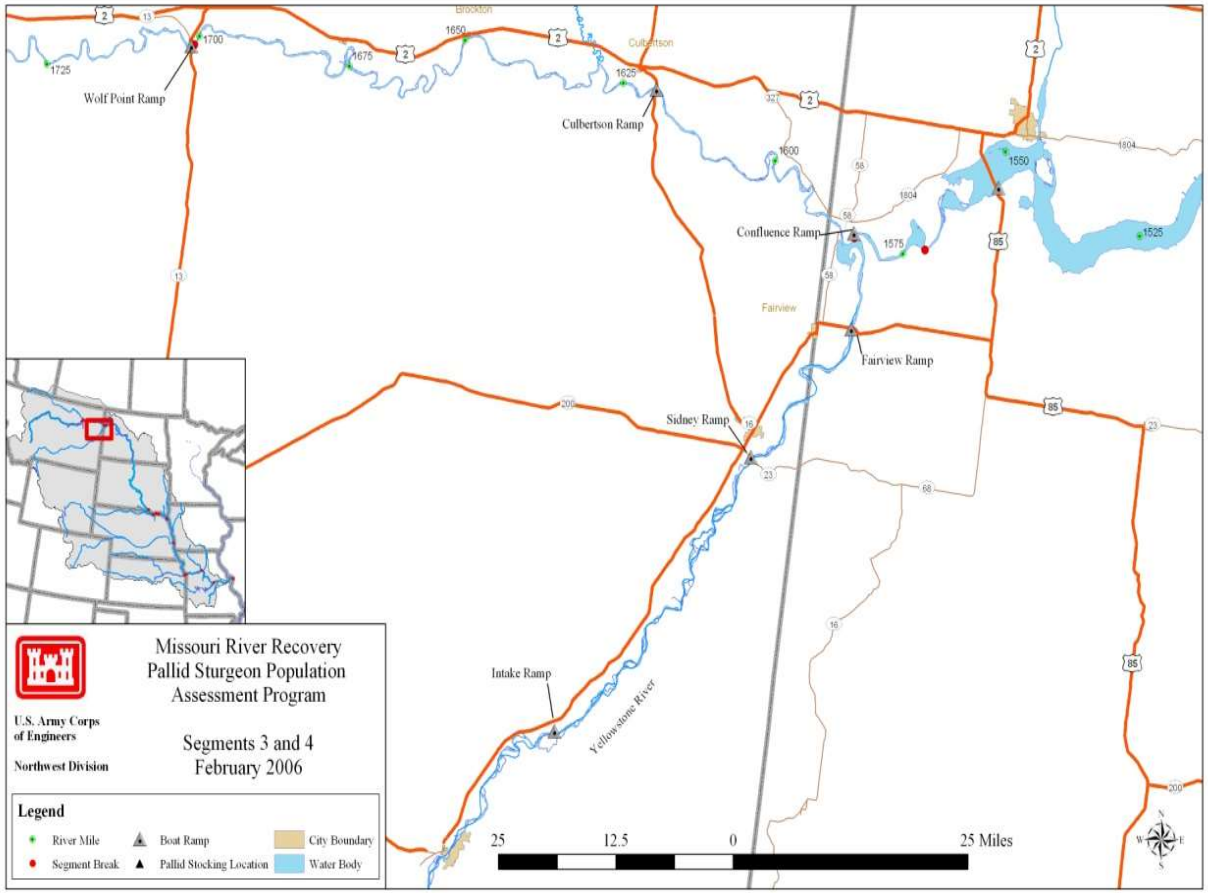

Figure 1. Map of Segment 3 of the Missouri River with major tributaries, common landmarks, and historic stocking locations for pallid sturgeon. Segment 3 encompasses the Missouri River from Wolf Point, MT (River Mile 1701.0) to the confluence of the Yellowstone River (River Mile 1582.0).

Results

Effort

A total of 12 randomly selected river bends were sampled in Segment 3 during 2018. All 12 bends were sampled once each, with trammel net, during both sturgeon and fish community seasons, respectively. Comparatively, trotlines were used to sample each bend once, with half of the bends sampled during sturgeon season, and the other half sampled during fish community season. Additionally, the sampling regime in 2018 followed the same protocol as that of 2016 and 2017, whereas during 2006-2015, 22 randomly selected bends were sampled once each during both seasons.

Overall, 202 trammel nets were deployed throughout Segment 3 during the 2018 field season, which accounted for 48.0 km of river being sampled. Seasonally, drifts were nearly equal, with 102 taking place during sturgeon season and 100 trammel net drifts occurring during fish community season. Consequentially, distance sampled was also comparable with 24.6 and 23.4 km of sampling during the sturgeon and fish community seasons, respectively. In terms of sampling methodology, only 5% (n=10) of trammel net drifts were of non-random, duplicate origin.

Additionally, a total of 96 trotlines were deployed in Segment 3 during 2018. As stated above, half of the randomly selected bends (n=6) were sampled during sturgeon season, while the other half (n=6) were sampled during fish community season. With 20 hooks per trotline, a total of 1,920 nightcrawler-baited hooks were set in Segment 3 in 2018.

The specific habitat measurements for pallid sturgeon captured in random deployments by macro and meso habitat is displayed in Table 1. Additionally, Table 4 through 7 shows the number of pallid sturgeon captured by random deployments by gear and macro habitat, as well as effort expended in those macro habitats.

Table 1. Number of bends sampled, mean number of deployments, and total number of deployments by macrohabitat for Segment 3 on the Missouri River during the sturgeon season and fish community season in 2018.

Gear	Number of Bends	Mean Effort	Macrohabitat[a]			
			CHXO	ISB	OSB	SCCL
			Sturgeon Season			
1.0” Trammel Net	12	8	34	36	26	0
			Fish Community Season			
1.0” Trammel Net	12	8	31	34	29	2
			Both Seasons			
Trotline	12	8	35	34	22	5

[a] Habitat abbreviations and definitions presented in Appendix B

Pallid Sturgeon

A total of 36 pallid sturgeon were captured throughout Segment 3 during the 2018 sampling season, all of which were of hatchery origin. Seasonally, more pallid sturgeon were handled during sturgeon season (n=23) than during fish community season (n=13). Trotlines proved to be a more affective gear, catching 27 pallid sturgeon, while the remaining nine were sampled via random trammel net deployments.

Temporally, sturgeon season trammel net drifts captured seven pallid sturgeon, while two were observed during fish community season. In relation, seasonal trammel net CPUE regarding pallid sturgeon (Fig. 5) throughout Segment 3 during the 2018 sampling year was recorded at 0.05 fish/100m and 0.01 fish/100m for the sturgeon and fish community seasons, respectively. In turn, a combined-season CPUE was then tabulated at 0.03 fish/100m.

Seasonality regarding trotline deployments throughout Segment 3 in 2018 saw more fish captured during sturgeon season (n=16) than during fish community season (n=11). Corresponding seasonal CUPE (Fig. 7) was reported at 0.33 fish/20 hooks and 0.23 fish/20 hooks for the sturgeon and fish community seasons, respectively. Seasonal CPUE led to a combined-season trotline CPUE of 0.28 fish/20 hooks.

The pallid sturgeon captured in Segment 3 during 2018 averaged 423 mm in fork length and 304 g in weight, with a range of 305 mm and 80 g to 980 mm to 3,960 g. A full description of length frequency can be found in Figure 3, while Relative Stock Density (RSD) can be found in Figure 8. The relative condition regarding all pallid sturgeon captured in Segment 3 can be found in Figure 4. In table 3, mean fork length, weight, relative condition factor (Kn) and absolute growth rates for hatchery-reared pallid sturgeon captures by year class at the time of stocking and recapture during 2018 from Segment 3 of the Missouri River.

Pallid sturgeon distribution (Fig. 2) throughout Segment 3 in 2018 remained variable, with emphasis on timing and locality of sampling. Of the 12 bends sampled with trammel net, pallid sturgeon were observed in five of them. Comparatively, of the 12 bends sampled with trotline, pallid sturgeon were detected in 11 of them. Multiple captures were recorded at two of the five trammel net bends where pallid sturgeon occurred, while eight of the 11 trotline bends exhibited multiple captures.

All 36 pallid sturgeon captured throughout Segment 3 in 2018 were of known year class. Year class in order of abundance were; 2016 (n=9), 2008 and 2009 (n=6), 2010 (n=5), 2015 (n=4), 2013 and 2014 (n=2), 2001 and 2017 (n=1). In addition, 27 of the 36 pallid sturgeon observed in Segment 3 were of known stocking location, with 20 individuals originating in the Missouri River and the remaining seven originating in the Yellowstone River. Stocking origination in rank of abundance were; Wolf Point and Culbertson each with 10 individuals, Intake (n=5) and Fallon (n=2). The stocking history related to RPMA 2 can be found in Appendix E.

The specific habitat measurements for pallid sturgeon captured in random deployments by macro and meso habitat is displayed in Table 2. Additionally, Table 4 through 7 shows the number of pallid sturgeon captured by random deployments by gear and macro habitat, as well as effort expended in those macro habitats.

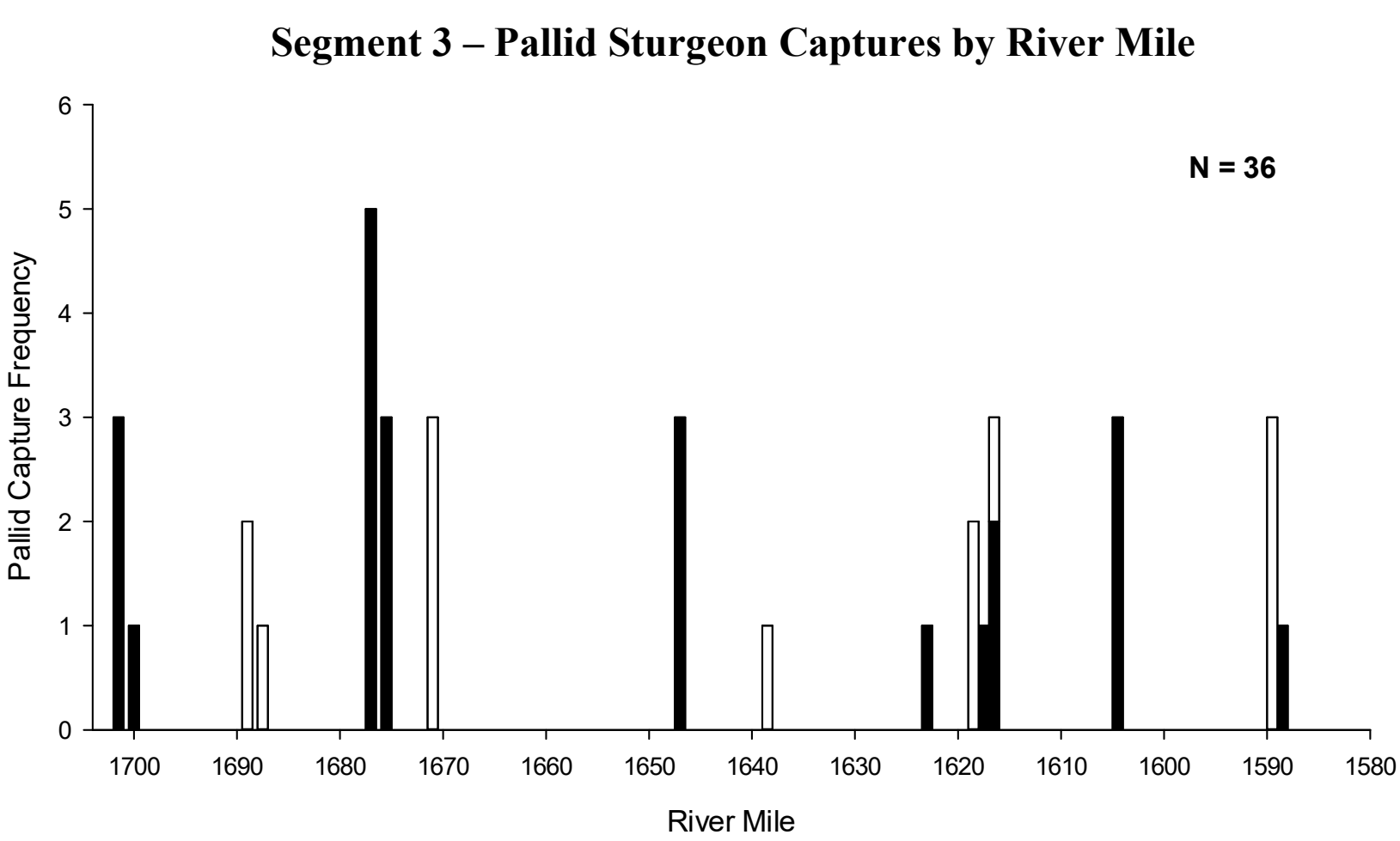

Figure 2. Distribution of pallid sturgeon captures by river mile for Segment 3 of the Missouri River during 2018. Black bars represent pallid captures during the sturgeon season and white bars during the fish community season. Figure includes all pallid captures including non-random and wild samples.

Table 2. Pallid sturgeon capture summaries for all gears relative to habitat type and environmental variables on the Missouri River during 2018. Means (minimum and maximum) are presented. Habitat definitions and codes presented in Appendix B.

Habitat		Depth (m)		Bottom Velocity (m/s)		Temperature (°C)		Turbidity (ntu)		Total Pallids Caught
MACRO	MESO	Effort	Catch	Effort	Catch	Effort	Catch	Effort	Catch	
CHXO	CHNB	2.6 (0.7-6.5)	2.7 (1.2-4.8)	0.69 (0.40-1.01)	0.68 (0.47-0.87)	15.2 (10.6-19.2)	16.2 (11.9-19.1)	111 (30-610)	103 (42-277)	10
ISB	CHNB	1.9 (0.5-5.0)	2.1 (1.0-3.8)	0.72 (0.02-1.09)	0.68 (0.38-0.86)	15.4 (10.4-19.3)	15.1 (11.7-17.9)	127 (29-603)	146 (29-377)	16
OSB	CHNB	3.0 (1.0-6.2)	2.7 (1.5-4.0)	0.79 (0.35-1.22)	0.56 (0.35-0.71)	15.3 (10.6-19.3)	14.7 (11.2-19.2)	102 (31-294)	92 (38-257)	10
SCCL	CHNB	1.8 (1.2-3.0)		0.66 (0.66-0.66)		15.6 (14.5-16.3)		74 (74-74)		.

Table 3. Mean fork length, weight, relative condition factor (Kn) and absolute growth rates for hatchery-reared pallid sturgeon captures by year class at the time of stocking and recapture during 2018 from Segment 3 of the Missouri River. Relative condition factor was calculated using the equation in Shuman et al. (2011).

Year Class	N	Length (mm)	Weight (g)	Kn	Length (mm)	Weight (g)	Kn	Length (mm/d)	Weight (g/d)
2001	1	.	.	.	980	3960.0	1.007	.	.
.	.	.	.	.	.	.	.	.	.
2008	6	.	.	.	437	261.7	0.944	.	.
.	.	.	.	.	18	35.8	0.045	.	.
2009	6	230	37.0	1.113	399	199.2	0.974	0.070	0.072
.	.	.	.	.	15	25.0	0.091	.	.
2010	5	270	70.0	1.019	424	231.0	0.930	0.064	0.063
.	.	120	92.0	0.089	18	24.8	0.098	0.043	0.053
2013	2	311	120.0	1.337	415	225.0	0.967	0.058	0.049
.	.	.	.	.	31	60.0	0.021	.	.
2014	2	299	85.0	1.074	383	140.0	0.786	0.060	0.039
.	.	42	28.0	0.140	25	30.0	0.000	0.032	0.032
2015	4	336	143.0	1.190	397	166.3	0.845	0.078	0.038
.	.	30	50.0	0.110	28	16.5	0.188	0.010	0.060
2016	9	367	168.5	1.080	403	176.1	0.823	0.105	0.041
.	.	20	25.6	0.052	29	33.4	0.065	0.029	0.049
2017	1	275	67.0	1.119	308	90.0	1.035	0.516	0.359
.	.	.	.	.	.	.	.	.	.

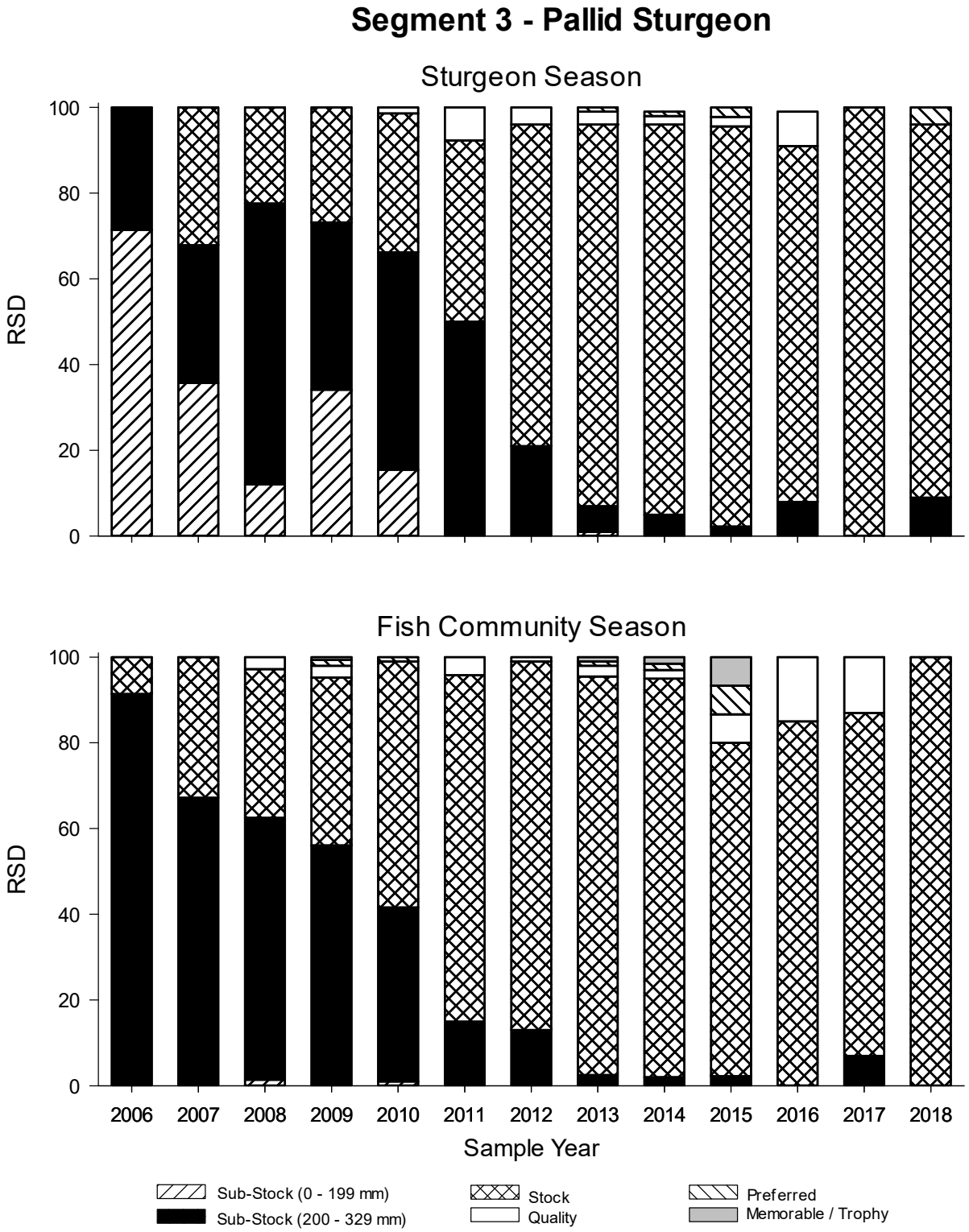

Figure 3. Proportion of total catch by length group for all pallid sturgeon captured with all gear by length category from 2006-2018 in Segment 3 in the Missouri River. Length categories determined using the methods proposed by Shuman et al. (2006).

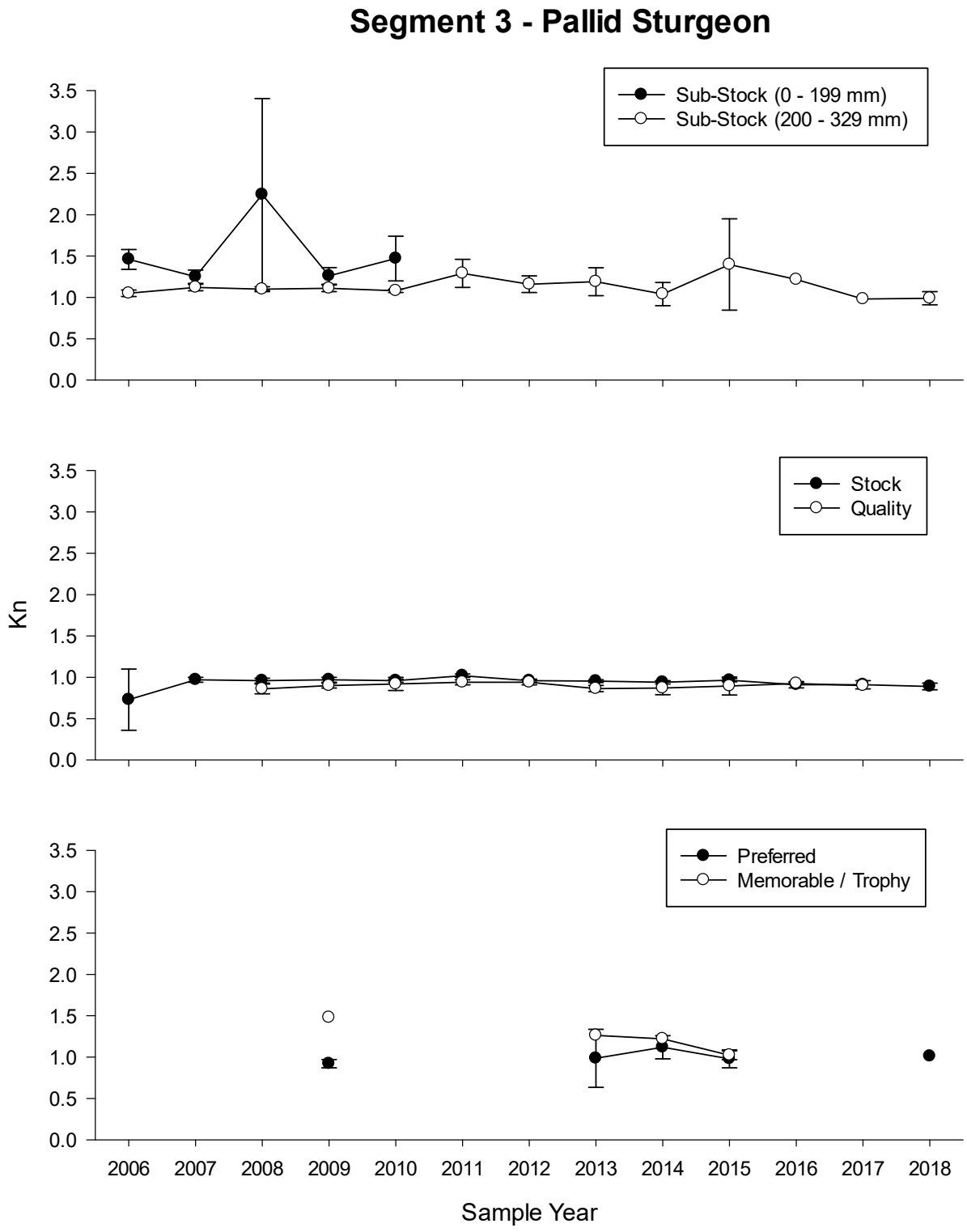

Figure 4. Relative condition factor (Kn) for all pallid sturgeon captured with all gear by incremental relative stock density (RSD) length category from 2006-2018 in Segment 3 in the Missouri River. Length categories determined using the methods proposed by Shuman et al. (2006). Relative condition factor was calculated using the equation in Shuman et al. (2011).

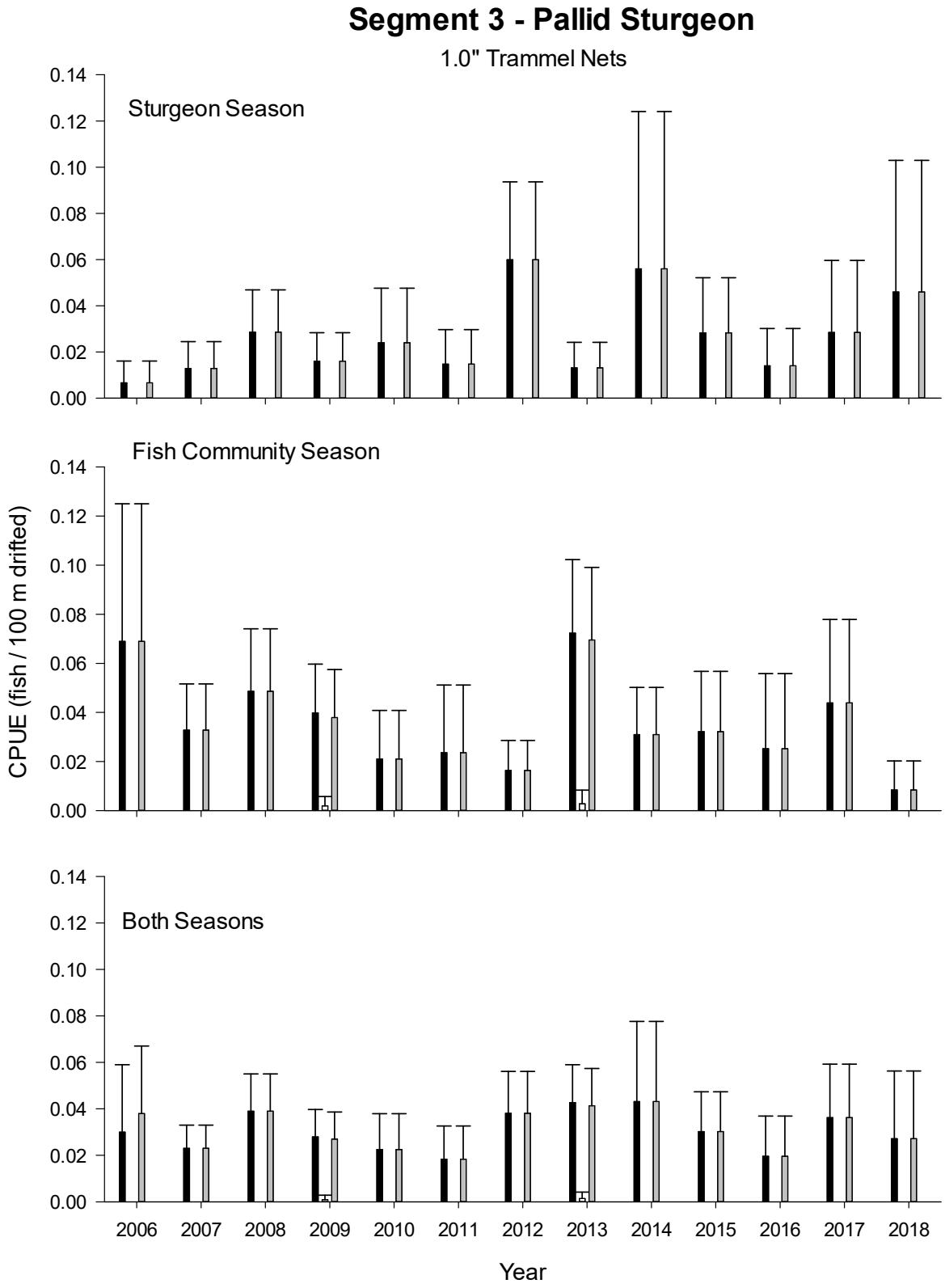

Figure 5. Mean annual catch per unit effort (+/- 2 SE) of all (black bars), wild (white bars), hatchery reared (gray bars) pallid sturgeon using 1.0" trammel nets in Segment 3 of the Missouri River from 2006-2018.

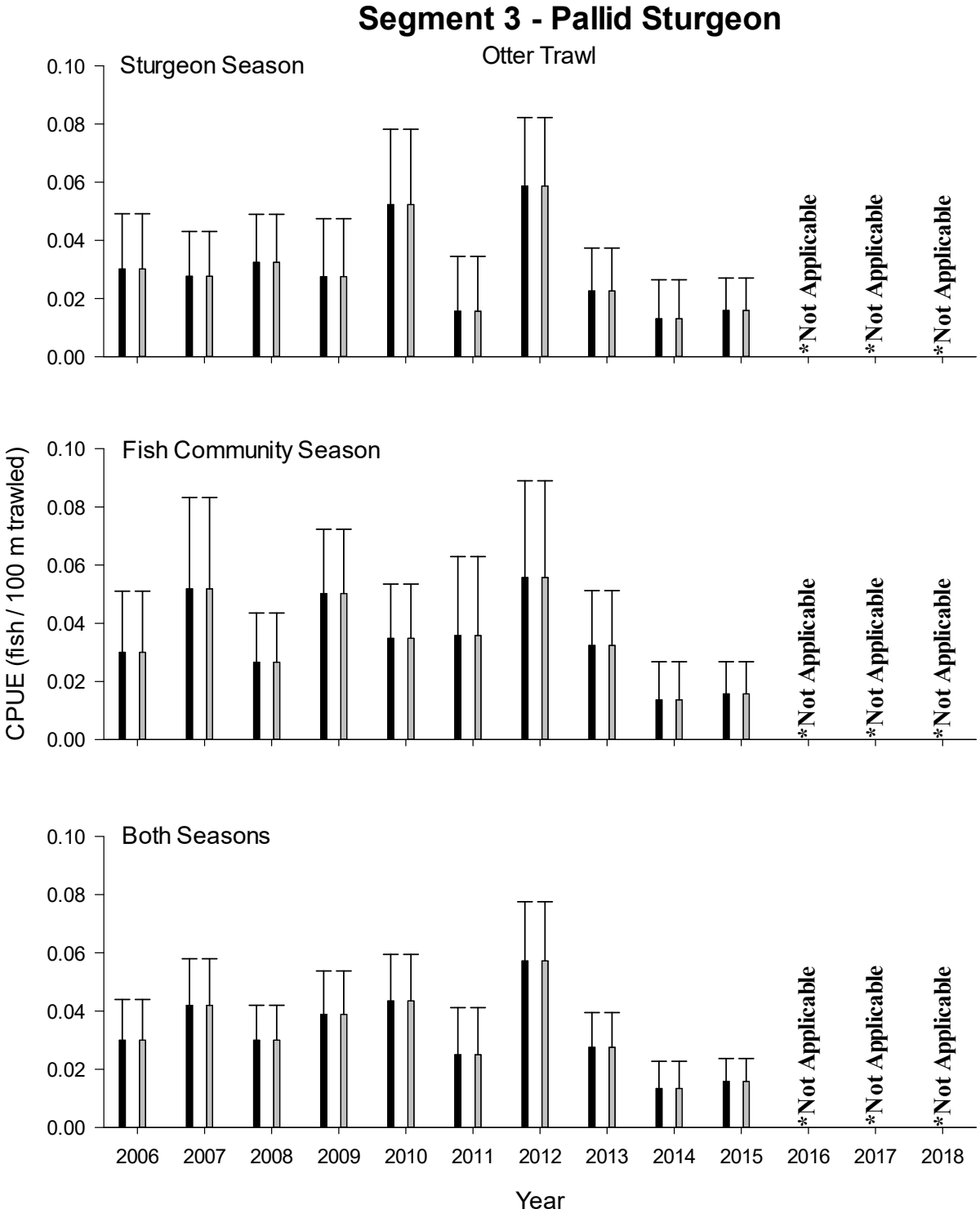

Figure 6. Mean annual catch per unit effort (+/- 2 SE) of all (black bars), wild (white bars), hatchery reared (gray bars) pallid sturgeon using otter trawls in Segment 3 of the Missouri River from 2006-2018. *Otter trawl not performed in 2016-2018.

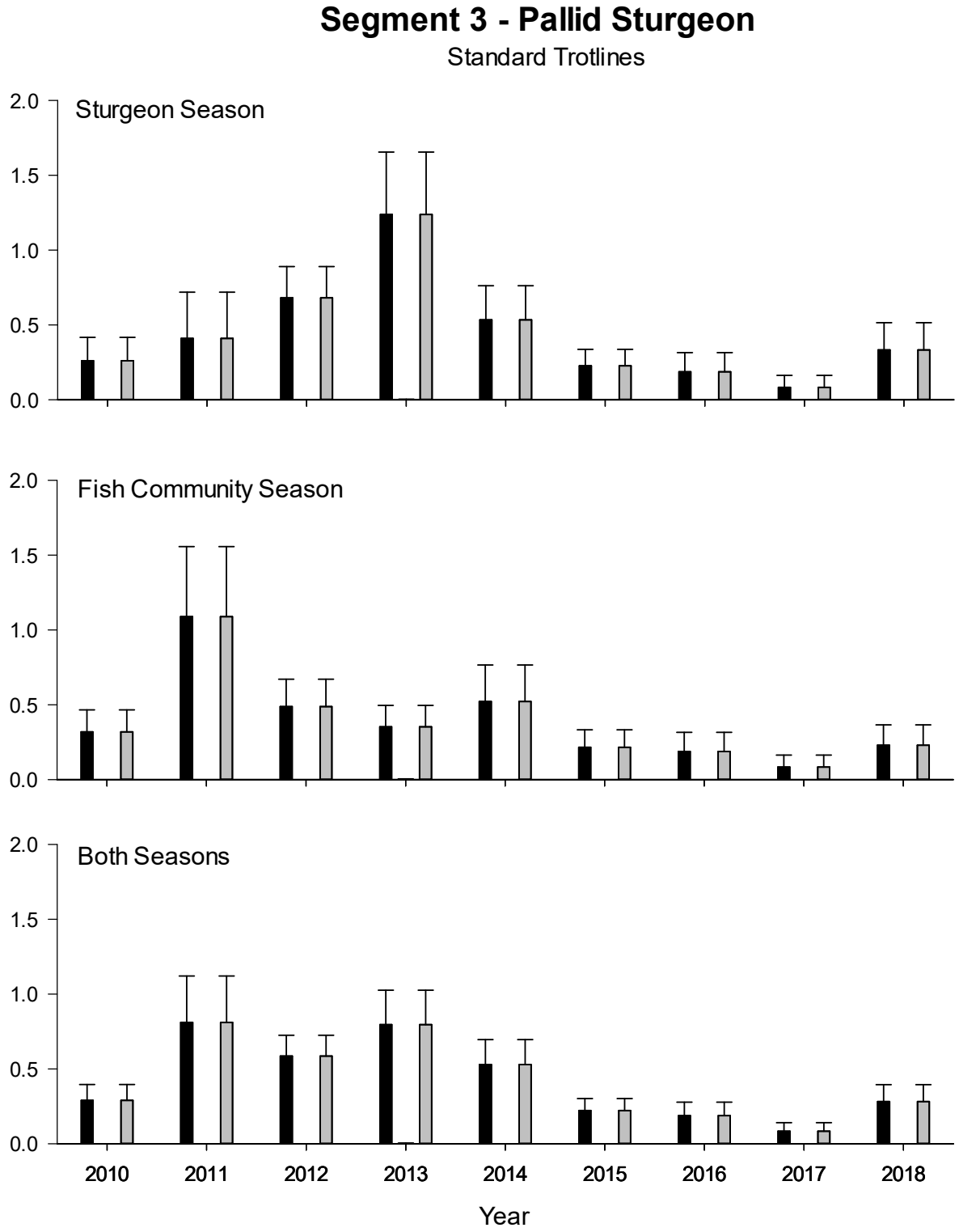

Figure 7. Mean annual catch per unit effort (+/- 2 SE) of all (black bars), wild (white bars), hatchery reared (gray bars), and unknown origin (cross-hatched bars) pallid sturgeon using trotlines in Segment 3 of the Missouri River from 2010-2018.

Table 4. Total number of sub-stock size (0-199 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2018. The percent of total effort for each gear in each habitat is presented on the second line of each gear type.

		Macrohabitat[a]			
Gear	**N**	**CHXO**	**ISB**	**OSB**	**SCCL**
		Sturgeon Season			
1.0” Trammel Net	0	0	0	0	0
		39	37	24	0
		Fish Community Season			
1.0” Trammel Net	0	0	0	0	0
		34	34	30	3
		Both Seasons			
Trot Line	0	0	0	0	0
		36	35	23	5

Table 5. Total number of sub-stock size (200-329 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2018. The percent of total effort for each gear in each habitat is presented on the second line of each gear type.

		Macrohabitat[a]			
Gear	**N**	**CHXO**	**ISB**	**OSB**	**SCCL**
		Sturgeon Season			
1.0” Trammel Net	1	0	100	0	0
		39	37	24	0
		Fish Community Season			
1.0” Trammel Net	0	0	0	0	0
		34	34	30	3
		Both Seasons			
Trot Line	1	100	0	0	0
		36	35	23	5

Table 6. Total number of stock size (330-629 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2018. The percent of total effort for each gear in each habitat is presented on the second line of each gear type.

		Macrohabitat[a]			
Gear	**N**	**CHXO**	**ISB**	**OSB**	**SCCL**
			Sturgeon Season		
1.0” Trammel Net	5	0	80	20	0
		39	37	24	0
			Fish Community Season		
1.0” Trammel Net	2	0	50	50	0
		34	34	30	3
			Both Seasons		
Trot Line	26	35	35	31	0
		36	35	23	5

Table 7. Total number of quality size and greater (≥630 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2018. The percent of total effort for each gear in each habitat is presented on the second line of each gear type.

		Macrohabitat[a]			
Gear	**N**	**CHXO**	**ISB**	**OSB**	**SCCL**
			Sturgeon Season		
1.0” Trammel Net	1	0	100	0	0
		39	37	24	0
			Fish Community Season		
1.0” Trammel Net	0	0	0	0	0
		34	34	30	3
			Both Seasons		
Trot Line	0	0	0	0	0
		36	35	23	5

Table 8. Total number of pallid sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2018. The percent of total effort for each gear in each habitat is presented on the second line of each gear type.

		Macrohabitat[a]			
Gear	**N**	**CHXO**	**ISB**	**OSB**	**SCCL**
			Sturgeon Season		
1.0” Trammel Net	7	0	86	14	0
		39	37	24	0
			Fish Community Season		
1.0” Trammel Net	2	0	50	50	0
		34	34	30	3
			Both Seasons		
Trot Line	27	37	33	30	0
		36	35	23	5

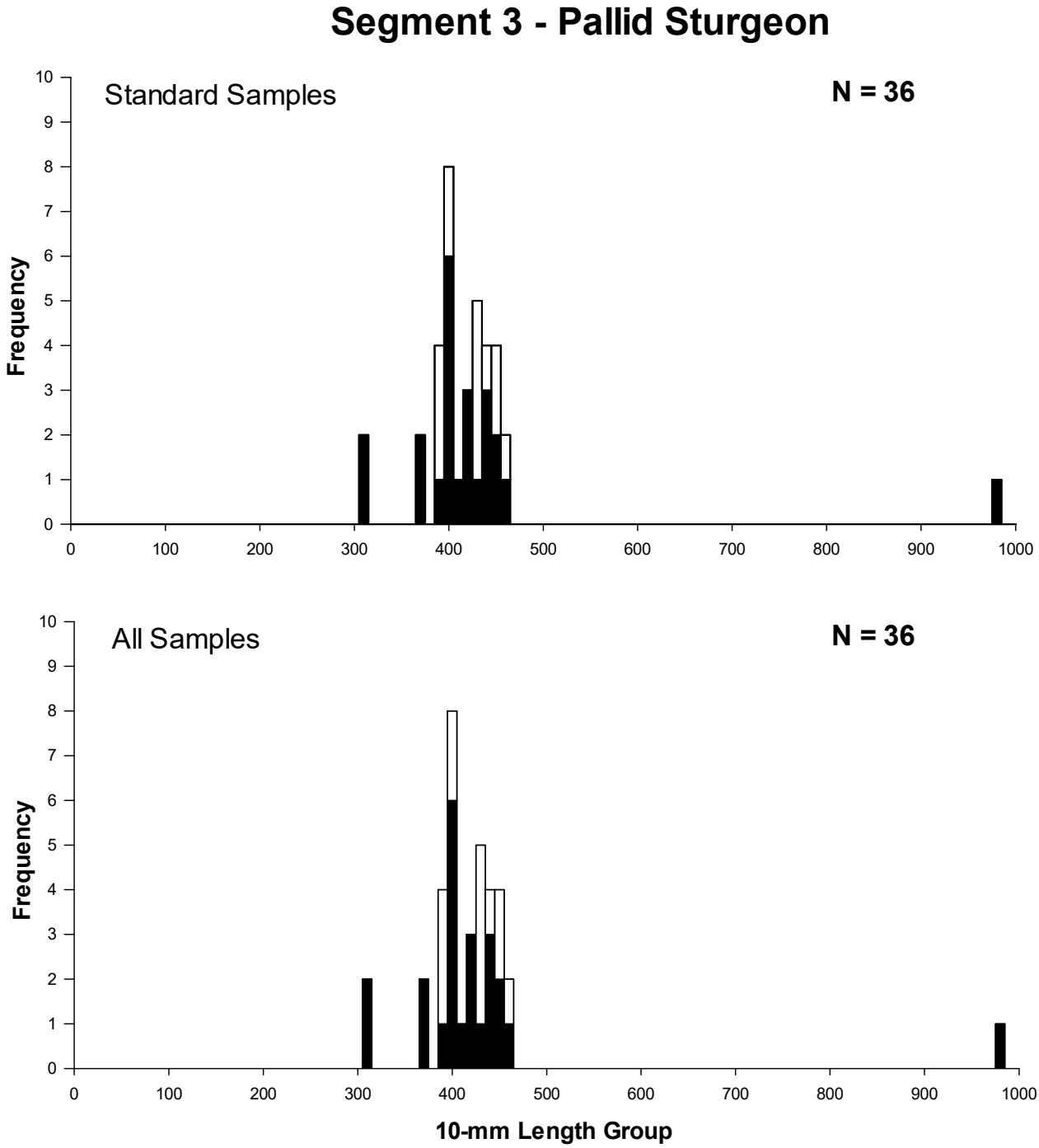

Figure 8. Length frequency of pallid sturgeon captured during the sturgeon season (black bars) and fish community season (white bars) in Segment 3 of the Missouri River during 2018. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2018. Pallid sturgeon of unknown origin are awaiting genetic verification.

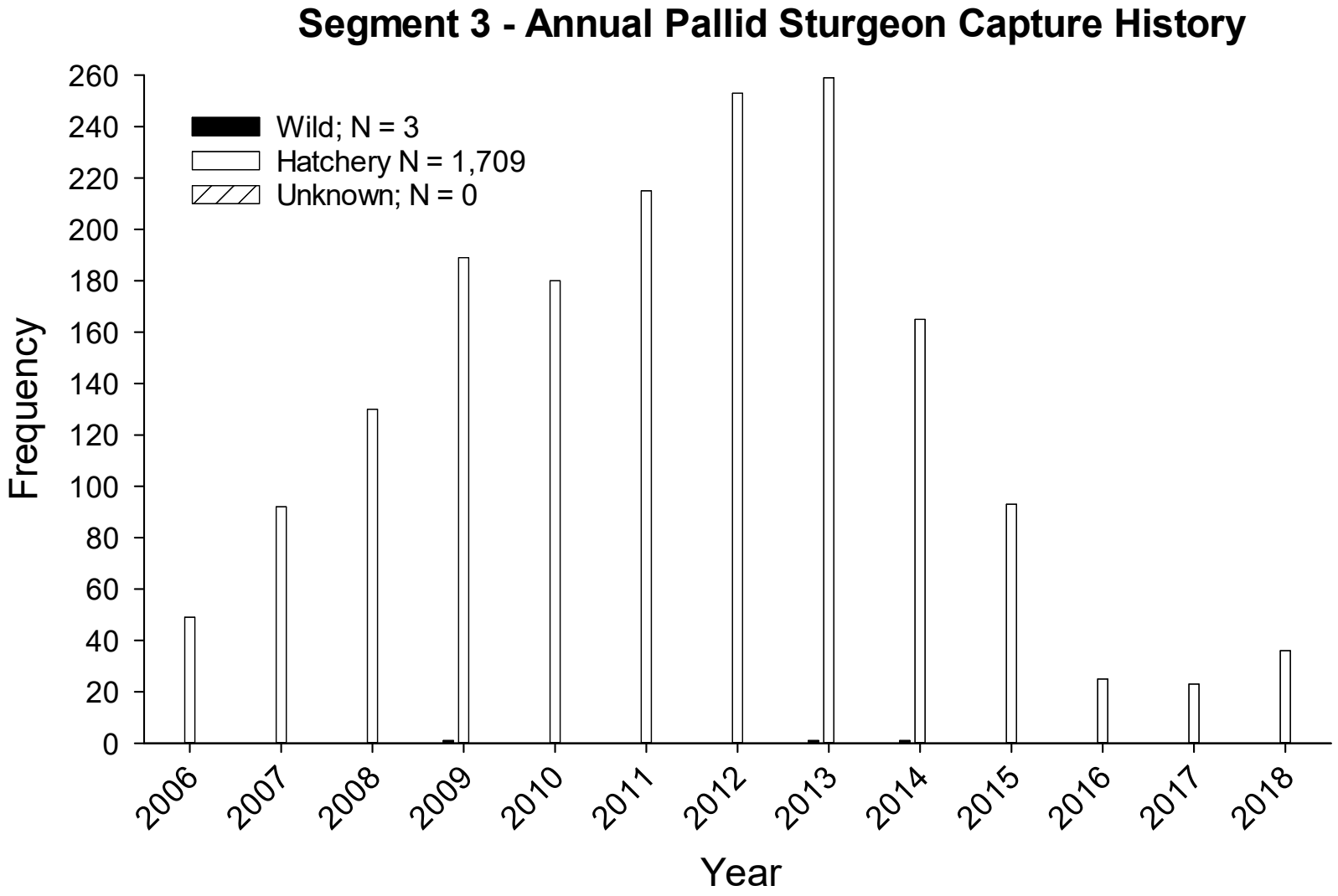

Figure 9. Annual capture history of wild (black bars), hatchery reared (white bars), and unknown origin (cross-hatched bars) pallid sturgeon collected in Segment 3 of the Missouri River from 2006-2018. Figure is designed to compare overall pallid sturgeon captures from year to year and is biased by variable effort among years. Figure includes all pallid captures including non-random and wild samples

Shovelnose X Pallid Sturgeon Hybrids

No shovelnose x pallid sturgeon hybrids have been collected in Segment 3 from 2006 to 2018.

Targeted Native River Species

Shovelnose Sturgeon

The sampling events throughout Segment 3 during the 2018 field season resulted in the capture of 161 shovelnose sturgeon. Temporally, more shovelnose sturgeon were observed during sturgeon season (n=107) than fish community season (n=54). In relation to gears, a greater number were witnessed via trammel net (n=87) when compared to trotline (n=74). Of the 87 shovelnose sturgeon observed in trammel nets, 10 were captured during non-random, duplicate sampling.

The aforementioned trammel net drifts which occurred throughout Segment 3 in 2018 led to seasonal CPUE, for the quality and above size class of shovelnose sturgeon, the most frequently observed size class, of 0.20 fish/100m and 0.11 fish/100m for the sturgeon and fish community seasons, respectively. Seasonal catch rates led to a combined-season CPUE of 0.15 fish/100m. Catch rates for the sub-stock and stock size categories of shovelnose sturgeon in Segment 3 remained low, yet comparable to previous years.

Temporally, trotline CPUE for Segment 3 during 2018 (Fig. 12), regarding the quality and above size class of shovelnose sturgeon, was reported at 1.13 fish/20 hooks and 0.42 fish/20 hooks for the sturgeon and fish community seasons, respectively. In turn, seasonal trotline catch rates led to a combined-season CPUE of 0.77 fish/20 hooks. Similarly, to trammel net, trotline captures of the sub-stock and stock size categories of shovelnose sturgeon remained low in Segment 3 of the Missouri River.

The shovelnose sturgeon observed throughout Segment 3 in 2018 averaged 443 mm in fork length and 330 g in weight, with a range of 288 mm and 90 g to 807 mm and 2,670 g. A full description of size, in the form of a length frequency histogram, can be found in Figure 13, while relative stock density (RSD) can be obtained in Figure 14. Year by year comparisons of relative weights (Wr) can be found in Figure 15.

The specific macro and meso habitats where shovelnose sturgeon were sampled in Segment 3 during 2018, by gear and size class, is depicted in Tables 9-12. Table 13 shows the total number of shovelnose sampled by gear and macro habitat.

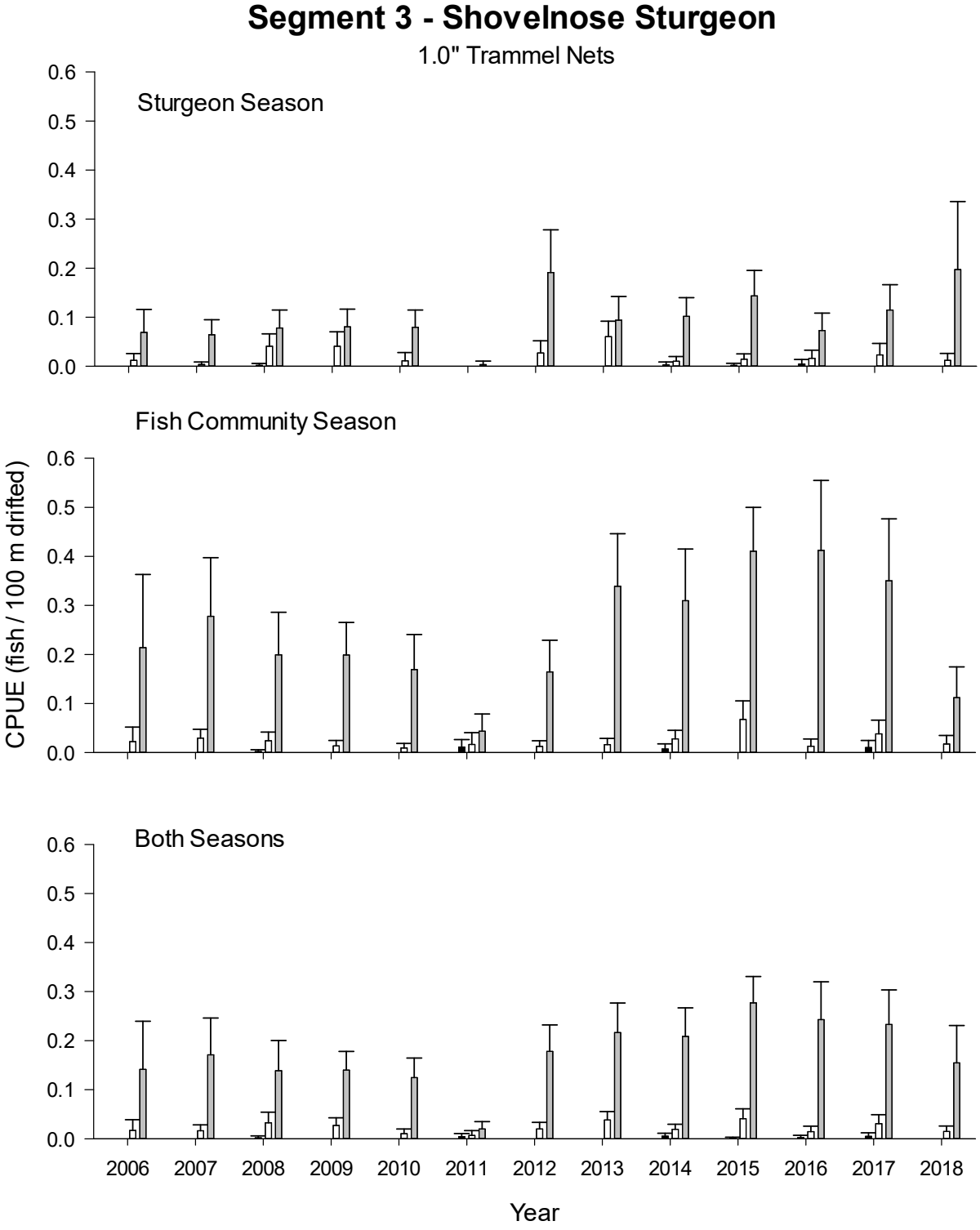

Figure 10. Mean annual catch per unit effort (+/- 2 SE) of sub-stock size (0-149 mm; cross-hatched bars), sub-stock size (150-249 mm; black bars), stock size (250-379 mm; white bars), and quality and above size (> 380 mm; gray bars) shovelnose sturgeon using 1.0" trammel nets in Segment 3 of the Missouri River from 2006-2018.

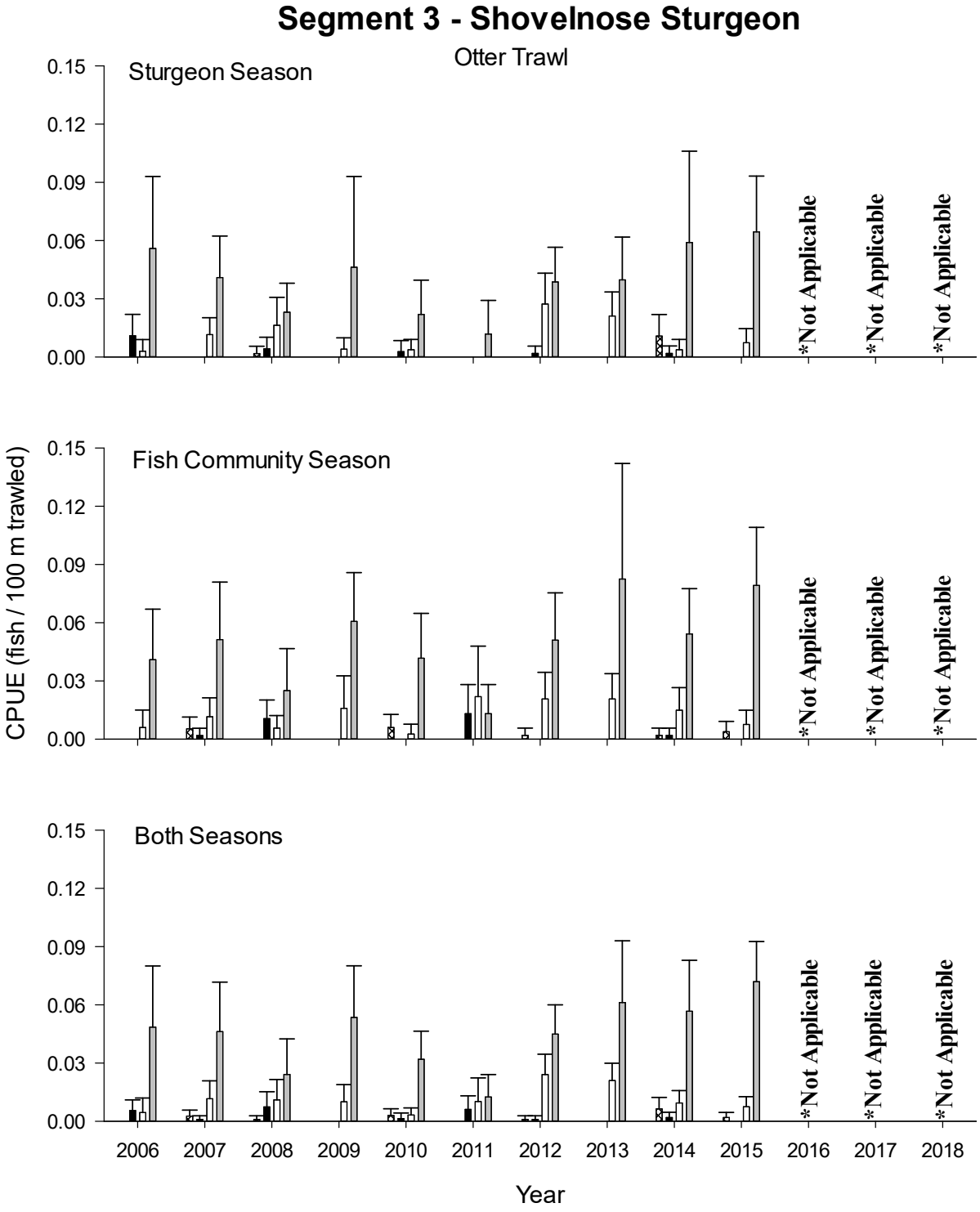

Figure 11. Mean annual catch per unit effort (+/- 2 SE) of sub-stock size (0-149 mm; cross-hatched bars), sub-stock size (150-249 mm; black bars), stock size (250-379 mm; white bars), and quality and above size (> 380 mm; gray bars) shovelnose sturgeon using otter trawls in Segment 3 of the Missouri River from 2006-2018. *Otter trawl not performed in 2016-2018.

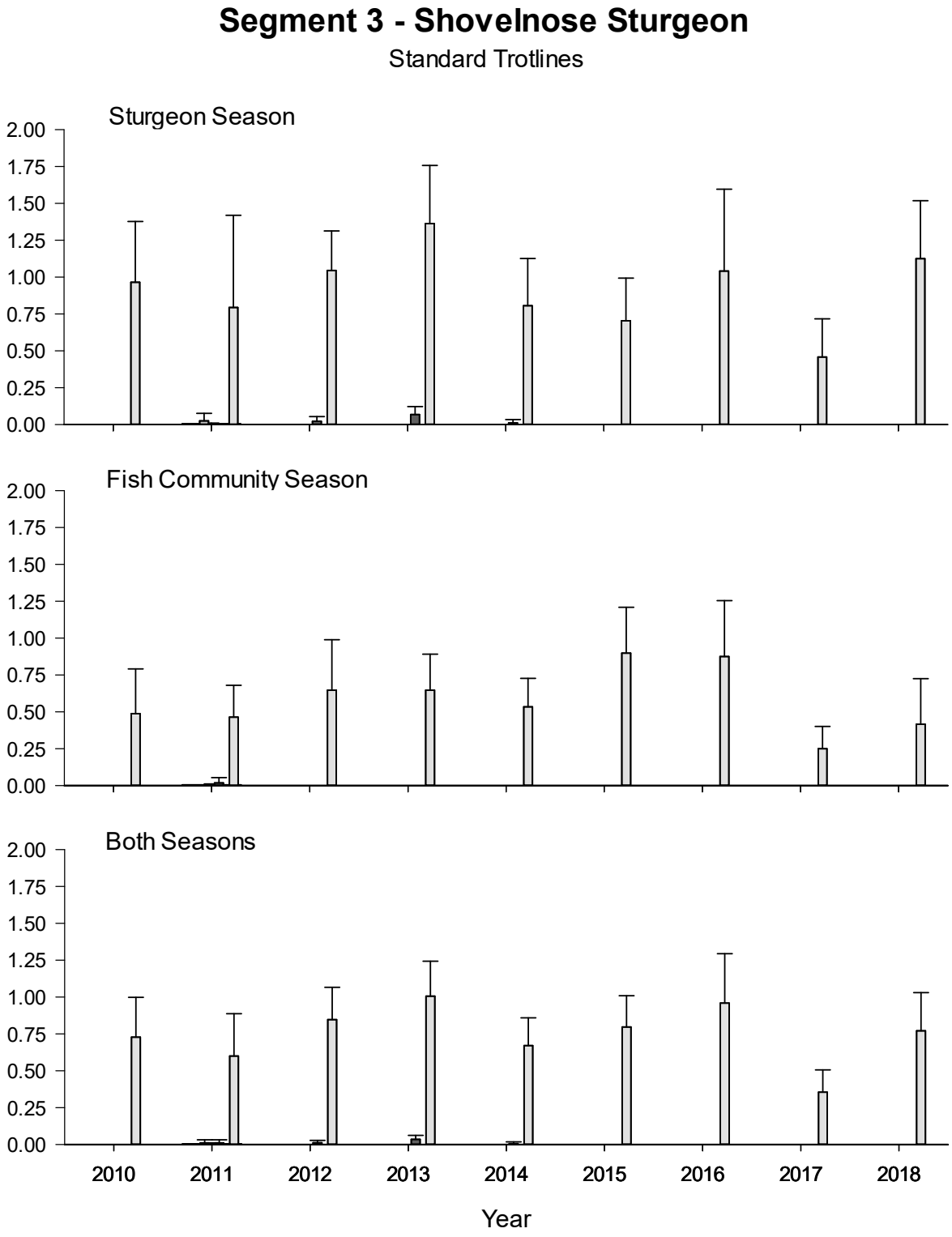

Figure 12. Mean annual catch per unit effort (+/- 2 SE) of sub-stock size (0-149 mm; cross-hatched bars), sub-stock size (150-249 mm; black bars), stock size (250-379 mm; white bars), and quality and above size (> 380 mm; gray bars) shovelnose sturgeon using trotlines in Segment 3 of the Missouri River from 2010-2018. Note that trotlines were not used as a standard gear from 2006 to 2009.

Table 9. Total number of sub-stock size (0-149 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2018. The percent of total effort for each gear in each habitat is presented on the second line of each gear type.

		Macrohabitat[a]			
Gear	**N**	**CHXO**	**ISB**	**OSB**	**SCCL**
			Sturgeon Season		
1.0” Trammel Net	0	0	0	0	0
		39	37	24	0
			Fish Community Season		
1.0” Trammel Net	0	0	0	0	0
		34	34	30	3
			Both Seasons		
Trot Line	0	0	0	0	0
		36	35	23	5

Table 10. Total number of sub-stock size (150-249 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2018. The percent of total effort for each gear in each habitat is presented on the second line of each gear type.

		Macrohabitat[a]			
Gear	**N**	**CHXO**	**ISB**	**OSB**	**SCCL**
		Sturgeon Season			
1.0” Trammel Net	0	0	0	0	0
		39	37	24	0
		Fish Community Season			
1.0” Trammel Net	0	0	0	0	0
		34	34	30	3
		Both Seasons			
Trot Line	0	0	0	0	0
		36	35	23	5

Table 11. Total number of stock size (250-379 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2018. The percent of total effort for each gear in each habitat is presented on the second line of each gear type.

		Macrohabitat[a]			
Gear	**N**	**CHXO**	**ISB**	**OSB**	**SCCL**
		Sturgeon Season			
1.0” Trammel Net	3	33	67	0	0
		39	37	24	0
		Fish Community Season			
1.0” Trammel Net	4	75	25	0	0
		34	34	30	3
		Both Seasons			
Trot Line	0	0	0	0	0
		36	35	23	5

Table 12. Total number of quality size and greater (≥380 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2018. The percent of total effort for each gear in each habitat is presented on the second line of each gear type.

		Macrohabitat[a]			
Gear	**N**	**CHXO**	**ISB**	**OSB**	**SCCL**
		Sturgeon Season			
1.0” Trammel Net	44	25	73	2	0
		39	37	24	0
		Fish Community Season			
1.0” Trammel Net	26	46	42	12	0
		34	34	30	3
		Both Seasons			
Trot Line	74	28	41	30	1
		36	35	23	5

Table 13. Total number of shovelnose sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2018. The percent of total effort for each gear in each habitat is presented on the second line of each gear type.

		Macrohabitat[a]			
Gear	**N**	**CHXO**	**ISB**	**OSB**	**SCCL**
			Sturgeon Season		
1.0” Trammel Net	47	26	72	2	0
		39	37	24	0
			Fish Community Season		
1.0” Trammel Net	30	50	40	10	0
		34	34	30	3
			Both Seasons		
Trot Line	74	28	41	30	1
		36	35	23	5

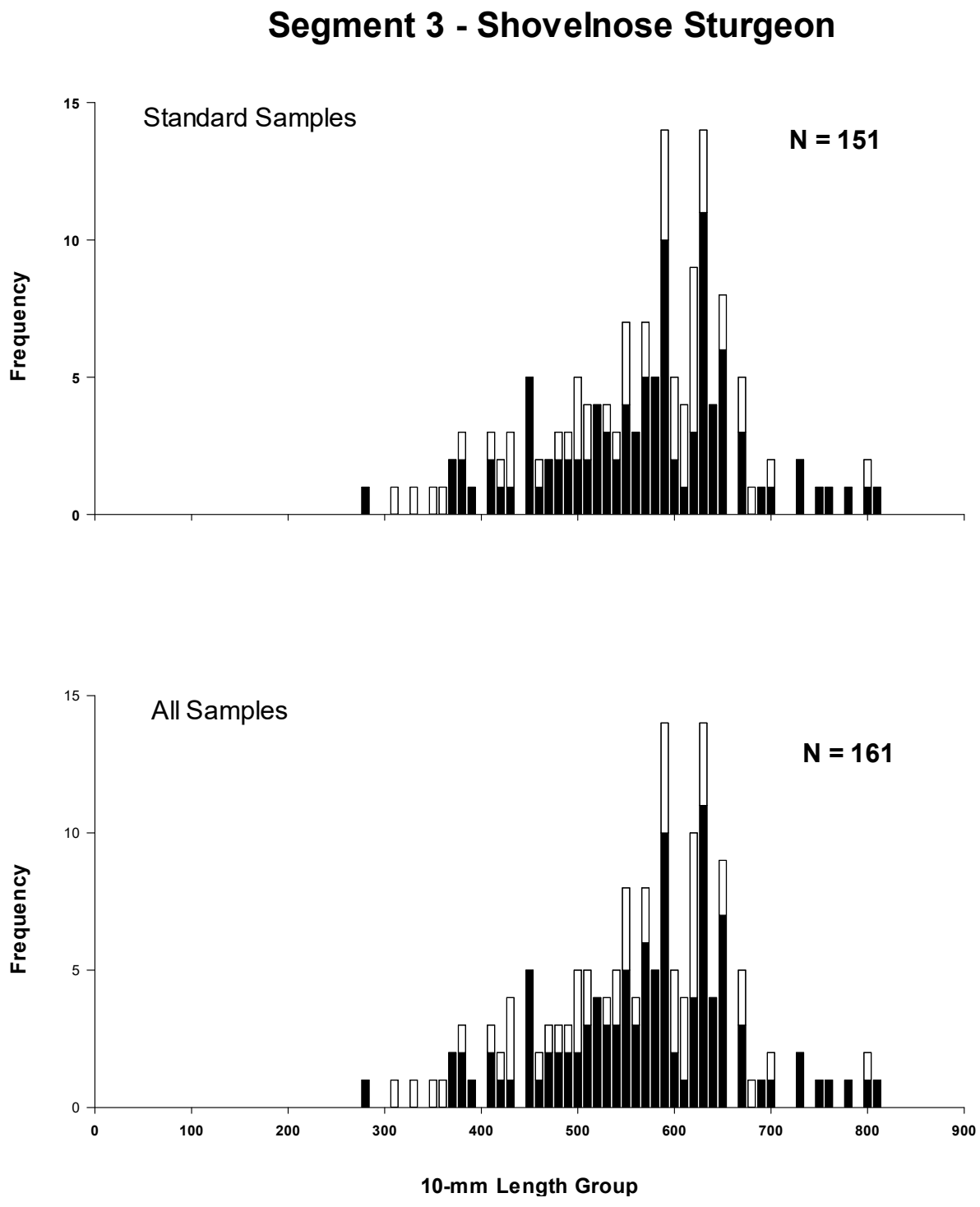

Figure 13. Length frequency of shovelnose sturgeon during the sturgeon season (black bars) and fish community season (white bars) in Segment 3 of the Missouri River during 2018. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2018.

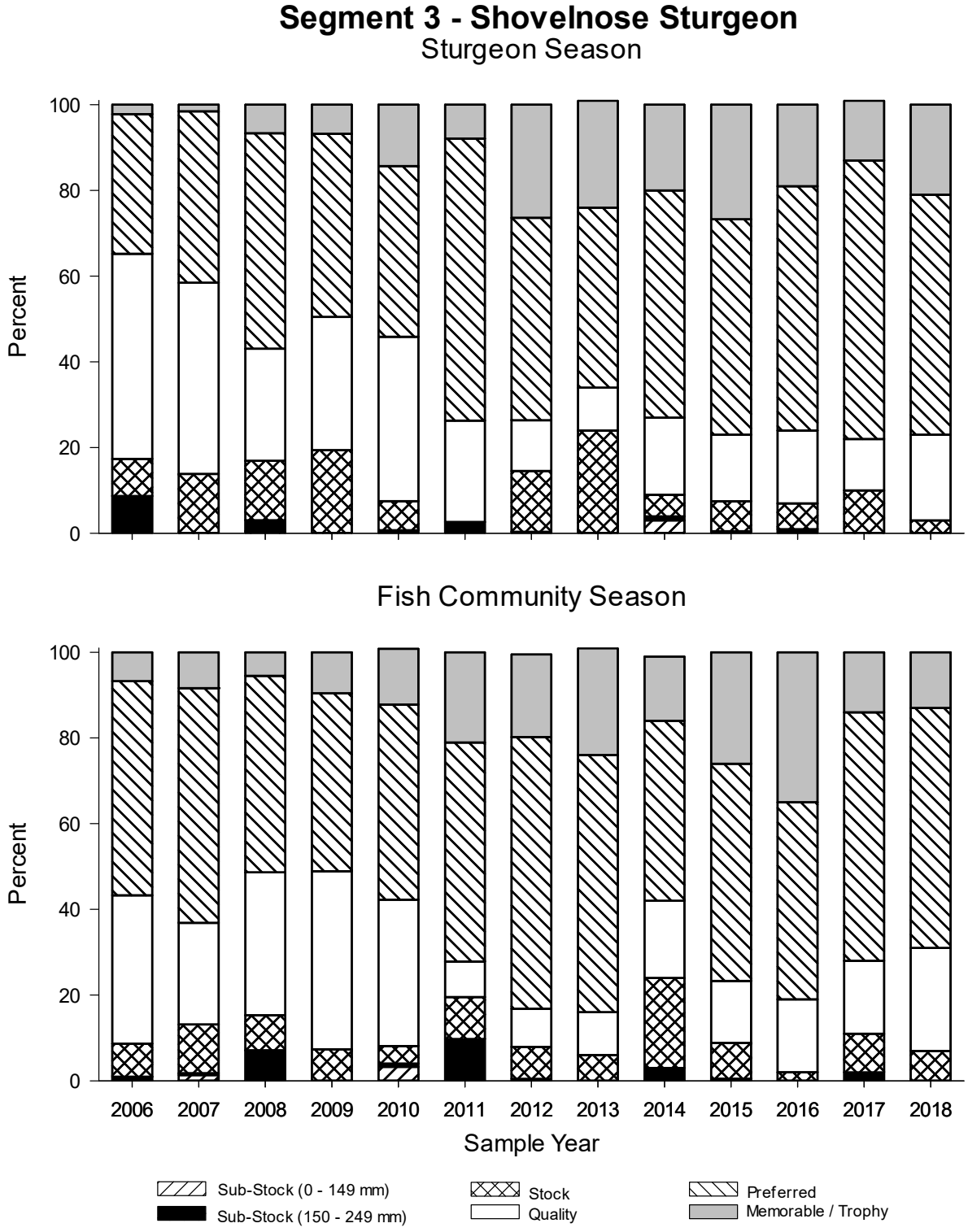

Figure 14. Proportion by length group for all shovelnose sturgeon captured with all gear by length category from 2006 to 2018 in Segment 3 in the Missouri River. Length categories determined using the methods proposed by Quist (1998).

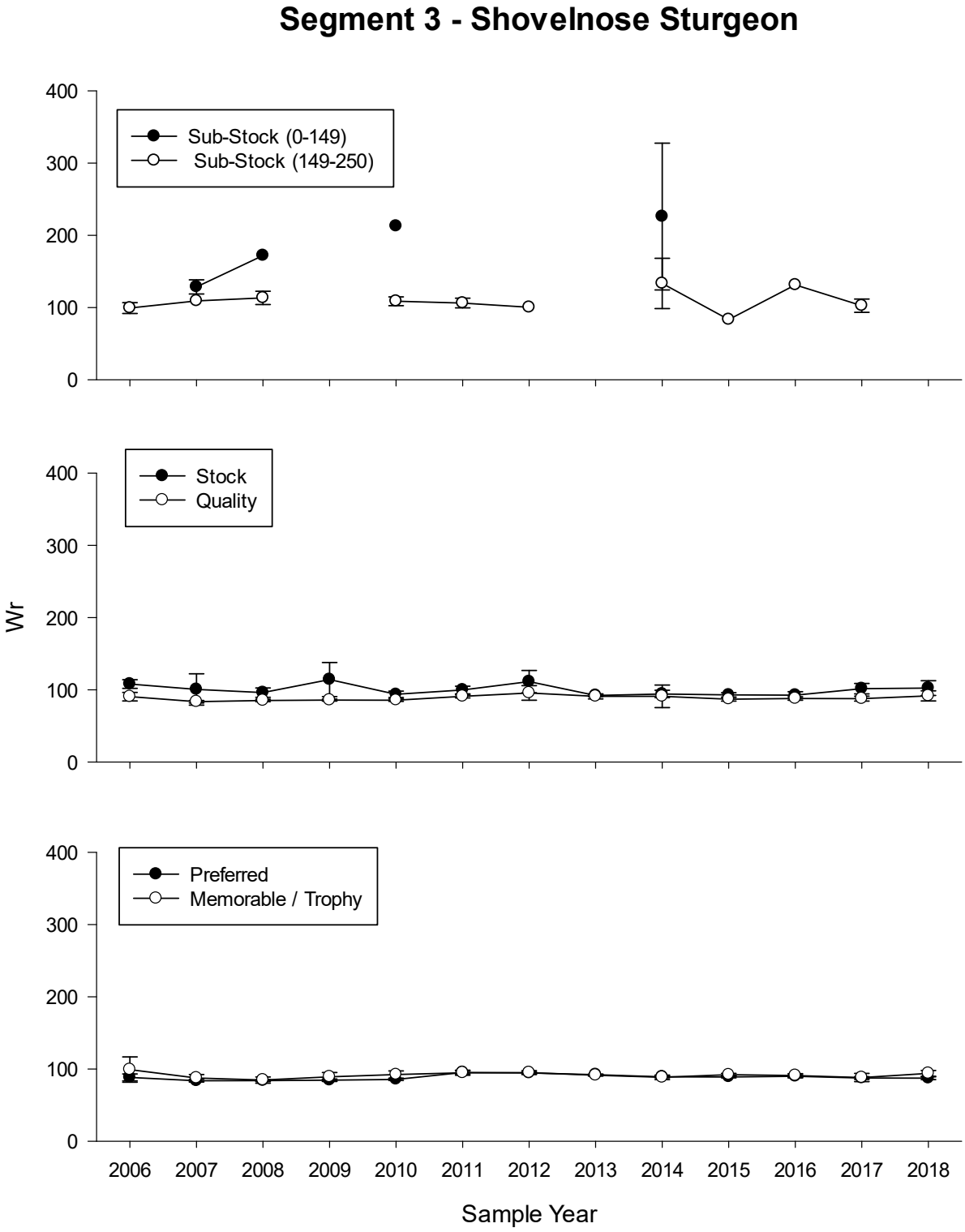

Figure 15. Relative weight (Wr) for all shovelnose sturgeon captured with all gear by incremental relative stock density (RSD) length category from 2006-2018 in Segment 3 in the Missouri River. Length categories determined using the methods proposed by Quist (1998).

Sturgeon Chub

Due to the abandonment of otter trawl and mini-fyke net as sampling gears, no sturgeon chubs were captured in Segment 3 during the 2018 field season.

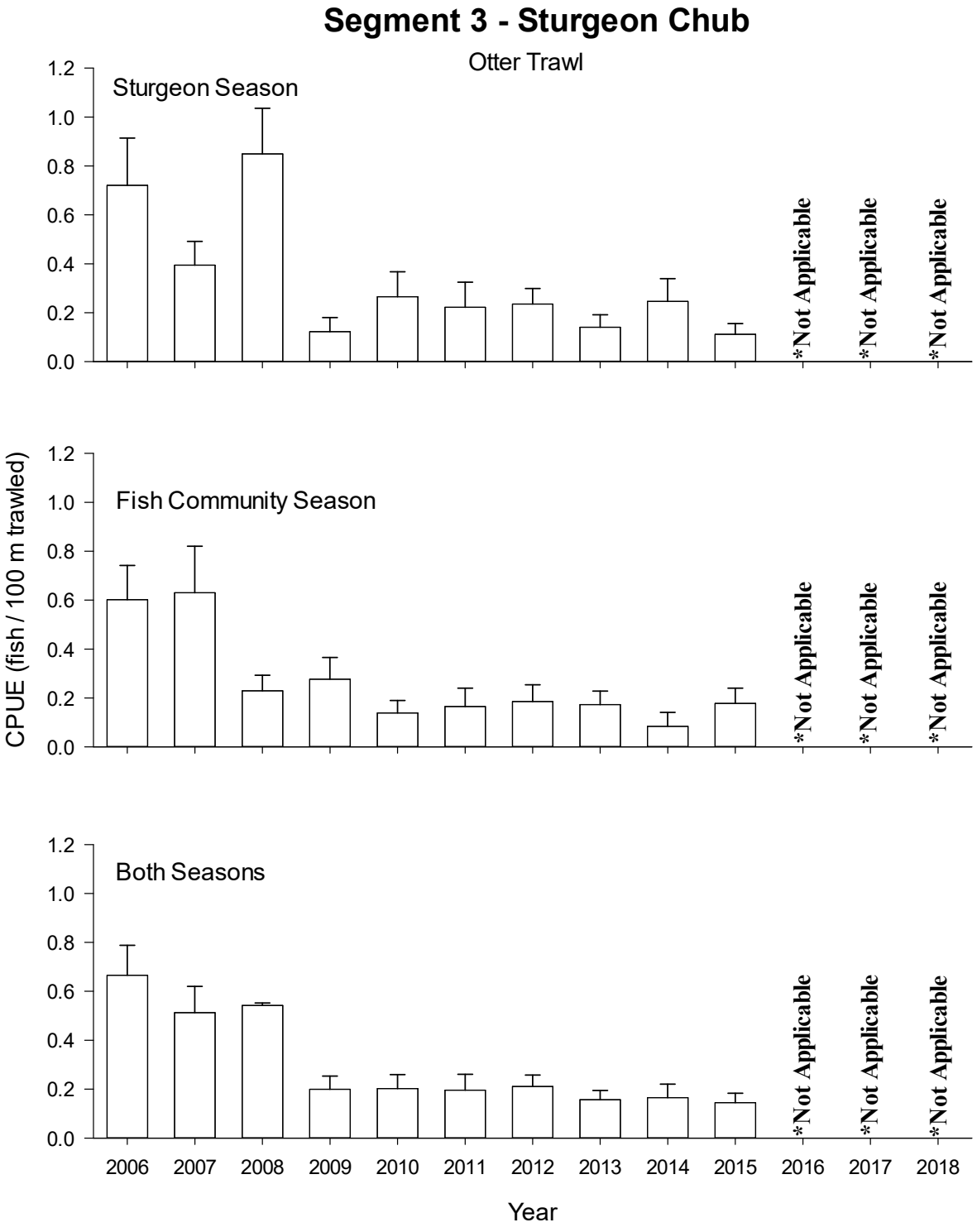

Figure 16. Mean annual catch per unit effort (+/- 2 SE) of sturgeon chub using otter trawls in Segment 3 of the Missouri River from 2006-2018. *Otter trawl not performed in 2016-2018.

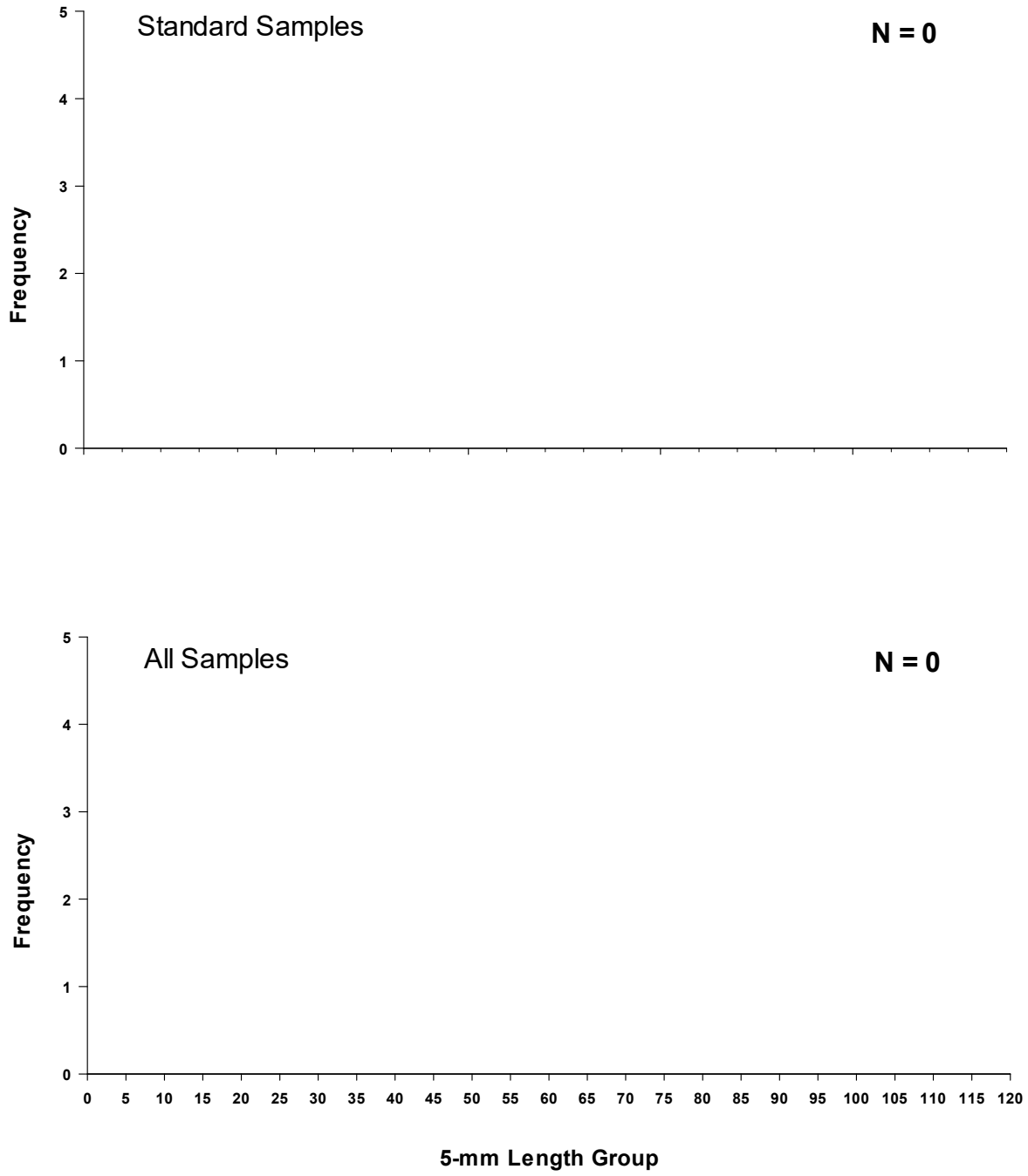

Figure 17. Length frequency of sturgeon chub during the sturgeon season (black bars) and the fish community season (white bars) in Segment 3 of the Missouri River during 2018. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2018.

Sicklefin Chub

Due to the abandonment of otter trawl and mini-fyke net as sampling gears, no sicklefin chubs were captured in Segment 3 during the 2018 field season.

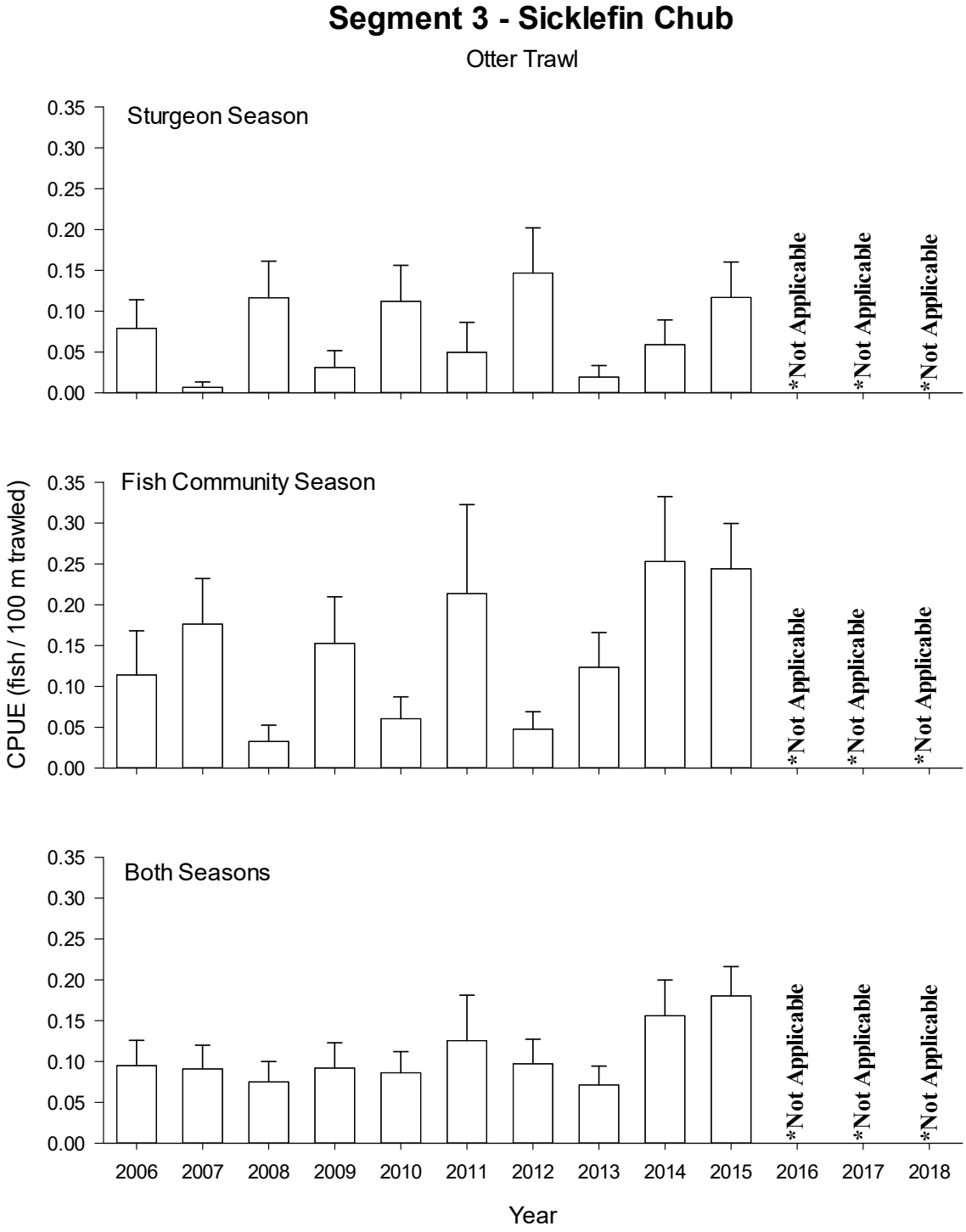

Figure 18. Mean annual catch per unit effort (+/- 2 SE) of sicklefin chub using otter trawls in Segment 3 of the Missouri River from 2006-2018. *Otter trawl not performed in 2016-2018.

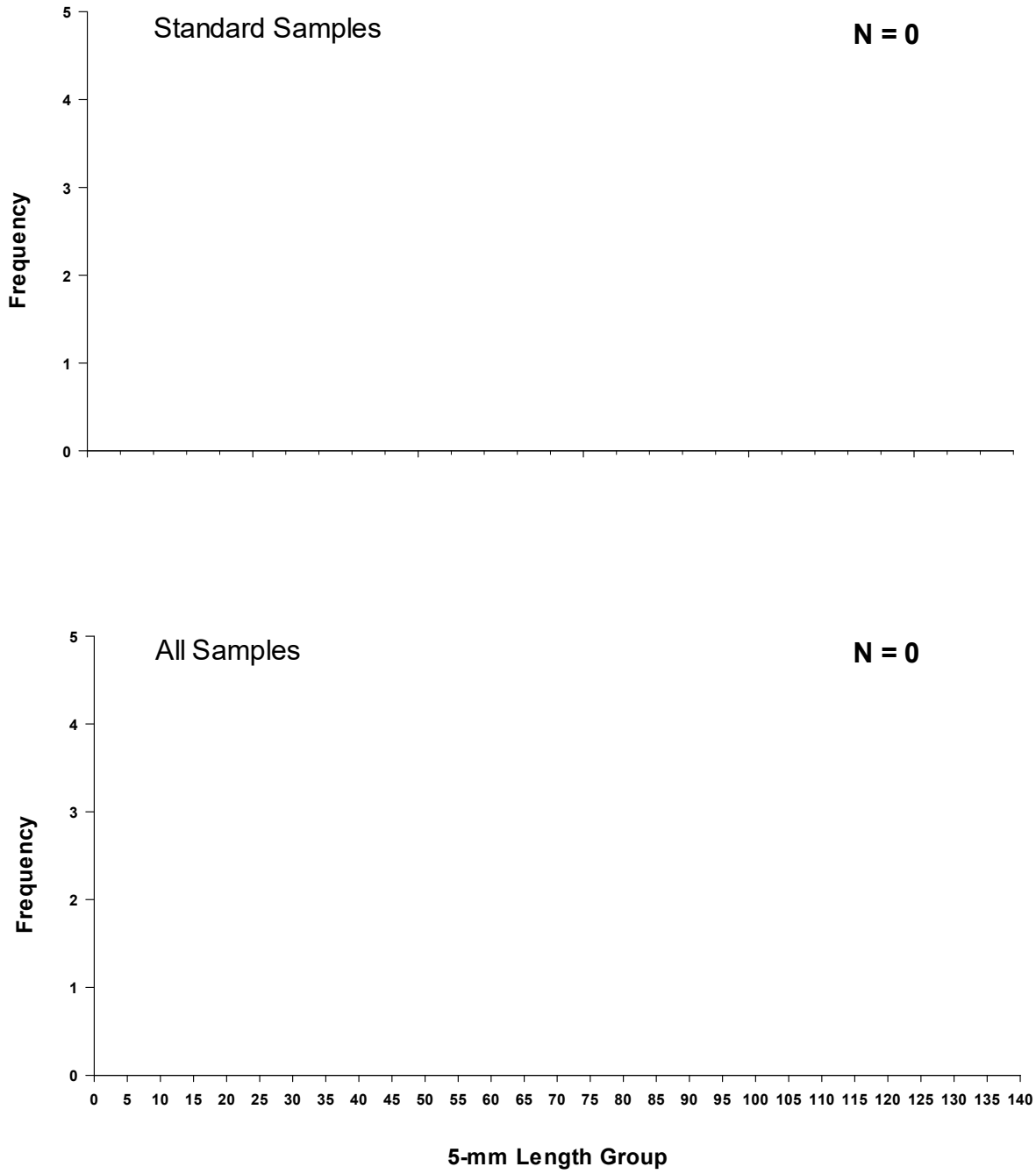

Figure 19. Length frequency of sicklefin chub during the sturgeon season (black bars) and the fish community season (white bars) in Segment 3 of the Missouri River during 2018. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2018.

Sand Shiner

Due to the abandonment of otter trawl and mini-fyke net as sampling gears, no sand shiners were captured in Segment 3 during the 2018 field season.

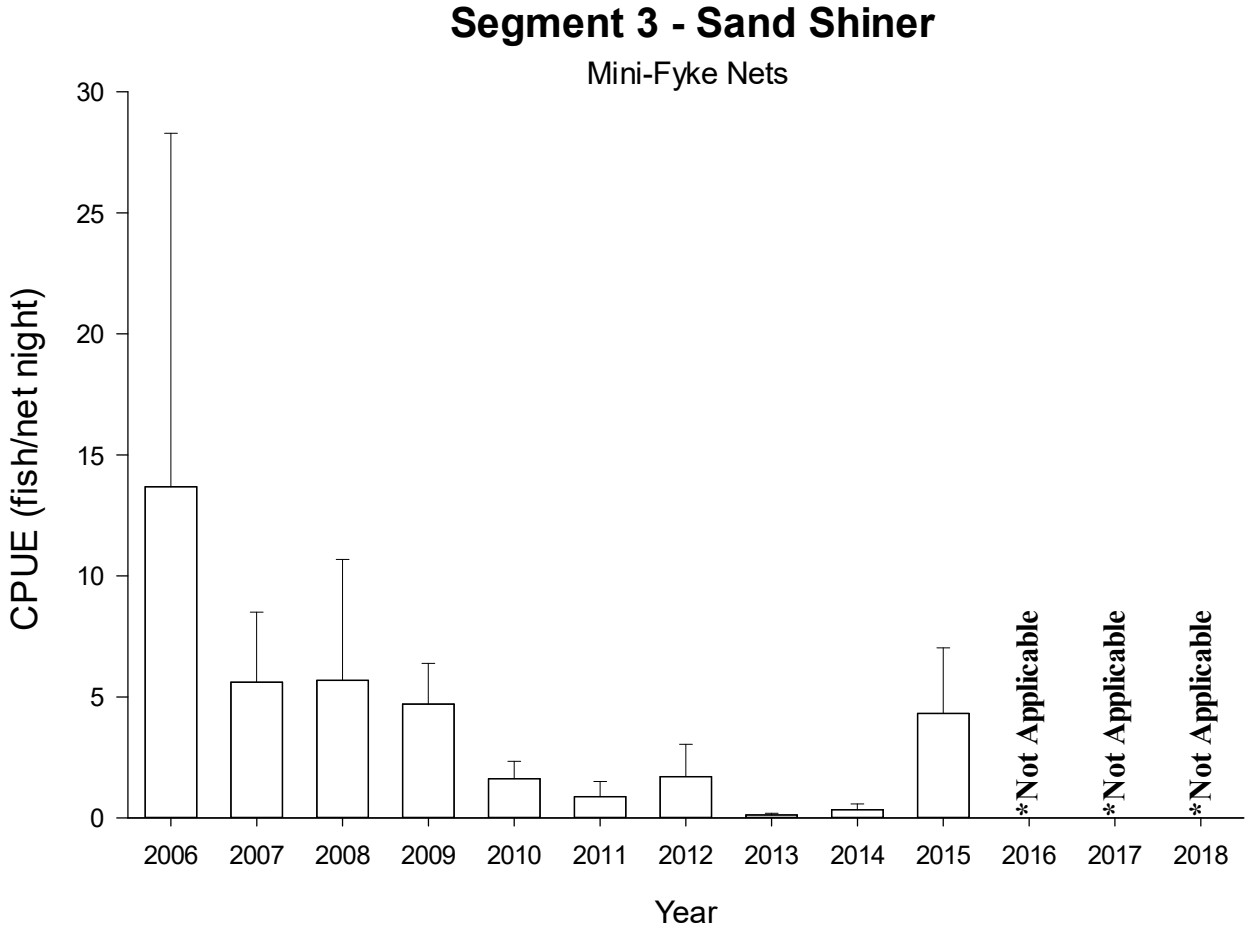

Figure 20. Mean annual catch per unit effort (+/- 2 SE) of sand shiner with mini-fyke nets in segment 3 of the Missouri River during fish community season 2006-2018. *Mini-fyke net not performed in 2016-2018.

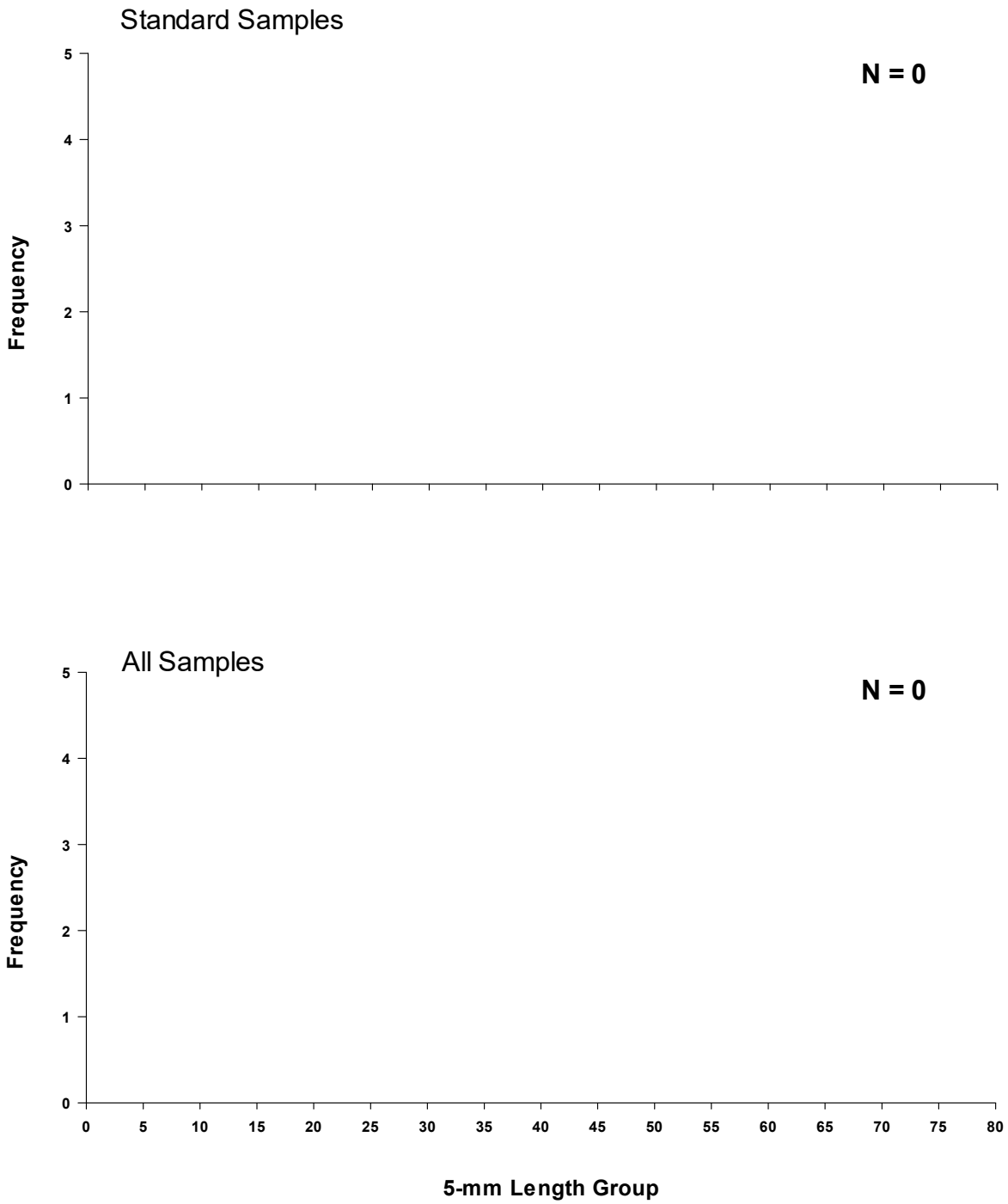

Figure 21. Length frequency of sand shiner during the sturgeon season (black bars) and the fish community season (white bars) in Segment 3 of the Missouri River during 2018. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2018.

***Hybognathus* spp**.

Due to the abandonment of otter trawl and mini-fyke net as sampling gears, no *Hybognathus* spp. were captured in Segment 3 during the 2018 field season.

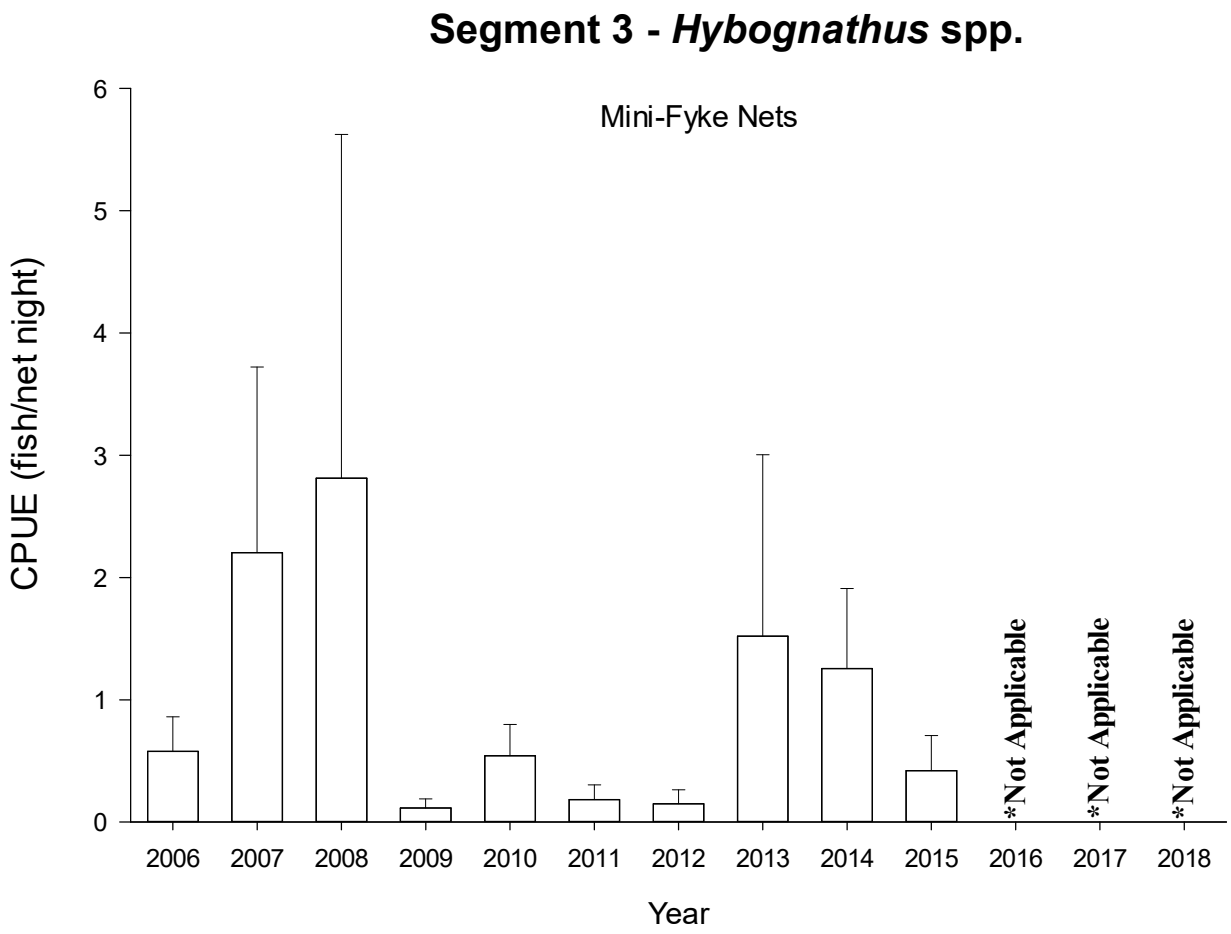

Figure 22. Mean annual catch per unit effort (+/- 2 SE) of *Hybognathus* spp. with mini-fyke nets in Segment 3 of the Missouri River during fish community season 2006-2018. *Mini-fyke net not performed in 2016-2018.

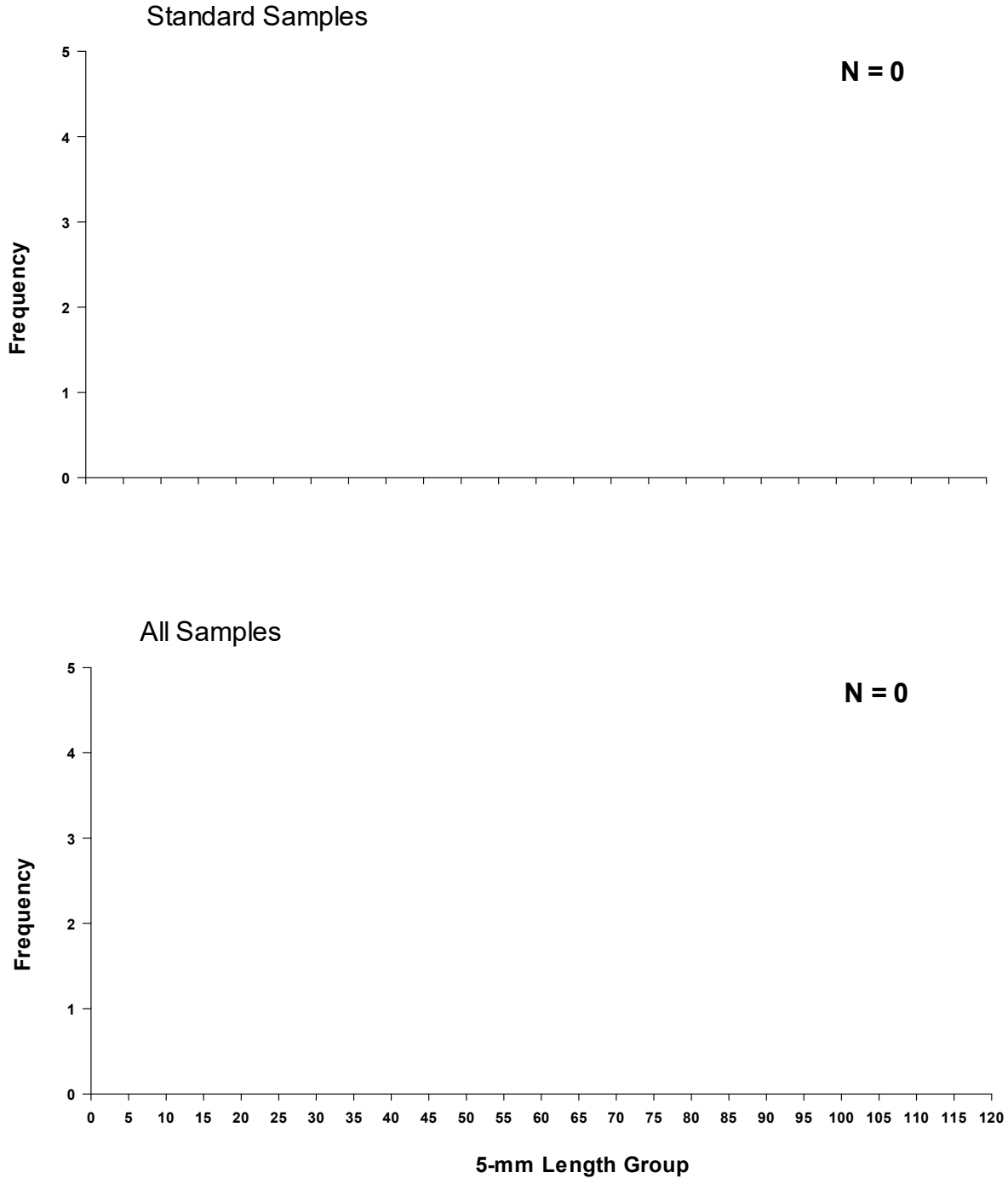

Figure 23. Length frequency of *Hybognathus* spp. caught during the sturgeon season (black bars) and the fish community season (white bars) in Segment 3 of the Missouri River during 2018. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2018.

Blue Sucker

Two blue suckers were captured in Segment 3 during the 2018 sampling season, both of which were observed in random trammel net drifts, one each during the sturgeon and fish community seasons, respectively. The associated trammel net CPUE, as well as historical catch data by season, can be found in Figure 24. The two individuals sampled in Segment 3 in 2018 were 474 mm and 715 mm in total length, respectively (Fig. 26). Further information regarding the specific macro habitat and associated capture information can be viewed in Table 14.

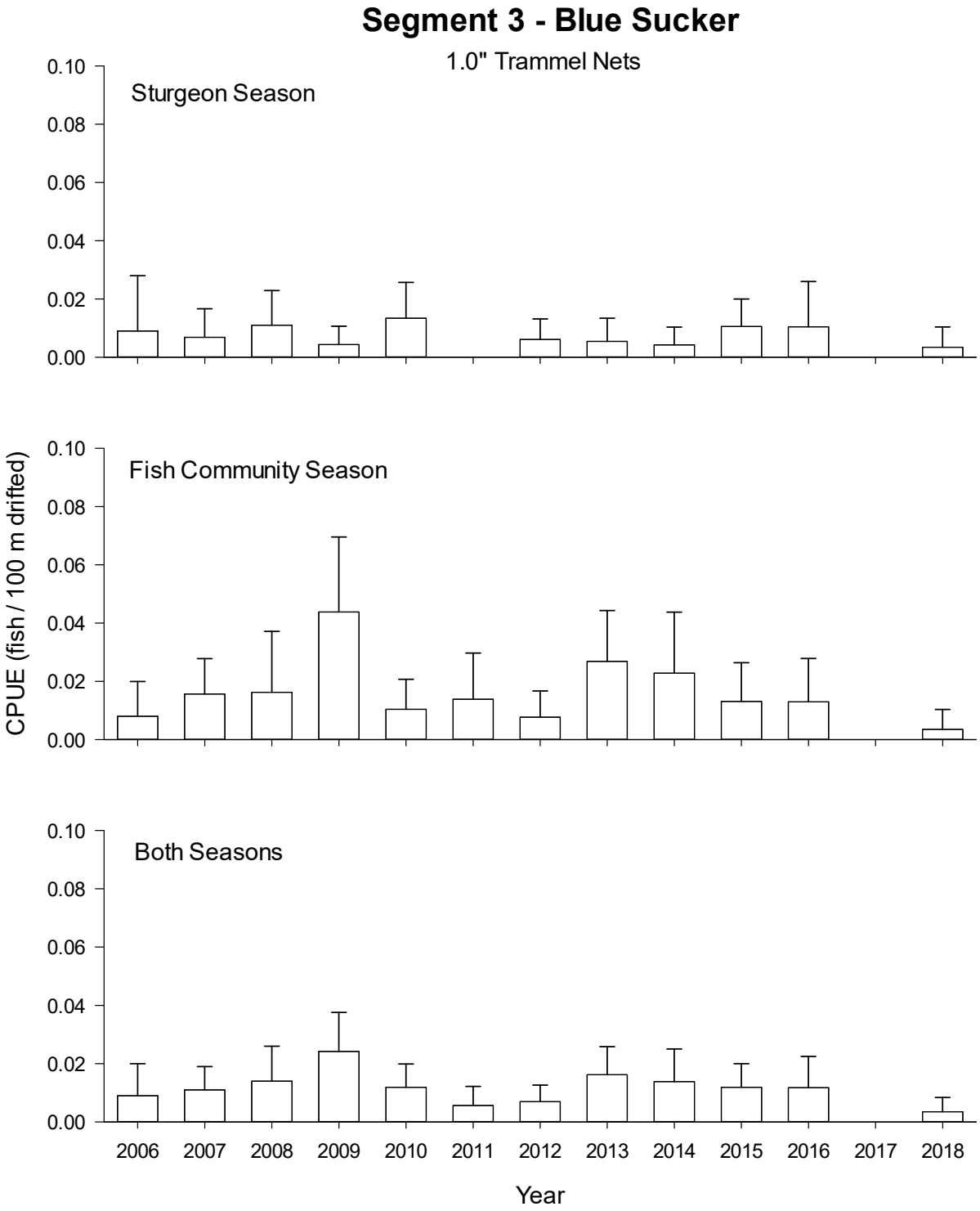

Figure 24. Mean annual catch per unit effort (+/- 2 SE) of blue sucker using 1.0" trammel nets in Segment 3 of the Missouri River from 2006-2018.

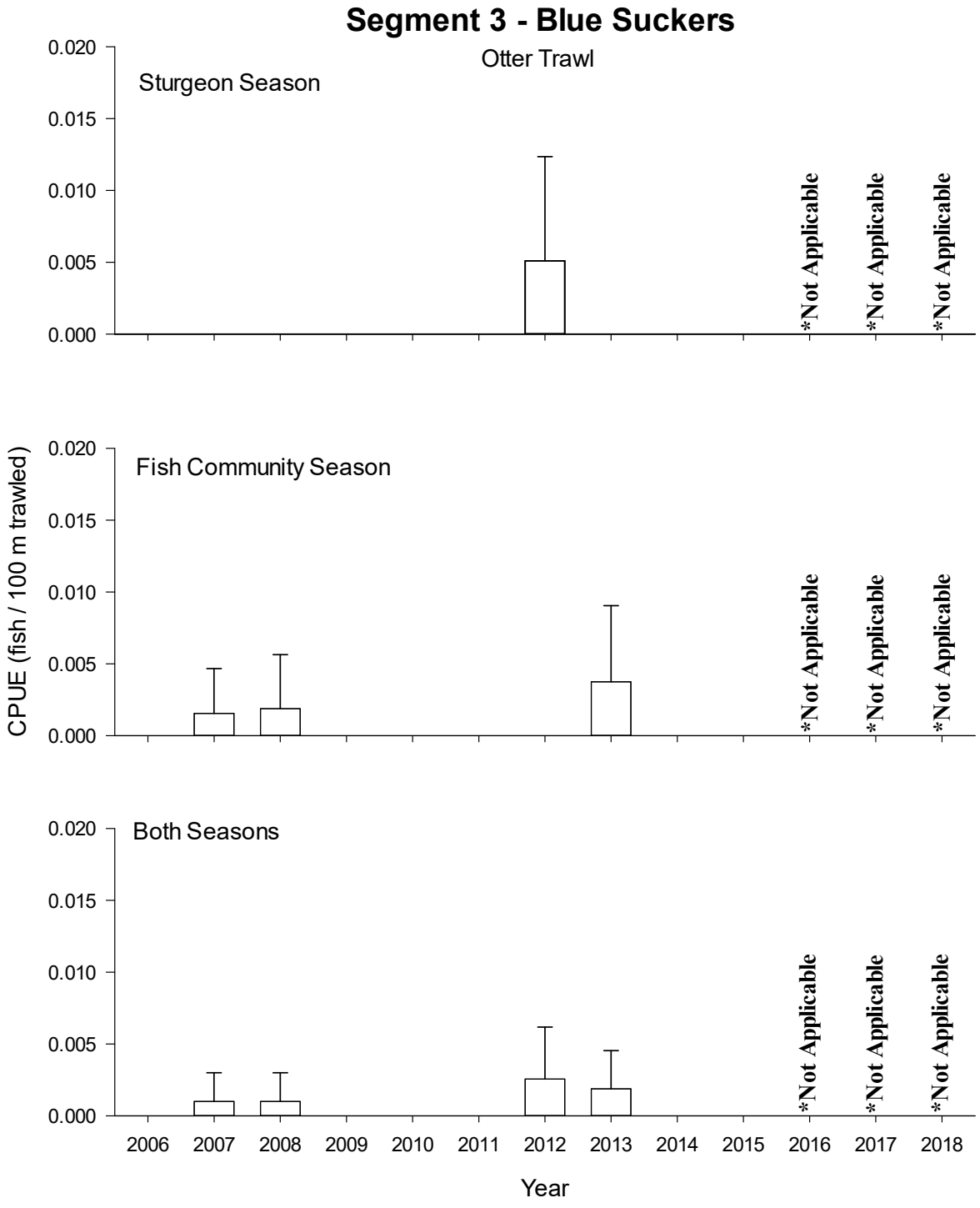

Figure 25. Mean annual catch per unit effort (+/- 2 SE) of blue sucker using otter trawls in Segment 3 of the Missouri River from 2006-2018. *Otter trawl not performed in 2016-2018.

Table 14. Total number of blue suckers captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2018. The percent of total effort for each gear in each habitat is presented on the second line of each gear type.

Gear	N	Macrohabitat[a]			
		CHXO	**ISB**	**OSB**	**SCCL**
			Sturgeon Season		
1.0” Trammel Net	1	0	100	0	0
		39	37	24	0
			Fish Community Season		
1.0” Trammel Net	1	0	100	0	0
		34	34	30	3
			Both Seasons		
Trot Line	0	0	0	0	0
		36	35	23	5

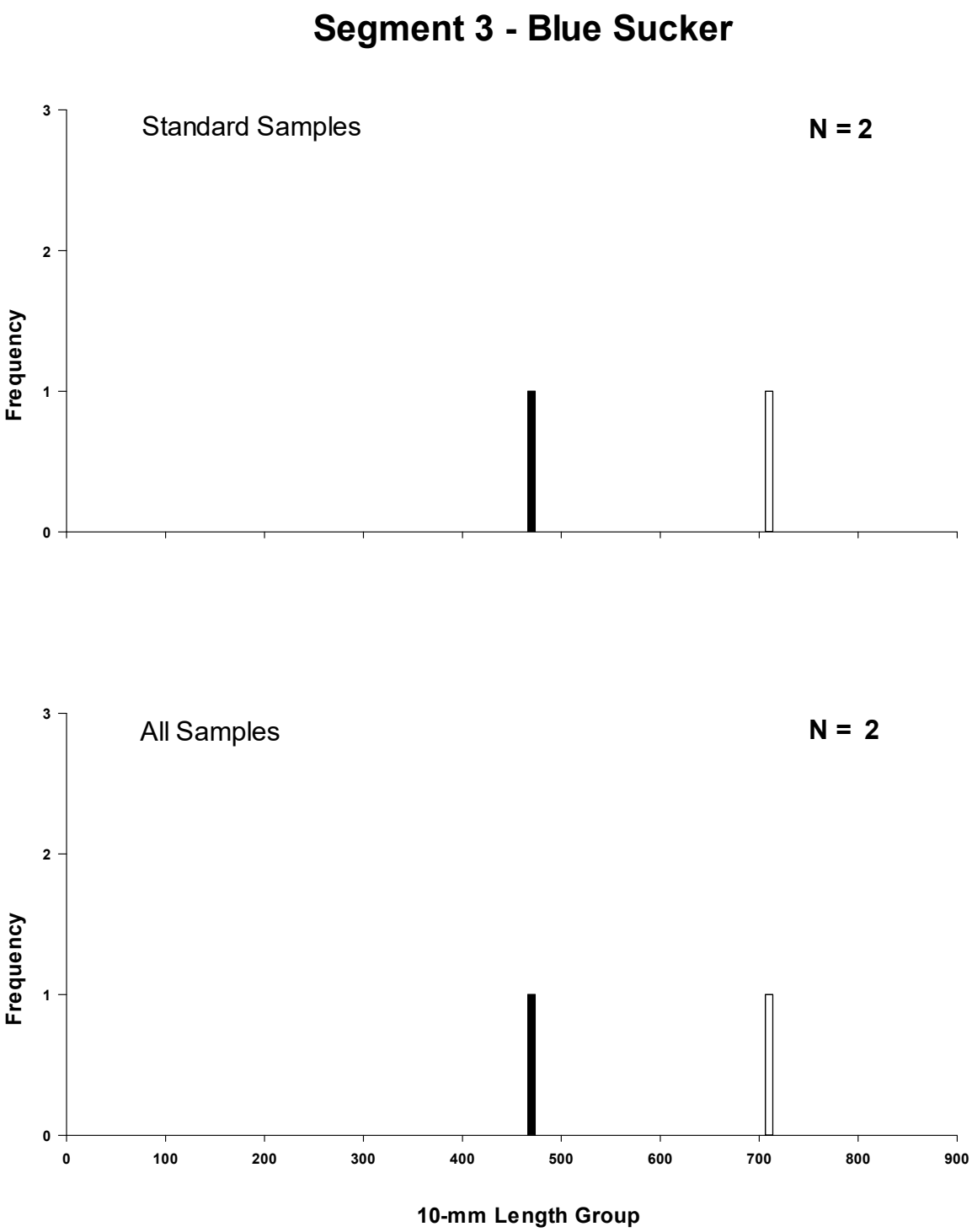

Figure 26. Length frequency of blue sucker during the sturgeon season (black bars) and the fish community season (white bars) in Segment 3 of the Missouri River during 2018. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2018.

Sauger

A total of 73 sauger were collected throughout Segment 3 in 2018, with all but one individual being captured via random trammel net deployments. Seasonally, more sauger were captured during sturgeon season (n=57) than were observed during fish community season (n=16). The lone sauger not represented in trammel net sampling was captured by on a trotline set.

With a higher propensity for sauger to be captured during sturgeon season, the associated CPUE for that season was reported at 0.22 fish/100m in Segment 3 during 2018. Fish community season CPUE was tabulated at 0.08 fish/100m, leading to a combined-season CPUE of 0.15 fish/100m.

The sauger observed throughout Segment 3 in 2018 averaged 350 mm in total length and 315 g in weight, with a length range of 249 mm to 514 mm. A complete length frequency for 2018 regarding the observed population of sauger in Segment 3 can be found in Figure 30.

Further information regarding the specific macro habitat and associated capture information can be viewed in Table 15.

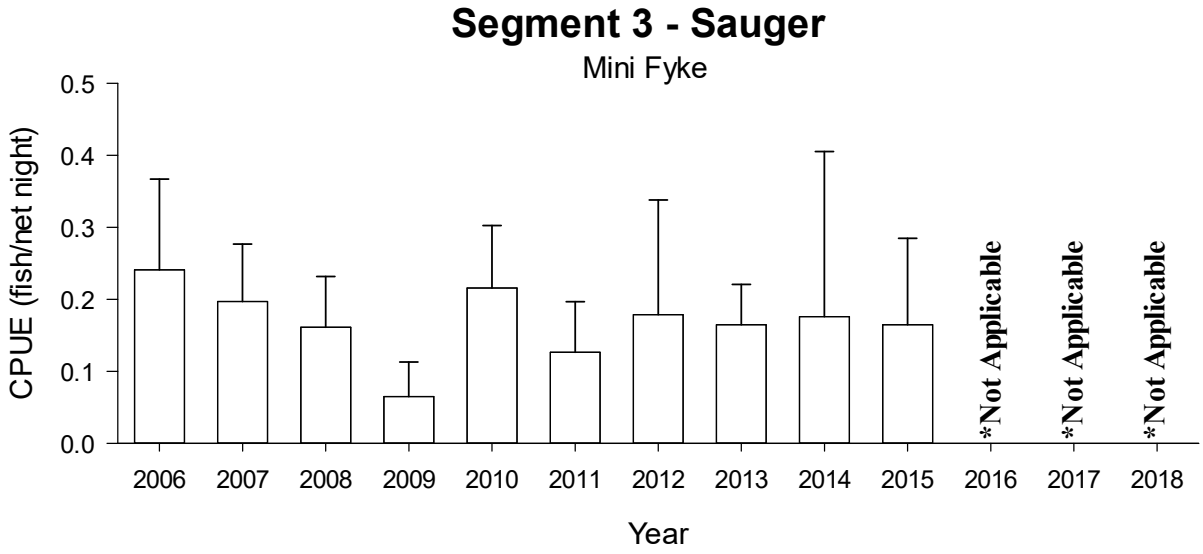

Figure 27. Mean annual catch per unit effort (+/- 2 SE) of sauger using mini-fyke nets in Segment 3 of the Missouri River from 2006-2018. *Mini-fyke net not performed in 2016-2018.

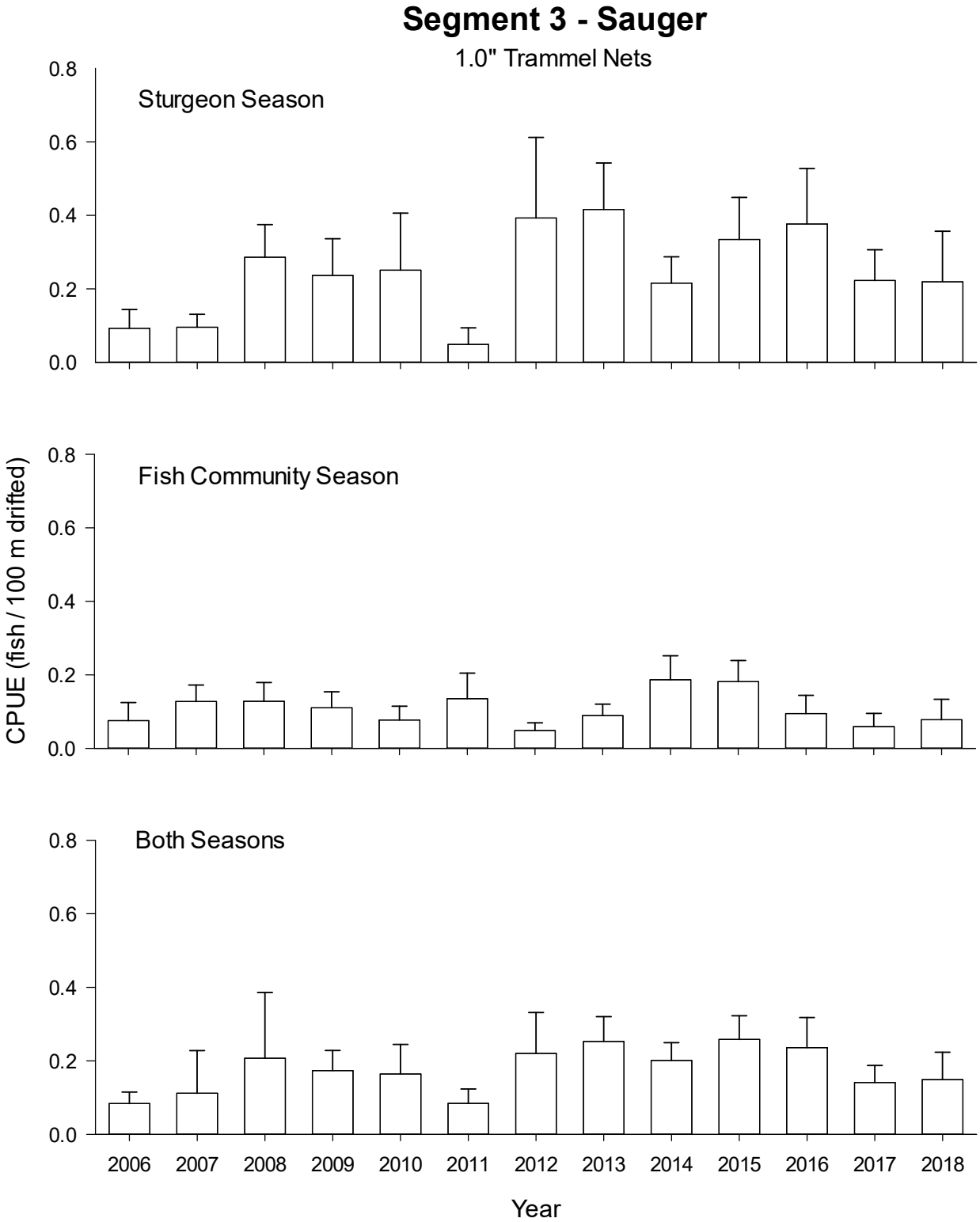

Figure 28. Mean annual catch per unit effort (+/- 2 SE) of sauger using 1.0" trammel nets in Segment 3 of the Missouri River from 2006-2018.

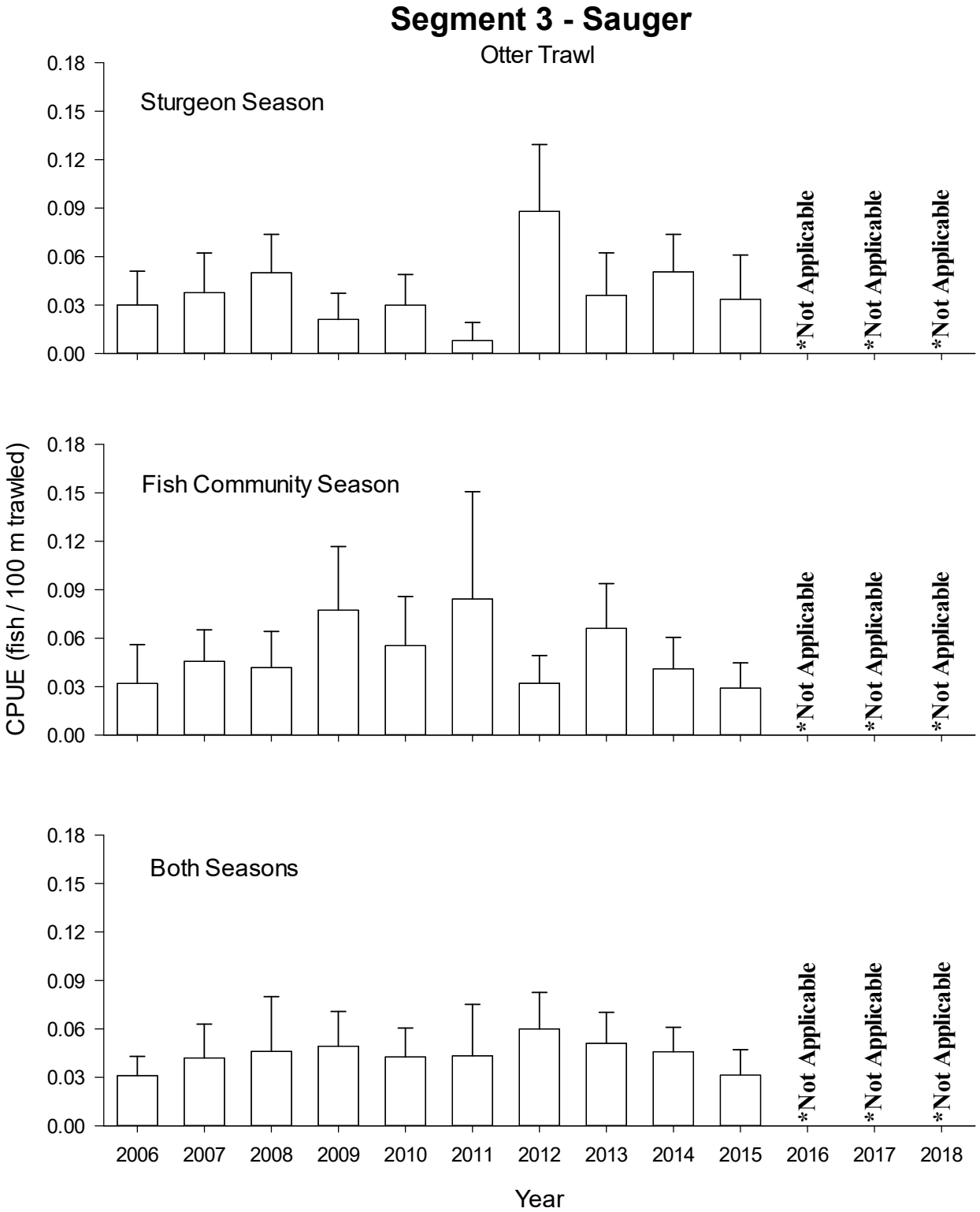

Figure 29. Mean annual catch per unit effort (+/- 2 SE) of sauger using otter trawls in Segment 3 of the Missouri River from 2006-2018. *Otter-trawl not performed in 2016-2018.

Table 15. Total number of sauger captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2018. The percent of total effort for each gear in each habitat is presented on the second line of each gear type.

Gear	N	Macrohabitat[a]			
		CHXO	**ISB**	**OSB**	**SCCL**
		Sturgeon Season			
1.0” Trammel Net	56	61	39	0	0
		39	37	24	0
		Fish Community Season			
1.0” Trammel Net	16	13	75	6	6
		34	34	30	3
		Both Seasons			
Trot Line	1	0	0	100	0
		36	35	23	5

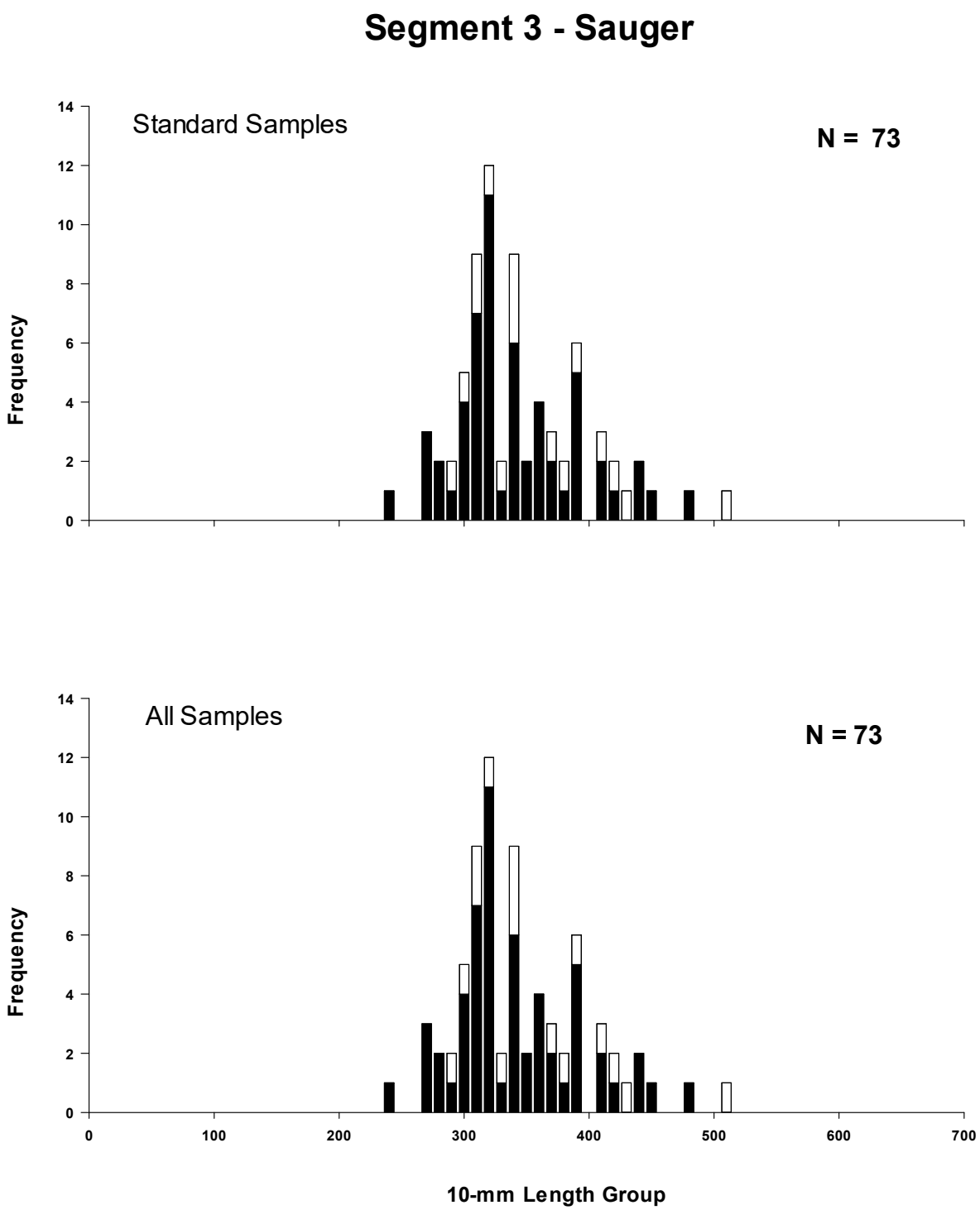

Figure 30. Length frequency of sauger during the sturgeon season (black bars) and the fish community season (white bars) in Segment 3 of the Missouri River during 2018. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2018.

Missouri River Fish Community

The sampling events which took place throughout Segment 3 during the 2018 field season culminated in the capture of 556 fish, which consisted of 17 different species. Inevitably, with the loss of otter trawl and mini-fyke net as sampling gears, coupled with a reduction in effort, total captures and species diversity were down considerably from previous sampling years (2006-2015).

The most frequently captured species throughout Segment 3 during the 2018 sampling season was shovelnose sturgeon, with 161 observations. Shovelnose sturgeon were regularly sampled with both standard bears, trammel net and trotline.

The second most abundant species, which was also observed in both trammel net and trotline deployments, was channel catfish *Ictalurus punctatus* (n=119). The third most common species witnessed, almost solely seen in trammel nets, was sauger (n=73). Rounding out the top five were goldeye *Hiodon alosoides* (n=56) and pallid sturgeon (n=36).

Other species found in Segment 3 during 2018 sampling events were; shorthead redhorse *Moxostoma macrolepidotum* (n=28), stonecat *Noturus flavus* (n=24), flathead chub *Platybogio gracilis* (n=22), walleye *Sander vitreus* (n=21) and river carpsucker *Carpiodes carpio* (n=10). Additional species sampled, but in low abundance (n=<10) were; common car *Cyprinus carpio*, freshwater drum *Aplodinotus grunniens*, burbot *Lota lota,* blue sucker, lake whitefish *Coregonus clupeaformis*, bigmouth buffalo *Ictiobus cyprinellus* and smallmouth buffalo *I. bubalus*.

Discussion

The 2018 field season marked the 13th consecutive sampling year for Pallid Sturgeon Population Assessment crews in Segment 3 of the Missouri River. Although this was the 13th year of sampling, it was the third consecutive year of a reduction in sampling gears, as well as sampling effort. Starting in 2016, both the otter trawl and mini-fyke net were abandoned as sampling gears. Additionally, effort was also reduced by nearly half, from 22 standard bends to 12 standard bends. Total pallid sturgeon captures during the 2018 field season(n=36) are much more comparable to 2017 (n=25) and 2016 (n=23) because of the similarity in effort.

Sampling throughout Segment 3 in 2018 indicated that pallid sturgeon remained present longitudinally throughout the entire stretch of Segment 3 of the Missouri River. However, with the reduction of sampling effort, drawing conclusions across larger portions of the segment may be difficult. Based on 2018 sampling, as well as previous years, trotlines appear to be the truest testament to whether pallid sturgeon inhabit any particular bend in this area of the Missouri River.

Sturgeon season trammel net CPUE (0.05 fish/100m) across Segment 3 in 2018 was the third highest reported catch rate since the Program's inception in 2006. However, with a tabulated CPUE of 0.01 fish/100m, a new all-time low was reported for fish community season. In turn, a combined-season catch rate was calculated at 0.03 fish/100m, which is identical to the 13-year average for Segment 3. Because of the stochasticity, both between seasons and among years, drawing any kind of temporal relationship remains difficult.

Trotline deployments throughout Segment 3 in 2018 led to season catch rates of 0.33 fish/20hooks and 0.23 fish/20hooks for the sturgeon and fish community seasons. Combined-season catch rates were then calculated at 0.28 fish/20hooks. All three seasonal metrics were neither alarmingly low or approaching historical highs. Although trotline has proved to be a formidable gear for sampling pallid sturgeon, it appears that neither they or trammel nets, as standalone gears are an adequate depiction of what is truly going on in the Missouri River. Moreover, elevated or decreased catch rates rarely coincide between the two gears.

The pallid sturgeon captured in Segment 3 during 2018 averaged 423 mm in fork length and 304 g in weight, with a range of 305 mm and 80 g to 980 mm to 3,960 g. The observed average in 2018 was within one millimeter of the observed average calculated in 2017. It is plausible that the similar average length observed throughout time is related to annual stocking

of smaller sized hatchery-reared pallid sturgeon in combination with the apparent slow growth of a large portion of age classes. Additionally, there appears to be nothing within relative condition patterns to cause alarm. However, using length-weight relationship alone appears to not be an appropriate measurement of pallid sturgeon health throughout Segment 3 of the Missouri River.

Shovelnose sturgeon, although not as abundant as in Segment 2, continued to be a common occurrence in Segment 3 during the 2018 field season, with 161 observations. They were witnessed while sampling with both trammel net (n=87) and trotline (n=74). Shovelnose sturgeon were also commonly caught during both sturgeon season (n=107) and fish community season (n=54).

Given the size selectivity of the standard gears used, the quality and above size class of shovelnose sturgeon are the most encountered, and therefore, are the most robust datasets to compare. Sturgeon season trammel net CPUE (0.20 fish/100m), an all-time high, combined with a fish community CPUE (0.11 fish/100m), the second lowest ever recorded, led to a combined-season CPUE of 0.15 fish/100m, which was just shy of the long-term average (0.17 fish/100m). With such a disparity between seasons, drawing any temporal conclusions becomes difficult, which may be why combine-season CPUE is the truest measurement when comparing from year to year. In that case, a slight downward trend may be exhibited since an all-time high was achieved in 2015.

Although never overly abundant, blue sucker captures were not well represented in Segment 3 sampling events during the 2018 field season. With the capture of only one individual during sturgeon season and another individual during fish community season, seasonal catch rates were very low. Although zero-catch season and years exist, it does not appear to be alarming, given that most of our blue sucker captures in any segment most likely relate to their long spawning migration movements.

A total of 73 sauger were collected within Segment 3 during the 2018 sampling season. Like those results witnessed in Segment 2, a higher proportion (78%) of Segment 3 sauger observations came during sturgeon season, when compared to fish community season (22%). In response, sturgeon season CPUE (0.22 fish/100m) was greater that the observed CPUE during fish community season (0.08 fish/100m). Catch rates have remained comparable across years, but the truest measure is that sturgeon season CPUE is nearly always higher than fish community season CPUE. Likely, similar to blue sucker, sauger observations in Segment 3 are likely related to springtime spawning movements.

With the suspension of the otter trawl and mini-fyke net as sampling gears, virtually all trend data for the small-bodied and young of the year target species was lost since 2015, which was the last year in which those gears were used. As hatchery-reared pallid sturgeon shift to sub-adult and adult age classes, these small-bodied and young of the year fishes, may become important, particularly to the lower sections of Segment 3.

Acknowledgments

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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
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

Appendix A. (continued).

Scientific name	Common name	Lettter Code
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
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

Appendix A. (continued).

Scientific name	Common name	Letter Code
Notropis wickliffi	Channel shiner	CNSN
Notropis spp.	Unidentified shiner	UNO
Opsopoeodus emiliae	Pugnose minnow	PNMW
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
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

Appendix A. (continued).

Scientific name	Common name	Letter Code
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	
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

Appendix A. (continued).

Scientific name	Common name	Letter Code
Fundulus zebrinus	Plains killifish	PKLF
	Poeciliidae - livebearers	
Gambusia affinis	Western mosquitofish	MQTF
	Atherinidae - silversides	
Labidesthes sicculus	Brook silverside	BKSS
	ORDER GASTEROSTEIFORMES	
	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

Appendix A. (continued).

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	WLEY
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
Apalone mutica	Smooth Softshell Turtle	SMST
Apalone spinifera	Spiny Softshell Turtle	SYST
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 Segment 3 for the long-term pallid sturgeon and associated fish community sampling program. Long-term monitoring began in 2006 for Segment 3.

Gear	Code	Type	Season	Years	CPUE units
Trammel Net – 1.0”inner mesh	TN	Standard	Both Seasons	2006 - Present	Fish / 100 m drift
Otter Trawl – 16 ft head rope	OT16	Standard	Both Seasons	2006 - Present	Fish / 100 m trawled
Mini-Fyke Net	MF	Standard	Fish Comm.	2006 - Present	Fish / net night
Beam Trawl	BT	Standard	Both Seasons	2003 - 2004	Fish / 100 m trawled
Bag Seine – half arc method pulled upstream	BSHU	Standard	Fish Comm.	2006	Fish / 100 m^2
Bag Seine – half arc method pulled downstream	BSHD	Standard	Fish Comm.	2006	Fish / 100 m^2
Bag Seine – half arc method pulled downstream	BSHD	Wild	Fish Comm.	2007-Present	Fish / 100 m^2
Push Trawl – 8 ft 4mm x 4mm	POT02	Evaluation	Fish Comm.	2007	Fish / m trawled
Trot Line	TL	Evaluation	Both Seasons	2009	Fish / hook night
Trot Line	TL	Standard	Both Seasons	2010-Present	Fish / hook night
Electrofishing	EF	Wild	Both Seasons	2010-Present	Fish/hour

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	School Trust FAS	STR	Missouri	1764.1
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 Segment 3of the Missouri River (RPMA 2). Note: no stocking occurred in 1999, 2001, 2012, and 2018.

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking[a]	Primary Mark	Secondary Mark
1998	Big Sky Bend	255	1997	8/11/1998	Yearling	PIT Tag	Elastomer
1998	Confluence	40	1997	8/11/1998	Yearling	PIT Tag	Elastomer
1998	Nohly Bridge	255	1997	8/11/1998	Yearling	PIT Tag	Elastomer
1998	Sidney	230	1997	8/11/1998	Yearling	PIT Tag	Elastomer
2000	Culbertson	34	1998	10/11/2000	2 yr Old	PIT Tag	
2000	Fairview	66	1998	10/11/2000	2 yr Old	PIT Tag	
2000	Sidney	66	1998	10/11/2000	2 yr Old	PIT Tag	
2000	Wolf Point	34	1998	10/11/2000	2 yr Old	PIT Tag	
2000	Culbertson	89	1999	10/17/2000	Yearling	PIT Tag	
2000	Fairview	150	1999	10/17/2000	Yearling	PIT Tag	
2000	Sidney	149	1999	10/17/2000	Yearling	PIT Tag	
2000	Wolf Point	90	1999	10/17/2000	Yearling	PIT Tag	
2002	Culbertson	270	2001	7/18/2002	Yearling	CWT	Elastomer
2002	Fairview	270	2001	7/18/2002	Yearling	CWT	Elastomer
2002	Intake	199	2001	7/18/2002	Yearling	CWT	Elastomer
2002	Sidney	271	2001	7/18/2002	Yearling	CWT	Elastomer
2002	Wolf Point	269	2001	7/18/2002	Yearling	CWT	Elastomer
2002	Culbertson	317	2001	7/26/2002	Yearling	PIT Tag	
2002	Fairview	360	2001	7/26/2002	Yearling	PIT Tag	
2002	Intake	97	2001	7/26/2002	Yearling	PIT Tag	
2002	Sidney	427	2001	7/26/2002	Yearling	PIT Tag	
2002	Wolf Point	425	2001	7/26/2002	Yearling	PIT Tag	
2002	Intake	155	2001	9/18/2002	Yearling	PIT Tag	
2003	Culbertson	1033	2002	8/7/2003	Yearling	PIT Tag	Elastomer
2003	Fairview	887	2002	8/7/2003	Yearling	PIT Tag	Elastomer
2003	Intake	1040	2002	8/7/2003	Yearling	PIT Tag	Elastomer

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking[a]	Primary Mark	Secondary Mark
2003	Wolf Point	926	2002	8/7/2003	Yearling	PIT Tag	Elastomer
2004	Milk River	821	2003	4/13/2004	Yearling	Elastomer	
2004	Culbertson	523	2003	8/9/2004	Yearling	PIT Tag	Elastomer
2004	Intake	347	2003	8/9/2004	Yearling	PIT Tag	Elasomer
2004	Sidney	397	2003	8/9/2004	Yearling	PIT Tag	Elastomer
2004	Wolf Point	379	2003	8/9/2004	Yearling	PIT Tag	Elastomer
2004	Larval Drift	30000	2004	7/2/2004	Fry		
2004	Larval Drift	50000	2004	7/8/2004	Fry		
2004	Larval Drift	25000	2004	7/20/2004	Fry		
2004	Larval Drift	25000	2004	7/23/2004	Fry		
2004	Larval Drift	25000	2004	7/27/2004	Fry		
2004	Culbertson	3819	2004	9/10/2004	Fingerling	CWT	Elastomer
2004	Sidney	2991	2004	9/10/2004	Fingerling	CWT	Elastomer
2004	Wolf Point	4040	2004	9/10/2004	Fingerling	CWT	Elastomer
2004	Mouth of Milk	3482	2004	10/15/2004	Advanced Fingerling	CWT	Elastomer
2004	Intake	2477	2004	11/18/2004	Advanced Fingerling	CWT	Elastomer
2005	Culbertson	288	2004	4/12/2005	Yearling	CWT	Elastomer
2005	Intake	309	2004	4/12/2005	Yearling	CWT	Elastomer
2005	Wolf Point	271	2004	4/12/2005	Yearling	CWT	Elastomer
2005	Intake	175	2004	8/19/2005	Yearling	PIT Tag	Elastomer
2005	Brockton	229	2005	10/5/2005	Advanced Fingerling	CWT	Elastomer
2005	Culbertson	226	2005	10/5/2005	Advanced Fingerling	CWT	Elastomer
2005	Intake	456	2005	10/5/2005	Advanced Fingerling	CWT	Elastomer
2005	Milk River	232	2005	10/5/2005	Advanced Fingerling	CWT	Elastomer
2005	Sidney	122	2005	10/5/2005	Advanced Fingerling	CWT	Elastomer
2005	Wolf Point	611	2005	10/12/2005	Advanced Fingerling	CWT	Elastomer
2005	Brockton	371	2005	10/13/2005	Advanced		
2005	Culbertson	1736	2005	10/13/2005	Advanced Fingerling	CWT	Elastomer
2005	Culbertson	182	2005	10/13/2005	Advanced Fingerling		
2005	Intake	313	2005	10/13/2005	Advanced Fingerling		

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking[a]	Primary Mark	Secondary Mark
2005	Milk River	845	2005	10/13/2005	Advanced Fingerling	CWT	Elastomer
2005	Mouth of Milk	371	2005	10/13/2005	Advanced Fingerling		
2005	Sidney	105	2005	10/13/2005	Advanced Fingerling		
2005	Wolf Point	1521	2005	10/13/2005	Advanced Fingerling	CWT	Elastomer
2005	Wolf Point	371	2005	10/13/2005	Advanced Fingerling		
2005	Culbertson	651	2005	10/19/2005	Advanced Fingerling	CWT	Elastomer
2005	Intake	2120	2005	10/19/2005	Advanced Fingerling	CWT	Elastomer
2005	Milk River	485	2005	10/19/2005	Advanced Fingerling	CWT	Elastomer
2005	Sidney	882	2005	10/19/2005	Advanced Fingerling	CWT	Elastomer
2005	Wolf Point	650	2005	10/19/2005	Advanced Fingerling	CWT	Elastomer
2006	Culbertson	235	2005	3/28/2006	Advanced Fingerling	Elastomer	
2006	Intake	327	2005	3/28/2006	Advanced Fingerling	Elastomer	
2006	Mouth of Milk	134	2005	3/28/2006	Advanced fingerling	Elastomer	
2006	Sidney	113	2005	3/28/2006	Advanced Fingerling	Elastomer	
2006	Wolf Point	232	2005	3/28/2006	Advanced Fingerling	Elastomer	
2006	Intake	970	2005	4/3/2006	Yearling	PIT Tag	Elastomer
2006	Sidney	314	2005	4/3/2006	Yearling	PIT Tag	Elastomer
2006	Culbertson	844	2005	4/5/2006	Yearling	PIT Tag	Elastomer
2006	Mouth of Milk	1007	2005	4/5/2006	Yearling	PIT Tag	Elastomer
2006	Wolf Point	866	2005	4/5/2006	Yearling	PIT Tag	Elastomer
2006	Culbertson	669	2005	5/1/2006	Yearling	PIT Tag	Scute Removed
2006	Intake	765	2005	5/1/2006	Yearling	PIT Tag	Scute Removed
2006	Mouth of Milk	650	2005	5/1/2006	Yearling	PIT Tag	Scute Removed
2006	Sidney	228	2005	5/1/2006	Yearling	PIT Tag	Scute Removed
2006	Wolf Point	653	2005	5/1/2006	Yearling	PIT Tag	Scute Removed
2006		1355	2005	5/1/2006	Yearling	PIT Tag	Scute Removed
2006	Culbertson	1544	2006	10/24/2006	Advanced Fingerling	Elastomer	
2006	Intake	1680	2006	10/24/2006	Advanced Fingerling	Elastomer	
2006	Mouth Milk	1117	2006	10/24/2006	Advanced Fingerling	Elastomer	
2006	Sidney	586	2006	10/24/2006	Advanced Fingerling	Elastomer	

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking[a]	Primary Mark	Secondary Mark
2006	Wolf Point	1553	2006	10/24/2006	Advanced Fingerling	Elastomer	
2006	School Trust	436	2006	11/8/2006	Advanced Fingerling	Elastomer	
2007	Culbertson	651	2006	4/5/2007	Yearling	PIT Tag	Scute Removed
2007	Fallon	491	2006	4/3/2007	Yearling	PIT Tag	Scute Removed
2007	Forsyth	492	2006	4/3/2007	Yearling	PIT Tag	Scute Removed
2007	Sidney	983	2006	4/3/2007	Yearling	PIT Tag	Scute Removed
2007	School Trust	639	2006	4/5/2007	Yearling	PIT Tag	Scute Removed
2007	Wolf Point	651	2006	4/5/2007	Yearling	PIT Tag	Scute Removed
2007	Wolf Point	428285	2007	7/9/2007	Fry		
2007	Grand Champs	5558	2007	7/13/2007	Fry		
2007	Miles City	13125	2007	7/18/2007	Fry		
2007	Intake	20763	2007	8/9/2007	Fry		
2007	Miles City	13675	2007	8/9/2007	Fry		
2007	Intake	336	2007	8/27/2007	Fingerling		
2007	Miles City	336	2007	8/27/2007	Fingerling		
2007	Wolf Point	672	2007	8/27/2007	Fingerling		
2007	Forsyth	690	2007	8/31/2007	Fingerling	CWT	
2007	Intake	615	2007	8/31/2007	Fingerling	CWT	
2007	School Trust	1160	2007	9/6/2007	Fingerling	CWT	
2007	Intake	293	2007	9/12/2007	Fingerling		
2007	Miles City	293	2007	9/12/2007	Fingerling		
2007	Wolf Point	586	2007	9/12/2007	Fingerling		
2007	Culbertson	6455	2007	9/14/2007	Fingerling	Elastomer	
2007	Fallon	4827	2007	9/14/2007	Fingerling	Elastomer	
2007	Forsyth	5370	2007	9/14/2007	Fingerling	Elastomer	
2007	Intake	7812	2007	9/14/2007	Fingerling	Elastomer	
2007	School Trust	6096	2007	9/14/2007	Fingerling	Elastomer	
2007	Sidney	1934	2007	9/14/2007	Fingerling	Elastomer	
2007	Wolf Point	6455	2007	9/14/2007	Fingerling	Elastomer	
2008	Culbertson	1384	2007	5/7/2008	Yearling	PIT Tag	Scute Removed

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking[a]	Primary Mark	Secondary Mark
2008	Culbertson	643	2007	3/26/2008	Yearling	Elastomer	
2008	Fallon	1307	2007	5/7/2008	Yearling	PIT Tag	Scute Removed
2008	Forsyth	1384	2007	5/7/2008	Yearling	PIT Tag	Scute Removed
2008	Forsyth	106	2007	3/26/2008	Yearling	Elastomer	
2008	Intake	2395	2007	5/7/2008	Yearling	PIT Tag	Scute Removed
2008	Intake	103	2007	3/26/2008	Yearling	Elastomer	
2008	School Trust	1325	2007	5/7/2008	Yearling	PIT Tag	Scute Removed
2008	School Trust	654	2007	3/26/2008	Yearling	Elastomer	
2008	Sidney	149	2007	5/7/2008	Yearling	PIT Tag	Scute Removed
2008	Sidney	67	2007	3/26/2008	Yearling	Elastomer	
2008	Wolf Point	1328	2007	5/7/2008	Yearling	PIT Tag	Scute Removed
2008	Wolf Point	416	2007	3/26/2008	Yearling	Elastomer	
2008	Miles City	4797	2008	7/30/2008	Fry		
2008	Grand Champs	24395	2008	7/30/2008	Fry		
2008	Culbertson	15630	2008	9/24/2008	Fingerling	Elastomer	
2008	Fallon	7930	2008	9/29/2008	Fingerling	Elastomer	
2008	Forsyth	7723	2008	9/29/2008	Fingerling	Elastomer	
2008	Intake	12642	2008	9/29/2008	Fingerling	Elastomer	
2008	Sidney	3186	2008	9/29/2008	Fingerling	Elastomer	
2008	Wolf Point	11717	2008	9/24/2008	Fingerling	Elastomer	
2009	Culbertson	1387	2008	4/13/2009	Yearling	PIT Tag	Scute Removed
2009	Fallon	1155	2008	4/13/2009	Yearling	PIT Tag	Scute Removed
2009	Forsyth	1166	2008	4/13/2009	Yearling	PIT Tag	Scute Removed
2009	Intake	2181	2008	4/13/2009	Yearling	PIT Tag	Scute Removed
2009	Sidney	710	2008	4/13/2009	Yearling	PIT Tag	Scute Removed
2009	Wolf Point	2162	2008	4/13/2009	Yearling	PIT Tag	Scute Removed
2009	Miles City	46260	2009	7/31/2009	Fry		
2009	Wolf Point	26175	2009	7/22/2009	Fry		
2009	Culbertson	10238	2009	9/24/2009	Fingerling	Elastomer	
2009	Fallon	5133	2009	9/23/2009	Fingerling	Elastomer	

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking[a]	Primary Mark	Secondary Mark
2009	Forsyth	5386	2009	9/23/2009	Fingerling	Elastomer	
2009	Intake	8374	2009	9/23/2009	Fingerling	Elastomer	
2009	Sidney	1865	2009	9/23/2009	Fingerling	Elastomer	
2009	Wolf Point	9946	2009	9/23/2009	Fingerling	Elastomer	
2009	Intake	8374	2009	9/23/2009	Fingerling	Elastomer	
2009	Sidney	1865	2009	9/23/2009	Fingerling	Elastomer	
2009	Wolf Point	9946	2009	9/23/2009	Fingerling	Elastomer	
2010	Fallon	721	2009	4/15/2010	Yearling	PIT Tag	Scute Removed
2010	Fallon	268	2009	8/3/2010	Yearling	PIT Tag	Scute Removed
2010	Fallon	1000	2010	10/7/2010	Fingerling	Elastomer	
2010	Forsyth	1402	2009	4/15/2010	Yearling	PIT Tag	Scute Removed
2010	Forsyth	268	2009	8/3/2010	Yearling	PIT Tag	Scute Removed
2010	Intake	1890	2009	4/15/2010	Yearling	PIT Tag	Scute Removed
2010	Intake	816	2009	6/4/2010	Yearling	Elastomer	
2010	Intake	541	2009	8/3/2010	Yearling	PIT Tag	Scute Removed
2010	Intake	1000	2010	10/7/2010	Fingerling	Elastomer	
2010	Sidney	331	2009	4/15/2010	Yearling	PIT Tag	Scute Removed
2010	Wolf Point	1309	2009	4/15/2010	Yearling	PIT Tag	Elastomer, Scute
2010	Wolf Point	858	2009	6/4/2010	Yearling	Elastomer	
2010	Wolf Point	425	2009	8/3/2010	Yearling	PIT Tag	Scute Removed
2010	Wolf Point	1000	2010	10/7/2010	Fingerling	Elastomer	
2010	Culbertson	65	2004	9/21/2010	6 Yr Old	PIT Tag	
2010	Culbertson	1337	2009	4/15/2010	Yearling	PIT Tag	Elastomer, Scute
2010	Culbertson	384	2009	6/4/2009	Yearling	PIT Tag	Scute Removed
2010	Culbertson	1000	2010	10/7/2010	Fingerling	Elastomer	
2010	School Trust	1766	2009	4/15/2010	Yearling	PIT Tag	Elastomer, Scute
2011	Culbertson	795	2010	5/5/2011	Yearling	PIT Tag	Scute Removed
2011	Wolf Point	797	2010	5/5/2011	Yearling	PIT Tag	Scute Removed
2011	Fallon	531	2010	5/5/2011	Yearling	PIT Tag	Scute Removed
2011	Forsyth	545	2010	5/5/2011	Yearling	PIT Tag	Scute Removed

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking[a]	Primary Mark	Secondary Mark
2011	Intake	510	2010	5/5/2011	Yearling	PIT Tag	Scute Removed
2011	Culbertson	262	2010	8/22/2011	Yearling	PIT Tag	Scute Removed
2011	Fallon	131	2010	8/22/2011	Yearling	PIT Tag	Scute Removed
2011	Forsyth	174	2010	8/22/2011	Yearling	PIT Tag	Scute Removed
2011	Intake	132	2010	8/22/2011	Yearling	PIT Tag	Scute Removed
2011	Wolf Point	262	2010	8/22/2011	Yearling	PIT Tag	Scute Removed
2013	Wolf Point	187	2012	4/22/2013	Yearling	PIT Tag	Scute Removed
2013	Culbertson	187	2012	4/22/2013	Yearling	PIT Tag	Scute Removed
2013	Intake	118	2012	4/22/2013	Yearling	PIT Tag	Scute Removed
2013	Fallon	185	2012	4/22/2013	Yearling	PIT Tag	Scute Removed
2014	Culbertson	212	2013	4/15/2014	Yearling	PIT Tag	Scute Removed
2014	Kinsey Bridge	214	2013	4/15/2014	Yearling	PIT Tag	Scute Removed
2014	Powder River Depot	210	2013	4/15/2014	Yearling	PIT Tag	Scute Removed
2014	Wolf Point	211	2013	4/15/2014	Yearling	PIT Tag	Scute Removed
2015	Culbertson	153	2014	4/20/2015	Yearling	PIT Tag	Scute Removed
2015	Fallon	146	2014	4/23/2015	Yearling	PIT Tag	Scute Removed
2015	Intake	109	2014	4/23/2015	Yearling	PIT Tag	Scute Removed
2015	Wolf Point	161	2014	4/20/2015	Yearling	PIT Tag	Scute Removed
2016	Culbertson	353	2015	4/5/2016	Yearling	PIT Tag	Scute Removed
2016	Fallon	357	2015	4/6/ 2016	Yearling	PIT Tag	Scute Removed
2016	Fallon	30	2015	5/2/2016	Yearling	PIT Tag/Radio	Scute Removed
2016	Intake	358	2015	4/6/2016	Yearling	PIT Tag	Scute Removed
2016	Intake	30	2015	5/2/2016	Yearling	PIT Tag/Radio	Scute Removed
2016	Wolf Point	357	2015	4/5/2016	Yearling	PIT Tag	Scute Removed
2017	Culbertson	133	2016	4/12/2017	Yearling	PIT Tag	Scute Removed
2017	Culbertson	416	2016	4/12/2017	Yearling	PIT Tag	Elastomer, Scute
2017	Fallon	132	2016	4/12/2017	Yearling	PIT Tag	Scute Removed
2017	Fallon	430	2016	4/12/2017	Yearling	PIT Tag	Elastomer, Scute
2017	Intake	131	2016	4/12/2017	Yearling	PIT Tag	Scute Removed
2017	Intake	411	2016	4/12/2017	Yearling	PIT Tag	Elastomer, Scute

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking[a]	Primary Mark	Secondary Mark
2017	Wolf Point	232	2016	4/12/2017	Yearling	PIT Tag	Scute Removed
2017	Wolf Point	315	2016	4/12/2017	Yearling	PIT Tag	Elastomer, Scute

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 during sturgeon season and fish community season for Segment 3 of the Missouri River during 2018. Species captured are listed alphabetically and their codes are presented in Appendix A. Asterisks with bold type indicate targeted native Missouri River species and habitat abbreviations are presented in Appendix B. Standard Error was not calculated when N < 2.

Appendix F1. 1.0” trammel net: overall season and segment summary. Lists CPUE (fish/100 m) and 2 standard errors on second line.

			CHXO	ISB	OSB	SCCL
species	Total Catch	Overall CPUE	CHNB	CHNB	CHNB	CHNB
BMBF	1	0.002	0	0	0.006	0
		0.003	0	0	0.012	0
BRBT	0	0	0	0	0	0
		0	0	0	0	0
BUSK	2	0.003	0	0.01	0	0
		0.005	0	0.013	0	0
CARP	3	0.008	0.005	0.017	0	0
		0.01	0.01	0.24	0	0
CNCF	53	0.104	0.079	0.182	0.038	0
		0.091	0.092	0.231	0.041	0
FHCB	18	0.045	0.038	0.087	0	0
		0.025	0.03	0.06	0	0
FWDM	0	0	0	0	0	0
		0	0	0	0	0
GDEY	40	0.086	0.085	0.131	0.031	0
		0.037	0.065	0.074	0.044	0
LKWF	2	0.004	0	0.011	0	0
		0.006	0	0.016	0	0

species	Total Catch	Overall CPUE	CHXO	ISB	OSB	SCCL
			CHNB	CHNB	CHNB	CHNB
NTPK	0	0	0	0	0	0
		0	0	0	0	0
PDSG	9	0.027	0	0.063	0.014	0
		0.029	0	0.078	0.02	0
RVCS	10	0.022	0.01	0.04	0.012	0
		0.015	0.014	0.033	0.024	0
SGER	72	0.149	0.194	0.218	0.007	0.168
		0.075	0.176	0.119	0.013	0.336
SHRH	13	0.035	0.047	0.049	0.006	0
		0.029	0.068	0.047	0.012	0
SMBF	1	0.002	0	0.005	0	0
		0.003	0	0.009	0	0
SNSG	77	0.169	0.155	0.298	0.028	0
		0.078	0.099	0.187	0.036	0
STCT	0	0	0	0	0	0
		0	0	0	0	0
WLYE	16	0.033	0.01	0.064	0.022	0
		0.02	0.014	0.046	0.034	0

Appendix F2. Otter trawl: overall season and segment summary. Lists CPUE (fish/100 m) and 2 standard errors on second line.

*Otter trawl not performed in 2018.

Appendix F3. Mini-fyke net: overall season and segment summary. Lists CPUE (fish/net night) and 2 standard errors on second line.

*Mini-fyke net not performed in 2018.

Appendix F4. Trotlines: overall season and segment summary. Lists CPUE (fish/20 hooks) and 2 standard errors on second line.

species	Total Catch	Overall CPUE	CHXO	ISB	OSB	SCCL
			CHNB	CHNB	CHNB	CHNB
BMBF	0	0	0	0	0	0
		0	0	0	0	0
BRBT	2	0.021	0.029	0	0.045	0
		0.029	0.057	0	0.091	0
BUSK	0	0	0	0	0	0
		0	0	0	0	0
CARP	1	0.01	0.029	0	0	0
		0.021	0.057	0	0	0
CNCF	64	0.667	0.857	0.441	0.818	0.2
		0.204	0.368	0.282	0.486	0.4
FHCB	4	0.042	0.029	0.029	0.091	0
		0.041	0.057	0.059	0.125	0
FWDM	4	0.042	0.029	0.059	0.045	0
		0.041	0.057	0.082	0.091	0
GDEY	15	0.156	0.171	0.265	0	0
		0.09	0.153	0.195	0	0
LKWF	0	0	0	0	0	0
		0	0	0	0	0

species	Total Catch	Overall CPUE	CHXO	ISB	OSB	SCCL
			CHNB	CHNB	CHNB	CHNB
NTPK	0	0.281	0.286	0.265	0.364	0
		0.114	0.175	0.195	0.281	0
PDSG	27	0	0	0	0	0
		0	0	0	0	0
RVCS	0	0.01	0	0	0.045	0
		0.021	0	0	0.091	0
SGER	1	0.146	0.171	0.176	0.045	0.2
		0.089	0.153	0.179	0.091	0.4
SHRH	14	0	0	0	0	0
		0	0	0	0	0
SMBF	0	0.771	0.6	0.882	1	0.2
		0.259	0.34	0.468	0.671	0.4
SNSG	74	0.25	0.171	0.088	0.682	0
		0.139	0.153	0.099	0.499	0
STCT	24	0.042	0.057	0	0.091	0
		0.041	0.08	0	0.125	0
WLYE	4	0.281	0.286	0.265	0.364	0
		0.114	0.175	0.195	0.281	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 season and the fish community season during 2018 for Segment 3 of the Missouri River. Species codes are located in Appendix A. Bold type denote targeted native Missouri River species.

	Sturgeon Season	**Fish Community Season**	**Both Seasons**
species	1.0” Trammel Net	1.0” Trammel Net	Trotline
BMBF	0.000	0.003	0.000
BRBT	0.000	0.000	0.021
BUSK	0.003	0.003	0.000
CARP	0.016	0.000	0.010
CNCF	0.175	0.033	0.667
FHCB	0.038	0.051	0.042
FWDM	0.000	0.000	0.042
GDEY	0.101	0.070	0.156
LKWF	0.000	0.008	0.000
PDSG	0.046	0.008	0.281
RVCS	0.040	0.003	0.000
SGER	0.220	0.078	0.010
SHRH	0.009	0.062	0.146
SMBF	0.003	0.000	0.000
SNSG	0.209	0.129	0.771
STCT	0.000	0.000	0.250
WLYE	0.057	0.010	0.042

Appendix I. Comprehensive list of bend numbers and bend river miles for Segment 3 of the Missouri River comparing bend selection for both sturgeon season (ST) and fish community season (FC) between years from 2006 - 2018.

Bend Number	Bend River Mile	Coordinates*		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Latitude	Longitude													
1	1701.5	48.06744	105.5325						ST, FC				ST, FC			ST
2	1700	48.07314	105.523							ST, FC	ST, FC	ST, FC				ST, FC
3	1698.5	48.09253	105.503										ST, FC			
4	1697.5	48.0919	105.4939							ST, FC					ST	
5	1696	48.09072	105.4575					ST, FC			ST, FC		ST, FC		ST, FC	
6	1695	48.08947	105.4386		ST, FC		ST, FC	ST, FC			ST, FC			ST	FC	
7	1693.5	48.09039	105.3633										ST, FC	ST, FC	ST, FC	
8	1692	48.09134	105.3734		ST, FC	ST, FC								FC	ST, FC	
9	1690.5	48.0929	105.3336							ST, FC	ST, FC	ST, FC		ST, FC		
10	1689	48.08243	105.324		ST, FC											FC
11	1687.5	48.0797	105.3033						ST, FC	ST, FC		ST, FC				ST, FC
12	1685.5	48.08757	105.257			ST, FC		ST, FC				ST, FC				
13	1684.5	48.0912	105.2475		ST, FC		ST, FC	ST, FC								
14	1683	48.08517	105.2247	ST, FC			ST, FC		ST, FC						FC	
15	1681.5	48.06341	105.2118				ST, FC			ST, FC					ST, FC	
16	1680	48.06636	105.1997	ST, FC									ST, FC			
17	1678.5	48.09023	105.1836		ST, FC								ST, FC			
18	1677	48.10268	105.1735		ST, FC						ST, FC					ST
19	1675.5	48.09255	105.1727			ST, FC										
20	1674	48.07865	105.1669			ST, FC			ST, FC							ST, FC
21	1672.5	48.07616	105.1239					ST, FC								
22	1671	48.07116	105.1064							ST, FC				ST		FC
23	1670	48.06138	105.1035									ST, FC	ST, FC	ST, FC		ST, FC

Bend Number	Bend River Mile	Coordinates*		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Latitude	Longitude													
24	1668.5	48.06103	105.0967							ST, FC		ST, FC		ST, FC		
25	1667	48.07748	105.067				ST, FC					ST, FC	ST, FC			
26	1666	48.06939	105.048			ST, FC	ST, FC	ST, FC	ST, FC							
27	1665	48.05456	105.0515							ST, FC					ST	
28	1664	48.05832	105.041				ST, FC							ST	ST, FC	
29	1663	48.08657	105.0019									ST, FC		ST, FC		
30	1661.5	48.08338	105.0087					ST, FC	ST, FC		ST, FC					
31	1660	48.07323	104.9977				ST, FC		ST, FC		ST, FC					
32	1659	48.06867	104.9993	ST, FC										FC		
33	1657	48.09531	104.9813	ST, FC						ST, FC			ST, FC	ST, FC		
34	1656	48.09737	104.9816				ST, FC					ST, FC	ST, FC			
35	1655	48.10115	104.9677			ST, FC	ST, FC			ST, FC						
36	1654	48.09348	104.9437							ST, FC						
37	1653	48.09515	104.9395		ST, FC	ST, FC		ST, FC								
38	1651	48.12806	104.9239		ST, FC	ST, FC			ST, FC				ST, FC	ST		
39	1650	48.13711	104.9218						ST, FC		ST, FC			ST, FC		
40	1648.5	48.14876	104.8982		ST, FC		ST, FC							ST, FC		
41	1647	48.14244	104.8712						ST, FC	ST, FC		ST, FC				ST
42	1646	48.12876	104.8575				ST, FC	ST, FC		ST, FC						ST, FC
43	1644.5	48.1204	104.8385				ST, FC		ST, FC	ST, FC						
44	1643	48.12765	104.7923				ST, FC								FC	
45	1641.5	48.12736	104.7617					ST, FC							ST, FC	
46	1640.5	48.1135	104.7488				ST, FC						ST, FC		ST, FC	
47	1639.5	48.11303	104.735		ST, FC	ST, FC					ST, FC		ST, FC			
48	1638.5	48.11906	104.7156		ST, FC	ST, FC										FC

Bend Number	Bend River Mile	Coordinates*		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Latitude	Longitude													
49	1637.5	48.12048	104.7044					ST, FC				ST, FC	ST, FC	ST	FC	ST, FC
50	1636.5	48.10395	104.6821	ST, FC				ST, FC	ST, FC		ST, FC			ST, FC	ST, FC	
51	1635.5	48.10472	104.6821						ST, FC						FC	
52	1634.5	48.10719	104.6587		ST, FC					ST, FC					ST, FC	
53	1633.5	48.11139	104.6321			ST, FC	ST, FC	ST, FC	ST, FC							
54	1632.5	48.11786	104.6223					ST, FC					ST, FC			
55	1631.5	48.13085	104.6179				ST, FC					ST, FC				
56	1630.5	48.13984	104.6045	ST, FC				ST, FC	ST, FC					FC		
57	1629.5	48.13993	104.6043			ST, FC					ST, FC	ST, FC	ST, FC	ST, FC		
58	1628.5	48.12988	104.5885						ST, FC	ST, FC		ST, FC				
59	1627	48.11385	104.5925						ST, FC							
60	1625.5	48.11823	104.5667		ST, FC		ST, FC	ST, FC		ST, FC						
61	1624	48.12555	104.5356						ST, FC					ST		
62	1623	48.11155	104.5103	ST, FC										ST, FC		ST
63	1622	48.11476	104.4969									ST, FC				ST, FC
64	1620.5	48.12325	104.4721		ST, FC	ST, FC						ST, FC				
65	1619.5	48.11113	104.4537						ST, FC		ST, FC					
66	1618.5	48.09912	104.4481				ST, FC					ST, FC				FC
67	1617.5	48.09658	104.4437		ST, FC	ST, FC		ST, FC			ST, FC					ST, FC
68	1616.5	48.08134	104.4154	ST, FC												ST, FC
69	1615	48.07642	104.3929		ST, FC					ST, FC			ST, FC			FC
70	1613.5	48.07464	104.373			ST, FC										ST, FC
71	1612	48.04856	104.3479								ST, FC					
72	1611	48.04604	104.339			ST, FC			ST, FC							
73	1610	48.04465	104.3211					ST, FC				ST, FC				

Bend Number	Bend River Mile	Coordinates*		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		Latitude	Longitude													
74	1608.5	48.04829	104.2829		ST, FC	ST, FC	ST, FC				ST, FC		ST, FC			
75	1606.5	48.035	104.2509	ST, FC		ST, FC				ST, FC	ST, FC		ST, FC			
76	1604.5	48.03568	104.2071	ST, FC			ST, FC	ST, FC				ST, FC				ST
77	1603	48.0441	104.1978			ST, FC					ST, FC					ST, FC
78	1598.5	48.04596	104.1837	ST, FC		ST, FC					ST, FC					
79	1597.5	48.03868	104.1639			ST, FC			ST, FC		ST, FC		ST, FC		ST	
80	1596	48.04502	104.1546				ST, FC								ST, FC	
81	1595	48.05317	104.1413		ST, FC	ST, FC		ST, FC				ST, FC			FC	
82	1594	48.0378	104.1241		ST, FC					ST, FC	ST, FC				ST, FC	
83	1593	48.02956	104.1027		FC	ST, FC						ST, FC				
84	1592	48.02939	104.1001						ST, FC							
85	1591	48.02138	104.0981			ST, FC									ST	
86	1590.5	48.02015	104.1002		ST, FC			ST, FC							ST, FC	
87	1589.5	48.0052	104.1017		ST, FC					ST, FC				FC		FC
88	1588.5	48.00281	104.07059											ST, FC	FC	ST, FC
89	1587	47.99909	104.0539								ST, FC				ST, FC	
90	1585.5	47.98677	104.0194							ST, FC			ST, FC			
91	1583.5	47.96973	104.0104								ST, FC	ST, FC				