

2017 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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March 2018

EXECUTIVE SUMMARY

The 2017 field season marked the 12th consecutive sampling year for Pallid Sturgeon Population Assessment crews in Segment 3 of the Missouri River. Although this was the 12th year of sampling, it was also the second consecutive year of a reduction in both sampling gears and a reduction in sampling effort. Neither the otter trawl or mini-fyke net was used in sampling during the 2016 or 2017 field season. Additionally, effort was also reduced by nearly half, from 22 standard bends to 12 standard bends. As such, pallid sturgeon captures in 2017 (n=23) were comparable to those witnessed in 2016 (n=25).

A total of 12 randomly selected river bends were sampled in Segment 3 during 2017. 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. A total of 215 trammel net deployments were utilized throughout Segment 3 during the 2017 field season, which totaled roughly 49 km of riverine habitat being sampled. Additionally, a total of 96 trotlines were deployed. With 20 hooks per trotline, a total of 1,920 nightcrawler-baited hooks were set in Segment 3 in 2017.

A total of 23 pallid sturgeon were captured in Segment 3 during the 2017 field season, all of which were of hatchery origin. Temporally, more sturgeon were captured during fish community season (n=15), than during sturgeon season (n=8). Trammel net was the more adept gear at catching pallid sturgeon, capturing 15 individuals. Comparatively, trotline was responsible for eight individuals. Of the 23 reported observations, all but one pallid sturgeon was captured during random gear deployments. Of the 12 bends sampled with trammel net, pallid sturgeon were observed in eight of them. Comparatively, of the 12 bends sampled via trotline, pallid sturgeon were present in five of them. Multiple pallid sturgeon captures were represented in three trammel net sampled bends, while multiple captures were represented in only two trotline bends.

Trammel net sampling led to a calculated CPUE of 0.03 fish/100m and 0.04 fish/100m for the sturgeon and fish community seasons, respectively. In turn, combined-season CPUE was then calculated to be 0.04 fish/100m. With identical seasonal CPUE recorded for trotline (0.08 fish/20 hooks), combined-season CPUE was also reported at 0.08 fish/20 hooks.

The pallid sturgeon captured in Segment 3 for the 2017 field season averaged 424 mm in fork length and 369 g in weight. Fork length ranged from 262 mm to 701 mm. Although comparable, trotline captured larger, on average, pallid sturgeon (443 mm), than did trammel net (415 mm). The majority of the individuals sampled (87%) fell into the stock size-category of pallid sturgeon, while two were observed in the quality size-classification, and one pallid sturgeon in the sub-stock (200-329 mm) size-category range. No major variations in relative condition between size groups were observed in 2017.

Of the 23 pallid sturgeon observed during 2017 sampling events in Segment 3, 22 were of known year class. Year class in order of abundance were; 2009 (n=5), 2016 (N=4), 2013 and 2015 (n=3), 2008 and 2010 (n=2), and 2002, 2005 and 2014 (n=1). Of the 23 pallid sturgeon observations, 17 were of known stocking location, all of which originated in RPMA 2. More pallid sturgeon captures originated from the Missouri River (n=11), than originated in the Yellowstone River (n=6). Stocking origination in rank of abundance were; Wolf Point (n=6), Culbertson (n=5), Sidney (n=2), while Fairview, Fallon, Intake, and Kinsey Bridge all had one representative.

A total of 155 shovelnose sturgeon were captured throughout Segment 3 during the 2017 sampling season. More shovelnose were captured during fish community season (n=104), than during sturgeon season (n=51). In relation to gears, more shovelnose sturgeon were observed in trammel net (n=121) compared to trotline (n=34). Random gear deployments accounted for the majority of observations (n=146), while nonrandom duplicate trammel net drifts netted an additional nine individuals.

During the 2017 field season, trammel net CPUE for the quality and above size class of shovelnose sturgeon, the most frequently observed size class, was reported at 0.11 fish/100m, 0.35 fish/100m, and 0.23 fish/100m for sturgeon season, fish community season, and combined-season, respectively. While trotline CPUE, regarding the quality and above size class of shovelnose sturgeon, was reported for the following three seasonal metrics; 0.46 fish/20 hooks, 0.25 fish/20 hooks, and 0.35 fish/20 hooks for sturgeon season, fish community season, and combined-season, respectively. Catch rates regarding both gears, for the sub-stock and stock size categories of shovelnose sturgeon in Segment 3, remain low, yet comparable, on a year by year basis.

The shovelnose sturgeon representatives captured in Segment 3 during the 2017 field season averaged 552 mm in fork length and 711 g in weight, with a range of 220 mm to 843 mm. Compared to Segment 2, Segment 3 exhibits a more complete population size structure, however, with the suspension of otter trawl as a sampling gear, the smaller size classes have been truncated from the length frequency histogram. No major variations in relative weight were observed in 2017. When adequate sample size is reached, relative weight has become more comparable, such as for the preferred and memorable/trophy size classes of shovelnose sturgeon. However, that transparency deteriorates as you move down to the smaller size classes due to smaller and more variable sample size.

Trammel net sampling events throughout Segment 3 in 2017 resulted in the capture of one blue sucker. However, this fish was captured in a nonrandom sample and therefore lead to catch rates of 0.0 fish/100m for all three seasonal metrics. It was the first time, since the Program's inception in 2006 that a blue sucker was not captured during random sampling events in Segment 3.

A total of 63 sauger were collected within Segment 3 during the 2017 sampling season, with a higher proportion (75%) of observations coming during sturgeon season, when compared to fish community season (25%). In relation to gear, all 63 individuals were captured via trammel net deployments, which led to trammel net CPUE reporting at 0.22 fish/100m, 0.06 fish/100m, and 0.14 fish/100m for the sturgeon, fish community, and combined seasons, respectively. The sauger captured during 2017 sampling events across Segment 3 averaged 358 mm in total length and 342 g in weight.

With the suspension of the otter trawl and mini-fyke net as sampling gears in 2016, virtually all trend data for the small-bodied target species (sturgeon and sicklefin chubs, *Hybognathus* spp., and sand shiner) was lost for the 2016 and 2017 field season. As hatchery-reared pallid sturgeon shift to sub-adult and adult age classes, these small bodies fishes, as well as others, may become important, particularly to the lower sections of Segment 3.

TABLE OF CONTENTS

Introduction	1
Study Area	4
Methods	5
Sample site selection and description	5
Sampling gear	6
Data Collection and Analysis	7
Results	12
Pallid sturgeon	14
Shovelnose X Pallid Sturgeon Hybrids	31
Targeted Native River Species	
Shovelnose sturgeon	32
Sturgeon chub	45
Sicklefin chub	48
Sand shiner	51
<i>Hybognathus</i> spp	54
Blue sucker	57
Sauger	62
Missouri River Fish Community	68
Discussion	69
Acknowledgments	72
References	73
Appendices	74

LIST OF TABLES

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 2017. N-E indicates the habitat is non-existent in the segment.

.....13

Pallid sturgeon

Table 2. Pallid sturgeon capture summaries for all gears relative to habitat type and environmental variables on the Missouri River during 2017. Means (minimum and maximum) are presented.

.....17

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 2017 from Segment 3 of the Missouri River. Relative condition factor was calculated using the equation in Shuman et al. (2011).

.....18

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 2017.

.....24

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 2017.

.....25

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 2017.

.....26

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 2017.

.....27

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 2017.

.....28

Shovelnose sturgeon

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 2017.

.....37

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 2017.	38
--	----

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 2017.	39
--	----

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 2017.	40
--	----

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 2017.	41
--	----

Blue sucker

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 2017.	60
---	----

Sauger

Table 15. Total number of saugers captured for each gear during each season and the proportion caught within each macrohabitat type in Segment 3 of the Missouri River during 2017.	66
--	----

LIST OF FIGURES

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)11

Pallid sturgeon

Figure 2. Distribution of pallid sturgeon captures by river mile for Segment 3 of the Missouri River during 2017. 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.16

Figure 3. Proportion of all pallid sturgeon captured by size group for gears from 2006-2017 in Segment 3 in the Missouri River. Length categories determined using the methods proposed by Shuman et al. (2006).19

Figure 4. Relative condition factor (Kn) for all pallid sturgeon captured with all gear by incremental relative stock density (RSD) length category from 2006-2017 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).20

Figure 5. Mean annual catch per unit effort (\pm 2 SE) of all (black bars), wild (white bars), hatchery reared (gray bars), and unknown origin (cross-hatched bars) pallid sturgeon using 1.0" trammel nets in Segment 3 of the Missouri River from 2006-2017. Pallid sturgeon of unknown origin are awaiting genetic verification.....21

Figure 6. Mean annual catch per unit effort (\pm 2 SE) of all (black bars), wild (white bars), hatchery reared (gray bars), and unknown origin (cross-hatched bars) pallid sturgeon using otter trawls in Segment 3 of the Missouri River from 2006-2017. Pallid sturgeon of unknown origin are awaiting genetic verification.22

Figure 7. Mean annual catch per unit effort (\pm 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 2010-2017. Pallid sturgeon of unknown origin are awaiting genetic verification.23

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 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.29

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

2006-2017. 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. Pallid sturgeon of unknown origin are awaiting genetic verification. 30

Shovelnose sturgeon

Figure 10. Mean annual catch per unit effort (\pm 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 2006-2017.34

Figure 11. Mean annual catch per unit effort (\pm 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 2006-2017.35

Figure 12. Mean annual catch per unit effort (\pm 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 2010-2017.36

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 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.42

Figure 14. Proportion of all shovelnose sturgeon captured with all gear by length category from 2006 to 2017 in Segment 3 in the Missouri River. Length categories determined using the methods proposed by Quist (1998).43

Figure 15. Relative weight (W_r) for all shovelnose sturgeon captured with all gear by incremental relative stock density (RSD) length category from 2006-2017 in Segment 3 in the Missouri River. Length categories determined using the methods proposed by Quist (1998)...
.....44

Sturgeon chub

Figure 16. Mean annual catch per unit effort (\pm 2 SE) of sturgeon chub using otter trawls in Segment 3 of the Missouri River from 2006-2017.46

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 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.47

Sicklefin chub

Figure 18. Mean annual catch per unit effort (\pm 2 SE) of sicklefin chub using otter trawls in Segment 3 of the Missouri River from 2006-2017.49

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 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.50

Sand shiner

Figure 20. Mean annual catch per unit effort (\pm 2 SE) of sand shiner with mini-fyke nets in Segment 3 of the Missouri River during fish community season 2006-2017.52

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 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.53

***Hybognathus* spp.**

Figure 22. Mean annual catch per unit effort (\pm 2 SE) of *Hybognathus* spp. with mini-fyke nets in Segment 3 of the Missouri River during fish community season 2006-2017.55

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 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.56

Blue sucker

Figure 24. Mean annual catch per unit effort (\pm 2 SE) of blue sucker using 1.0" trammel nets in Segment 3 of the Missouri River from 2006-2017.58

Figure 25. Mean annual catch per unit effort (\pm 2 SE) of blue sucker using otter trawls in Segment 3 of the Missouri River from 2006-2017.59

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 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.61

Sauger

Figure 27. Mean annual catch per unit effort (\pm 2 SE) of sauger using mini fyke nets in Segment 3 of the Missouri River from 2006-2017.63

Figure 28. Mean annual catch per unit effort (\pm 2 SE) of sauger using 1.0" trammel nets in Segment 3 of the Missouri River from 2006-2017.64

Figure 29. Mean annual catch per unit effort (\pm 2 SE) of sauger using otter trawls in Segment 3 of the Missouri River from 2006-2017.65

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 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.67

LIST OF 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.	75
Appendix B. Definitions and codes used to classify standard Missouri River habitats in the long term pallid sturgeon and associated fish community sampling program.	81
Appendix C. List of standard and wild gears, their corresponding codes in the database, seasons deployed, years used, and catch-per-unit-effort units for collection of Missouri River fishes for the long-term pallid sturgeon and associated fish community sampling program.	82
Appendix D. Stocking locations and codes for pallid sturgeon by Recovery Priority Management Area in the Missouri River Basin.	83
Appendix E. Juvenile and adult pallid sturgeon stocking summary for Segment 3 of the Missouri River (RPMA 2).	84
Appendix F. Total catch, overall mean catch per unit effort, and mean CPUE by mesohabitat within a macrohabitat for all species caught during sturgeon season and fish community season combined in Segment 3 of the Missouri River during 2017.	92
Appendix F1. 1.0” Trammel Net:	93
Appendix F2. Otter Trawl:	95
Appendix F3. Mini-fyke Net:	96
Appendix F4. Trotlines:	97
Appendix G. Hatchery names, locations, and abbreviations.	99
Appendix H. Alphabetic list of Missouri River fishes with total number caught by gear type for the sturgeon season and the fish community season during 2017 for Segment 3 of the Missouri River.	100
Appendix I. Comprehensive list of bend numbers and bend river miles for Segment 3 of the Missouri River comparing bend selection between years from 2006-2017.	102

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 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 during the 2016 or 2017 field season.

The fish community season extends from the beginning of July till 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 or 2017.

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.

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). However, due to the extremely low spring and summer flows that we've experienced in the past three years due to the operations of Fort Peck Dam, habitat formation is not occurring as it might have during the high runoff years of the 1990's.

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). Typically, 22 standard bends are sampled in Segment 3, however, due to the effort reduction exercise in 2017, 12 random bends were sampled.

In 2017, 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 in segment 2. 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 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.

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.

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 nephelometric 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 and Drobish (2016). Two fin pectoral fin clips ($\sim 2 \text{ cm}^2$) 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 (K_n) for all sampled pallid sturgeon was calculated using the following formula: $K_n = W / W'$, 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 2, 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.

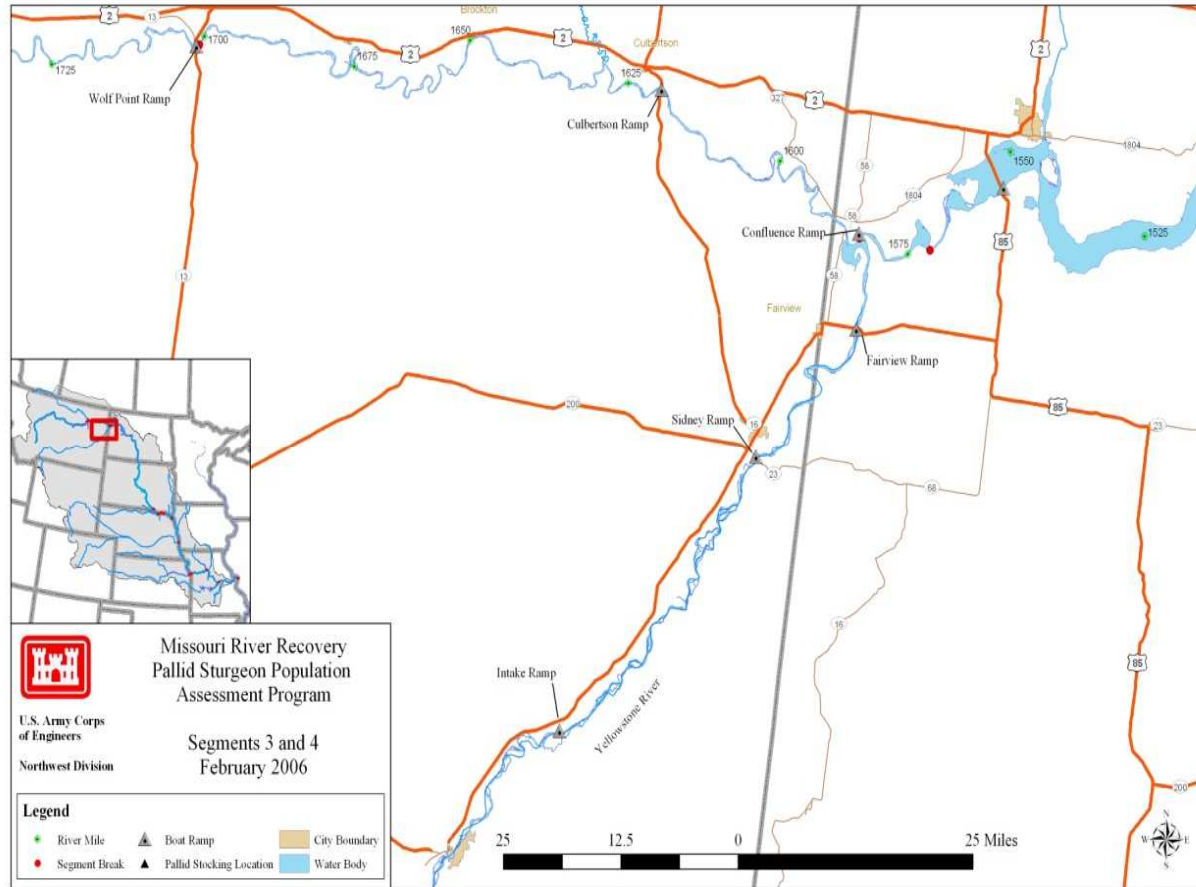


Figure 1. Map of Segment 3 of the Missouri River with major tributaries, common landmarks, and historic stocking locations for pallid sturgeon. Segment 3 encompasses the Missouri River from Wolf Point, MT (River Mile 1701.0) to the confluence of the Yellowstone River (River Mile 1582.0).

Results

Effort

A total of 12 randomly selected river bends were sampled in Segment 2 during 2017. 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 2017 followed the same protocol as that of 2016, whereas during 2006-2015, 22 bends were sampled once each during both seasons.

A total of 215 trammel net deployments were utilized throughout Segment 3 during the 2017 field season, which totaled roughly 49 km of riverine habitat being sampled. Seasonally, 104 drifts and 111 drifts equated to 22.8 km and 26.2 km of sampling for the sturgeon and fish community seasons, respectively. As expected, the 191 random trammel deployments accounted for the vast majority (43.9 km) of total distance sampled, when compared to the 24 non-random duplicate drifts (5.1 km).

Additionally, a total of 96 trotlines were deployed in Segment 3 during 2017. 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 2 in 2017.

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 2017.

Gear	Number of Bends	Mean Effort	Macrohabitat ^a			
			CHXO	ISB	OSB	SCCL
Sturgeon Season						
1.0” Trammel Net	12	7.92	38	33	24	0
Fish Community Season						
1.0” Trammel Net	12	8	38	32	26	0
Both Seasons						
Trotline	12	8	35	33	22	6

^a Habitat abbreviations and definitions presented in Appendix B

Pallid Sturgeon

A total of 23 pallid sturgeon were captured in Segment 3 during the 2017 field season, all of which were of hatchery origin. Temporally, more sturgeon were captured during fish community season ($n=15$), than during sturgeon season ($n=8$). Of the 23 reported observations, all but one pallid sturgeon was captured during random gear deployments.

Trammel net deployments throughout Segment 3 during the 2017 field season resulted in the capture of 15 individual pallid sturgeon. Seasonally, more trammel net observations were made during fish community season ($n=11$), than during sturgeon season ($n=4$). Trammel net sampling (Fig. 5) led to a calculated CPUE of 0.03 fish/100m and 0.04 fish/100m for the sturgeon and fish community seasons, respectively. In turn, combined-season CPUE was then calculated to be 0.04 fish/100m.

Trotline deployments throughout Segment 3 during the 2017 field season were responsible for the capture of eight pallid sturgeon. Temporally, seasonal captures were identical, with four observations each during the sturgeon and fish community seasons, respectively. In turn, trotline CPUE (Figure 7), was recorded at 0.08 fish/20hooks for all three seasonal catch metrics.

The pallid sturgeon captured in Segment 3 for the 2017 field season averaged 424 mm in fork length and 369 g in weight. Fork length ranged from 262 mm to 701 mm. Although comparable, trotline captured larger, on average, pallid sturgeon (443 mm), than did trammel net (415 mm). The majority of the individuals sampled (87%) fell into the stock size-category of pallid sturgeon, while two were observed in the quality size-classification, and one pallid sturgeon in the sub-stock (200-329 mm) size-category range. No major variations in relative condition (K_n) were observed in 2017. 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.

Pallid sturgeon distribution throughout Segment 3 remains variable, with emphasis on the timing and locality of sampling (Fig. 2). Of the 12 bends sampled with trammel net, pallid sturgeon were observed in eight of them. Comparatively, of the 12 bends sampled via trotline, pallid sturgeon were present in five of them. Multiple pallid sturgeon captures were represented

in three trammel net sampled bends, while multiple captures were represented in only two trotline bends.

Of the 23 pallid sturgeon observed during 2017 sampling events in Segment 3, 22 were of known year class (Table 3). Year class in order of abundance were; 2009 (n=5), 2016 (N=4), 2013 and 2015 (n=3), 2008 and 2010 (n=2), and 2002, 2005 and 2014 (n=1). Mean fork length, weight, relative condition factor (Kn) and absolute growth rates for hatchery-reared pallid sturgeon captures by year class metrics can be found in Table 3.

Of the 23 pallid sturgeon observations, 17 were of known stocking location, all of which originated in RPMA 2. More pallid sturgeon captures originated from the Missouri River (n=11), than originated in the Yellowstone River (n=6). Stocking origination in rank of abundance were; Wolf Point (n=6), Culbertson (n=5), Sidney (n=2), and Fairview, Fallon, Intake, and Kinsey Bridge all had one representative. 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.

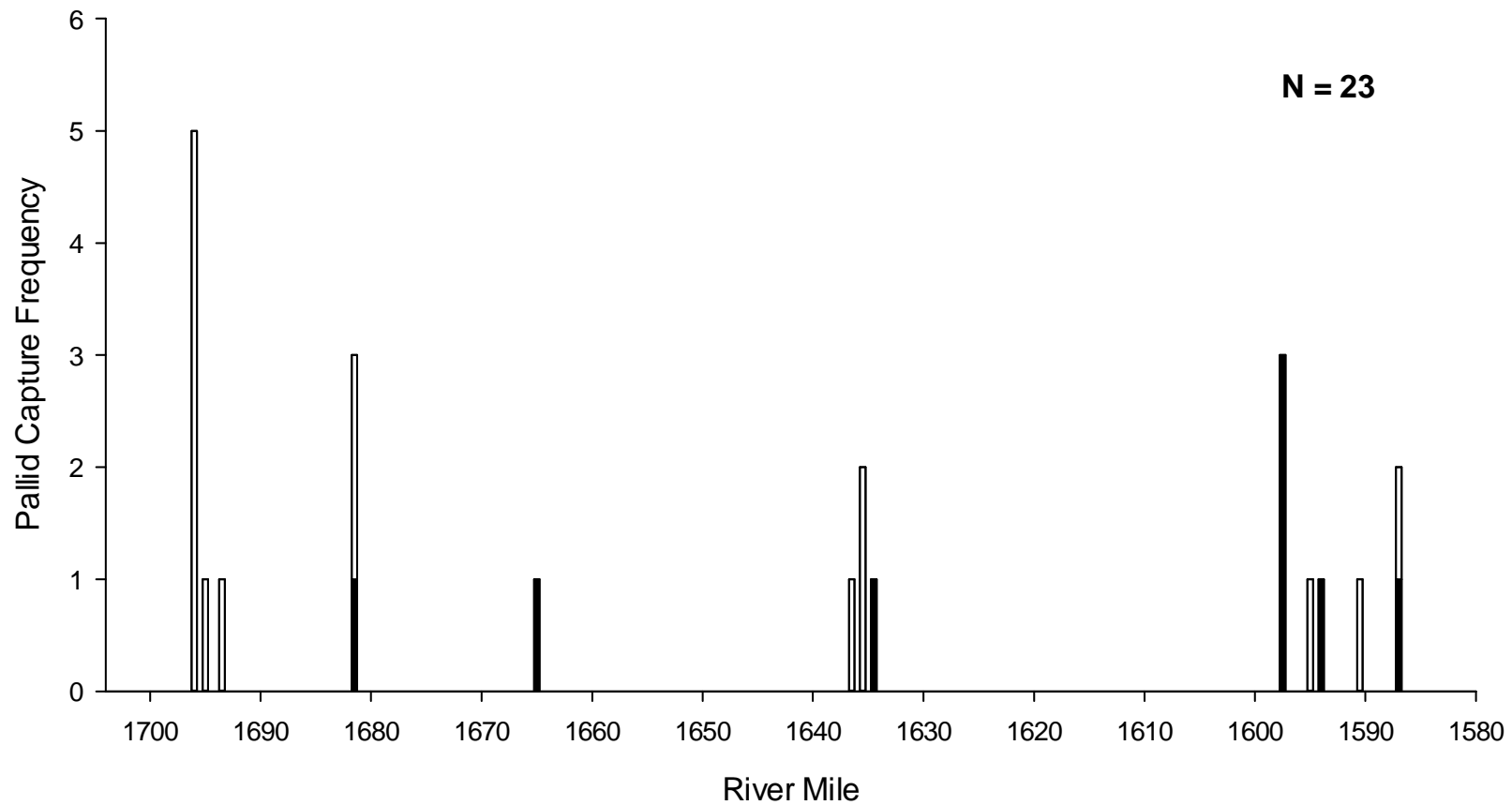


Figure 2. Distribution of pallid sturgeon captures by river mile for Segment 3 of the Missouri River during 2017. Black bars represent pallid captures during the sturgeon season and white bars during the fish community season. Figure includes all pallid captures including non-random and wild samples.

Table 2. Pallid sturgeon capture summaries for all gears relative to habitat type and environmental variables on the Missouri River during 2017. 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	1.8 (0.3-4.9)	1.6 (1.2-2.4)	0.68 (0.44-0.93)	0.62 (0.44-0.83)	16.7 (12.1-20.1)	17.4 (12.9-20.0)	55 (19-103)	63 (20-103)	13
ISB	CHNB	1.7 (1.1-4.2)	1.9 (1.3-2.9)	0.63 (0.17-0.90)	0.68 (0.53-0.84)	16.7 (1.5-20.3)	17.4 (13.2-20.3)	62 (17-123)	74 (32-119)	7
OSB	CHNB	2.5 (1.2-5.3)	2.1 (2.0-2.2)	0.74 (0.30-0.96)	0.69 (0.68-0.70)	16.8 (12.2-20.1)	14.7 (12.8-16.5)	55 (19-112)	55 (28-81)	2
SCCL	CHNB	1.5 (1.2-1.9)	1.2 (1.2-1.2)	0.64 (0.64-0.64)	0.64 (0.64-0.64)	17.1 (14.8-20.2)	14.8 (14.8-14.8)	23 (23-23)	23 (23-23)	1

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 2017 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)
2002	1	269	.	.	701	1175.0	0.901	0.084	.
.
2005	1	.	.	.	653	930.0	0.901	.	.
.
2008	2	.	.	.	481	275.0	0.755	.	.
.	.	.	.	.	151	150.0	0.358	.	.
2009	5	.	.	.	412	233.0	1.020	.	.
.	.	.	.	.	14	36.1	0.064	.	.
2010	2	.	.	.	401	212.5	1.023	.	.
.	.	.	.	.	10	35.0	0.085	.	.
2013	3	285	82.7	1.225	377	151.7	0.891	0.076	0.057
.	.	15	14.7	0.037	23	32.8	0.028	0.025	0.034
2014	1	327	126.0	1.190	404	185.0	0.871	0.088	0.068
.
2015	3	357	166.0	1.174	406	191.7	0.880	0.146	0.103
.	.	.	.	.	35	41.8	0.052	.	.
2016	4	324	115.8	0.980	355	132.5	0.875	0.272	0.141
.	.	74	78.9	0.080	79	84.5	0.086	0.060	0.047

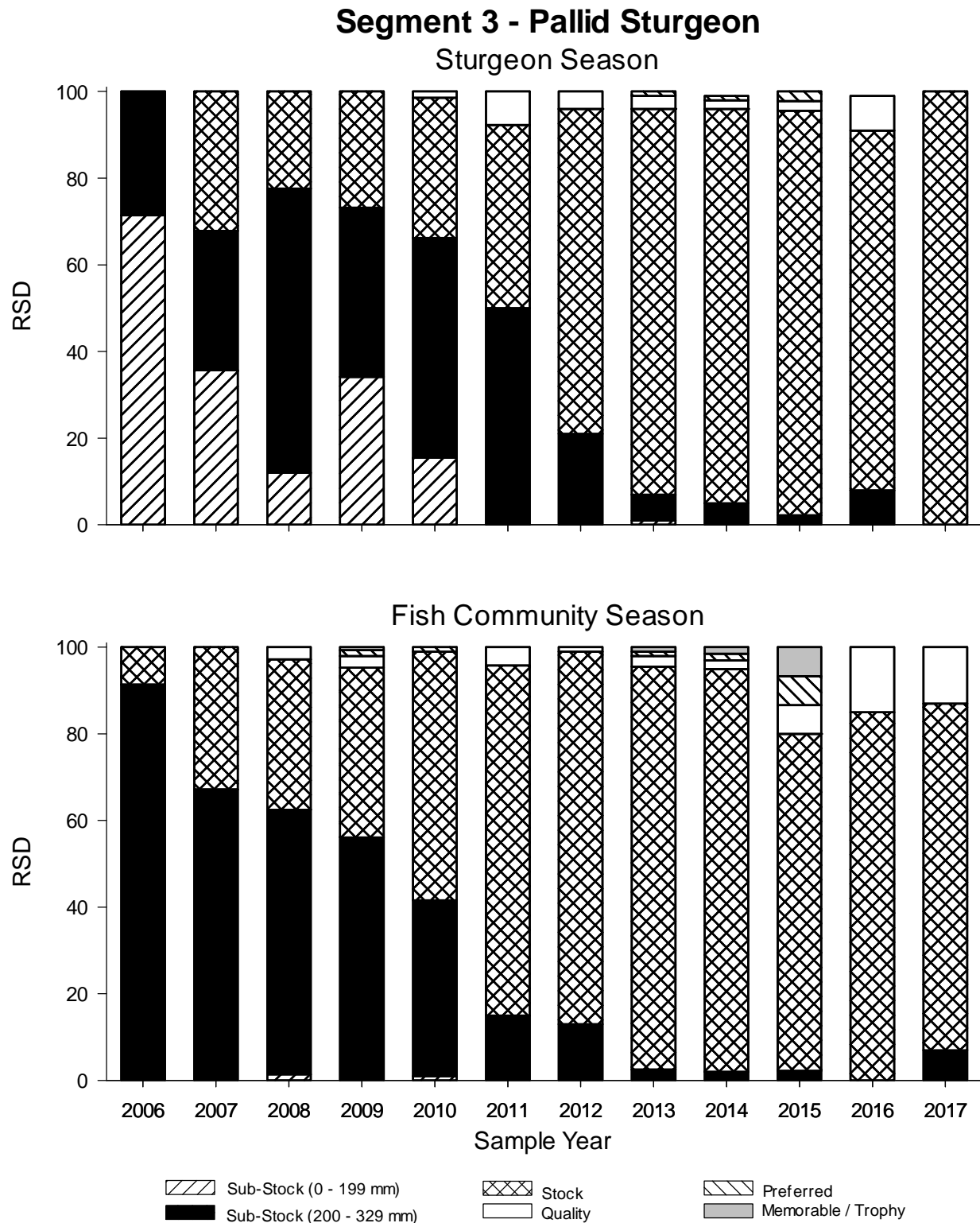


Figure 3. Proportion of total catch by length group for all pallid sturgeon captured with all gear by length category from 2006-2017 in Segment 3 in the Missouri River. Length categories determined using the methods proposed by Shuman et al. (2006).

Segment 3 - Pallid Sturgeon

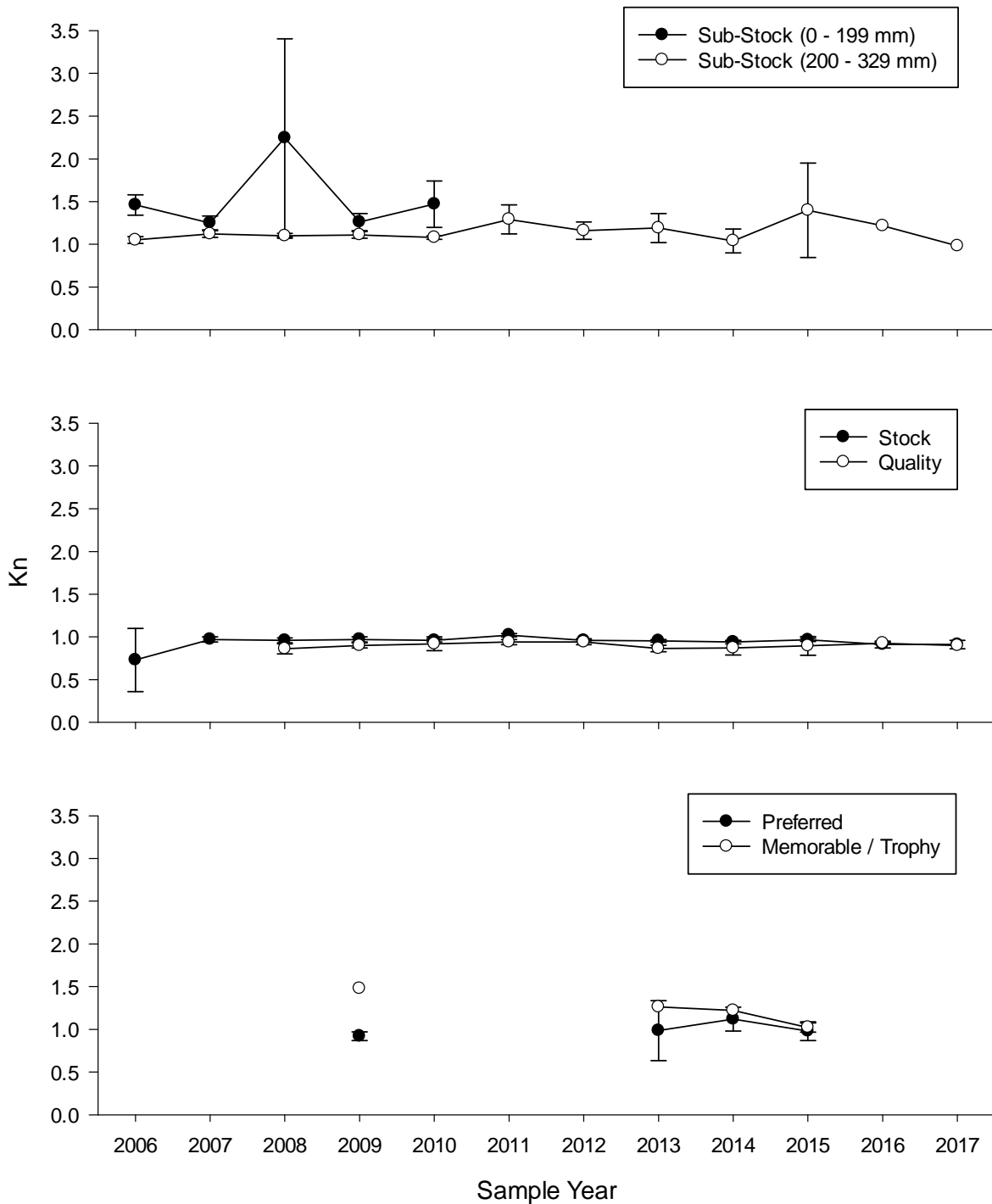


Figure 4. Relative condition factor (Kn) for all pallid sturgeon captured with all gear by incremental relative stock density (RSD) length category from 2006-2017 in Segment 3 in the Missouri River. Length categories determined using the methods proposed by Shuman et al. (2006). Relative condition factor was calculated using the equation in Shuman et al. (2011).

Segment 3 - Pallid Sturgeon

1.0" Trammel Nets

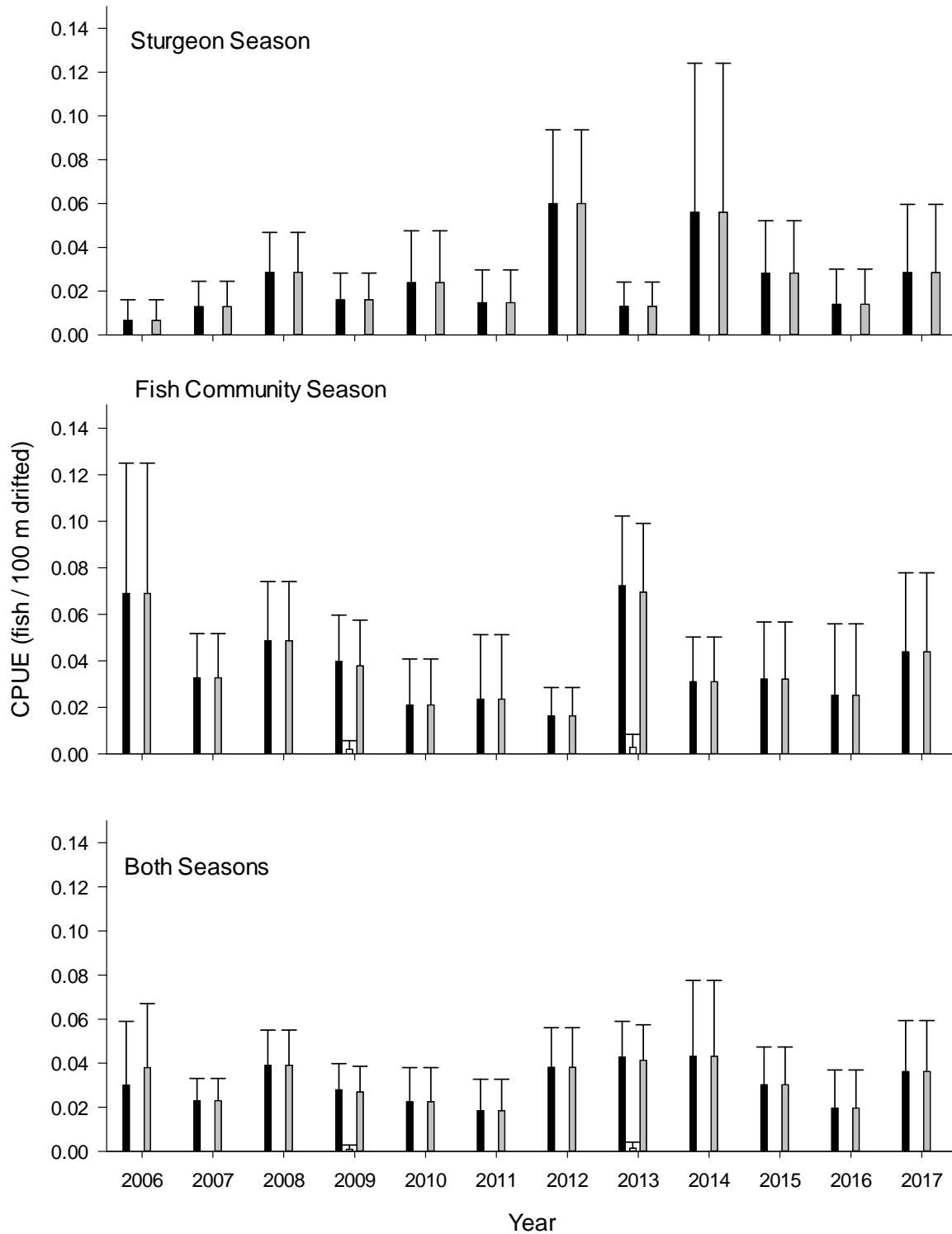


Figure 5. Mean annual catch per unit effort (± 2 SE) of all (black bars), wild (white bars), hatchery reared (gray bars) pallid sturgeon using 1.0" trammel nets in Segment 3 of the Missouri River from 2006-2017.

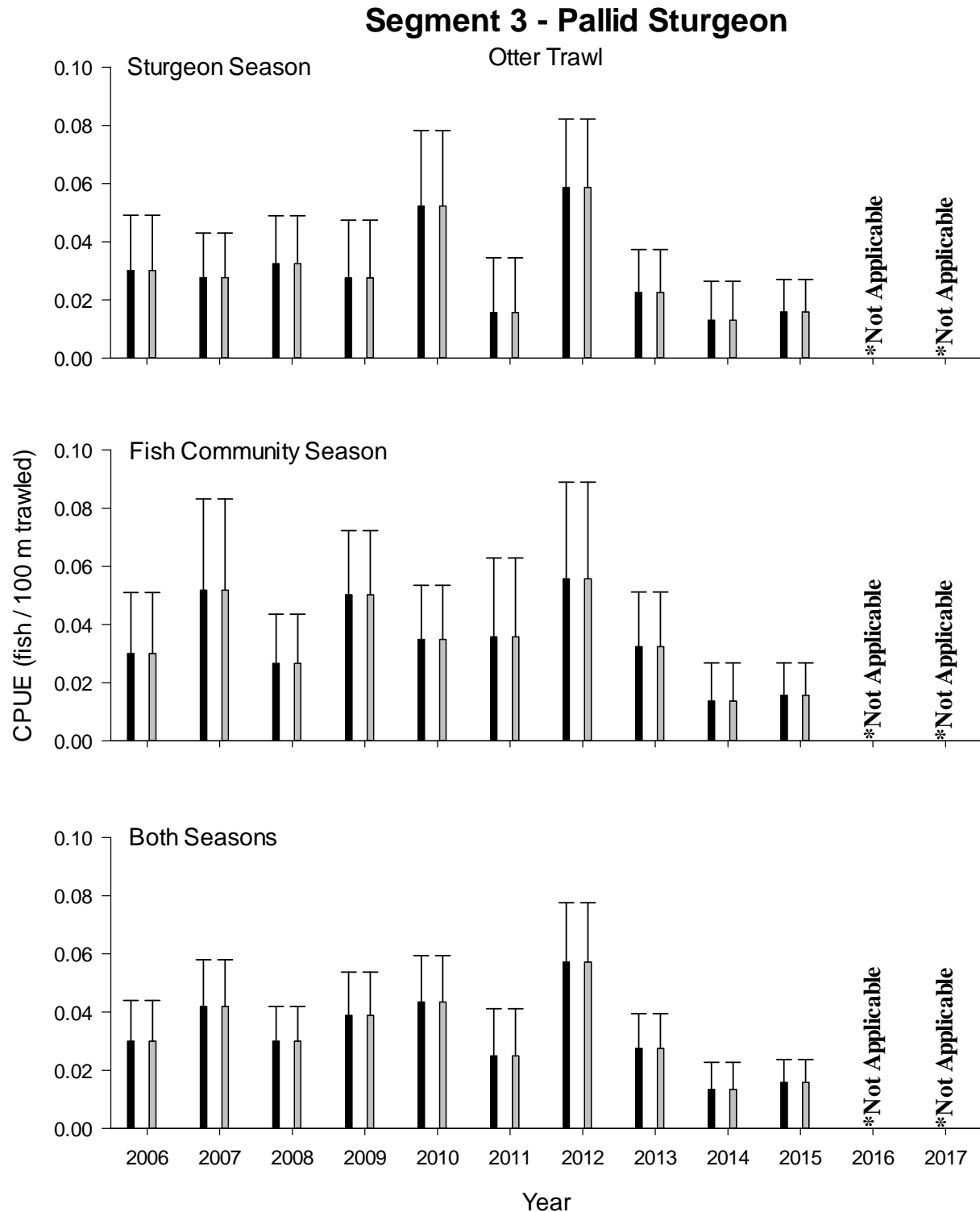


Figure 6. Mean annual catch per unit effort (\pm 2 SE) of all (black bars), wild (white bars), hatchery reared (gray bars) pallid sturgeon using otter trawls in Segment 3 of the Missouri River from 2006-2017. *Otter trawl not performed in 2016 or 2017.

Segment 3 - Pallid Sturgeon

Standard Trotlines

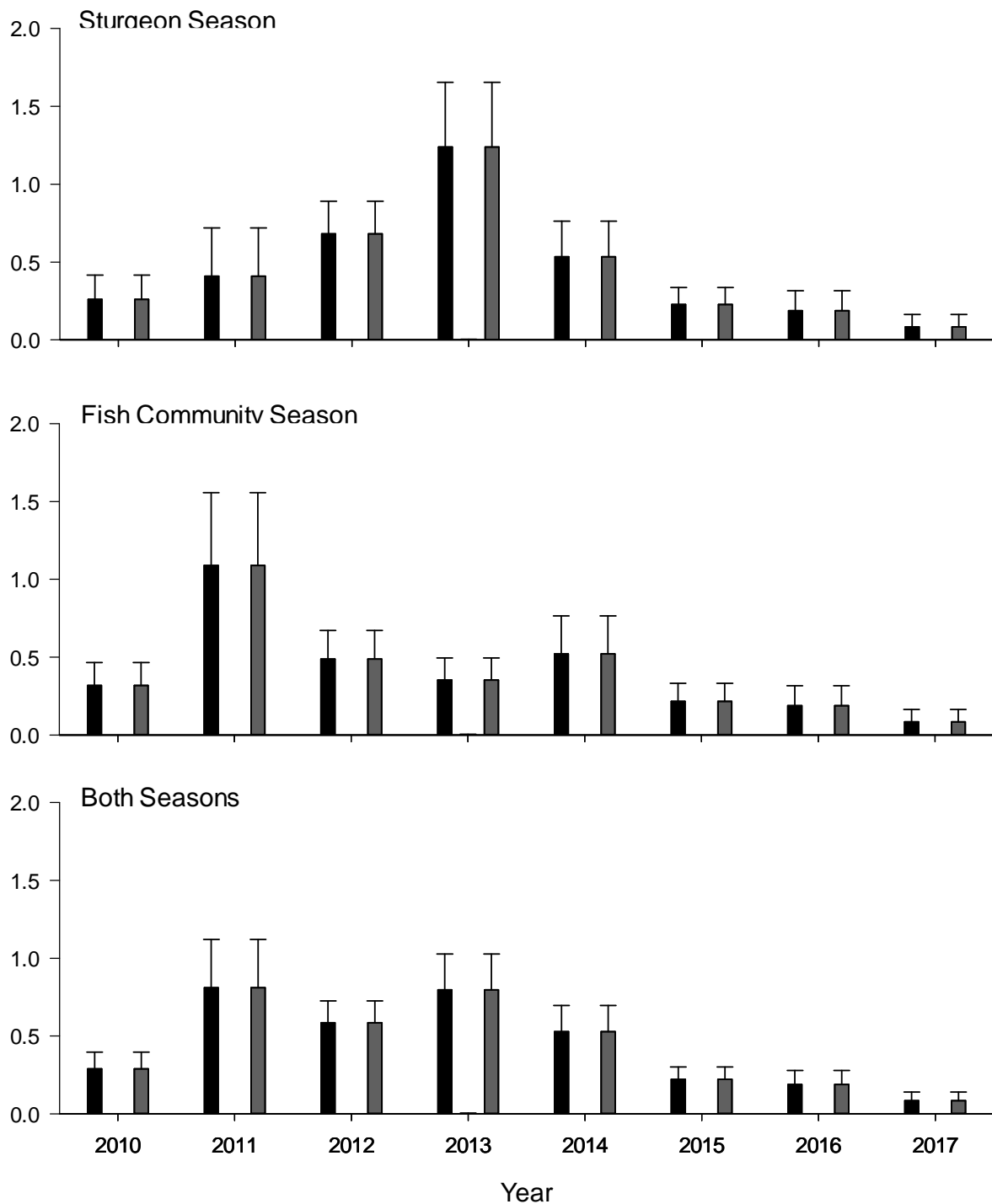


Figure 7. Mean annual catch per unit effort (± 2 SE) of all (black bars), wild (white bars), hatchery reared (gray bars), and unknown origin (cross-hatched bars) pallid sturgeon using trotlines in Segment 3 of the Missouri River from 2010-2017.

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 2017. 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	0	0	0	0	0
		43	33	24	0
Fish Community Season					
1.0” Trammel Net	0	0	0	0	0
		44	32	25	0
Both Seasons					
Trot Line	0	0	0	0	0
		36	34	23	6

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 2017. 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	0	0	0	0	0
		43	33	24	0
Fish Community Season					
1.0” Trammel Net	1	0	0	100	0
		44	32	25	0
Both Seasons					
Trot Line	0	0	0	0	0
		36	34	23	6

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 2017. 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	4	25	75	0	0
		43	33	24	0
Fish Community Season					
1.0” Trammel Net	8	63	38	0	0
		44	32	25	0
Both Seasons					
Trot Line	7	71	14	0	14
		36	34	23	6

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 2017. 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	0	0	0	0	0
		43	33	24	0
Fish Community Season					
1.0” Trammel Net	1	100	0	0	0
		44	32	25	0
Both Seasons					
Trot Line	1	0	0	100	0
		36	34	23	6

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 2017. 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	4	25	75	0	0
		43	33	24	0
Fish Community Season					
1.0” Trammel Net	10	60	30	10	0
		44	32	25	0
Both Seasons					
Trot Line	8	63	13	13	13
		36	34	23	6

Segment 3 - Pallid Sturgeon

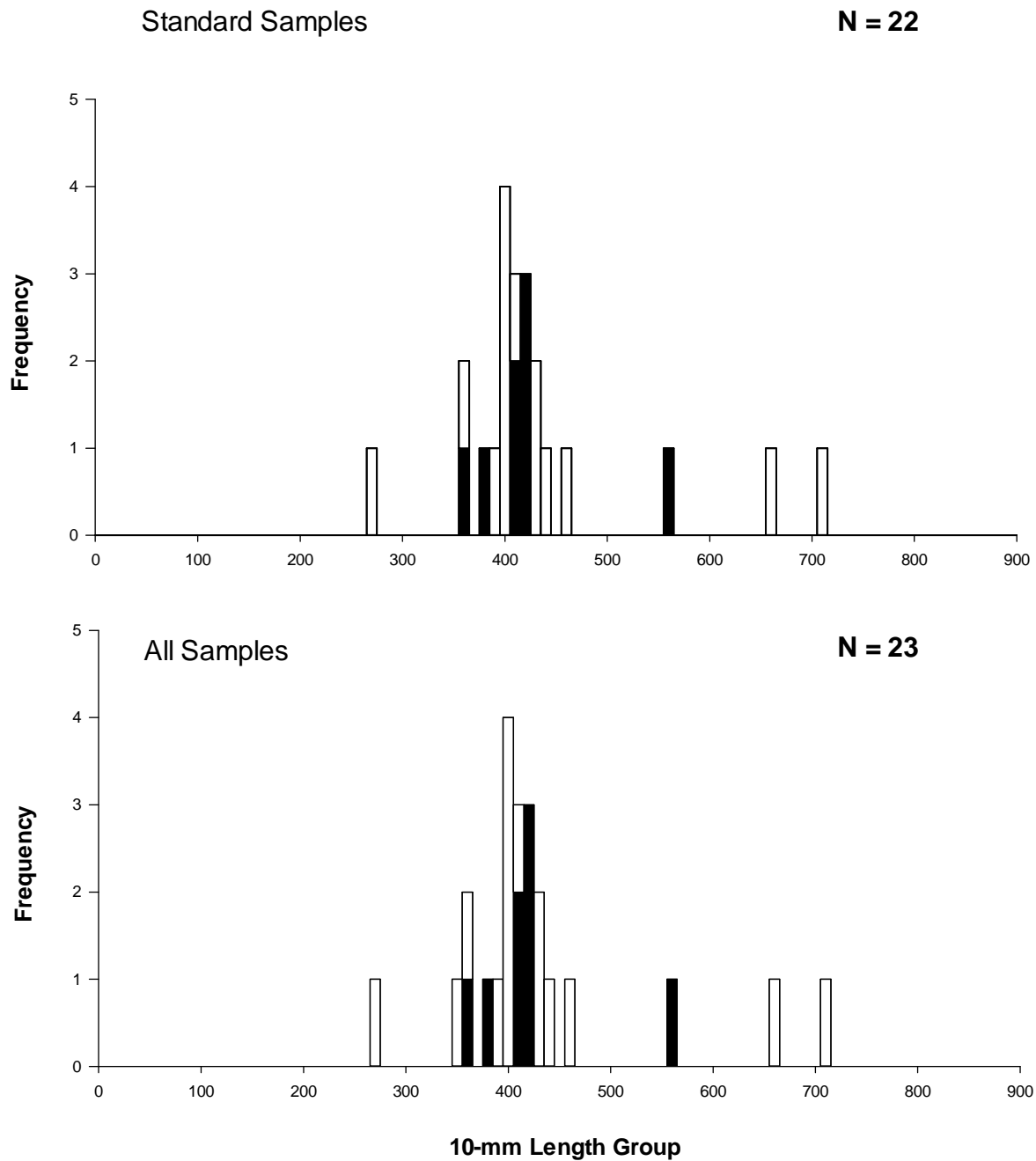


Figure 8. Length frequency of pallid sturgeon captured during the sturgeon season (black bars) and fish community season (white bars) in Segment 3 of the Missouri River during 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017. Pallid sturgeon of unknown origin are awaiting genetic verification.

Segment 3 - Annual Pallid Sturgeon Capture History

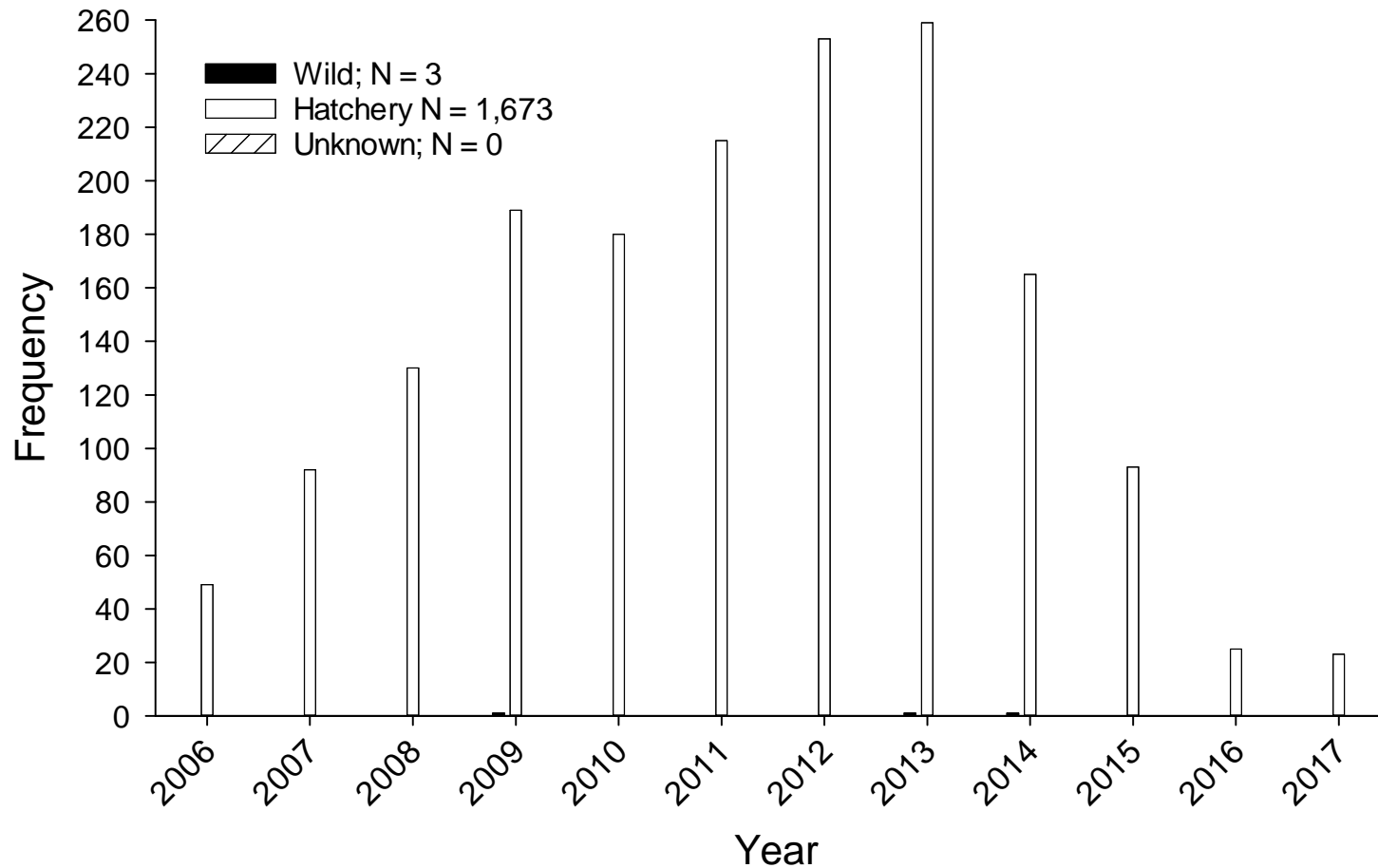


Figure 9. Annual capture history of wild (black bars), hatchery reared (white bars), and unknown origin (cross-hatched bars) pallid sturgeon collected in Segment 3 of the Missouri River from 2006-2017. Figure is designed to compare overall pallid sturgeon captures from year to year and is biased by variable 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 were collected in Segment 3 during 2017 or during the previous 11 years of sampling.

Targeted Native River Species

Shovelnose Sturgeon

A total of 155 shovelnose sturgeon were captured throughout Segment 3 during the 2017 sampling season. Temporally, more were captured during fish community season (n=104), than during sturgeon season (n=51). In relation to gears, more shovelnose sturgeon were observed in trammel net (n=121) compared to trotline (n=34). Random gear deployments accounted for the majority of observations (n=146), while nonrandom duplicate trammel net drifts netted an additional nine individuals.

During the 2017 field season, trammel net CPUE (Figure 10) for the quality and above size class of shovelnose sturgeon, the most frequently observed size class, was reported at 0.11 fish/100m, 0.35 fish/100m, and 0.23 fish/100m for sturgeon season, fish community season, and combined-season, respectively. Catch rates for the sub-stock and stock size categories of shovelnose sturgeon in Segment 3 remained low, yet comparable, on a year by year basis.

Trotline CPUE for Segment 3 during 2017 (Fig. 12), regarding the quality and above size class of shovelnose sturgeon, was reported for the following three seasonal metrics; 0.46 fish/20 hooks, 0.25 fish/20 hooks, and 0.35 fish/20 hooks for sturgeon season, fish community season, and combined-season, respectively. 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.

A year by year comparison of relative weights (W_r), related to the observed shovelnose sturgeon in Segment 3, can be found in Figure 15. When adequate sample size is reached, W_r has become more comparable, such as for the preferred and memorable/trophy size classes of shovelnose sturgeon. However, that transparency deteriorates as you move down to the smaller size classes due to smaller and more variable sample size.

The shovelnose sturgeon representatives captured in Segment 3 during the 2017 field season averaged 552 mm in fork length and 711 g in weight, with a range of 220 mm to 843 mm. Compared to Segment 2, Segment 3 exhibits a more complete population size structure, however, with the suspension of otter trawl as a sampling gear, the smaller size classes have been

truncated from the length frequency histogram (Figure 13). A visual representation of relative stock density (RSD) can be found in Figure 14.

The specific macro and meso habitats where shovelnose sturgeon were sampled in Segment 3 during 2017, 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.

Segment 3 - Shovelnose Sturgeon

1.0" Trammel Nets

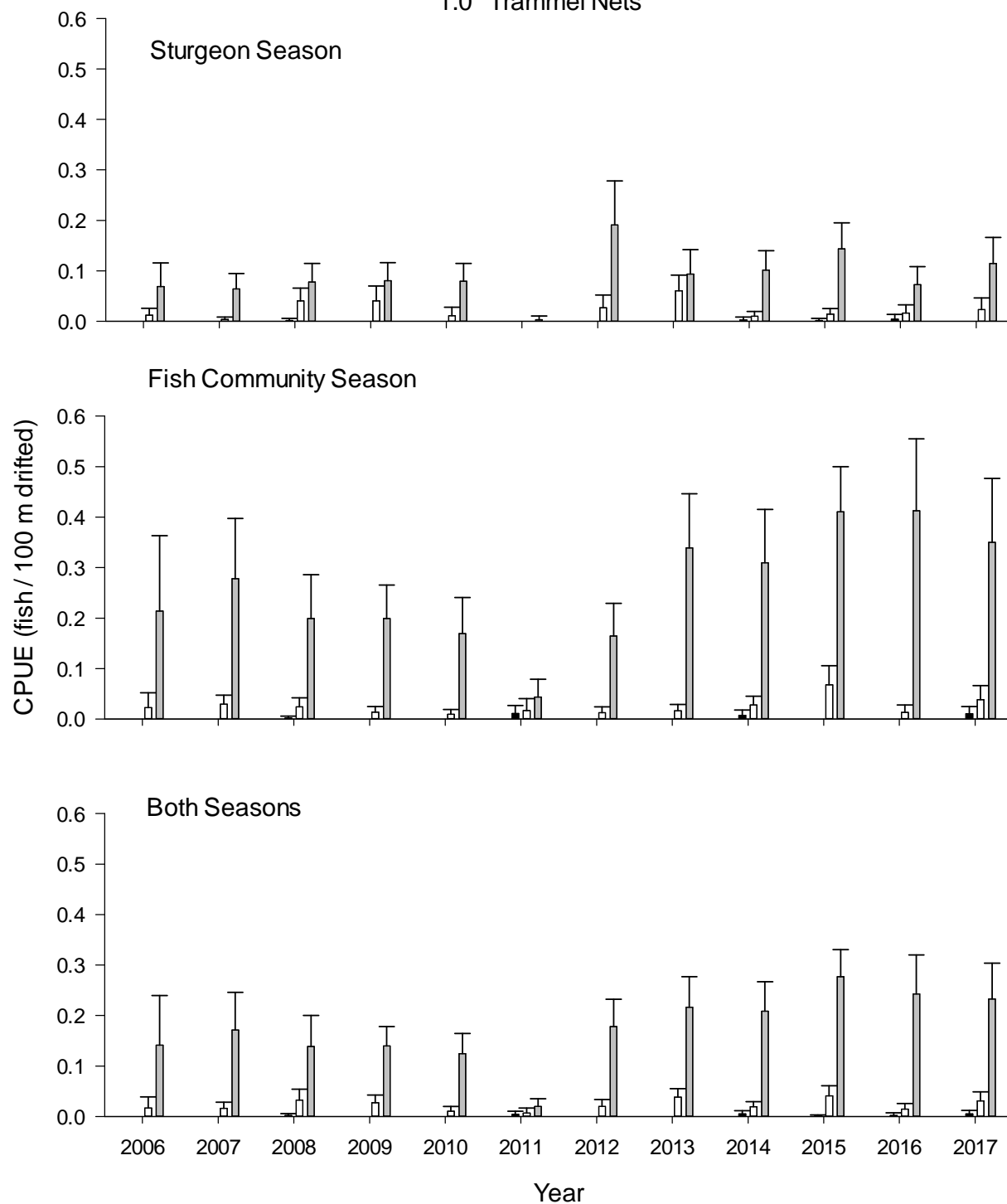


Figure 10. Mean annual catch per unit effort (± 2 SE) of sub-stock size (0-149 mm; cross-hatched bars), sub-stock size (150-249 mm; black bars), stock size (250-379 mm; white bars), and quality and above size (> 380 mm; gray bars) shovelnose sturgeon using 1.0" trammel nets in Segment 3 of the Missouri River from 2006-2017.

Segment 3 - Shovelnose Sturgeon

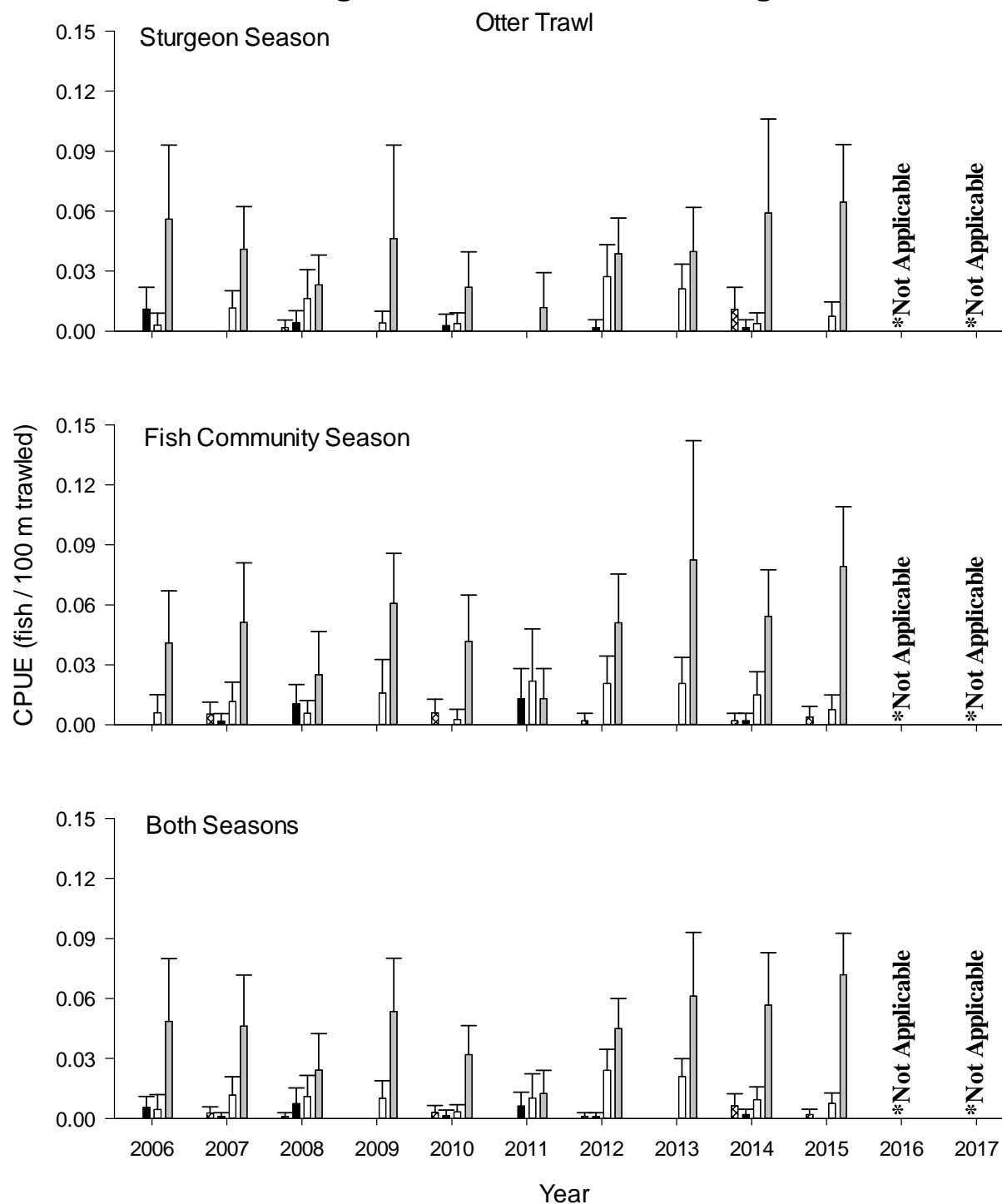


Figure 11. Mean annual catch per unit effort (± 2 SE) of sub-stock size (0-149 mm; cross-hatched bars), sub-stock size (150-249 mm; black bars), stock size (250-379 mm; white bars), and quality and above size (> 380 mm; gray bars) shovelnose sturgeon using otter trawls in Segment 3 of the Missouri River from 2006-2017. *Otter trawl not performed in 2016 or 2017.

Segment 3 - Shovelnose Sturgeon

Standard Trotlines

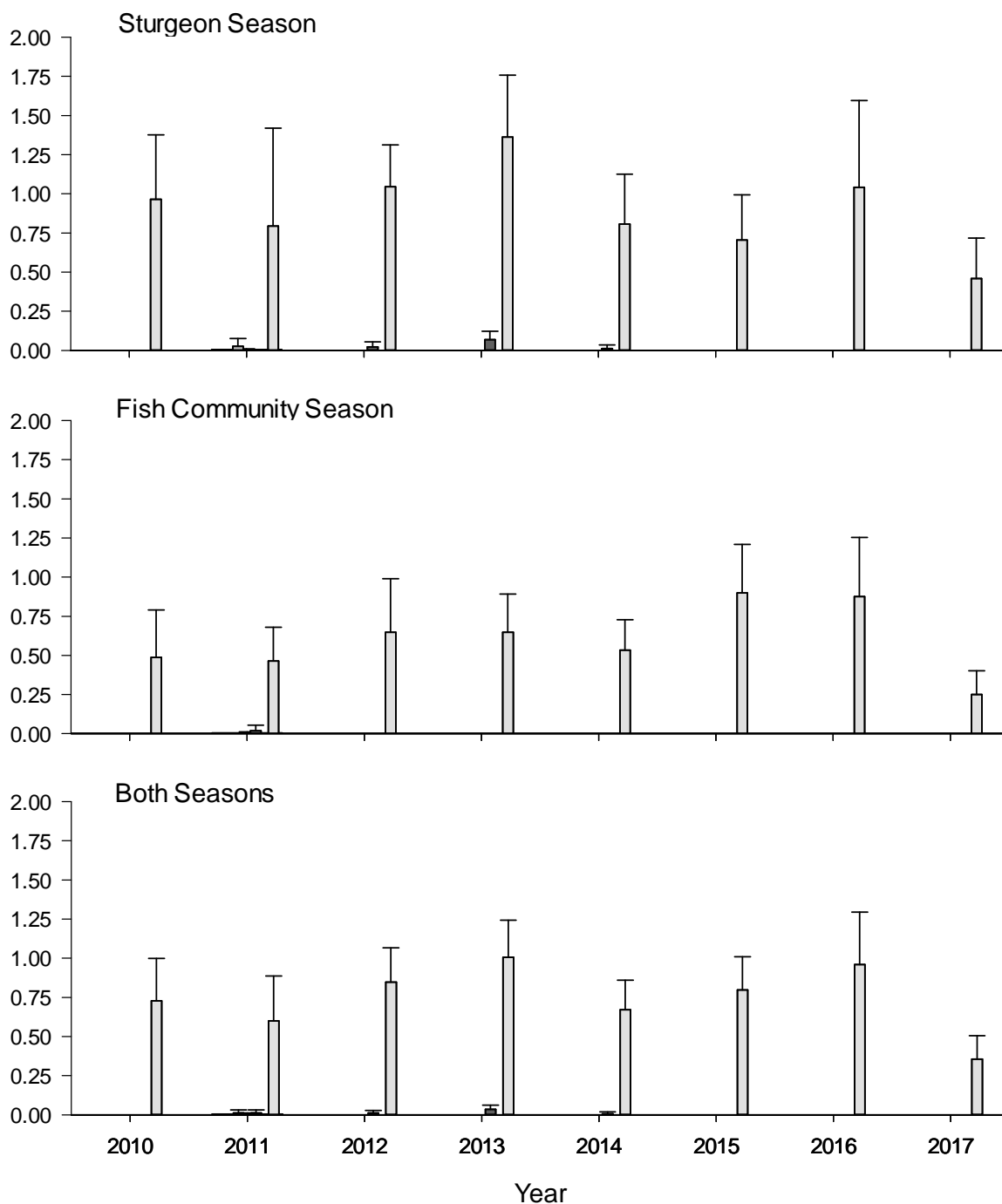


Figure 12. Mean annual catch per unit effort (± 2 SE) of sub-stock size (0-149 mm; cross-hatched bars), sub-stock size (150-249 mm; black bars), stock size (250-379 mm; white bars), and quality and above size (> 380 mm; gray bars) shovelnose sturgeon using trotlines in Segment 3 of the Missouri River from 2010-2017. 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 2017. 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	0	0	0	0	0
		43	33	24	0
Fish Community Season					
1.0” Trammel Net	0	0	0	0	0
		44	32	25	0
Both Seasons					
Trot Line	0	0	0	0	0
		36	34	23	6

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 2017. 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	0	0	0	0	0
		43	33	24	0
Fish Community Season					
1.0” Trammel Net	2	0	50	50	0
		44	32	25	0
Both Seasons					
Trot Line	0	0	0	0	0
		36	34	23	6

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 2017. 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	4	25	25	50	0
		43	33	24	0
Fish Community Season					
1.0'' Trammel Net	8	25	63	13	0
		44	32	25	0
Both Seasons					
Trot Line	0	0	0	0	0
		36	34	23	6

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 2017. 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	23	35	43	22	0
		43	33	24	0
Fish Community Season					
1.0” Trammel Net	75	49	32	19	0
		44	32	25	0
Both Seasons					
Trot Line	34	35	21	32	12
		36	34	23	6

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 2017. 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	27	33	41	26	0
		43	33	24	0
Fish Community Season					
1.0” Trammel Net	85	46	35	19	0
		44	32	25	0
Both Seasons					
Trot Line	34	35	21	32	12
		36	34	23	6

Segment 3 - Shovelnose Sturgeon

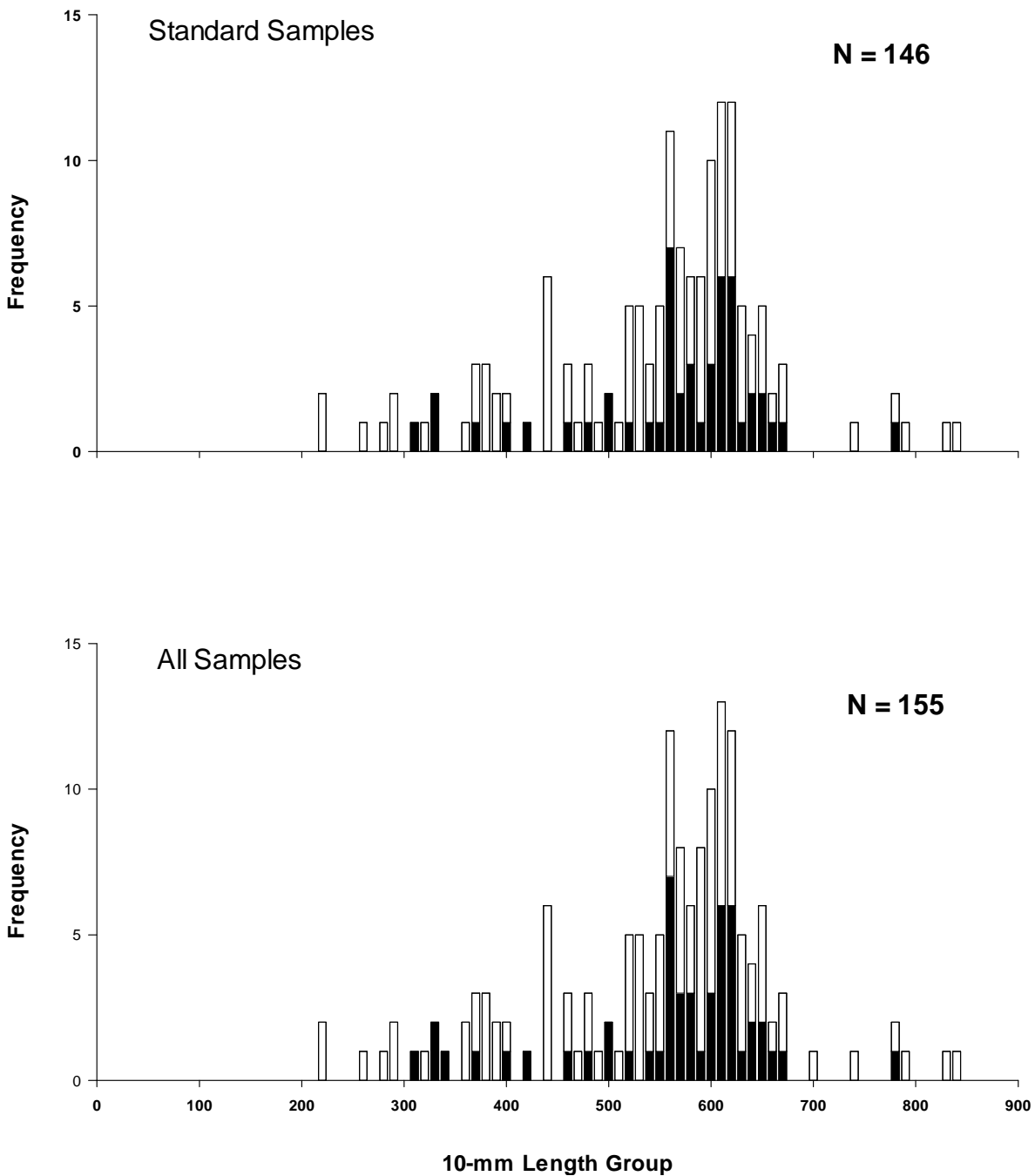
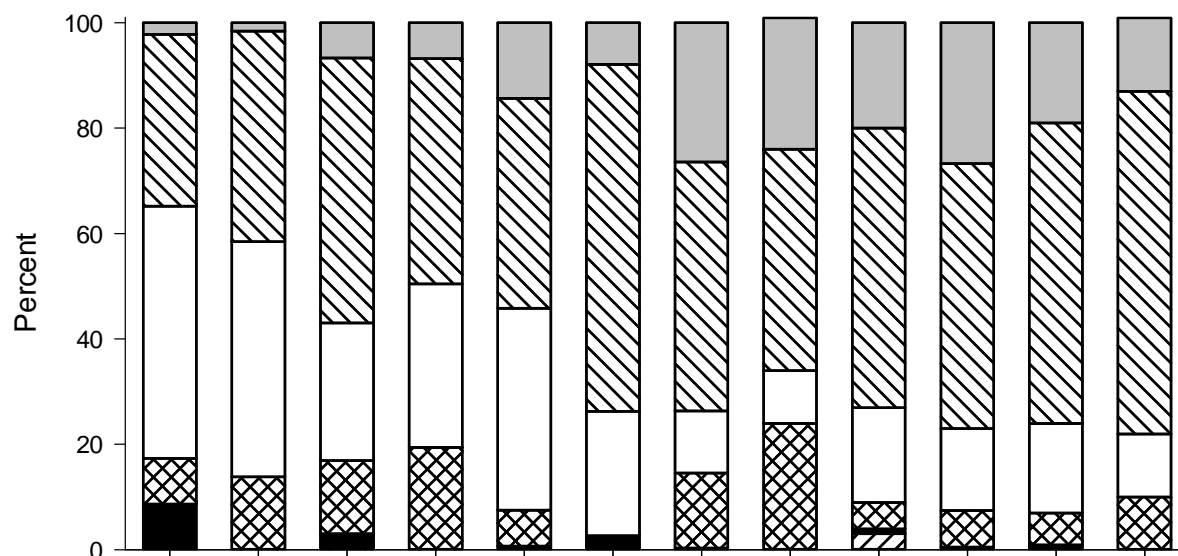


Figure 13. Length frequency of shovelnose sturgeon during the sturgeon season (black bars) and fish community season (white bars) in Segment 3 of the Missouri River during 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.

Segment 3 - Shovelnose Sturgeon Sturgeon Season



Fish Community Season

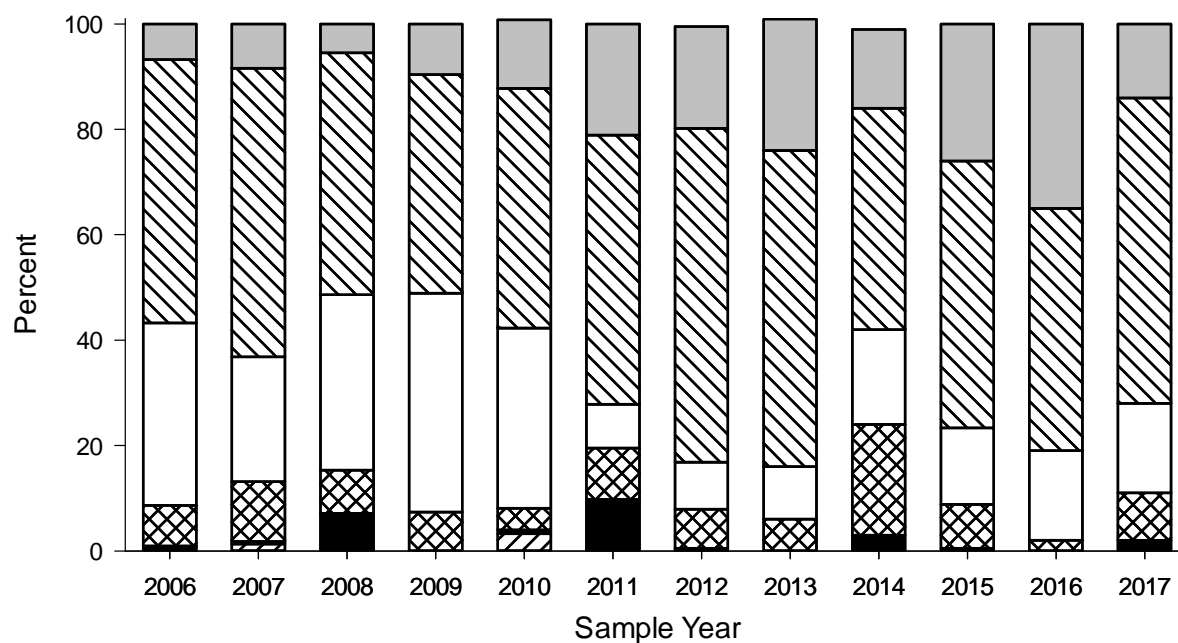


Figure 14. Proportion by length group for all shovelnose sturgeon captured with all gear by length category from 2006 to 2017 in Segment 3 in the Missouri River. Length categories determined using the methods proposed by Quist (1998).

Segment 3 - Shovelnose Sturgeon

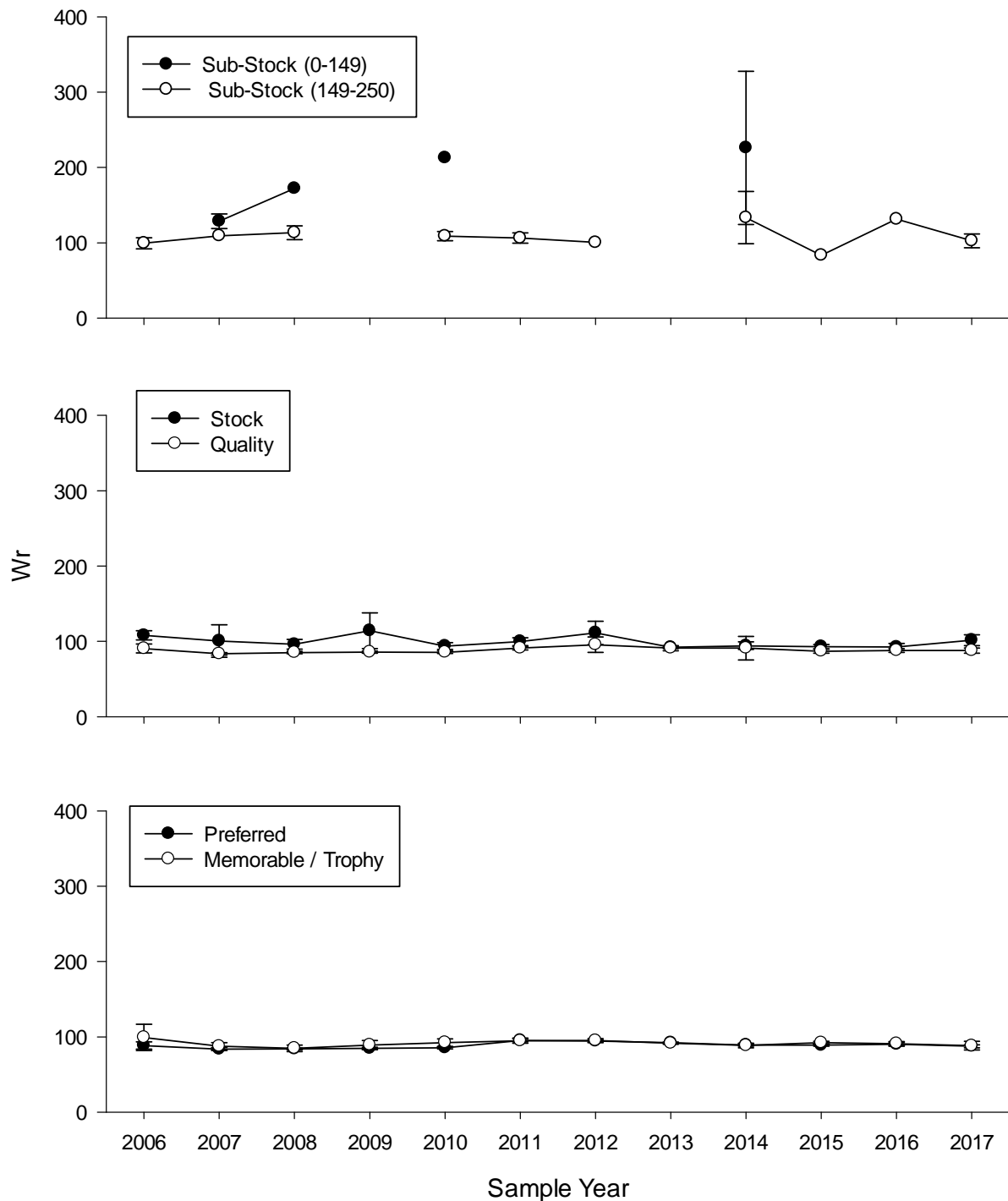


Figure 15. Relative weight (Wr) for all shovelnose sturgeon captured with all gear by incremental relative stock density (RSD) length category from 2006-2017 in Segment 3 in the Missouri River. Length categories determined using the methods proposed by Quist (1998).

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 2017 field season.

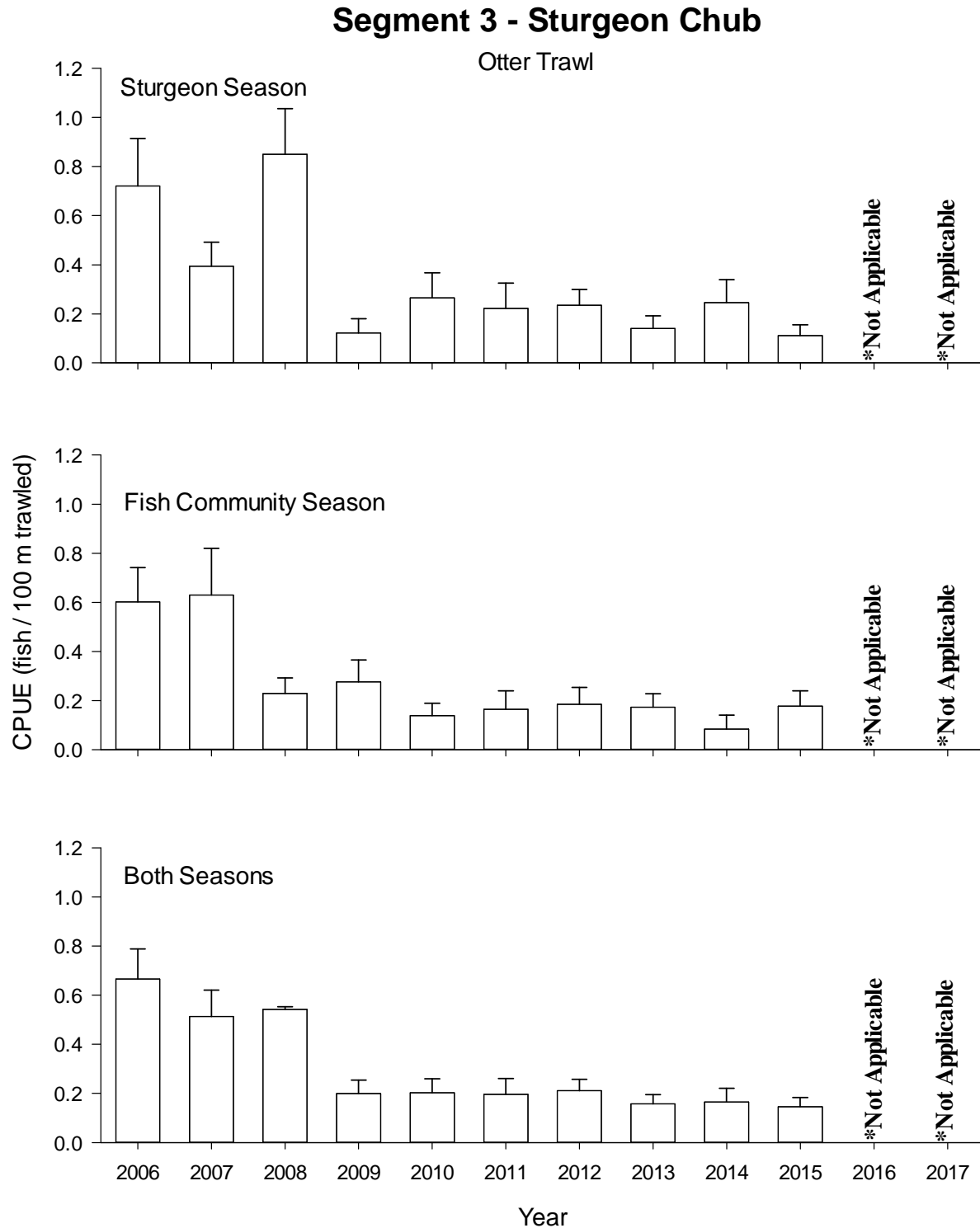


Figure 16. Mean annual catch per unit effort (± 2 SE) of sturgeon chub using otter trawls in Segment 3 of the Missouri River from 2006-2017. *Otter trawl not performed in 2016 or 2017.

Segment 3 - Sturgeon Chub

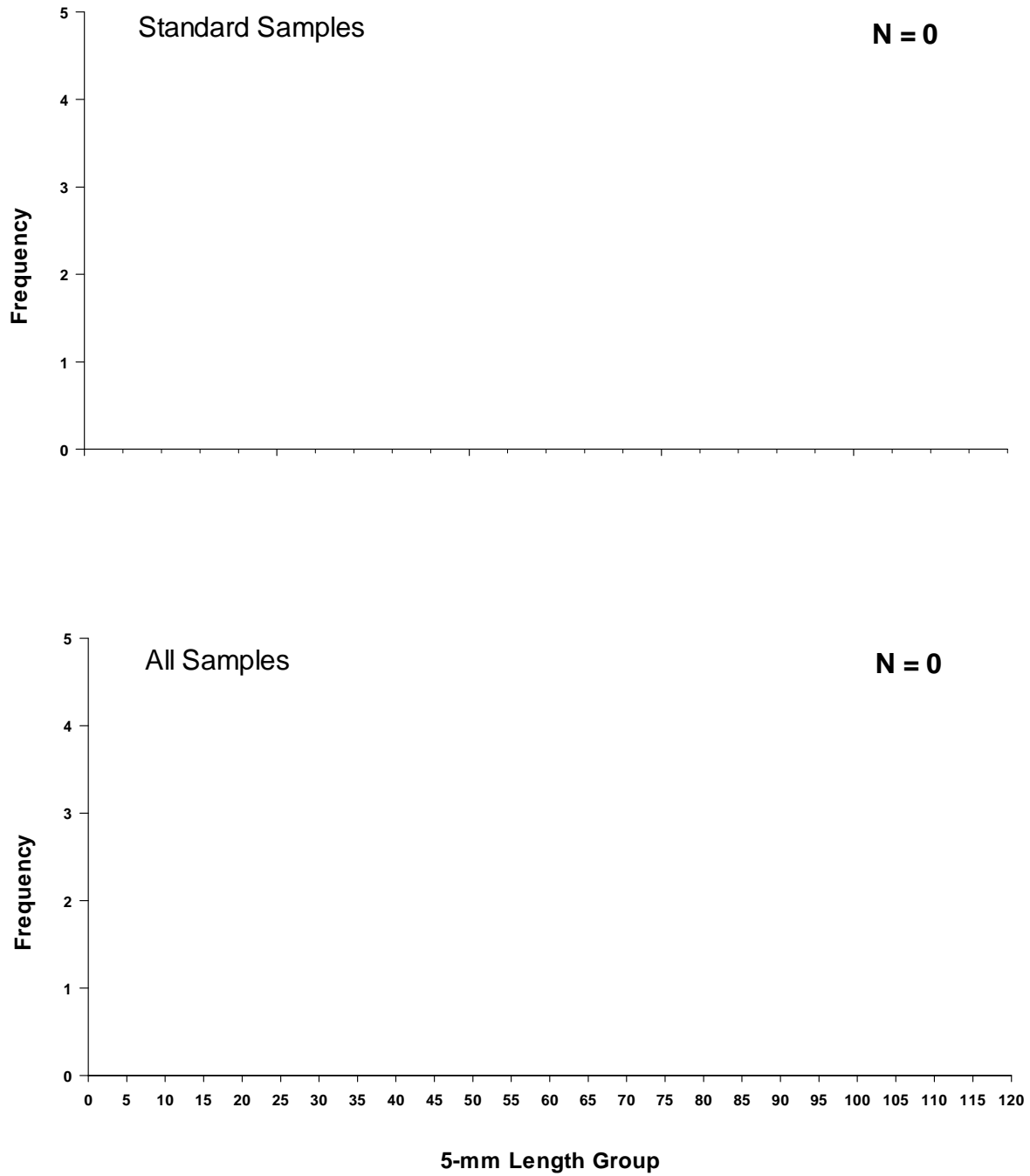


Figure 17. Length frequency of sturgeon chub during the sturgeon season (black bars) and the fish community season (white bars) in Segment 3 of the Missouri River during 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.

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 2017 field season.

Segment 3 - Sicklefin Chub

Otter Trawl

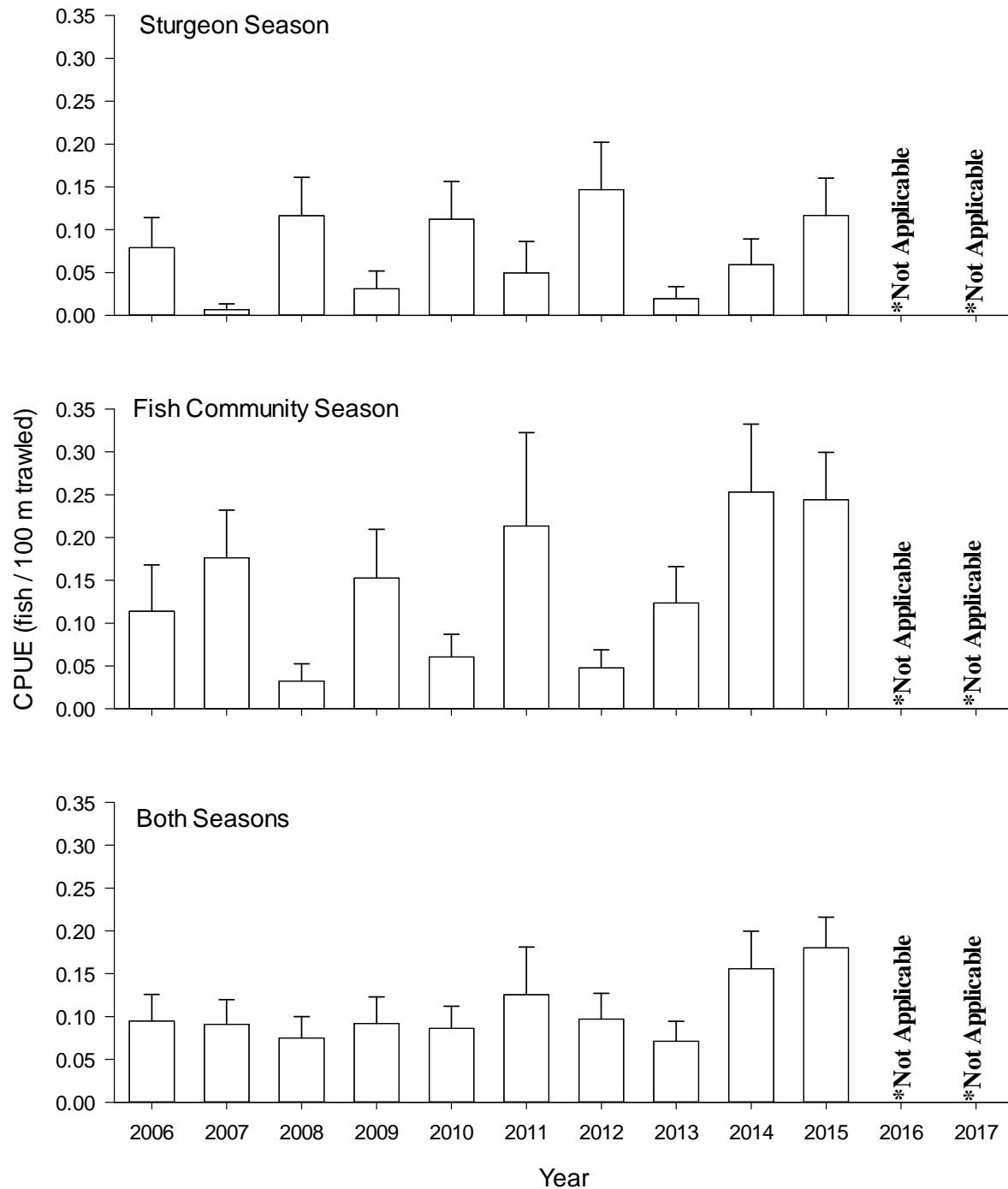


Figure 18. Mean annual catch per unit effort (± 2 SE) of sicklefin chub using otter trawls in Segment 3 of the Missouri River from 2006-2017. *Otter trawl not performed in 2016 or 2017.

Segment 3 - Sicklefin Chub

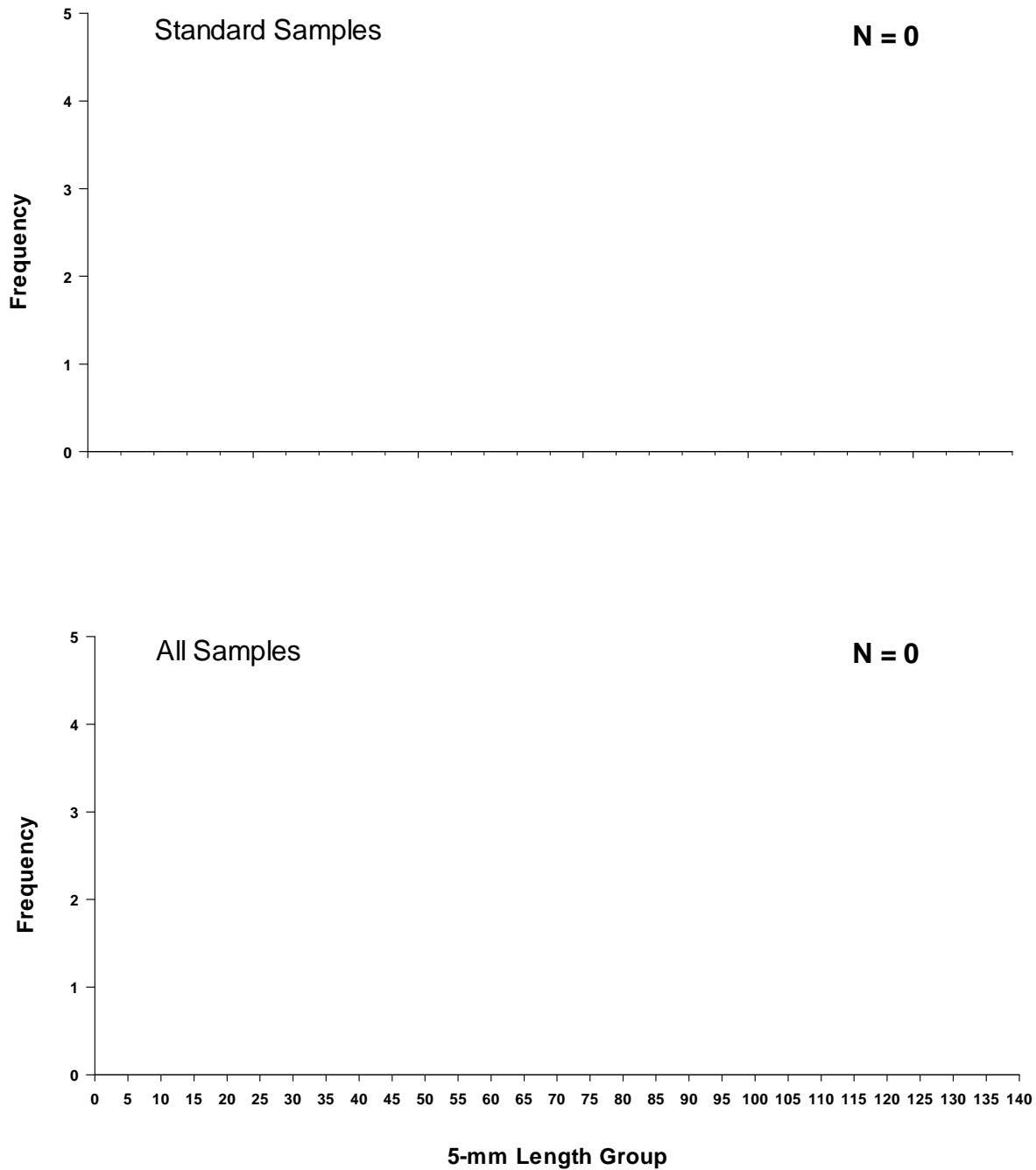


Figure 19. Length frequency of sicklefin chub during the sturgeon season (black bars) and the fish community season (white bars) in Segment 3 of the Missouri River during 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.

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 2017 field season.

Segment 3 - Sand Shiner

Mini-Fyke Nets

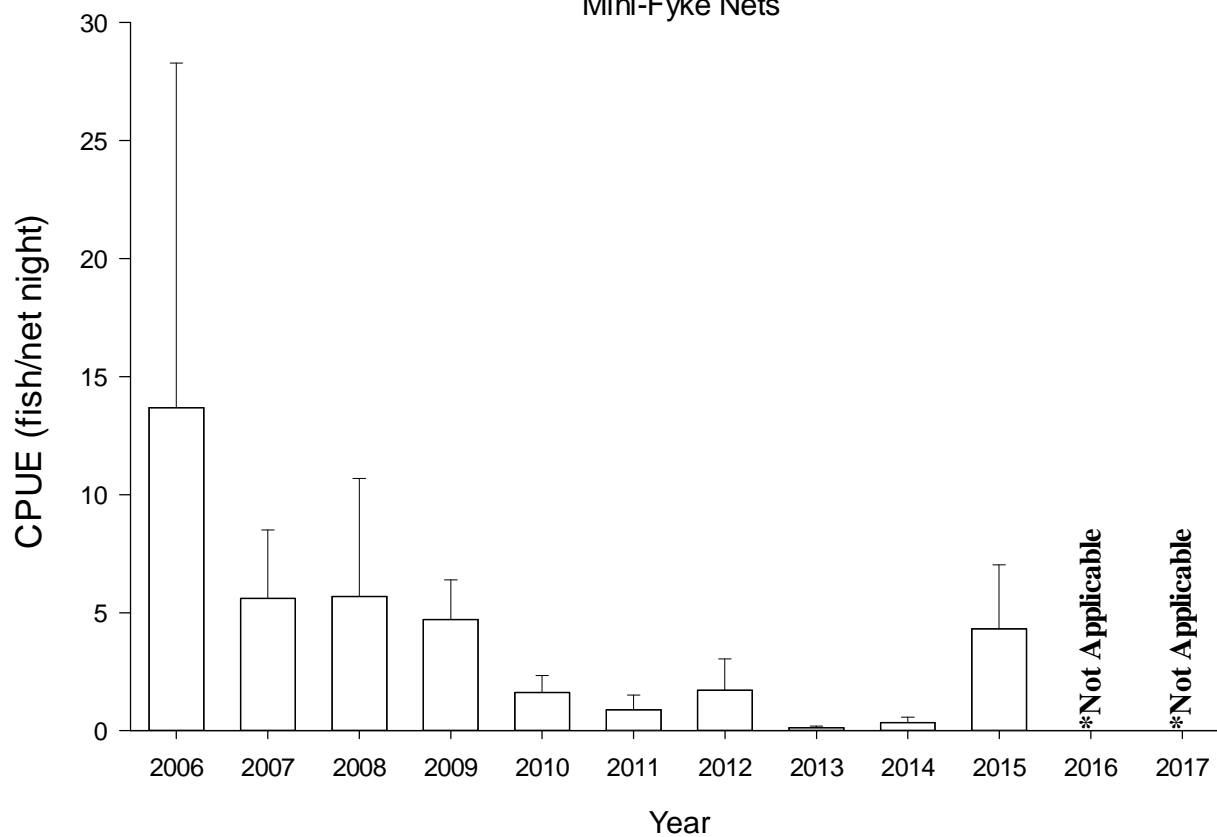


Figure 20. Mean annual catch per unit effort (± 2 SE) of sand shiner with mini-fyke nets in segment 3 of the Missouri River during fish community season 2006-2017. *Mini-fyke net not performed in 2016 or 2017.

Segment 3 - Sand Shiner

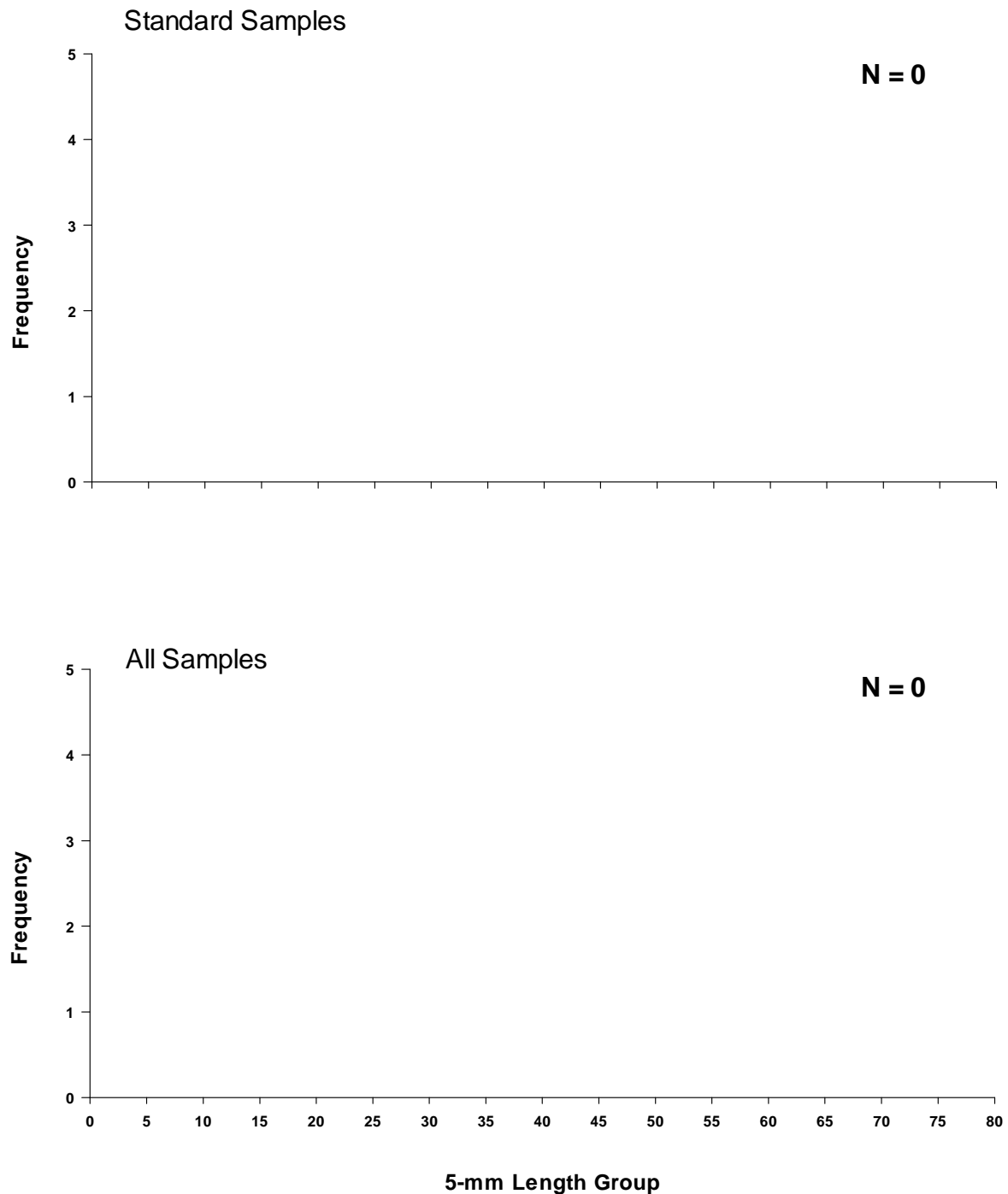


Figure 21. Length frequency of sand shiner during the sturgeon season (black bars) and the fish community season (white bars) in Segment 3 of the Missouri River during 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.

***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 2017 field season.

Segment 3 - *Hybognathus* spp.

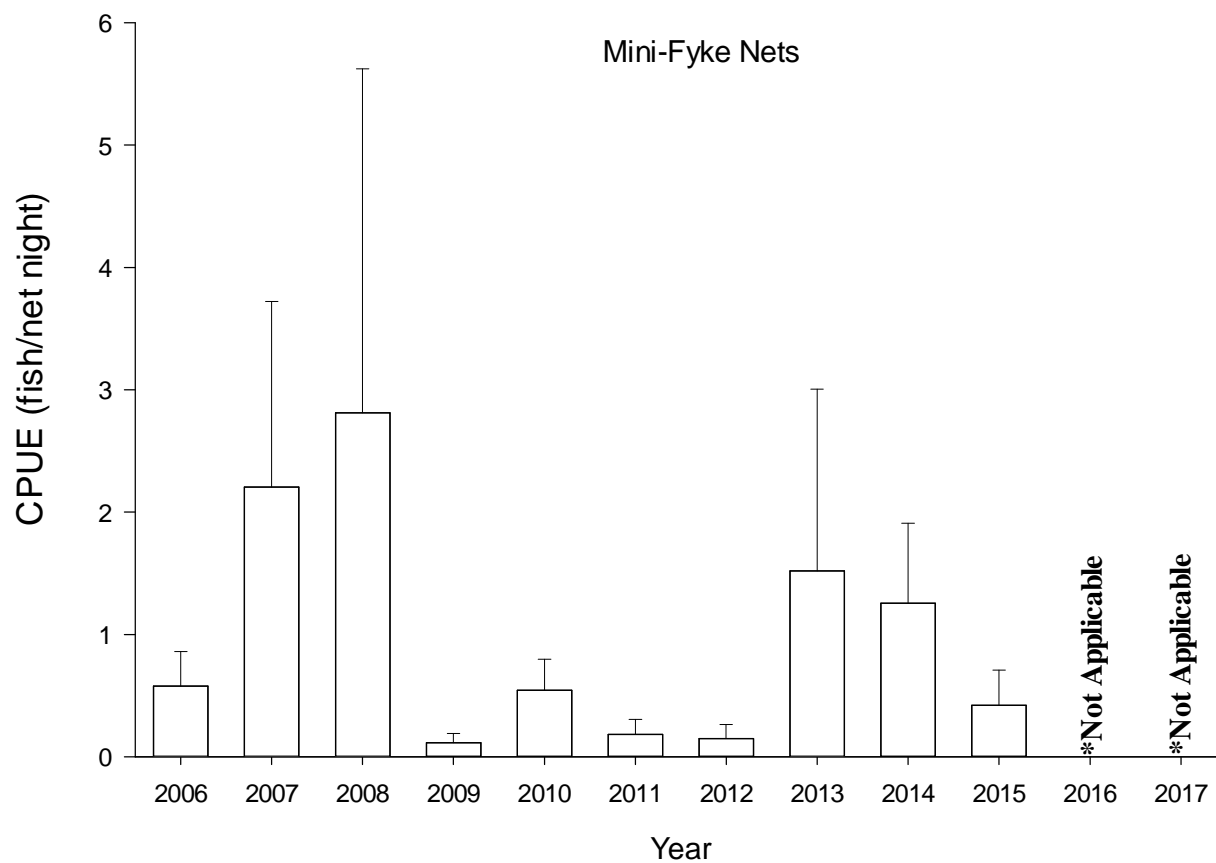


Figure 22. Mean annual catch per unit effort (± 2 SE) of *Hybognathus* spp. with mini-fyke nets in Segment 3 of the Missouri River during fish community season 2006-2017. *Mini-fyke net not performed in 2016 or 2017.

Segment 3 - *Hybognathus* spp.

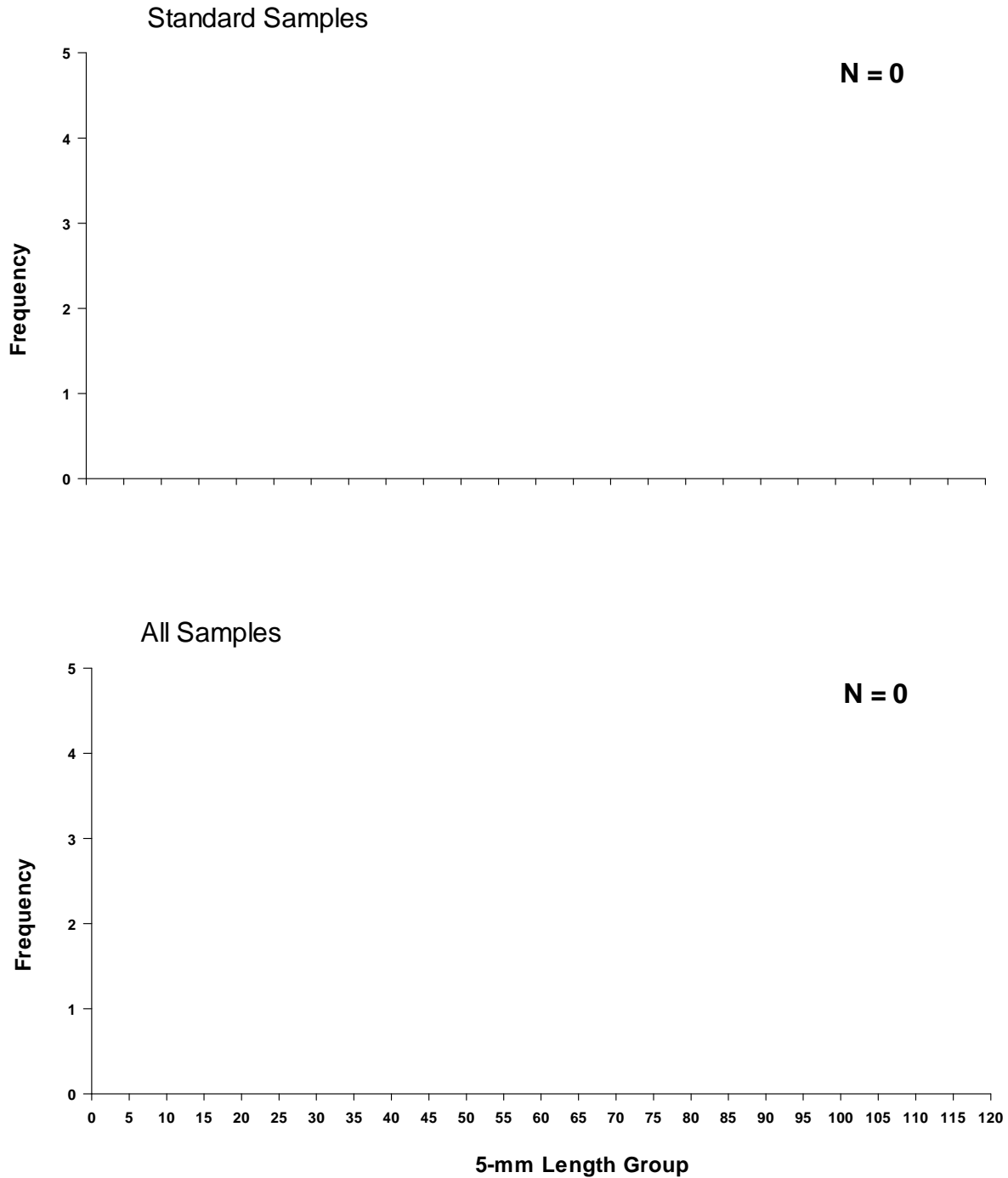


Figure 23. Length frequency of *Hybognathus* spp. caught during the sturgeon season (black bars) and the fish community season (white bars) in Segment 3 of the Missouri River during 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.

Blue Sucker

Sampling events throughout Segment 3 in 2017 led to the capture of only one blue sucker. The above-mentioned fish was observed during a non-random trammel net drift, which occurred during sturgeon season. The sole blue sucker measured 762 mm in total length and weighed 3,740 g in weight. Furthermore, because the fish was captured during a non-random, duplicate trammel net deployment, the associated CPUE for all three seasonal metrics was reported at 0.0 fish/100 m.

Segment 3 - Blue Sucker

1.0" Trammel Nets

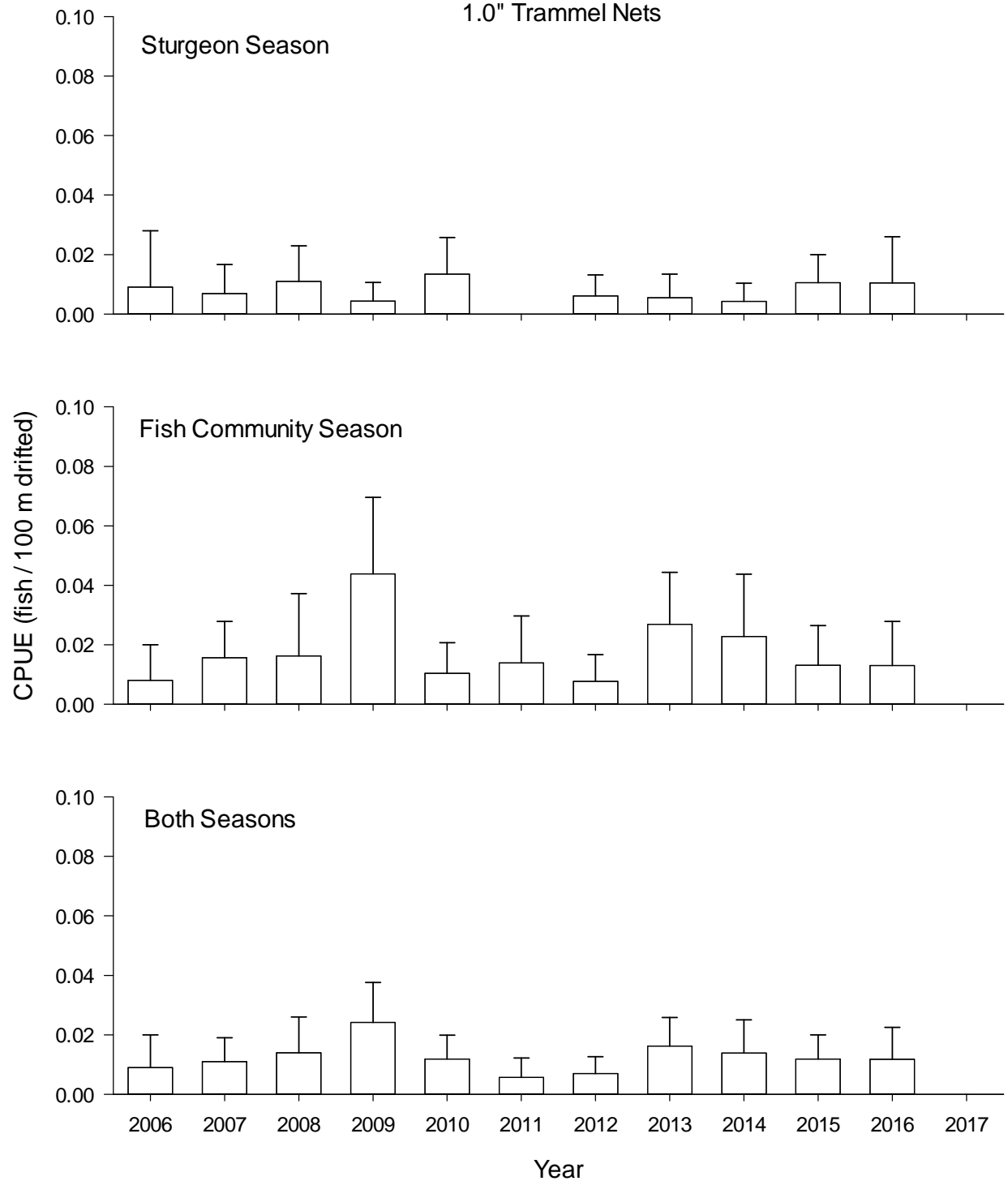


Figure 24. Mean annual catch per unit effort (± 2 SE) of blue sucker using 1.0" trammel nets in Segment 3 of the Missouri River from 2006-2017.

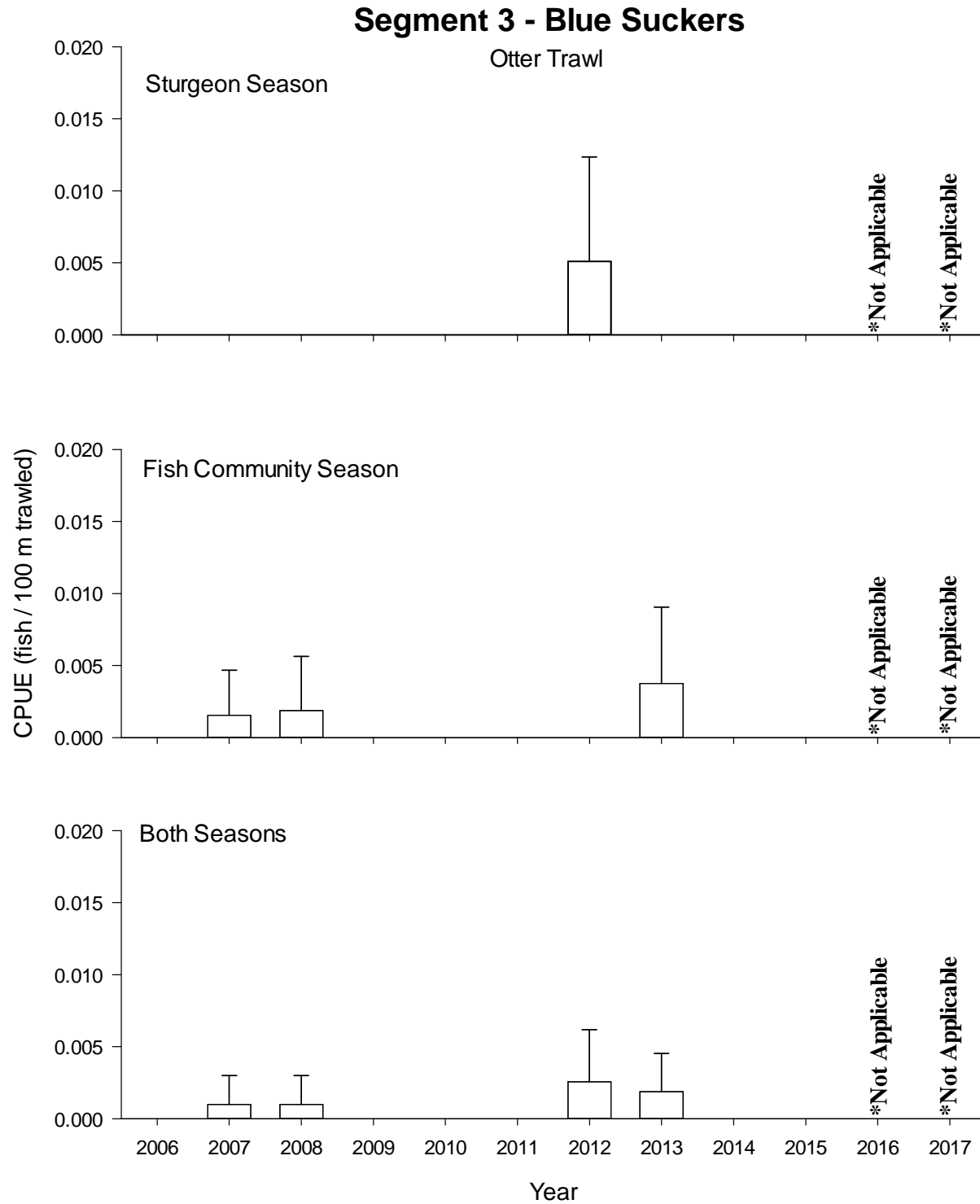


Figure 25. Mean annual catch per unit effort (± 2 SE) of blue sucker using otter trawls in Segment 3 of the Missouri River from 2006-2017. *Otter trawl not performed in 2016 or 2017.

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 2017. 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	0	0	0	0	0
		43	33	24	0
Fish Community Season					
1.0” Trammel Net	0	0	0	0	0
		44	32	25	0
Both Seasons					
Trot Line	0	0	0	0	0
		36	34	23	6

Segment 3 - Blue Sucker

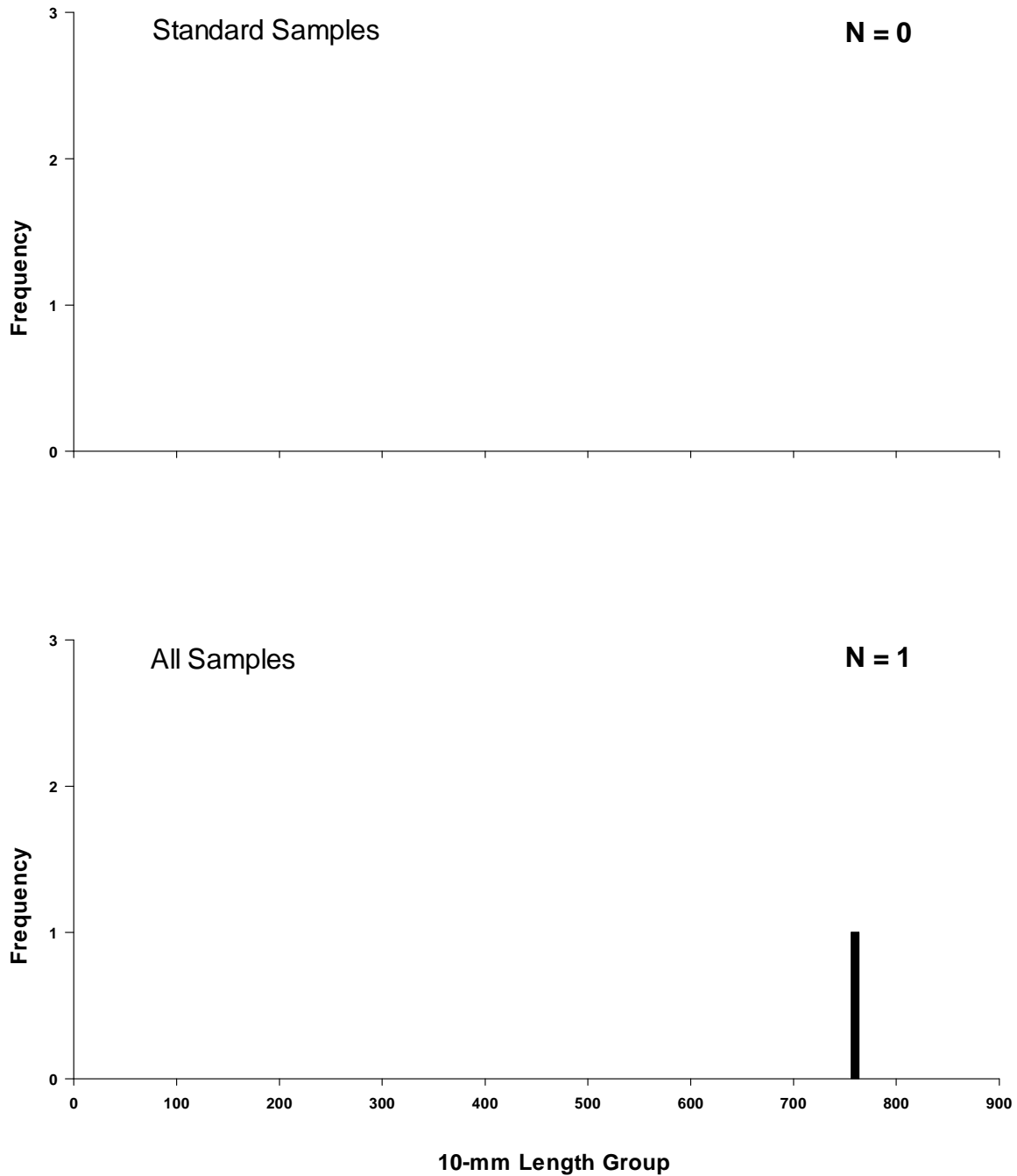


Figure 26. Length frequency of blue sucker during the sturgeon season (black bars) and the fish community season (white bars) in Segment 3 of the Missouri River during 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.

Sauger

A total of 63 sauger were collected within Segment 3 during the 2017 sampling season. A higher proportion (75%) of sauger observations came during sturgeon season, when compared to fish community season (25%). In relation to gear, all 63 individuals were captured via trammel net deployments. Of the 63 sightings, 58 were observed during random sampling, while the remaining five were captured during non-random, duplicate drifts.

The associated trammel net CPUE (Figure 28) was reported at 0.22 fish/100m, 0.06 fish/100m, and 0.14 fish/100m for the sturgeon, fish community, and combined seasons, respectively.

The sauger captured during 2017 sampling events across Segment 3 averaged 358 mm in total length and 342 g in weight. With the loss of otter trawl and mini-fyke net as sampling gears, smaller age classes, including young of the year, were absent from 2017 sampling. A complete length frequency for 2017 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.

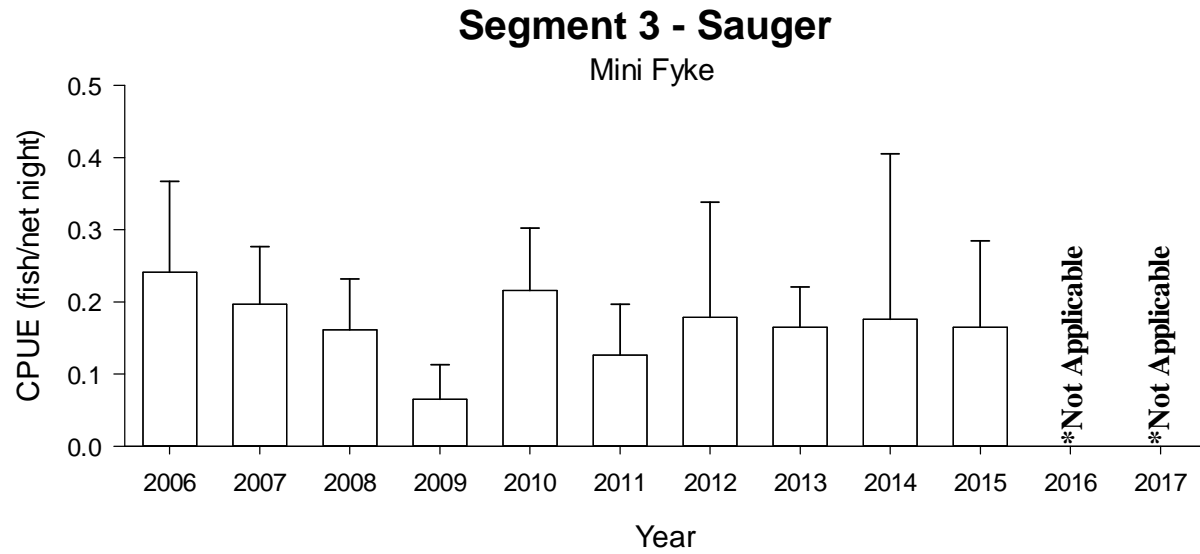


Figure 27. Mean annual catch per unit effort (± 2 SE) of sauger using mini-fyke nets in Segment 3 of the Missouri River from 2006-2017. *Mini-fyke net not performed in 2016 or 2017.

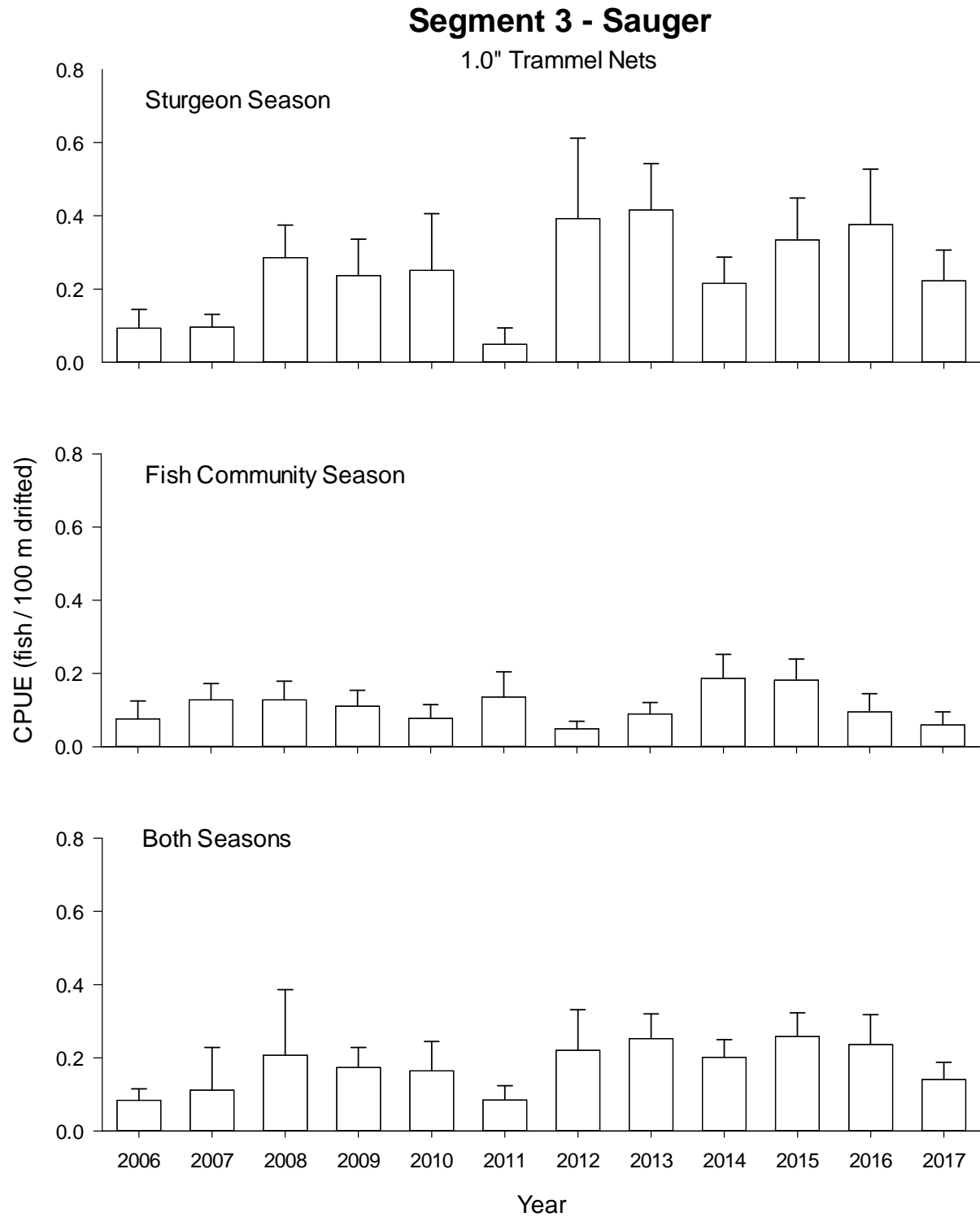


Figure 28. Mean annual catch per unit effort (± 2 SE) of sauger using 1.0" trammel nets in Segment 3 of the Missouri River from 2006-2017.

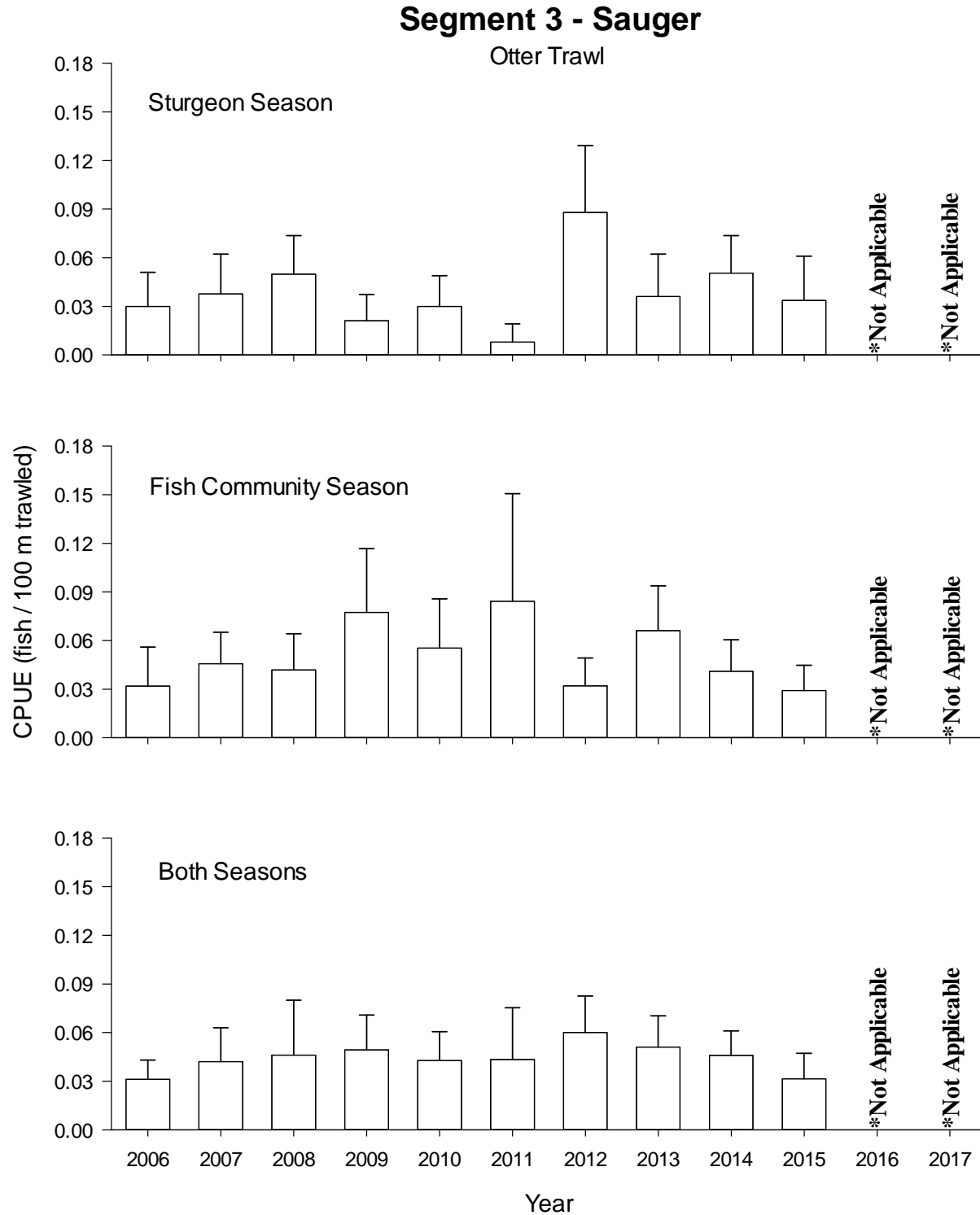


Figure 29. Mean annual catch per unit effort (\pm 2 SE) of sauger using otter trawls in Segment 3 of the Missouri River from 2006-2017. *Otter-trawl not performed in 2016 or 2017.

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 2017. 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	44	43	43	14	0
		43	33	24	0
Fish Community Season					
1.0” Trammel Net	14	36	57	7	0
		44	32	25	0
Both Seasons					
Trot Line	0	0	0	0	0
		36	34	23	6

Segment 3 - Sauger

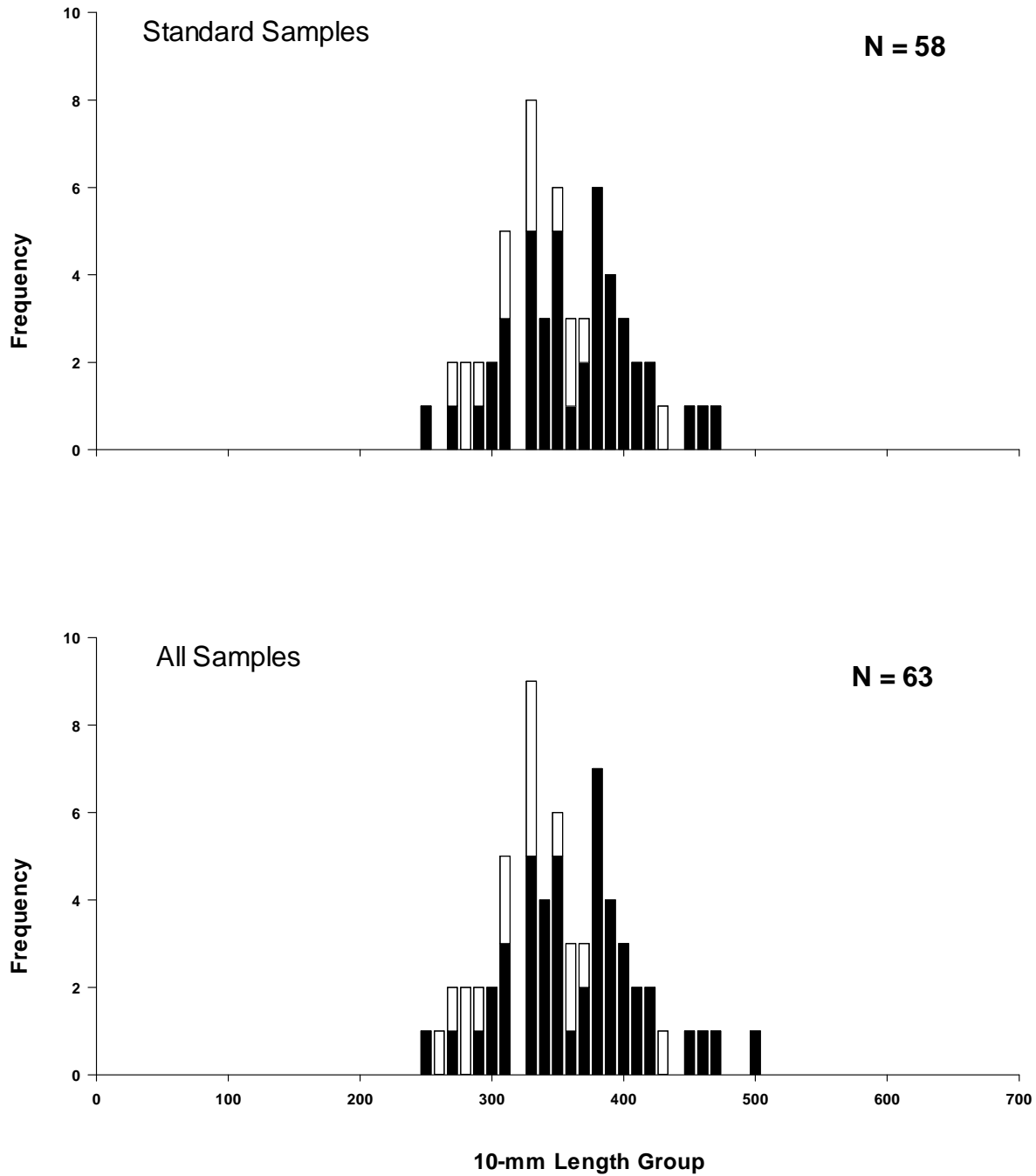


Figure 30. Length frequency of sauger during the sturgeon season (black bars) and the fish community season (white bars) in Segment 3 of the Missouri River during 2017. Standard samples include standard gears, random bends, and random subsamples. All samples include all sampling conducted during 2017.

Missouri River Fish Community

The sampling events which took place throughout Segment 3 during the 2017 field season culminated in the capture of 616 individual fish, which consisted of 18 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 abundant species observed, with 155 collections, was shovelnose sturgeon. The second most encountered fish species (n=138) was goldeye *Hiodon alosoides*. The third most observed species was channel catfish *Ictalurus punctatus* (n=92), followed by sauger (n=63). Rounding out the top five of the most commonly captured fish species was flathead chub *Platygobio gracilis*, with 38 observations.

The other eight species present, but in low abundance were; northern pike *Esox Lucius*, burbot *Lota lota*, freshwater drum *Aplodinotus grunniens*, smallmouth *Actiobus bubalus* and bigmouth buffalo *I. cyprinellus*, lake whitefish *Coregonus clupeaformis*, and stonecat *Noturus flavus*.

Discussion

The 2017 field season marked the 12th consecutive sampling year for Pallid Sturgeon Population Assessment crews in Segment 2 of the Missouri River. Although this was the 12th year of sampling, it was also the second consecutive year of a reduction in both sampling gears and a reduction in sampling effort. Neither the otter trawl or mini-fyke net was used in sampling during the 2016 or 2017 field season. Additionally, effort was also reduced by nearly half, from 22 standard bends to 12 standard bends. As such, pallid sturgeon captures in were comparable in 2017 (n=23) to those witnessed in 2016 (n=25).

During the 2017 field season, sampling indicated that pallid sturgeon remained present longitudinally throughout the entire stretch of Segment 3 of the Missouri River. With the reduction of sampling effort leading to a smaller proportion of Segment 3 being sampled, drawing any kind of conclusion based on the distribution data is difficult. Additionally, what appears to be large portions of Segment 3 lacking pallid sturgeon catch data could be attributed to a lack of sampling in those areas. It is likely that, if those areas were sampled with trammel net and trotline, pallid sturgeon detections would be evident.

Pallid sturgeon distribution throughout Segment 3 remains variable, with emphasis on the timing and locality of sampling. Of the 12 bends sampled with trammel net, pallid sturgeon were observed in 8 of them. Comparatively, of the 12 bends sampled via trotline, pallid sturgeon were present in 5 of them. Multiple pallid sturgeon captures were represented in three trammel net sampled bends, while multiple captures were represented in only two trotline bends.

The reported trammel net CPUE for pallid sturgeon captures in Segment 3 during 2017 was calculated at 0.03 fish/100m, 0.04 fish/100m, and 0.04 fish/100m for the sturgeon, fish community and combined seasons, respectively. Although all three catch metrics are comparable to previous years, undulating patterns of catch rates, particularly regarding seasonal observations, make drawing any kind of conclusion or pattern difficult. Although catch rate stochasticity isn't as pronounced when looking at combined-season CPUE, no concrete temporal relationship has been established.

Trotline deployments throughout Segment 3 during the 2017 field season led to a CPUE of 0.08 fish/20 hooks for all three seasonal catch metrics. The CPUE observed was the lowest catch rate recorded since trotline was introduced into Segment 3 as a standard gear in 2010. Furthermore, the new record low witnessed seems to be part of a general downward trend in

trotline catch rates dating back as far as 2014. Although trotline has proved to be a formidable gear for sampling pallid sturgeon, it appears that neither trotlines or trammel nets as standalone gears provide 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 throughout Segment 3 during the 2017 sampling year averaged 424 mm in fork length and 369 grams in weight. Although average size has remained relatively comparable from year to year, it is of potential concern that a large portion of represented year classes are similar in average length. However, the lack of captures regarding larger hatchery origin fish (>700 mm) are not particularly alarming, given that they are more frequently encountered further downstream in Segment 4.

Shovelnose sturgeon, although not as abundant as in Segment 2, continued to be a common occurrence in Segment 3 during the 2017 field season, with 155 observations. They were captured while sampling with both trammel net (n=121) and trotline (n=34).

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. Trammel net CPUE was reported at 0.11 fish/100m, 0.35 fish/100m, and 0.23 fish/100m for sturgeon season, fish community season, and combined-season, respectively. While trotline CPUE for Segment 3 was reported for the following three seasonal metrics; 0.46 fish/20 hooks, 0.25 fish/20 hooks, and 0.35 fish/20 hooks for sturgeon season, fish community season, and combined-season, respectively. Like pallid sturgeon, catch rates for shovelnose sturgeon seem to have followed a similar pattern; comparable CPUE for trammel net and a down-trend for trotline. Again, although both gears are practical for catching shovelnose sturgeon, neither gears in or of themselves can depict the intricacies of the Missouri River.

The shovelnose sturgeon observed during the 2017 field season in Segment 3 averaged 552 mm in fork length and 711 g in weight. Although average length is not drastically different from Segment 2 to Segment 3 (~55 mm), it is evident that Segment 3 has a propensity to harbor a more complete population size structure. For example, even with the abandonment of the otter trawl, a higher proportion of shovelnose sturgeon under 400 mm were captured in Segment 3 (14%) than were observed in Segment 2 (1%).

Although never overly abundant, blue sucker captures were not well represented in Segment 3 sampling events during the 2017 field season. With the capture of one individual, as the result of a non-random trammel net drift, catch rates were 0.0 fish/100m for all three seasonal

metrics. It was the first time, since the Program's inception in 2006, that a blue sucker was not captured during random sampling events in Segment 3. However, even looking back at the highest total catch reported, dating back to 2009 (n=23), it is not overly alarming to see the lack of blue suckers represented in the catch data.

A total of 63 sauger were collected within Segment 3 during the 2017 sampling season. Like those results witnessed in Segment 2, a higher proportion (75%) of Segment 3 sauger observations came during sturgeon season, when compared to fish community season (25%). In relation to gear, all 63 individuals were captured via trammel net deployments, which led to trammel net CPUE reporting at 0.22 fish/100m, 0.06 fish/100m, and 0.14 fish/100m for the sturgeon, fish community, and combined seasons, respectively. All three seasonal catch metrics were down slightly from the levels observed in 2016, however, it is obvious that the trammel net remains the clear choice of gear to monitor sauger. The sauger captured during 2017 sampling events across Segment 3 averaged 358 mm in total length and 342 g in weight. With the loss of otter trawl and mini-fyke net as sampling gears, smaller age classes, including young of the year, were absent from 2016 and 2017 sampling.

With the suspension of the otter trawl and mini-fyke net as sampling gears, virtually all trend data for the small-bodied target species (sturgeon and sicklefin chubs, *Hybognathus* spp., and sand shiner) was lost for the 2016 and 2017 field season. As hatchery-reared pallid sturgeon shift to sub-adult and adult age classes, these small bodies fishes, as well as others, may become important, particularly to the lower sections of Segment 3.

Acknowledgments

We would like to thank the U.S. Army Corps of Engineers for providing funding to the Pallid Sturgeon Population Assessment Program, especially Tim Welker and George Williams for providing guidance to the work group. Our seasonal employees, Martin Etchemendy, Austin Gaffney, and Calvin Rezac for their countless hours in the field pulling gear as well as in the shop assuring boats were stocked and gear was kept in working order. We would like to thank Steve Dalbey for taking care of the much-needed business while we were out in the field. A special thanks to Pat Braaten of the U.S. Geological Survey for answering any type of questions regarding the Missouri River fish community. Thanks to Ryan Wilson et al. of the U.S. Fish and Wildlife Service for all of the collaboration between our offices.

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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		
<i>Ichthyomyzon castaneus</i>	Chestnut lamprey	CNLP
<i>Ichthyomyzon fossor</i>	Northern brook lamprey	NBLP
<i>Ichthyomyzon unicuspis</i>	Silver lamprey	SVLP
<i>Ichthyomyzon gagei</i>	Southern brook lamprey	SBLR
Petromyzontidae	Unidentified lamprey	ULY
Petromyzontidae larvae	Unidentified larval lamprey	LVLPL
CLASS OSTEICHTHYES – BONY FISHES		
ORDER ACIPENSERIFORMES		
Acipenseridae – sturgeons		
<i>Acipenser fulvescens</i>	Lake sturgeon	LKSG
<i>Scaphirhynchus</i> spp.	Unidentified Scaphirhynchus	USG
<i>Scaphirhynchus albus</i>	Pallid sturgeon	PDSG*
<i>Scaphirhynchus platyrhynchus</i>	Shovelnose sturgeon	SNSG*
<i>S. albus</i> X <i>S. platyrhynchus</i>	Pallid-shovelnose hybrid	SNPD
Polyodontidae – paddlefishes		
<i>Polyodon spathula</i>	Paddlefish	PDFH
ORDER LEPISTOSTEIFORMES		
Lepisosteidae – gars		
<i>Lepisosteus oculatus</i>	Spotted gar	STGR
<i>Lepisosteus osseus</i>	Longnose gar	LNGR
<i>Lepisosteus platostomus</i>	Shortnose gar	SNGR
ORDER AMMIFORMES		
Amiidae – bowfins		
<i>Amia calva</i>	Bowfin	BWFN
ORDER OSTEOGLOSSIFORMES		
Hiodontidae – mooneyes		
<i>Hiodon alosoides</i>	Goldeye	GDEY
<i>Hiodon tergisus</i>	Mooneye	MNEY
ORDER ANGUILLIFORMES		
Anguillidae – freshwater eels		
<i>Anguilla rostrata</i>	American eel	AMEL
ORDER CLUPEIFORMES		
Clupeidae – herrings		
<i>Alosa alabame</i>	Alabama shad	ALSD
<i>Alosa chrysochloris</i>	Skipjack herring	SJHR
<i>Alosa pseudoharengus</i>	Alewife	ALWF
<i>Dorosoma cepedianum</i>	Gizzard shad	GZSD
<i>Dorosoma petenense</i>	Threadfin shad	TFSD

Appendix A. (continued).

Scientific name	Common name	Letter Code
<i>D. cepedianum</i> X <i>D. petenense</i>	Gizzard-threadfin shad hybrid	GSTS
ORDER CYPRINIFORMES		
Cyprinidae – carps and minnows		
<i>Campostoma anomalum</i>	Central stoneroller	CLSR
<i>Campostoma oligolepis</i>	Largescale stoneroller	LSSR
<i>Carassius auratus</i>	Goldfish	GDFH
<i>Carassius auratus</i> X <i>Cyprinus carpio</i>	Goldfish-Common carp hybrid	GFCC
<i>Couesius plumbens</i>	Lake chub	LKCB
<i>Ctenopharyngodon idella</i>	Grass carp	GSCP
<i>Cyprinella lutrensis</i>	Red shiner	RDSN
<i>Cyprinella spiloptera</i>	Spotfin shiner	SFSN
<i>Cyprinus carpio</i>	Common carp	CARP
<i>Erimystax x-punctatus</i>	Gravel chub	GVCB
<i>Hybognathus argyritis</i>	Western slivery minnow	WSMN*
<i>Hybognathus hankinsoni</i>	Brassy minnow	BSMN
<i>Hybognathus nuchalis</i>	Mississippi silvery minnow	SVMW
<i>Hybognathus placitus</i>	Plains minnow	PNMW*
<i>Hybognathus</i> spp.	Unidentified <i>Hybognathus</i>	HBNS
<i>Hypophthalmichthys molitrix</i>	Silver carp	SVCP
<i>Hypophthalmichthys nobilis</i>	Bighead carp	BHCP
<i>Luxilus chrysocephalus</i>	Striped shiner	SPSN
<i>Luxilus cornutus</i>	Common shiner	CMSN
<i>Luxilus zonatus</i>	Bleeding shiner	BDSN
<i>Lythrurus unbratilis</i>	Western redbfin shiner	WRFS
<i>Macrhybopsis aestivalis</i>	Shoal chub	SKCB*
<i>Macrhybopsis gelida</i>	Sturgeon chub	SGCB*
<i>Macrhybopsis meeki</i>	Sicklefin chub	SFCB*
<i>Macrhybopsis storeriana</i>	Silver chub	SVCB
<i>M. aestivalis</i> X <i>M. gelida</i>	Shoal-Sturgeon chub hybrid	SPST
<i>M. gelida</i> X <i>M. meeki</i>	Sturgeon-Sicklefin chub hybrid	SCSC
<i>Macrhybopsis</i> spp.	Unidentified chub	UHY
<i>Margariscus margarita</i>	Pearl dace	PLDC
<i>Mylocheilus caurinus</i>	Peamouth	PEMT
<i>Nocomis biguttatus</i>	Hornyhead chub	HHCB
<i>Notemigonus crysoleucas</i>	Golden shiner	GDSN
<i>Notropis atherinoides</i>	Emerald shiner	ERSN
<i>Notropis blennioides</i>	River shiner	RVSN
<i>Notropis boops</i>	Bigeye shiner	BESN
<i>Notropis burchanani</i>	Ghost shiner	GTSN
<i>Notropis dorsalis</i>	Bigmouth shiner	BMSN
<i>Notropis greeni</i>	Wedgespot shiner	WSSN
Cyprinidae – carps and minnows		
<i>Notropis heterolepis</i>	Blacknose shiner	BNSN
<i>Notropis hudsonius</i>	Spottail shiner	STSN
<i>Notropis nubilus</i>	Ozark minnow	OZMW
<i>Notropis rubellus</i>	Rosyface shiner	RYSN
<i>Notropis shumardi</i>	Silverband shiner	SBSN
<i>Notropis stilbius</i>	Silverstripe shiner	SSPS
<i>Notropis stramineus</i>	Sand shiner	SNSN*
<i>Notropis topeka</i>	Topeka shiner	TPSN
<i>Notropis volucellus</i>	Mimic shiner	MMSN

Appendix A. (continued).

Scientific name	Common name	Letter Code
<i>Notropis wickliffi</i>	Channel shiner	CNSN
<i>Notropis</i> spp.	Unidentified shiner	UNO
<i>Opsopoeodus emiliae</i>	Pugnose minnow	PNMW
<i>Phenacobius mirabilis</i>	Suckermouth minnow	SMMW
<i>Phoxinus eos</i>	Northern redbelly dace	NRBD
<i>Phoxinus erythrogaster</i>	Southern redbelly dace	SRBD
<i>Phoxinus neogaeus</i>	Finescale dace	FSDC
<i>Pimephales notatus</i>	Bluntnose minnow	BNMW
<i>Pimephales promelas</i>	Fathead minnow	FHMW
<i>Pimephales vigilax</i>	Bullhead minnow	BHMW
<i>Platygobio gracilis</i>	Flathead chub	FHCB
<i>P. gracilis</i> X <i>M. meeki</i>	Flathead-sicklefin chub hybrid	FCSC
<i>Rhinichthys atratulus</i>	Blacknose dace	BNDC
<i>Rhinichthys cataractae</i>	Longnose dace	LNDC
<i>Richardsonius balteatus</i>	Redside shiner	RDSS
<i>Scardinius erythrophthalmus</i>	Rudd	RUDD
<i>Semotilus atromaculatus</i>	Creek chub	CKCB
	Unidentified Cyprinidae	UCY
	Unidentified Asian Carp	UAC
Catostomidae - suckers		
<i>Carpiodes carpio</i>	River carpsucker	RVCS
<i>Carpiodes cyprinus</i>	Quillback	QLBK
<i>Carpiodes velifer</i>	Highfin carpsucker	HFCS
<i>Carpiodes</i> spp.	Unidentified Carpiodes	UCS
<i>Catostomus catostomus</i>	Longnose sucker	LNSK
<i>Catostomus commersonii</i>	White sucker	WTSK
<i>Catostomus platyrhynchus</i>	Mountain sucker	MTSK
<i>Catostomus</i> spp.	Unidentified <i>Catostomus</i> spp.	UCA
<i>Cycleptus elongatus</i>	Blue sucker	BUSK*
<i>Hypentelium nigricans</i>	Northern hog sucker	NHSK
<i>Ictiobus bubalus</i>	Smallmouth buffalo	SMBF
<i>Ictiobus cyprinellus</i>	Bigmouth buffalo	BMBF
<i>Ictiobus niger</i>	Black buffalo	BKBF
<i>Ictiobus</i> spp.	Unidentified buffalo	UBF
<i>Minytrema melanops</i>	Spotted sucker	SPSK
<i>Moxostoma anisurum</i>	Silver redhorse	SVRH
<i>Moxostoma carinatum</i>	River redhorse	RVRH
<i>Moxostoma duquesnei</i>	Black redhorse	BKRH
<i>Moxostoma erythrurum</i>	Golden redhorse	GDRH
<i>Moxostoma macrolepidotum</i>	Shorthead redhorse	SHRH
<i>Moxostoma</i> spp.	Unidentified redhorse	URH
Catostomidae - suckers	Unidentified Catostomidae	UCT
ORDER SILURIFORMES		
Ictaluridae – bullhead catfishes		
<i>Ameiurus melas</i>	Black bullhead	BKBH
<i>Ameiurus natalis</i>	Yellow bullhead	YLBH
<i>Ameiurus nebulosus</i>	Brown bullhead	BRBH
<i>Ameiurus</i> spp.	Unidentified bullhead	UBH
<i>Ictalurus furcatus</i>	Blue catfish	BLCF

Appendix A. (continued).

Scientific name	Common name	Letter Code
<i>Ictalurus punctatus</i>	Channel catfish	CNCF
<i>I. furcatus</i> X <i>I. punctatus</i>	Blue-channel catfish hybrid	BCCC
<i>Ictalurus</i> spp.	Unidentified <i>Ictalurus</i> spp.	UCF
<i>Noturus exilis</i>	Slender madtom	SDMT
<i>Noturus flavus</i>	Stonecat	STCT
<i>Noturus gyrinus</i>	Tadpole madtom	TPMT
<i>Noturus nocturnus</i>	Freckled madtom	FKMT
<i>Pylodictis olivaris</i>	Flathead catfish	FHCF
ORDER SALMONIFORMES		
Esocidae - pikes		
<i>Esox americanus vermiculatus</i>	Grass pickerel	GSPK
<i>Esox lucius</i>	Northern pike	NTPK
<i>Esox masquinongy</i>	Muskellunge	MSKG
<i>E. lucius</i> X <i>E. masquinongy</i>	Tiger Muskellunge	TGMG
Umbridae - mudminnows		
<i>Umbra limi</i>	Central mudminnow	MDMN
Osmeridae - smelts		
<i>Osmerus mordax</i>	Rainbow smelt	RBST
Salmonidae - trouts		
<i>Coregonus artedii</i>	Lake herring or cisco	CSCO
<i>Coregonus clupeaformis</i>	Lake whitefish	LKWF
<i>Oncorhynchus aguabonita</i>	Golden trout	GDTT
<i>Oncorhynchus clarkii</i>	Cutthroat trout	CTTT
<i>Oncorhynchus kisutch</i>	Coho salmon	CHSM
<i>Oncorhynchus mykiss</i>	Rainbow trout	RBTT
<i>Oncorhynchus nerka</i>	Sockeye salmon	SESM
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	CNSM
<i>Prosopium cylindraceum</i>	Bonneville cisco	BVSC
<i>Prosopium williamsoni</i>	Mountain whitefish	MTWF
<i>Salmo trutta</i>	Brown trout	BNTT
<i>Salvelinus fontinalis</i>	Brook trout	BKTT
<i>Salvelinus namaycush</i>	Lake trout	LKTT
<i>Thymallus arcticus</i>	Arctic grayling	AMGL
ORDER PERCOPSIFORMES		
Percopsidae – trout-perches		
<i>Percopsis omiscomaycus</i>	Trout-perch	TTPH
ORDER GADIFORMES		
Gadidae - cods		
<i>Lota lota</i>	Burbot	BRBT
ORDER ATHERINIFORMES		
Cyprinodontidae - killifishes		
<i>Fundulus catenatus</i>	Northern studfish	NTSF
<i>Fundulus diaphanus</i>	Banded killifish	BDKF
<i>Fundulus notatus</i>	Blackstripe topminnow	BSTM
<i>Fundulus olivaceus</i>	Blackspotted topminnow	BPTM
<i>Fundulus sciadicus</i>	Plains topminnow	PTMW

Appendix A. (continued).

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

Appendix A. (continued).

Scientific name	Common name	Letter Code
<i>Etheostoma blennioides</i>	Greenside darter	GSDR
<i>Etheostoma caeruleum</i>	Rainbow darter	RBDR
<i>Etheostoma exile</i>	Iowa darter	IODR
<i>Etheostoma flabellare</i>	Fantail darter	FTDR
<i>Etheostoma gracile</i>	Slough darter	SLDR
<i>Etheostoma microperca</i>	Least darter	LTDR
<i>Etheostoma nigrum</i>	Johnny darter	JYDR
<i>Etheostoma punctulatum</i>	Stippled darter	STPD
<i>Etheostoma spectabile</i>	Orange throated darter	OTDR
<i>Etheostoma tetrazonum</i>	Missouri saddled darter	MSDR
<i>Etheostoma zonale</i>	Banded darter	BDDR
<i>Etheostoma</i> spp.	Unidentified <i>Etheostoma</i> spp.	UET
<i>Perca flavescens</i>	Yellow perch	YWPH
<i>Percina caprodes</i>	Logperch	LGPH
<i>Percina cymatotaenia</i>	Bluestripe darter	BTDR
<i>Percina evides</i>	Gilt darter	GLDR
<i>Percina maculata</i>	Blackside darter	BSDR
<i>Percina phoxocephala</i>	Slenderhead darter	SHDR
<i>Percina shumardi</i>	River darter	RRDR
<i>Percina</i> spp.	Unidentified <i>Percina</i> spp.	UPN
	Unidentified darter	UDR
<i>Sander canadense</i>	Sauger	SGER*
<i>Sander vitreus</i>	Walleye	WLEY
<i>S. canadense</i> X <i>S. vitreus</i>	Sauger-walleye hybrid/Saugeye	SGWE
<i>Sander</i> spp.	Unidentified <i>Sander</i> (formerly <i>Stizostedion</i>) spp.	UST
	Unidentified Percidae	UPC
Sciaenidae - drums		
<i>Aplodinotus grunniens</i>	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	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 3 of the Missouri River (RPMA 2)

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
2003	Wolf Point	926	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
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	Elastomer
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		
2005	Milk River	845	2005	10/13/2005	Advanced Fingerling	CWT	Elastomer

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking ^a	Primary Mark	Secondary Mark
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	
2006	Wolf Point	1553	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	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
2008	Culbertson	643	2007	3/26/2008	Yearling	Elastomer	

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking ^a	Primary Mark	Secondary Mark
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	
2009	Forsyth	5386	2009	9/23/2009	Fingerling	Elastomer	

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking ^a	Primary Mark	Secondary Mark
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
2011	Intake	510	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	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
2016	Mouth of Milk	697,388	2016	6/27/2016	Free Embryo		
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 2017. 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.

species	Total Catch	Overall CPUE	CHXO	ISB	OSB
			CHNB	CHNB	CHNB
BMBF	2	0.004	0.004	0.006	0
		0.005	0.009	0.012	0
BRBT	3	0.006	0.009	0.006	0
		0.006	0.012	0.012	0
CARP	6	0.017	0.043	0	0
		0.015	0.037	0	0
CNCF	33	0.072	0.11	0.043	0.053
		0.032	0.06	0.041	0.06
FHCB	28	0.06	0.06	0.086	0.025
		0.03	0.033	0.075	0.035
FWDM	0	0	0	0	0
		0	0	0	0
GDEY	77	0.18	0.185	0.165	0.192
		0.052	0.076	0.083	0.124
LKWF	2	0.005	0.007	0.006	0
		0.007	0.014	0.012	0
NTPK	2	0.005	0.004	0.01	0
		0.008	0.009	0.021	0

species	Total Catch	Overall CPUE	CHXO	ISB	OSB
			CHNB	CHNB	CHNB
PDSG	14	0.036	0.036	0.054	0.014
		0.023	0.037	0.048	0.029
RVCS	11	0.028	0.009	0.044	0.036
		0.018	0.012	0.04	0.043
SGER	58	0.141	0.139	0.203	0.062
		0.047	0.079	0.092	0.049
SHRH	24	0.053	0.028	0.089	0.044
		0.028	0.026	0.067	0.048
SMBF	2	0.005	0	0.008	0.009
		0.007	0	0.015	0.018
SNSG	112	0.269	0.28	0.281	0.237
		0.077	0.149	0.115	0.116
STCT	0	0	0	0	0
		0	0	0	0
UCA	1	0.002	0	0	0.007
		0.004	0	0	0.015
WLYE	26	0.085	0.114	0.09	0.034
		0.043	0.09	0.065	0.033

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 2017.

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 2017.

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	1	0.01	0.029	0	0	0
		0.021	0.057	0	0	0
CARP	4	0.042	0.029	0.091	0	0
		0.041	0.057	0.102	0	0
CNCF	56	0.583	0.486	0.788	0.409	0.667
		0.182	0.237	0.424	0.252	0.422
FHCB	7	0.073	0.086	0.03	0.091	0.167
		0.053	0.096	0.061	0.125	0.333
FWDM	4	0.042	0.029	0.061	0.045	0
		0.041	0.057	0.084	0.091	0
GDEY	51	0.531	0.6	0.364	0.545	1
		0.185	0.298	0.286	0.451	0.73
LKWF	0	0	0	0	0	0
		0	0	0	0	0
NTPK	2	0.021	0.029	0.03	0	0
		0.029	0.057	0.061	0	0

species	Total Catch	Overall CPUE	CHXO	ISB	OSB	SCCL
			CHNB	CHNB	CHNB	CHNB
PDSG	8	0.083	0.143	0.03	0.045	0.167
		0.057	0.12	0.061	0.091	0.333
RVCS	0	0	0	0	0	0
		0	0	0	0	0
SGER	0	0	0	0	0	0
		0	0	0	0	0
SHRH	8	0.083	0.114	0.091	0.045	0
		0.064	0.136	0.102	0.091	0
SMBF	0	0	0	0	0	0
		0	0	0	0	0
SNSG	34	0.354	0.343	0.212	0.5	0.667
		0.151	0.245	0.169	0.451	0.422
STCT	1	0.01	0	0.03	0	0
		0.021	0	0.061	0	0
UCA	0	0	0	0	0	0
		0	0	0	0	0
WLYE	2	0.021	0.057	0	0	0
		0.029	0.08	0	0	0

Appendix G. Hatchery names, locations and abbreviations.

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

Appendix H. Alphabetic list of Missouri River fishes with total catch per unit effort by gear type for the sturgeon season and the fish community season during 2017 for Segment 3 of the Missouri River. Species codes are located in Appendix A. Asterisks and 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	0.004	0.003	0.000
BRBT	0.000	0.011	0.010
CARP	0.012	0.022	0.042
CNCF	0.057	0.088	0.583
FHCB	0.049	0.070	0.073
FWDM	0.000	0.000	0.042
GDEY	0.182	0.178	0.531
LKWF	0.000	0.010	0.000
NTPK	0.011	0.000	0.021
PDSG	0.028	0.044	0.083
RVCS	0.035	0.021	0.000
SGER	0.223	0.059	0.000
SHRH	0.038	0.067	0.083
SMBF	0.000	0.010	0.000
SNSG	0.138	0.399	0.354
STCT	0.000	0.000	0.010

	Sturgeon Season	Fish Community Season	Both Seasons
species	1.0" Trammel Net	1.0" Trammel Net	Trotline
WLYE	0.155	0.015	0.021

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 - 2017.

Bend Number	Bend River Mile	Coordinates*		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
		Latitude	Longitude												
1	1701.5	48.06744	105.5325						ST, FC				ST, FC		
2	1700	48.07314	105.523							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										
11	1687.5	48.0797	105.3033						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				
19	1675.5	48.09255	105.1727			ST, FC									
20	1674	48.07865	105.1669			ST, FC			ST, FC						
21	1672.5	48.07616	105.1239					ST, FC							
22	1671	48.07116	105.1064							ST, FC				ST	

		Coordinates*													
Bend Number	Bend River Mile	Latitude	Longitude	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
23	1670	48.06138	105.1035									ST, FC	ST, FC	ST, FC	
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			
42	1646	48.12876	104.8575				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

		<u>Coordinates*</u>													
Bend Number	Bend River Mile	Latitude	Longitude	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
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									
49	1637.5	48.12048	104.7044					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	
63	1622	48.11476	104.4969									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			
67	1617.5	48.09658	104.4437		ST, FC	ST, FC		ST, FC			ST, FC				
68	1616.5	48.08134	104.4154	ST, FC											
69	1615	48.07642	104.3929		ST, FC					ST, FC			ST, FC		
70	1613.5	48.07464	104.373			ST, FC									

		Coordinates*													
Bend Number	Bend River Mile	Latitude	Longitude	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
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			
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			
77	1603	48.0441	104.1978			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	
88	1588.5	48.00281	104.07059											ST, FC	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			