2006 Annual Report

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

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

Segment 3 of the Missouri River extends from river mile 1701 near Wolf Point, MT downstream to the confluence of the Yellowstone River at river mile 1582 in North Dakota. This was the first year segment 3 was sampled in accordance with the Population Assessment program. Twelve randomly selected river bends were sampled during both the sturgeon (spring) and fish community (summer and fall) seasons. Standard gears included otter trawls and trammel nets, which were used in both seasons, while mini fyke nets and the beam trawl were utilized during the fish community season. Additionally, "wild" bag seines were used in segment 3 within 4 of the 12 randomly selected bends. Additional "wild" sampling took place in non-randomly selected bends within segment 3 during 2006.

A total of 49 pallid sturgeon *Scaphirhynchus albus* were captured in segment 3 during the 2006 field season. One pallid sturgeon was of unknown origin, while the remaining 48 were of verified hatchery origin. Of the total, 14 and 35 pallid sturgeon were sampled during the sturgeon and fish community seasons, respectively. More pallid sturgeon were captured in the downstream river bends of segment 3 when compared to upstream bends. No adult or YOY pallid sturgeon were sampled in segment 3 during standard sampling during 2006. A total of five age classes of hatchery reared pallid sturgeon were sampled, with the 2005 year class making up the majority (85.4%).

The otter trawl was the most effective gear for sampling pallid sturgeon during the spring in the sturgeon season, while trammel nets were most effective during the summer and fall, fish community season. One pallid sturgeon was captured in each of the bag seine and beam trawl, while none were captured in mini fyke nets.

A total of 150 shovelnose sturgeon *Scaphirhynchus platorynchus* were sampled in segment 3 during 2006, resulting in a shovelnose to pallid sturgeon ratio of 1:3.06. Trammel nets caught more shovelnose sturgeon than any other gear. On average the otter trawl sampled smaller shovelnose sturgeon when compared to trammel nets. However, no YOY or age-1 shovelnose sturgeon were sampled in segment 3 during 2006.

Very few (N = 4) blue suckers *Cycleptus elongatus* were sampled in segment 3. All blue suckers were ≥ 650 mm, indicating only old individuals were present. Various age classes of saugers *Sander canadense* were present in segment 3, including YOY and age-1 saugers.

Saugers were sampled in various gears, with a total of 125 sampled. A total of 148 western silvery minnows *Hybognathus argyritis* were sampled in various gears, with the majority sampled in shallow water sand bar habitats. No plains minnows *Hybognathus placitus* were sampled in segment 3 during 2006.

The most common target species was the sand shiner, with 1,650 sampled. Similar to the western silvery minnow, the majority of sand shiners were sampled in shallow water sand bar habitats with mini fyke nets and bag seines.

A total of 598 sturgeon chubs were sampled, with the majority being captured in the otter trawl. Sturgeon chubs were more abundant in the middle and lower river bends of segment 3. Similarly, sicklefin chubs were most abundant in the middle and lower bends of segment 3 and absent above river mile 1683. A total of 122 sicklefin chubs were sampled, with the majority (89.3%) being captured in otter trawls. No speckled chubs were sampled in segment 3 during 2006.

In all, 17,180 fish consisting of 31 species were sampled in segment 3 during 2006. Considerably more fish were sampled during the fish community season (N = 16,477) when compared to the sturgeon season (N = 703). More species were collected in mini fyke nets (N = 21) and bag seines (N = 21) than otter trawls (N = 19), trammel nets (N = 16), or beam trawls (N = 14).

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Introduction

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

The Pallid Sturgeon Population Assessment Program (program) is guided by the RPA's in the 2003 Amendment to the 2000 Biological Opinion. The program is a comprehensive monitoring plan designed to assess survival, movement, distribution, habitat use, and physical characteristics of these habitats used by wild and hatchery reared juvenile pallid sturgeon (Drobish 2006). 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 (Drobish 2006). 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 and otter trawl are standard gears used in segments 1-4 during sturgeon season, and appear to be an effective method to sample pallid sturgeon.

The fish community season extends from the beginning of July till the end of October 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. Additionally, during 2006 bag seines and beam trawls were used on half of the combined bends in segments 2 and 3. This effort will provide a data that is more comparable to data collected by past researchers and particularly data from the Benthic Fishes Study.

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 pallids sturgeon diet 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 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 less flow regulated than upstream segments due to the upstream 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 sediment load, 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 highly dynamic stretch of river is more reminiscent of what the Missouri River looked like before it became one of the most regulated and impounded rivers in the United States (Galat et al, 2005).

Methods

Sampling methods for the Pallid Sturgeon Population Assessment Program were conducted in accordance with the Standard Operating Procedures (Drobish 2006), 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 Drobish (2006). A general description of those 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). Segment 3 consisted of twelve randomly selected bends. All 12 bends were sampled during both the sturgeon season (November through June) and the Fish Community Season (July through October).

Two gears, trammel net and otter trawl were considered standard gears for both the sturgeon and fish community seasons. The trammel net was used in all 12 randomly selected bends during both seasons, while the otter trawl was used in the 12 and 11 randomly selected bends during the sturgeon and fish community seasons, respectively. Additionally, mini fyke nets and the beam trawl were also considered standard gears for the fish community season. All 12 randomly selected bends were sampled with mini fyke nets during the fish community season. However, due to time constraints and the evaluation of the bag seine, we randomly selected half of the 24 bends in segments 2 and 3 combined for beam trawling and half to be sampled with the bag seine. Consequently, during the fish community season, eight bends in segment 3 were randomly sampled with the beam trawl and four were randomly sampled with the bag seine.

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 Drobish (2006).

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.

Bag Seine

The bag seine is 9.1m long by 1.8m high with a bag of 1.8 m wide x 1.8 m high x 1.8m deep. The seine is made of 6.4 mm “ace” mesh and has a 29.5kg lead line attached to the bottom. A mud line was also attached to the bottom to facilitate seining silty or muddy bottoms. The bag seine was used in bar mesohabitats. Seines were pulled either in a downstream or upstream direction using a quarter arc, half arc, or rectangular method.

Beam Trawl

The standard beam trawl has a width of 2 m, a height of 0.5 m and a length of 5.5 m. The inner mesh size is 3.18 mm and outer mesh size of 38.1 mm and a cod end opening of 165.0 mm. The bottom of the mouth of the trawl has a 9.53 mm tickler chain attached. The beam trawl is attached to a steel frame with two steel skids to help in dragging the bottom The beam trawl is deployed over the bow of the boat and was towed parallel to the current in downstream direction for a minimum of 75 m with a maximum distance of 300 m.

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 and bag seine samples (middle of the seine). All GPS locations were taken using a Garmin GPS 76 unit with Wide Area Augmentation System (WAAS) capability.

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. A wading rod was also used to take two depths for bag seine hauls (midpoint between shore and the outer width of the seine and one at full extended width of the haul at the midpoint of the seine haul length).

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.

Substrate was determined for habitats > 1.2 m in depth using a Hesse style substrate sampler. For habitats < 1.2 m in depth, a random hand grab was made. Substrate samples were reported as the percentage of sand, silt, gravel in each sample. In addition, the amount of cobble and organic material was qualitatively determined.

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

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

Genetic Verification

Genetic verification for pallid sturgeon or potential hybrids followed the methods outlined in Drobish (2006). Two fin pectoral fin clips (~ 2 cm^2) are taken from any pallid sturgeon of unknown origin. Fin samples are then preserved in 95% non-denatured alcohol for genetic analysis. All samples are sent to the U.S. Fish and Wildlife Service's Abernathy Fish Technology Center for analysis and archiving.

Relative Condition

Relative condition (Kn) for all sampled pallid sturgeon was calculated using the following formula: Kn = W / W', where W is the fork length of the specimen and W' is the length-specific mean weight predicted by the weight-length relationship equation calculated for that population. Since no weight length-relationship exists for the hatchery reared pallid sturgeon population in segment 2, we used the weight-length relationship [$\log_{10} W = -6.378 + 3.357 \log_{10} L$ ($r^2 = 0.9740$)] derived by Keenlyne and Evanson (1993) for pallid sturgeon throughout their range.

Incremental Stock Density

Incremental stock density (RSD) was used to describe the size structure of pallid and shovelnose sturgeon sampled in segment 2. We used the length categories proposed by Shuman et al. (2006) for pallid sturgeon and Quist et al. (1998) for shovelnose sturgeon. 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 RSD.

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. Cathc-per-unit-effort was both stratified by season and combined, 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.

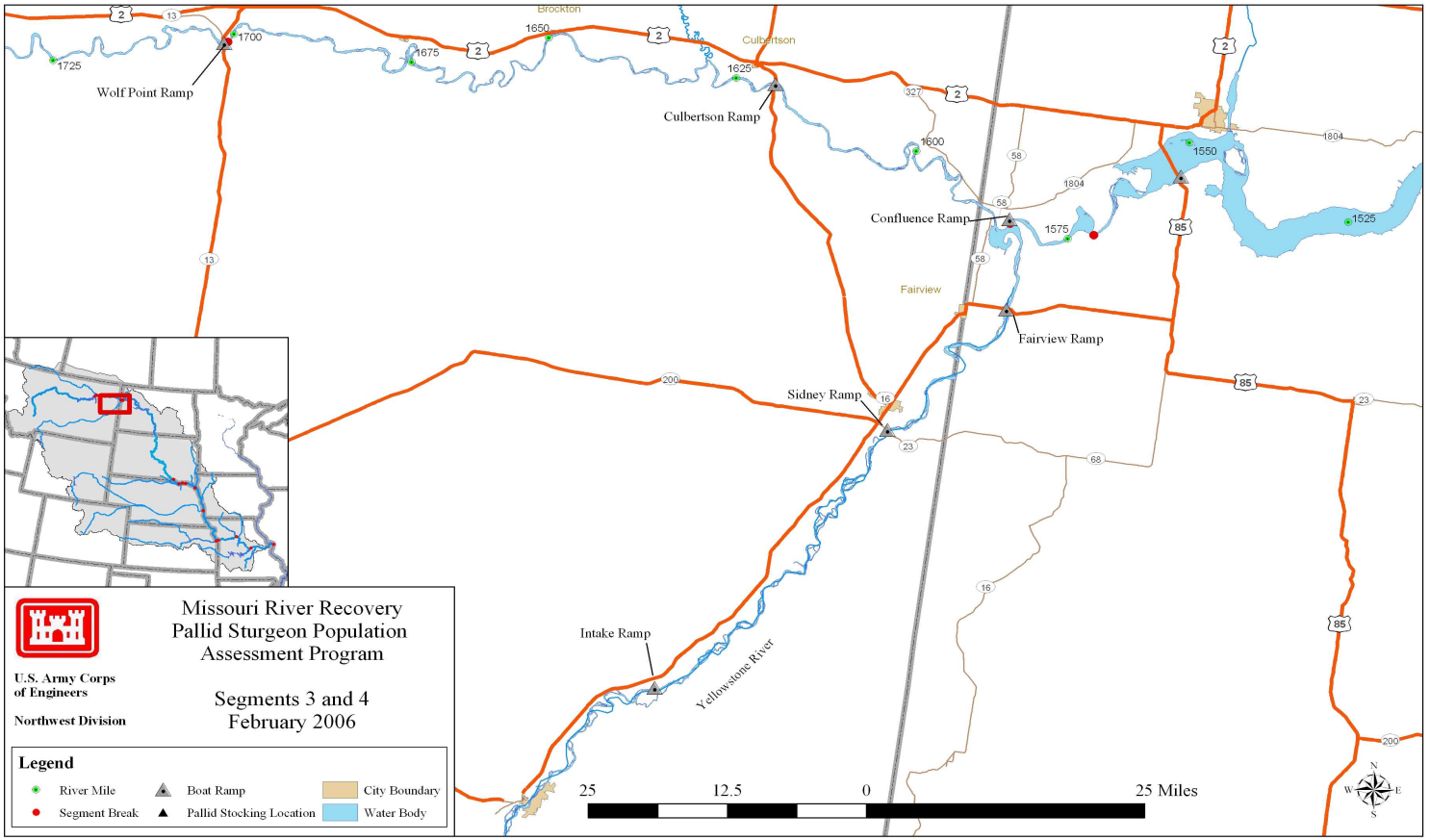

Figure 1a. Map of segment 3 of the Missouri River with major tributaries, common landmarks, and historic stocking locations for pallid sturgeon. Segment 3 encompasses the Missouri River from Wolf Point, MT (River Mile 1701.0) to the confluence with the Yellowstone River (River Mile 1582.0).

Results

Pallid Sturgeon

Forty-nine pallid sturgeon were captured in segment 3 during the 2006 field season (Figure 1b). One pallid sturgeon was of unknown origin, while the remaining 48 were of verified hatchery origin. The one unknown origin pallid sturgeon was the smallest (116 mm fork length (FL)) sampled during 2006. Genetics were taken this pallid sturgeon and the results are not currently available. Of the total, 14 and 35 pallid sturgeon were sampled during the sturgeon and fish community seasons, respectively. Pallid sturgeon were captured throughout much of segment 3 with one exception. No pallid sturgeon were captured between river mile 1639 to 1679. However, only two river bends within that area were sampled. More pallid sturgeon were captured in the downstream sections of segment 3 when compared to upstream sections (Figure 1b). The highest abundance of pallid sturgeon occurred in river mile 1607, where 13 pallid sturgeon were captured (sturgeon season N= 4; fish community season N = 9).

A limited size distribution of pallid sturgeon was observed in segment 3 during 2006 (Figure 8). No pallid sturgeon > 370 mm and only 2 < 145 mm FL were observed. Since sturgeon smaller than 160 mm FL were stocked in May in segment 3, we saw no signs of natural recruitment in the segment during 2006. However, genetic verification for the one unknown pallid captured is needed to verify whether it is of hatchery or wild origin.

The average size of pallid sturgeon was smaller during sturgeon season (mean FL = 190 mm) than during the fish community season (mean FL = 270 mm). The incremental relative stock categories in Table 7 show the difference in size classes captured during both seasons. During the sturgeon season 10 pallid sturgeon were in the smaller sub-stock category of 0-199 mm FL, while 4 were in the larger sub-stock category of 200 to 329 mm FL. Stock sized or larger pallid sturgeon were not captured during the sturgeon season. The size of pallid sturgeon shifted during the fish community season, with 32 falling in the larger sub-stock category and 3 falling in the stock (330-629 mm FL) category. This shift in the sizes of pallid sturgeon sampled between the two sampling seasons is likely due to two things. First, pallid sturgeon captured during the sturgeon season likely grew throughout the

spring and summer months putting them into larger size classes during fish community season. Secondly, pallid sturgeon stocked during July were on average larger than fish stocked during May and six of those fish were captured during the fish community season.

Growth rates for recaptured pallid sturgeon with adequate stocking information are shown in Table 6. The highest growth rates (0.44 mm/day) were seen in the 2005 year class fish stocked in 2006. Pallid sturgeon stocked in 2003 and 2002 showed growth rates of 0.10 and 0.12 mm/day. Pallid sturgeon relative condition (Kn) ranged from 1.09 (2005 year class) to 0.62 (2002 year class) (Table 6). The number of pallid sturgeon captured by year class was as follows: 2005: N = 41, 2004: N = 2, 2003: N = 3, 2002: N = 2, 2001: N = 1.

Pallid sturgeon were captured at both random (N = 36) and non-random (Wild) (N = 13) bends. Furthermore, only 15 pallid sturgeon were captured in random subsamples, while 34 were captured in duplicate (non-random) subsamples. Additionally, of the 13 pallid sturgeon sampled in randomly selected bends, only 11 were sampled in random subsamples.

During the sturgeon season, otter trawls were most effective in sampling pallid sturgeon with a catch-per-unit-effort (CPUE) of 0.028 fish/100m (not including the one pallid sturgeon of unknown origin), when compared to trammel nets (CPUE = 0.007 fish/100m). Conversely, during the fish community season trammel nets had a higher CPUE (0.069) than otter trawls (0.021 fish/100m). One pallid sturgeon was captured using the beam trawl, which correlated to a CPUE of 0.004 fish/100m. No pallid sturgeon were captured in mini-fyke nets in segment 3. Surprisingly, one pallid sturgeon was captured in a bag seine in river mile 1701.5, just 0.5 river miles away from the Wolf Point stocking location.

The macro- and meso-habitats that pallid sturgeon were captured by season and size class can be found in Tables 9 through 16. For the smaller sub-stock size (0-199 mm FL) pallid sturgeon sampled during the sturgeon season, 56% were sampled in inside bends, 11% in outside bends and 33% in small-connected side channels. All were captured in channel border mesohabitats. During the sturgeon season, of the larger sub-stock sized (200-329 mm FL) pallid sturgeon, three were sampled in inside bends and one in outside bends. For the fish community season, 82% of the larger sub-stock sized pallid sturgeon that were captured with trammel nets were sampled in small connected side channels, even though this macrohabitat made up only 13% of the macro habitats sampled. Conversely, the otter trawl captured 75% (N = 6) of the larger substock sized pallids during fish community season in

inside bends, although they made up only 36% of the macro habitats sampled. All of the larger sub-stock sized pallid sturgeon were captured in channel border mesohabitats.

Three stock sized (330-629 mm FL) pallid sturgeon were collected during the fish community season. One was captured in each of an outside bend, inside bend and channel crossover. Two of the three were sampled in channel border mesohabitats and one was captured within an island tip mesohabitat.

Water temperature ranged between 5.2 and 23.0 ^{o}C for pallid captures (Table 3). Turbidity ranged between 14 and 384 NTU's. The average depth for pallid captures per habitat type ranged from 1.3 to 1.5 m, with a minimum sample depth of 0.5 m and maximum of 2.7 m.

Since 2006 was the first year of Population Assessment sampling in segment 3, no comparisons between years were made, however Figure 9 shows the total number of pallid sturgeon sampled by origin. Additionally, no pallid x shovelnose sturgeon hybrids were found in segment 3 during 2006.

Table 1. Number of bends sampled, mean effort per bend (mean number of deployments), and total effort by macrohabitat (total number of deployments) for segment 3 on the Missouri River during fall through spring (sturgeon season) and summer (fish community season) in 2006. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	Number of Bends	Mean Effort	Macrohabitat													
			BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Fall through Spring - Sturgeon Season																
1 Inch Trammel Net	12	9.42		29				35	30	19						
2.5 Inch Trammel Net																
Beam Trawl																
Gill Net																
Otter Trawl	12	10.33		29				41	32	22						
Summer – Fish Community Season																
1 Inch Trammel Net	12	9.42		31				34	32	16						
Beam Trawl	8	9.50		21				24	21	8	2					
Mini-Fyke Net	12	6.92		7				30	5	14	22	5				
Otter Trawl	11	9.82		28				38	28	14						

Table 2. Number of bends sampled, mean effort per bend (mean number of deployments), and total effort by mesohabitat (total number of deployments) for segment 3 on the Missouri River during fall through spring (sturgeon season) and summer (fish community season) in 2006. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	Number of bends	Mean Effort	**Mesohabitat**				
			BAR	POOL	CHNB	TLWG	ITIP
Fall through Spring – Sturgeon Season							
1 Inch Trammel Net	12	9.42			102		11
Otter Trawl	12	10.33			114		10
Summer – Fish Community Season							
1 Inch Trammel Net	12	9.42			109		4
Beam Trawl	8	9.50			73		3
Mini-Fyke Net	12	6.92	77		1		
Otter Trawl	11	9.82			100		8

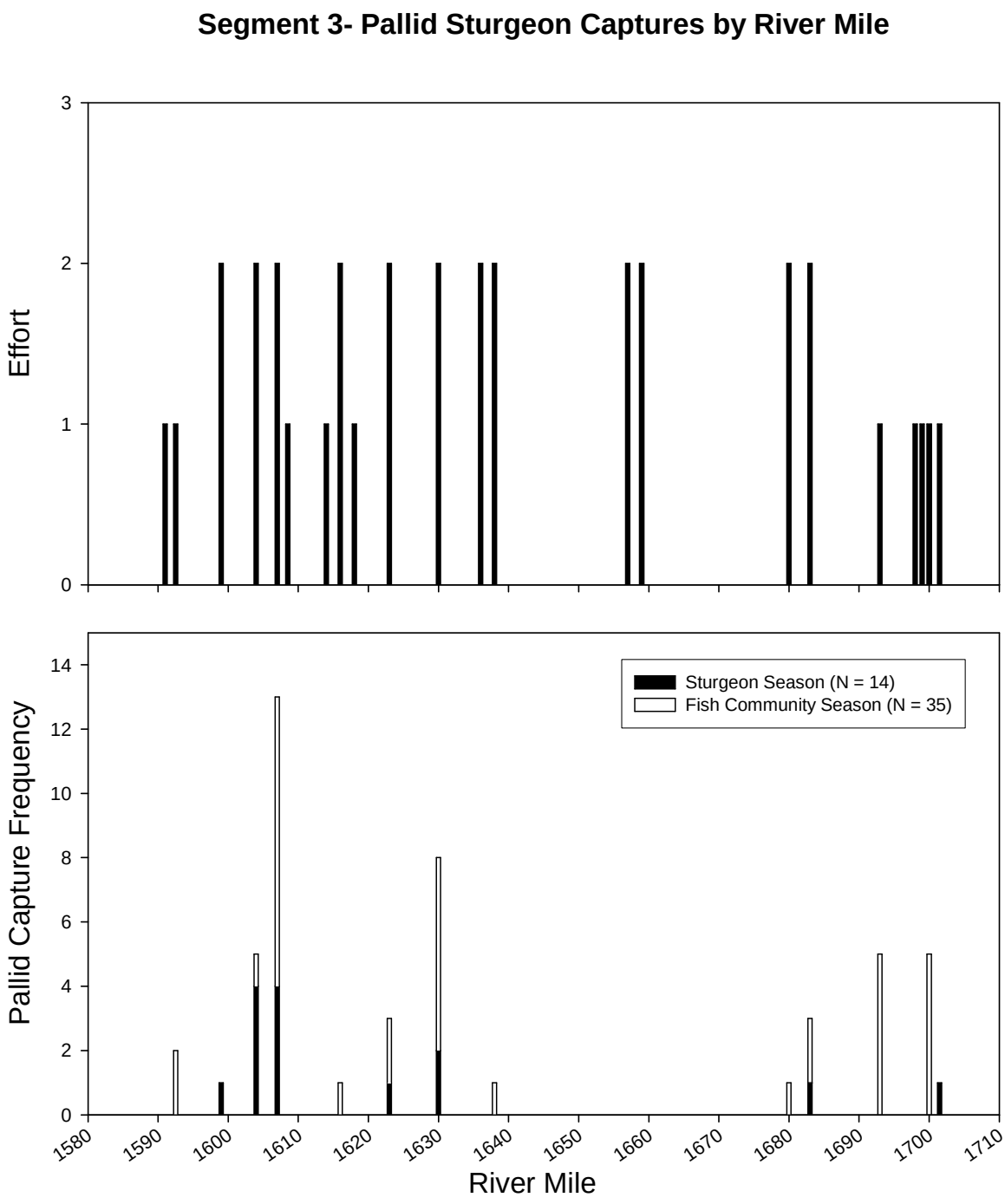

Figure 1b. Distribution of: A) seasonal sampling effort and B) pallid sturgeon captures by river mile for segment 3 of the Missouri River during 2006. Sampling effort of 2 indicates bend sampled in both sturgeon and fish community seasons. Sampling effort of 1 indicates bend was sampled in only one season. Black bars represent pallid captures during Sturgeon Season and white bars during Fish Community Season. Figure includes all pallid captures including non-random and wild samples.

Table 3. Pallid sturgeon (PDSG) capture summaries for all gears relative to habitat type and environmental variables on the Missouri River during 2006. Means (minimum and maximum) are presented. Habitat definitions and codes presented in Appendix B. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Macro-	Meso-	Depth (m) (Effort)	Depth (m) (Catch)	Bottom Velocity (m/s) (Effort)	Bottom Velocity (m/s) (Catch)	Temp. ℃ (Effort)	Temp. ℃ (Catch)	Turbidity (ntu) (Effort)	Turbidity (ntu) (Catch)	Total Pallids caught
CHXO	BAR	0.4 (0.1-0.8)		0.12 (0-0.27)		7.9 (4.3-12.5)		65 (21-134)		0
	CHNB	2.0 (0.2-7.4)	1.4 (1.2-1.8)	0.63 (0.24-0.94)	0.6 (0.44-0.67)	17.6 (4.3-23)	19.0 (13.6-22.8)	58 (14-383)	154 (33-383)	4
ISB	BAR	0.4 (0.1-1.2)		0.1 (0-0.28)		17.0 (4.3-23.1)		50 (13-313)		0
	CHNB	1.6 (0.5-6)	1.4 (0.5-2.7)	0.6 (0.25-0.82)	0.59 (0.39-0.8)	17.7 (4.3-23.1)	16.5 (5.2-22.8)	63 (14-402)	99 (14-384)	24
OSB	BAR	0.4 (0.3-0.5)		0.04 (0.01-0.06)		12.6 (7.0-19.0)		34 (16-49)		0
	CHNB	2.1 (0.5-12.3)	1.5 (1-2)	0.63 (0.23-0.88)	0.70 (0.66-0.73)	17.8 (4.3-23.5)	17.2 (14.5-20.0)	56 (14-383)	37 (25-55)	3
SCCL	BAR	0.4 (0.2-0.7)		0.07 (0-0.21)		18.3 (4.3-23.8)		29 (14-52)		0
	CHNB	1.5 (0.5-3.3)	1.3 (1-2.5)	0.61 (0.41-0.75)	0.53 (0.47-0.64)	15.9 (4.3-23.2)	11.8 (9.7-18.1)	33 (17-80)	40	12
	TLWG	1.4 (1.1-1.9)	1.5 (1.4-1.5)	0.44	0.44	20.5 (20.1-20.9)	20.2 (20.1-20.5)	16	16	4
	ITIP	1.7 (0.7-6.5)	1.3 (0.9-1.7)	0.54 (0.26-0.79)	0.54	18.5 (7.5-23.1)	19.2 (15.4-23)	55 (31-150)	76 (33-120)	2
SCCS	BAR	0.4 (0.2-0.7)		0.07 (0-0.25)		16.2 (4.4-21.5)		51 (8-333)		0
	CHNB	1.9				22.1				0
	ITIP	2.0		0.45		22.1		25		0
SCN	-	0.5 (0.4-0.6)		0		22 (20-24)		49 (22-86)		

Table 6. Mean fork length, weight, relative condition factor (Kn), and growth rates for hatchery-reared pallid sturgeon captures by year class at the time of stocking and recapture during 2006 from segment 3 of the Missouri River. Relative condition factor was calculated using the equation in Keenlyne and Evanson (1993). Standard error (+/- 2SE) was calculated where N>1 and is represented on second line of each year.

Year class	N	Stock Data			Recapture Data			Growth Data	
		Length (mm)	Weight (g)	Kn	Length (mm)	Weight (g)	Kn	Length (mm/d)	Weight (g/d)
2001									
2002	2	212			346	79.0	0.62	0.12	
		43			47	42.0	0.57	0.004	
2003	3	248	75	1.49	318	100.7	0.95	0.1	
		14			7	19.6	0.13	0.005	
2004	1				261	58	1.07		
2005	28	255	46.5	1.22	235	47.4	1.09	0.44	-0.08
		16	5.2	0.06	22	11.1	0.08	0.09	0.31
2006									

Table 7. Incremental relative stock density (RSD)[a] and relative condition factor (Kn) for all pallid sturgeon captured with all gears by a length category during 2006 in segment 3 of the Missouri River. Length categories[b] determined using the methods proposed by Shuman et al. (2006). Relative condition factor was calculated using the equation in Keenlyne and Evanson (1993).

Length Category	N	RSD	Kn (2SE)
	Sturgeon Season		
Sub-stock (0-199)	10	--	1.40 (0.12)
Sub-stock (200-329)	4	--	0.90 (0.03)
Stock			
Quality			
Preferred			
Memorable			
Trophy			
Overall Kn	14		1.25 (0.16)
	Fish Community Season		
Sub-stock (0-199)			
Sub-stock (200-329)	32	--	0.98 (0.04)
Stock	3	--	0.67 (0.34)
Quality			
Preferred			
Memorable			
Trophy			
Overall Kn	35		0.95 (0.06)

[a] RSD = (# of fish of a specified length class / # of fish ≥ minimum stock length fish) * 100.
[b] Length categories based on the percentage of the largest known pallid sturgeon: Sub-stock FL < 330 mm (20 %), Stock FL =330 - 629 mm (20 – 36 %), Quality FL = 630 – 839 mm (36 – 45 %), Preferred FL = 840 – 1039 mm (45 – 59 %), Memorable FL = 1040 – 1269 mm (59 – 74 %), Trophy FL > 1270 mm (>74 %).

Segment 3 - Pallid Sturgeon / Sturgeon Season

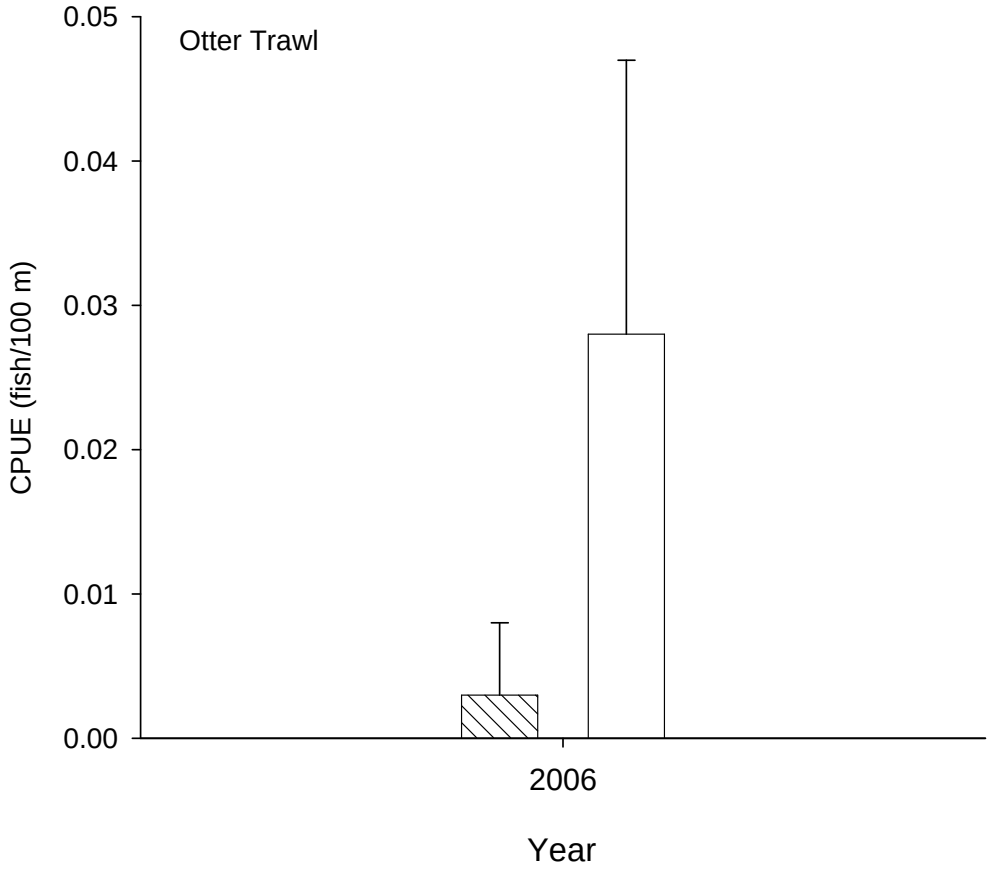

Figure 2. Mean annual catch-per-unit-effort (+/- 2 SE) of unkown origin (diagonol bars) and hatchery reared (white bars) pallid sturgeon using otter trawls in segment 3 of the Missouri River during sturgeon season 2006.

Segment 3 - Pallid Sturgeon / Sturgeon Season

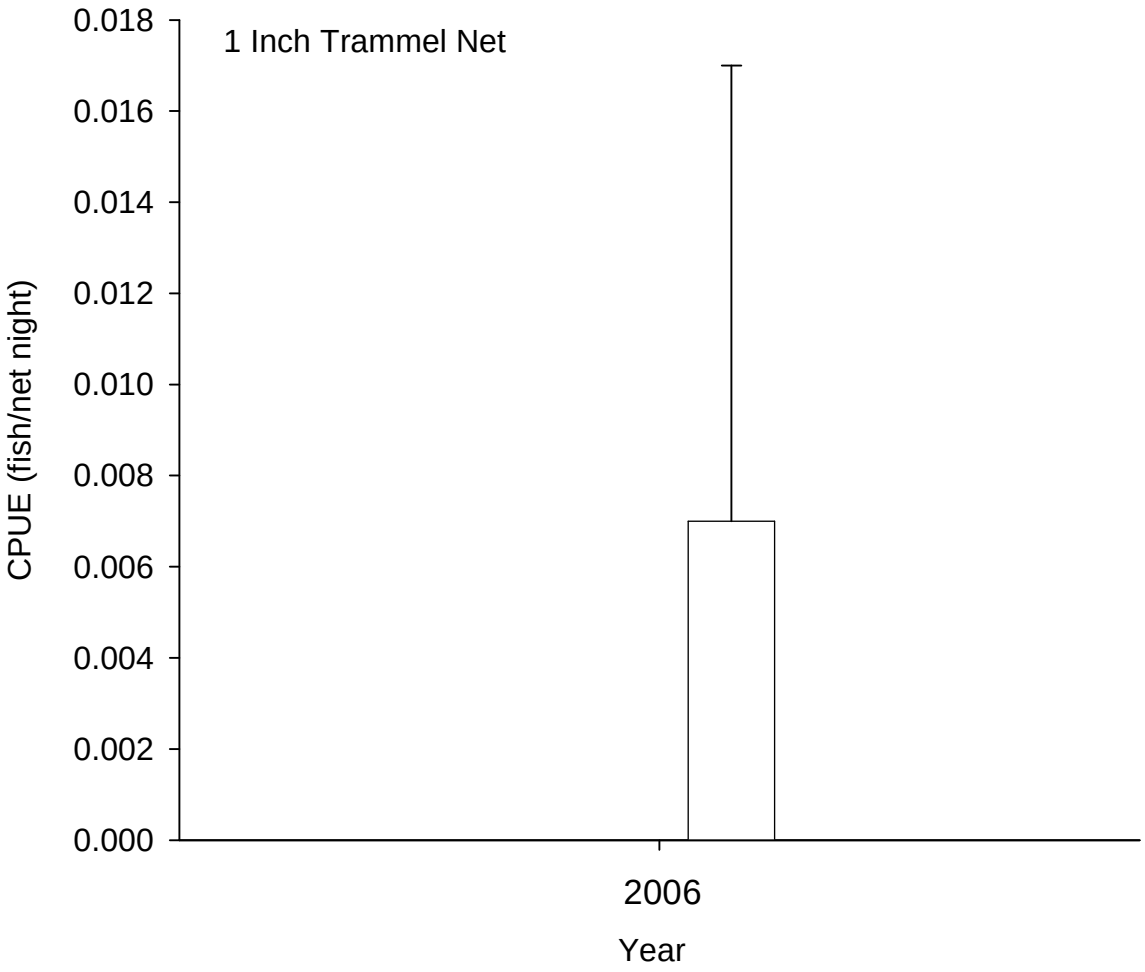

Figure 3. Mean annual catch-per-unit-effort (+/- 2 SE) of wild (black bars) and hatchery reared (white bars) pallid sturgeon using 1 inch trammel nets in segment 3 of the Missouri River during sturgeon season 2006.

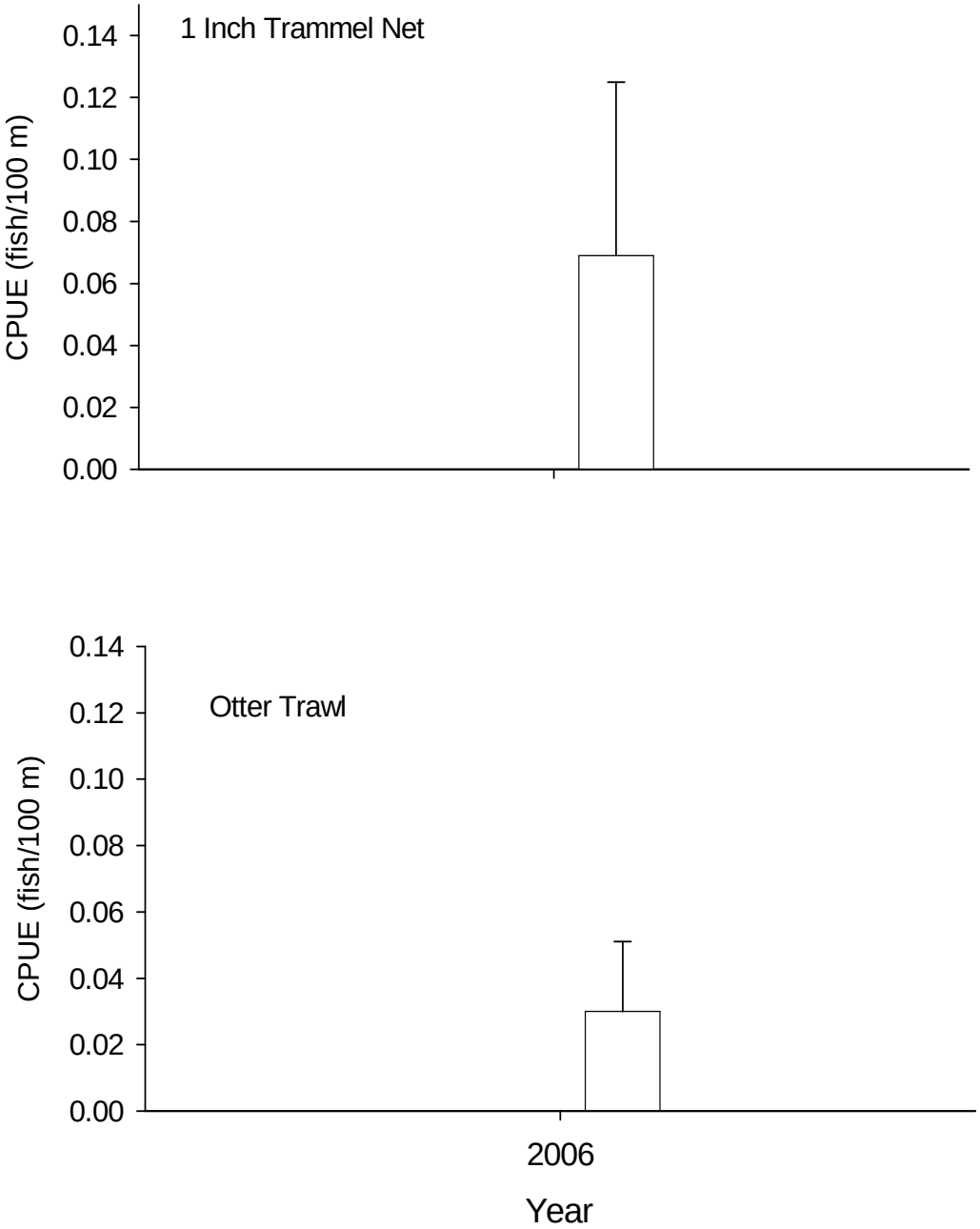

Figure 5. Mean annual catch-per-unit-effort (+/- 2 SE) of wild (black bars) and hatchery reared (white bars) pallid sturgeon using 1 inch trammel nets and otter trawls in segment 3 of the Missouri River during fish community season 2006. Note the differences in the Y-axis'.

Segment 3 - Pallid Sturgeon / Fish Community Season

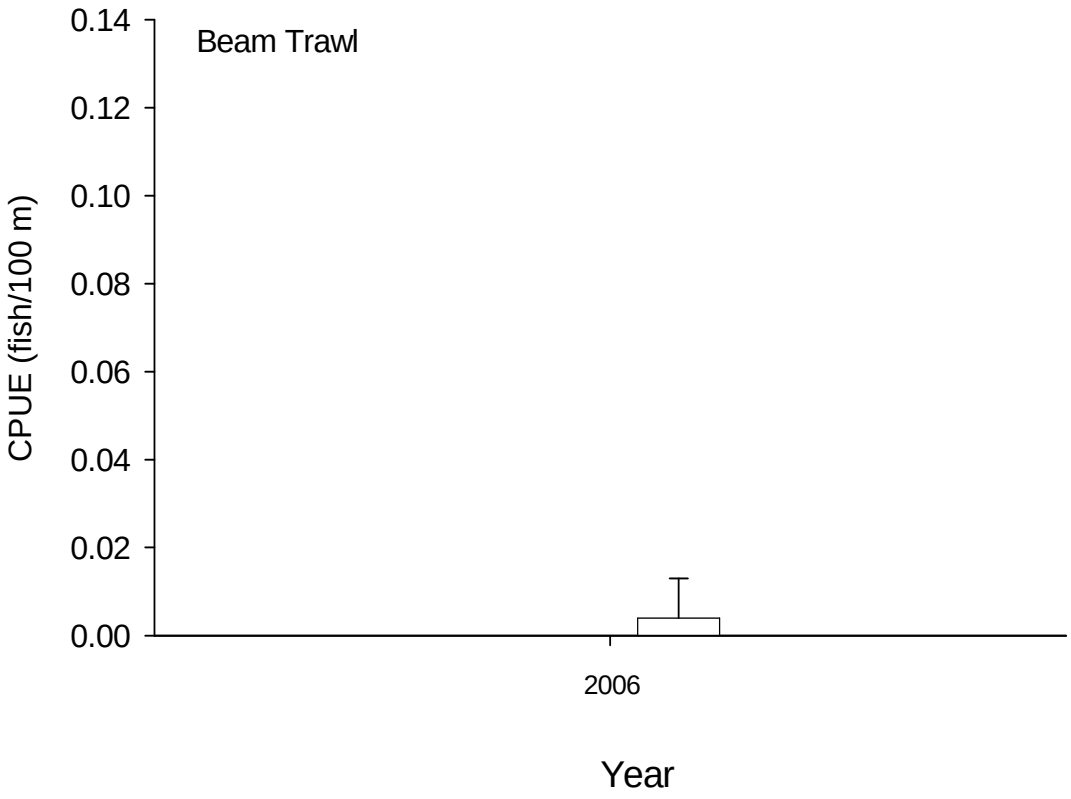

Figure 6. Mean annual catch-per-unit-effort (+/- 2 SE) of wild (black bars) and hatchery reared (white bars) pallid sturgeon using beam trawls in segment 3 of the Missouri River during fish community season 2006.

Segment 3 - Pallid Sturgeon / Fish Community Season

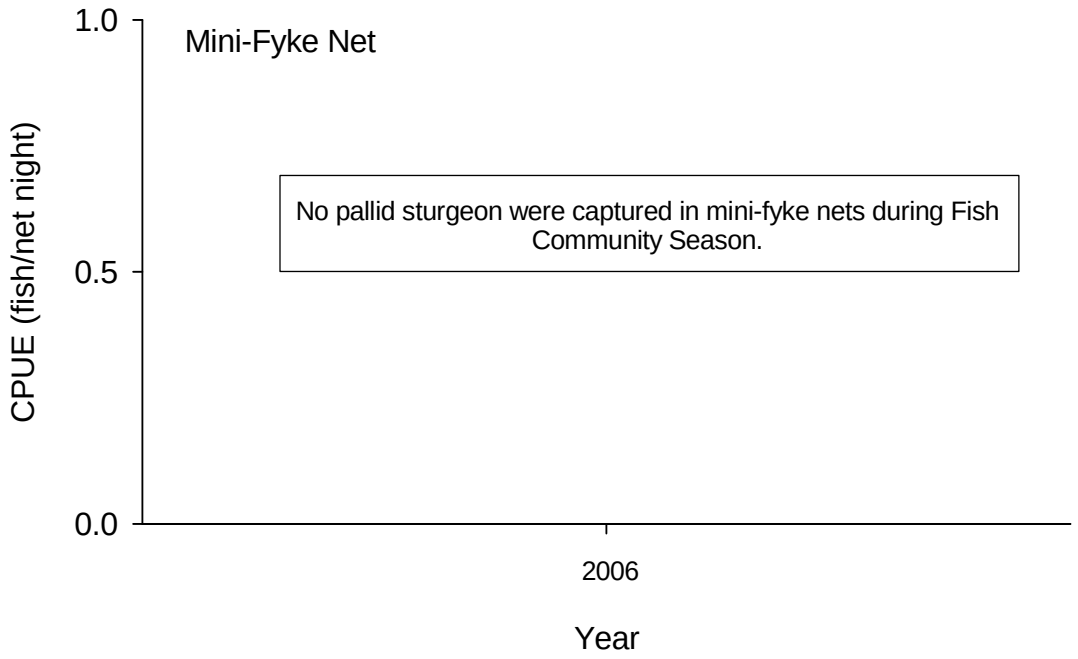

Figure 7. Mean annual catch-per-unit-effort (+/- 2 SE) of wild (black bars) and hatchery reared (white bars) pallid sturgeon using mini-fyke nets in segment 3 of the Missouri River during fish community season 2006.

Table 9. 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 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0		(27)				(33)	(27)	(13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	9		(24)				56 (33)	11 (26)	33 (17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	0		(29)				(31)	(27)	(13)						
Beam Trawl	0		(26)				(36)	(26)	(9)	(2)					
Mini-Fyke Net	0		(8)				(36)	(6)	(17)	(27)	(6)				
Otter Trawl	0		(28)				(36)	(25)	(11)						

Table 10. Total number of sub-stock size (0-199 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	0		(92)	(8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	9		100 (93)	(7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	0		(97)	(3)		
Beam Trawl			(98)	(2)		
Mini-Fyke Net	0	(93)	(1)			
Otter Trawl	0		(95)	(5)		

Table 11. 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 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	2		0 (27)				100 (33)	0 (27)	0 (13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	2		0 (24)				50 (33)	50 (26)	0 (17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	11		9 (29)				9 (31)	0 (27)	82 (13)						
Beam Trawl	1		 (26)				100 (36)	0 (26)	0 (9)	0 (2)					
Mini-Fyke Net	0		 (8)				 (36)	 (6)	 (17)	 (27)	 (6)				
Otter Trawl	8		25 (28)				75 (36)	0 (25)	0 (11)						

Table 12. Total number of sub-stock size (200-329 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	2		100 (92)	0 (8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	2		100 (93)	0 (7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	11		100 (97)	0 (3)		
Beam Trawl	1		100 (98)	0 (2)		
Mini-Fyke Net	0	(93)	(1)			
Otter Trawl	8		100 (95)	0 (5)		

Table 13. 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 2 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Macrohabitat**													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0		(27)				(33)	(27)	(13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	0		(24)				(33)	(26)	(17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	2		50 (29)				0 (31)	50 (27)	0 (13)						
Beam Trawl			(26)				(36)	(26)	(9)	(2)					
Mini-Fyke Net			(8)				(36)	(6)	(17)	(27)	(6)				
Otter Trawl	1		0 (28)				0 (36)	0 (25)	100 (11)						

Table 14. Total number of stock size (330-629 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	0		(92)	(8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	0		(93)	(7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	2		100 (97)	0 (3)		
Beam Trawl	0		(98)	(2)		
Mini-Fyke Net	0	(93)	(1)			
Otter Trawl	1		0 (95)	100 (5)		

Table 15. 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 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0		(27)				(33)	(27)	(13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	0		(24)				(33)	(26)	(17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	0		(29)				(31)	(27)	(13)						
Beam Trawl	0		(26)				(36)	(26)	(9)	(2)					
Mini-Fyke Net	0		(8)				(36)	(6)	(17)	(27)	(6)				
Otter Trawl	0		(28)				(36)	(25)	(11)						

Table 16. Total number of quality size and greater (≥630 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	0		(92)	(8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	0		(93)	(7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	0		(97)	(3)		
Beam Trawl	0		(98)	(2)		
Mini-Fyke Net	0	(93)	(1)			
Otter Trawl	0		(95)	(5)		

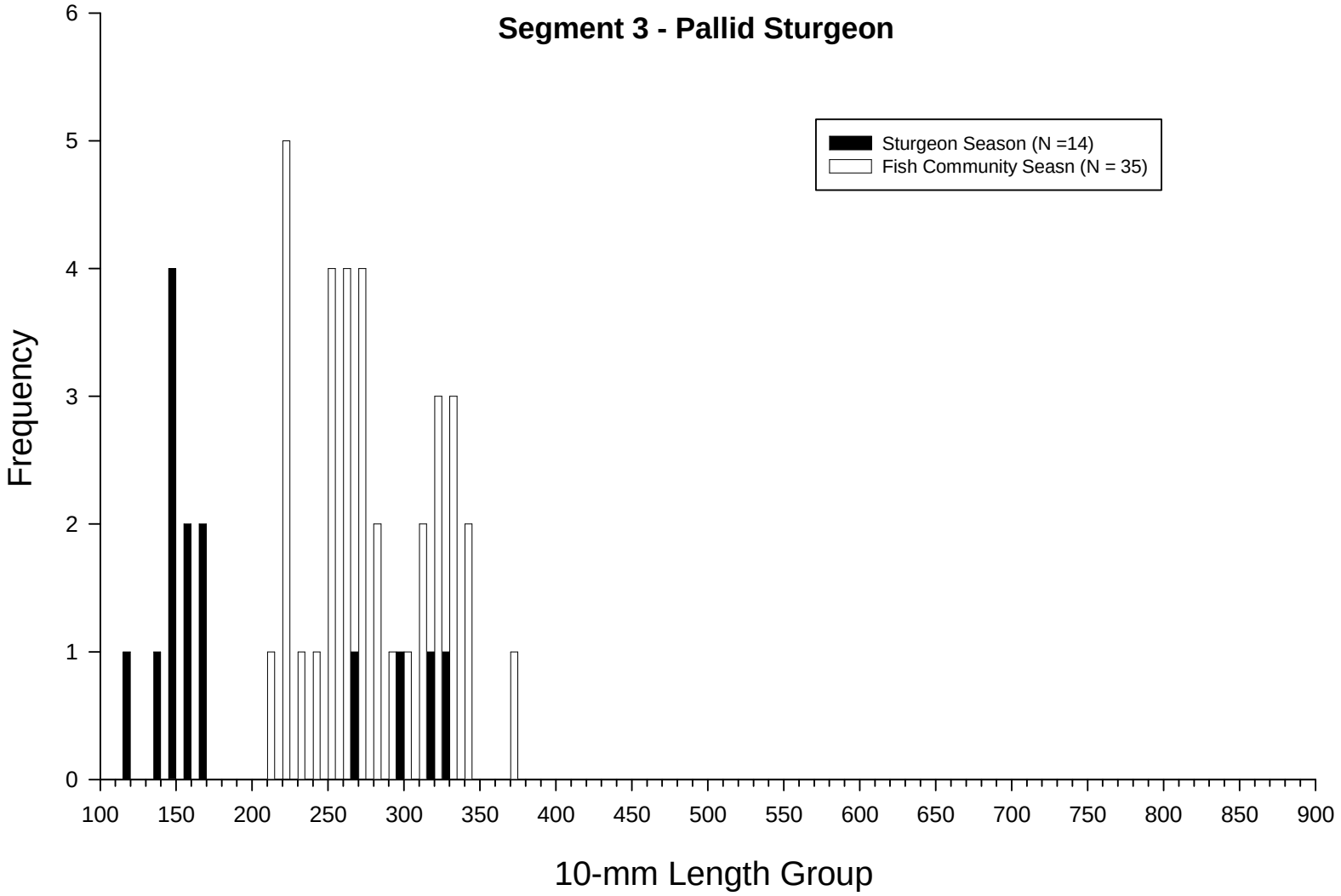

Figure 8. Length frequency of pallid sturgeon captured during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 3 of the Missouri River during 2006 including non-random and wild samples.

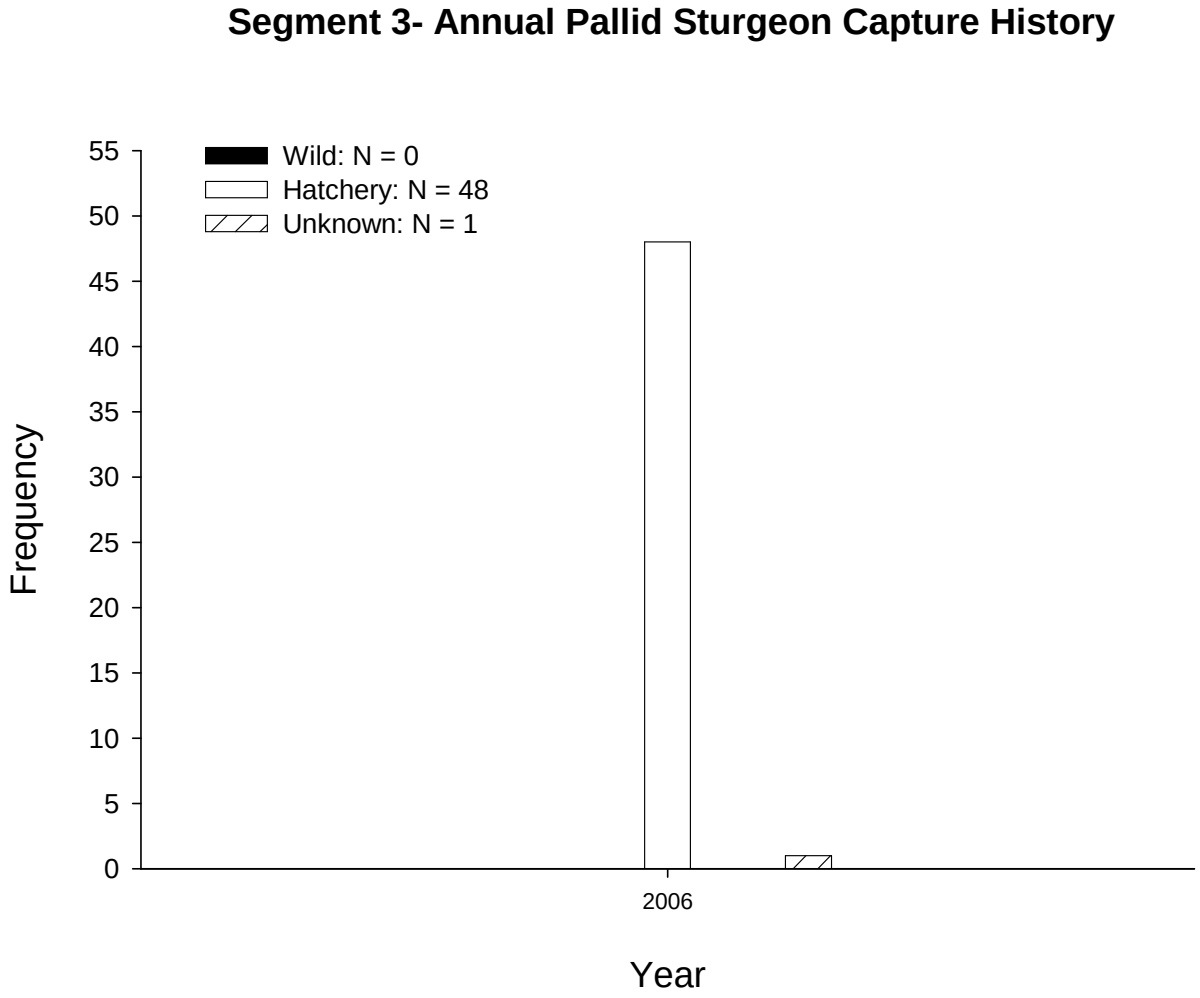

Figure 9. Annual capture history of wild (black bars) and hatchery reared (white bars) pallid sturgeon collected in segment 3 of the Missouri River during 2006. Figure is designed to compare overall pallid sturgeon captures from year to year and may be biased by variable effort between years.

Targeted Native River Species

Shovelnose Sturgeon

During the 2006 field season 150 shovelnose sturgeon were captured in segment 3. All were sampled using standard gears, which included trammel nets (N = 93), otter trawl (N = 52) and beam trawls (N = 5). More shovelnose sturgeon were captured during fish community season (N = 104), when compared to sturgeon season (N = 36). Of the total, 108 were sampled in random bends and 42 were sampled in non-randomly selected bends. Shovelnose sturgeon were captured in both random subsamples (N = 116) and nonrandom duplicate samples (N = 34). A total of 94 shovelnose sturgeon were captured during random subsamples in randomly selected bends. Shovelnose sturgeon were sampled throughout the length of segment 3.

A much wider size distribution was observed for shovelnose sturgeon when compared to pallid sturgeon in segment 3 (Figures 8 and 17). However, few (N = 4) shovelnose sturgeon < 200 mm FL were captured, while the majority were between 350 and 650 mm FL. Based on length at age data from Pierce et al. (2003), no YOY or age-1 shovelnose sturgeon were sampled in segment 3 during 2006. Additionally, the majority of shovelnose were age-7 or older. Incremental relative stock density for shovelnose sturgeon captured in random bends breaks down the length frequency histogram further (Table 25). During the sturgeon season, the substock (150 –249 mm FL) and stock (250-379 mm FL) categories had a RSD value of 9.52, whereas the remaining categories had RSD values as follows: quality = 53.38, preferred = 35.71, and memorable = 2.38. The RSD values shifted slightly during the fish community season, with the substock (150-249 mm FL) category having a RSD value of 1.64 and the stock category of 11.48, with the remaining groups having RSD values of 32.79, 49.18, 4.92, and 1.64 for quality, preferred, memorable, and trophy categories, respectively. The presence of sub-stock sized juvenile shovelnose sturgeon in segment 3 lends evidence that juvenile rearing is occurring in segment 3, although it is likely limited. The mean relative weight for shovelnose sturgeon was higher during the sturgeon season (Wr = 97.99) than during the fish community season (Wr = 87.95).

The CPUE graphs (Figures 11 to 16) for shovelnose sturgeon by gear by size category further illustrate the length frequency histogram in Figure 8. Shovelnose sturgeon CPUE for quality size and above were greater than the smaller size classes for all gears that captured shovelnose sturgeon, except the beam trawl (Figure 16). While the otter trawl and trammel nets

both sampled larger shovelnose sturgeon at a higher frequency, there were differences between the two gears. Trammel nets had the highest CPUE for larger shovelnose sturgeon during both the sturgeon (CPUE = 0.069) and the fish community seasons (CPUE = 0.214) (Figures 12 and 14). Both trammel nets and otter trawls had higher CPUE during the fish community season when compared to the sturgeon season. The only gear to sample all sizes of shovelnose sturgeon with a relatively similar CPUE was the beam trawl. However, the beam trawl CPUE was very low for all size classes, since a total of only five shovelnose sturgeon were sampled during the fish community season. No shovelnose sturgeon were sampled using mini fyke nets in segment 3 during 2006.

All randomly sampled substock sized (150-249 mm FL) shovelnose sturgeon (N = 5) were sampled in inside bend macrohabitats and channel border mesohabitats (Tables 19 and 20). Stock sized shovelnose sturgeon were captured in inside bends (N = 6), outside bends (N = 2), small connected side channels (N = 2), and channel crossovers (N =1) (Table 21). All but one (N = 11) were sampled in channel border mesohabitats, while the other was sampled in an island tip mesohabitat (Table 22).

The proportion of randomly sampled large (≥ 380 mm FL) shovelnose sturgeon sampled in macrohabitats and the proportion that those habitats were sampled is shown in Table 23. Larger randomly sampled shovelnose sturgeon were sample in inside bends (N = 36), outside bends (N = 34), small connected side channels (N = 11), and channel crossovers (N = 9). The majority (N = 90) of randomly sampled large shovelnose sturgeon were sampled in channel border mesohabitats, while the remaining two were sampled in island tip mesohabitats (Table 24). The proportion of shovelnose sturgeon sampled in mesohabitats was similar to the proportion that those habitats were sampled.

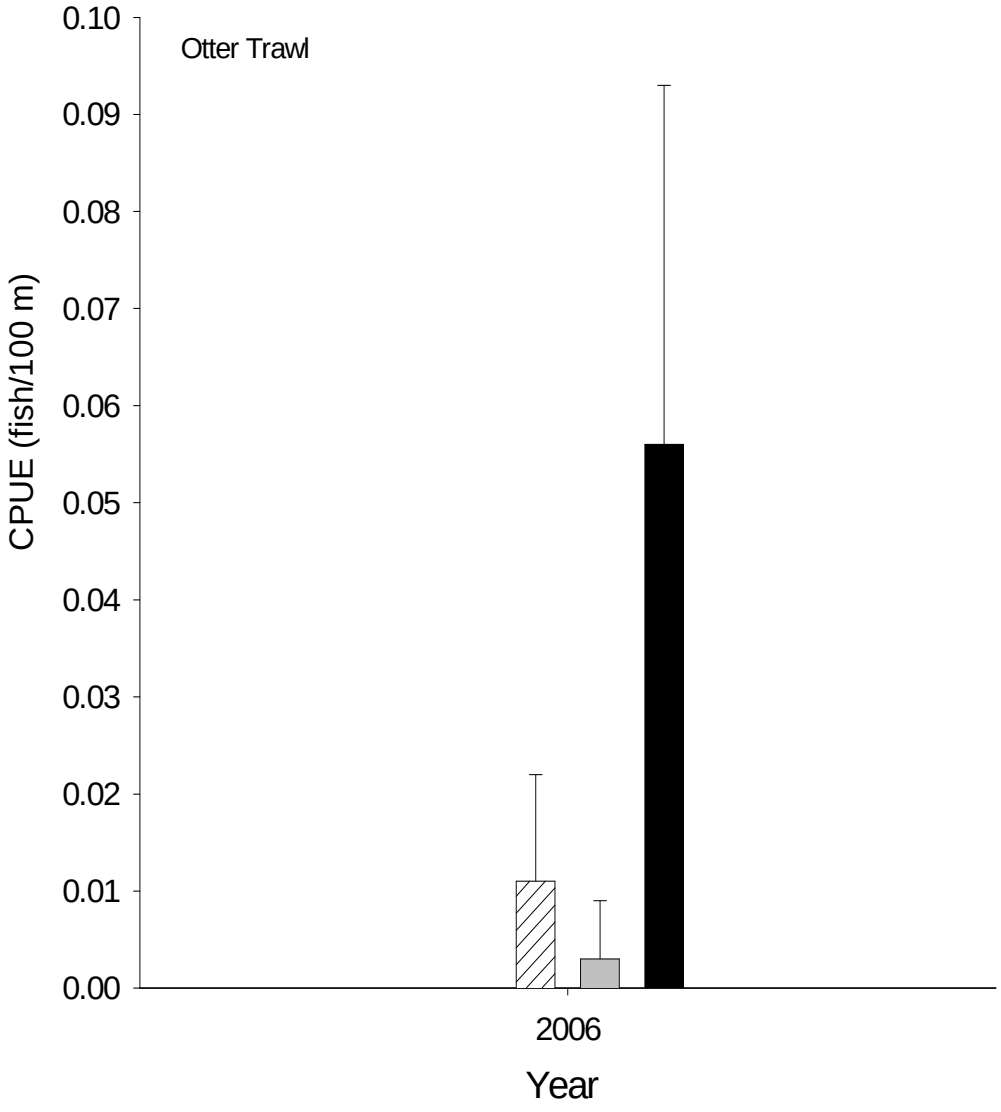

Figure 11. Mean annual catch-per-unit-effort (+/- 2SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size (> 380 mm; black bars) shovelnose sturgeon using otter trawls in segment 3 of the Missouri River during sturgeon season 2006.

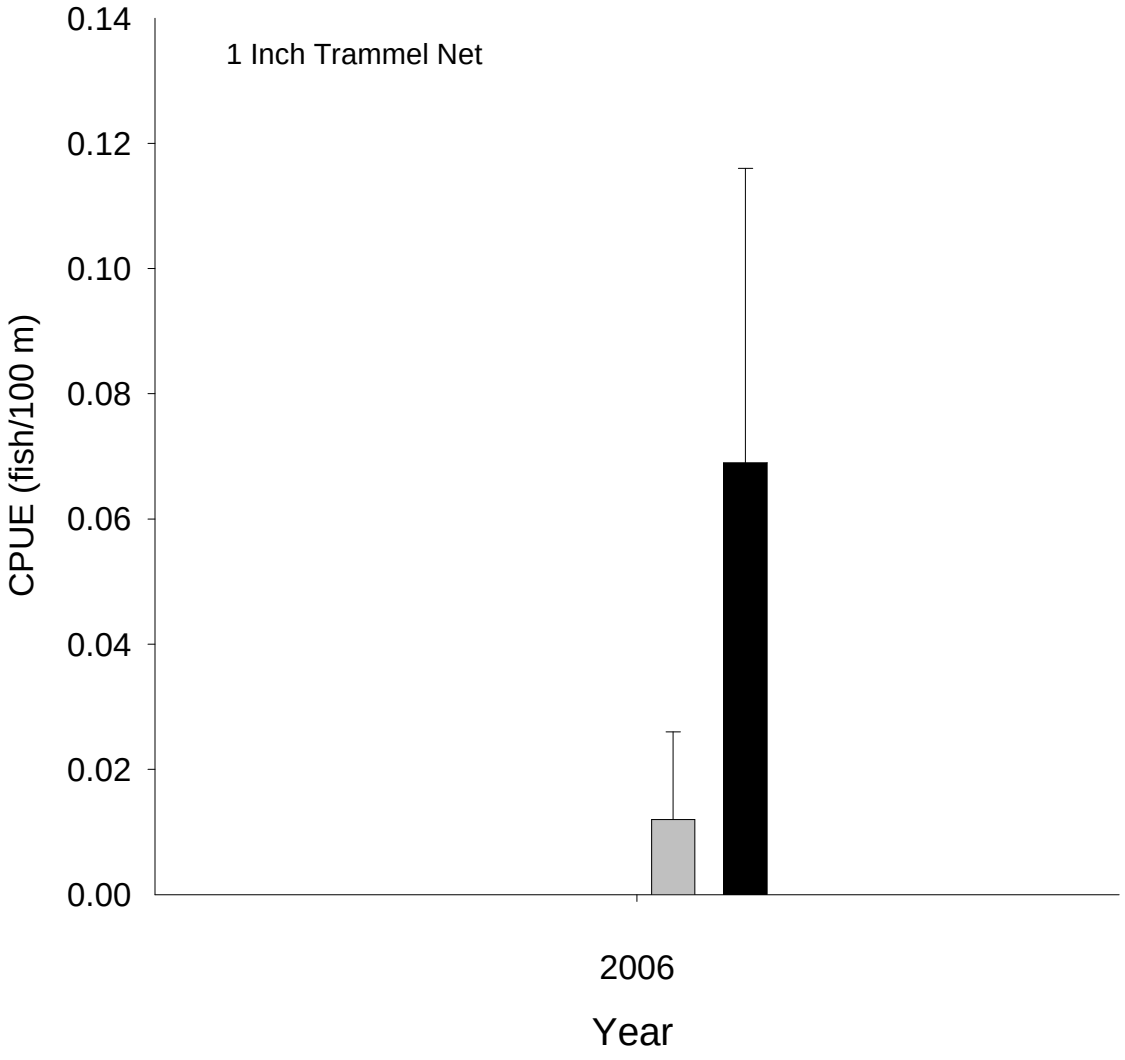

Figure 12. Mean annual catch-per-unit-effort (+/- 2SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size (> 380 mm; black bars) shovelnose sturgeon using 1 and 2.5 inch trammel nets in segment 3 of the Missouri River during sturgeon season 2006.

Segment 3 - Shovelnose Sturgeon / Fish Community Season

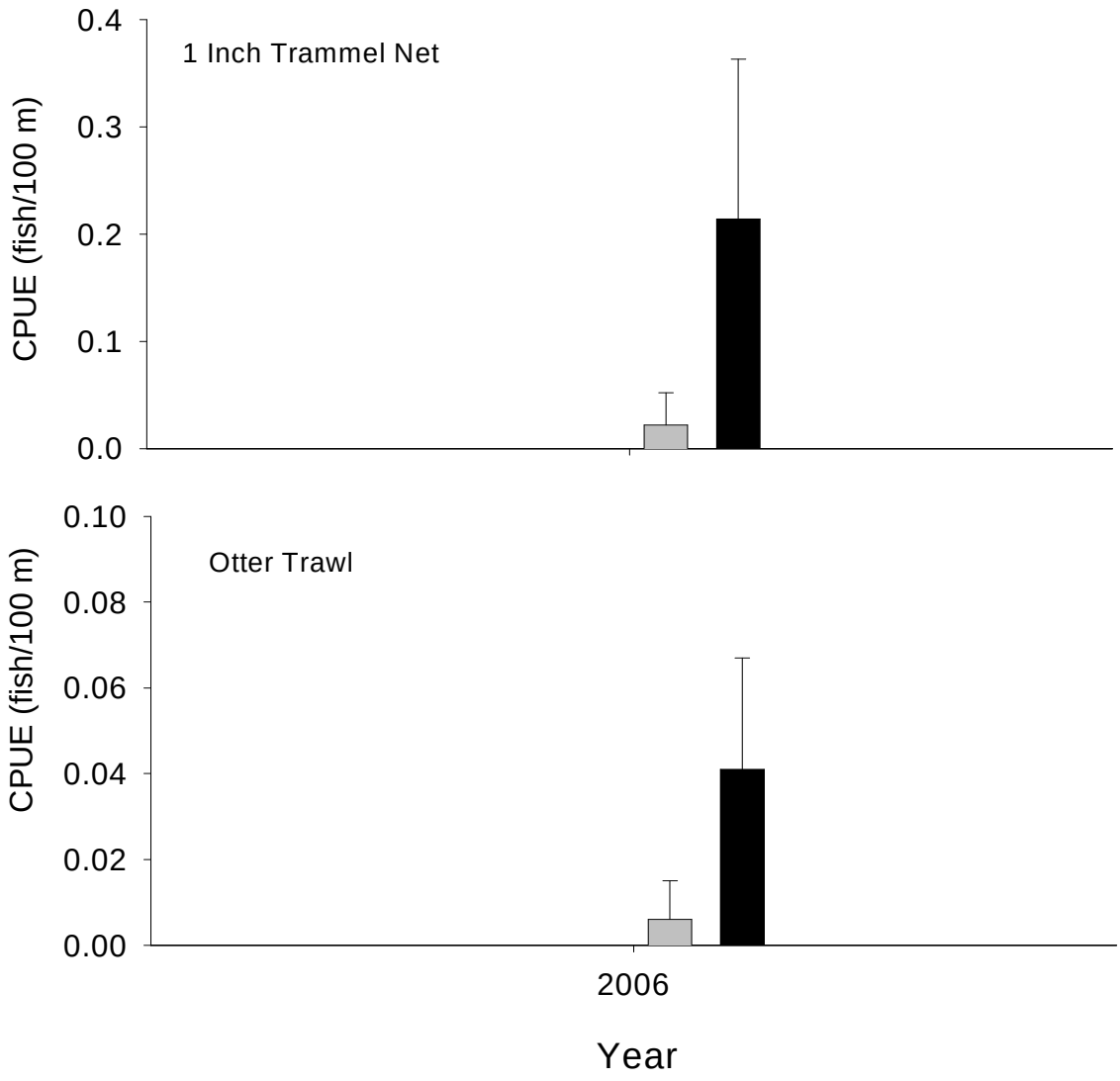

Figure 14. Mean annual catch-per-unit-effort (+/- 2SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size (> 380 mm; black bars) shovelnose sturgeon using 1 inch trammel nets and otter trawls in segment 3 of the Missouri River during fish community season 2006. Note the difference in scale between the Y-axis'.

Segment 3 - Shovelnose Sturgeon / Fish Community Season

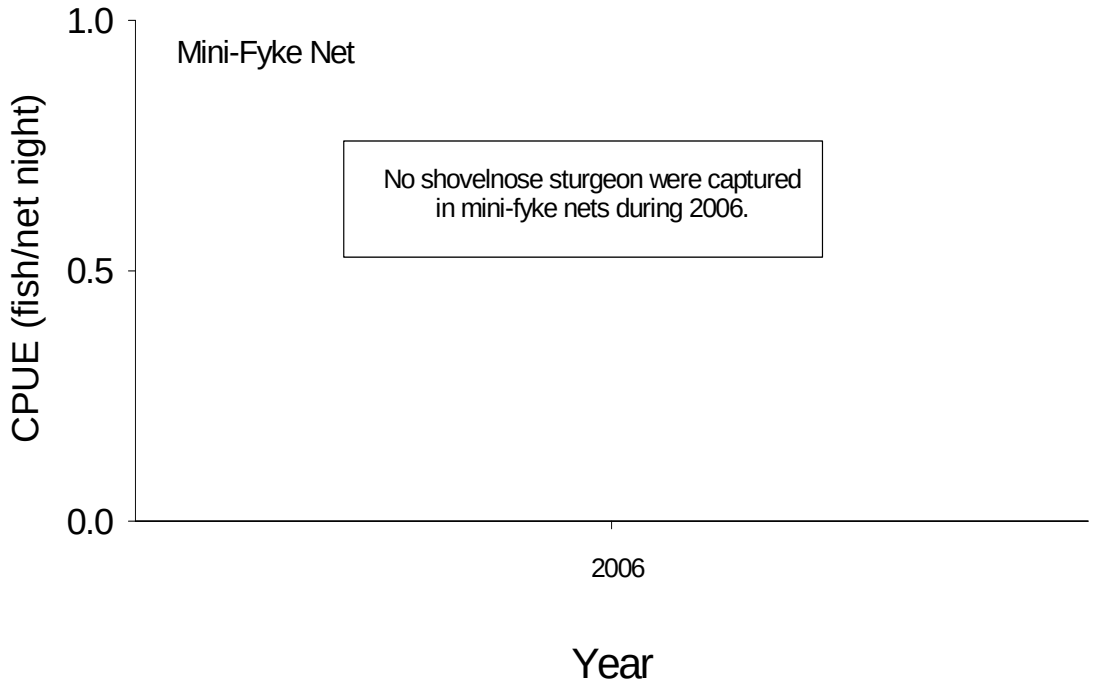

Figure 15. Mean annual catch-per-unit-effort (+/- 2SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size (> 380 mm; black bars) shovelnose sturgeon using mini-fyke nets and bag seines in segment 3 of the Missouri River during fish community season 2006.

Segment 3 - Shovelnose Sturgeon / Fish Community Season

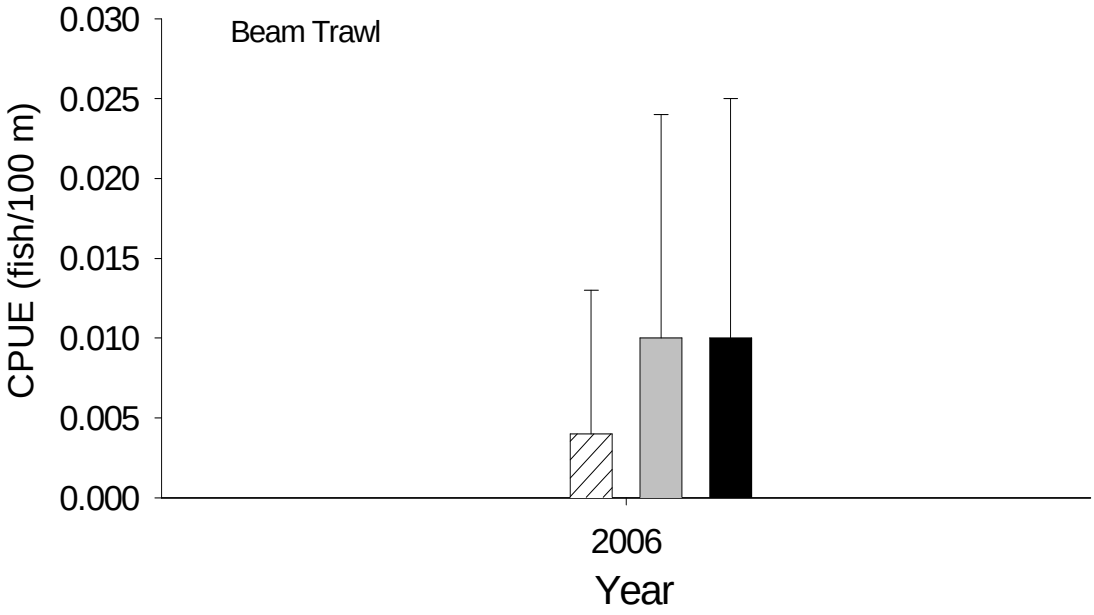

Figure 16. Mean annual catch-per-unit-effort (+/- 2SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size (> 380 mm; black bars) shovelnose sturgeon using beam trawls in segment 3 of the Missouri River during fish community season 2006.

Table 17. 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 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0		(27)				(33)	(27)	(13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	0		(24)				(33)	(26)	(17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	0		(29)				(31)	(27)	(13)						
Beam Trawl	0		(26)				(36)	(26)	(9)	(2)					
Mini-Fyke Net	0		(8)				(36)	(6)	(17)	(27)	(6)				
Otter Trawl	0		(28)				(36)	(25)	(11)						

Table 18. Total number of sub-stock size (0-149 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	0		(92)	(8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	0		(93)	(7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	0		(97)	(3)		
Beam Trawl	0		(98)	(2)		
Mini-Fyke Net	0	(93)	(1)			
Otter Trawl	0		(95)	(5)		

Table 19. 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 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0		(27)				(33)	(27)	(13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	4		0 (24)				100 (33)	0 (26)	0 (17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	0		(29)				(31)	(27)	(13)						
Beam Trawl	1		0 (26)				100 (36)	0 (26)	0 (9)	0 (2)					
Mini-Fyke Net	0		(8)				(36)	(6)	(17)	(27)	(6)				
Otter Trawl	0		(28)				(36)	(25)	(11)						

Table 20. Total number of sub-stock size (150-249 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	0		(92)	(8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	4		100 (93)	0 (7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	0		(97)	(3)		
Beam Trawl	1		100 (98)	0 (2)		
Mini-Fyke Net	0	(93)	(1)			
Otter Trawl	0		(95)	(5)		

Table 21. 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 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	3		0 (27)				67 (33)	0 (27)	33 (13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	1		0 (24)				0 (33)	100 (26)	0 (17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	3		0 (29)				67 (31)	33 (27)	0 (13)						
Beam Trawl	2		0 (26)				100 (36)	0 (26)	0 (9)	0 (2)					
Mini-Fyke Net	0		(8)				(36)	(6)	(17)	(27)	(6)				
Otter Trawl	2		50 (28)				0 (36)	0 (25)	50 (11)						

Table 22. Total number of stock size (250-379 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	3		67 (92)	33 (8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	1		100 (93)	0 (7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	3		100 (97)	0 (3)		
Beam Trawl	2		100 (98)	0 (2)		
Mini-Fyke Net	0	(93)	(1)			
Otter Trawl	2		100 (95)	0 (5)		

Table 23. 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 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	20		15 (27)				50 (33)	15 (27)	20 (13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	18		6 (24)				28 (33)	39 (26)	28 (17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	41		12 (29)				37 (31)	46 (27)	5 (13)						
Beam Trawl	2		(26)				50 (36)	0 (26)	50 (9)	0 (2)					
Mini-Fyke Net	0		(8)				(36)	(6)	(17)	(27)	(6)				
Otter Trawl	11		0 (28)				45 (36)	45 (25)	9 (11)						

Table 24. Total number of quality size and greater (≥380 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	20		95 (92)	5 (8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	18		94 (93)	6 (7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	41		100 (97)	0 (3)		
Beam Trawl	2		100 (98)	0 (2)		
Mini-Fyke Net	0	(93)	(1)			
Otter Trawl	11		100 (95)	0 (5)		

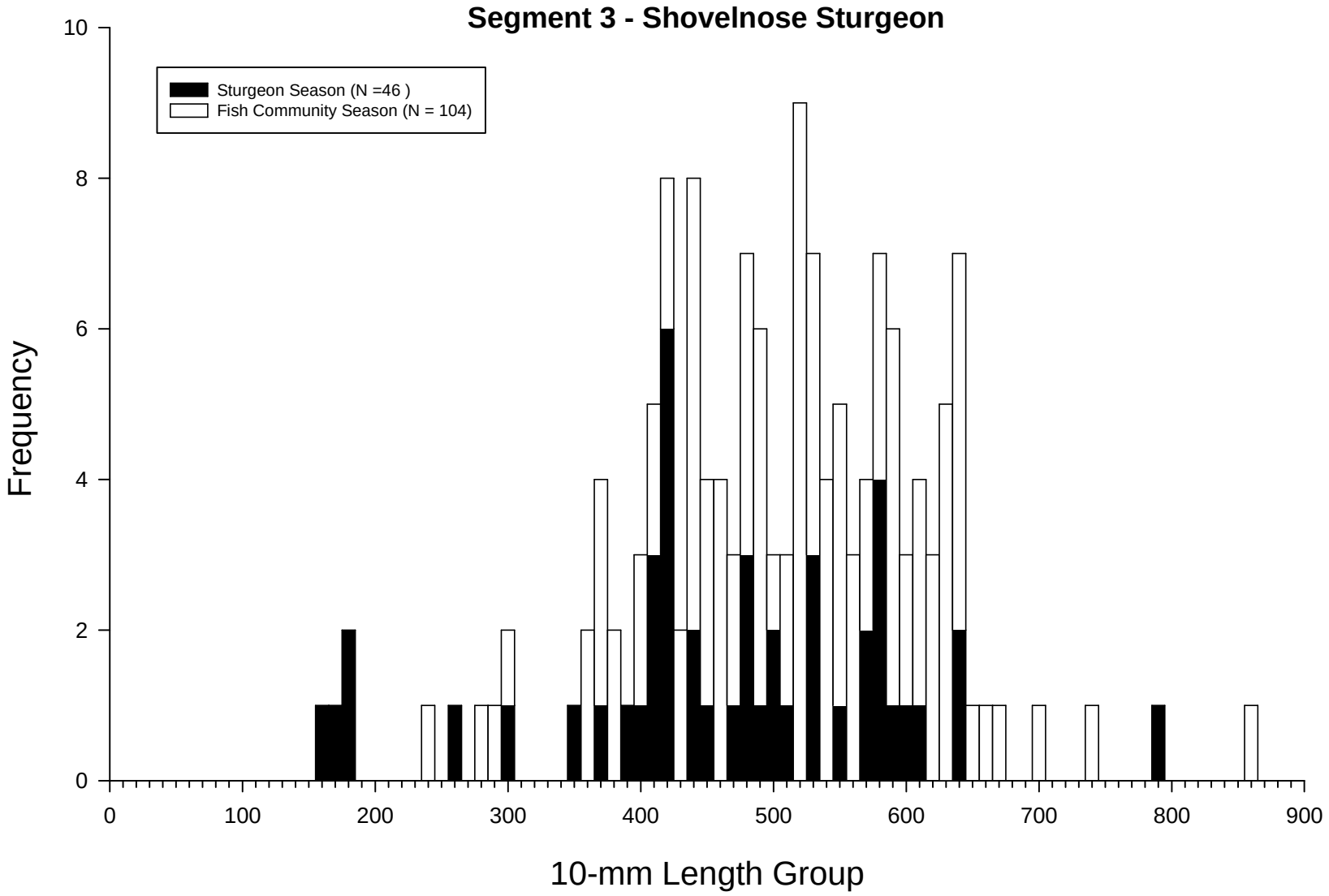

Figure 17. Length frequency of all shovelnose sturgeon from fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) sampled in segment 3 of the Missouri River during 2006.

Table 25. Incremental relative stock density (RSD)[a] and mean relative weight (Wr) by a length category for shovelnose sturgeon sampled in random bends in segment 3 of the Missouri River during 2006. Length categories[b] determined using methods proposed by Quist (1998).

Length category	N	RSD	Wr (2SE)
Sturgeon Season			
Sub-stock (0-149 mm)			
Sub-stock (150-249 mm)	4	9.52	100.55 (9.27)
Stock	4	9.52	136.61 (98.64)
Quality	22	53.38	95.04 (9.47)
Preferred	15	35.71	90.50 (9.06)
Memorable	1	2.38	110.57
Trophy			
Overall Wr	46		97.99 (9.96)
Fish Community Season			
Sub-stock (0-149 mm)			
Sub-stock (150-249 mm)	1	1.64	95.09
Stock	7	11.48	91.81 (18.95)
Quality	20	32.79	85.76 (6.49)
Preferred	30	49.18	87.14 (5.73)
Memorable	3	4.92	86.41 (11.13)
Trophy	1	1.64	126.17
Overall Wr	62		87.95 (4.22)

[a] RSD = (# of fish of a specified length class / # of fish ≥ minimum stock length fish) * 100.

[b] Length categories based on the percentage of the largest known shovelnose sturgeon: Sub-stock FL < 250 mm (20 %), Stock FL =250-379 mm (20 – 36 %), Quality FL = 380 – 509 mm (36 – 45 %), Preferred FL = 510 - 639 mm (45 – 59 %), Memorable FL = 640 – 809 mm (59 – 74 %), Trophy FL > 810 mm (>74 %).

Sturgeon Chub

A total of 598 sturgeon chubs were sampled in segment 3 during 2006. Of those, 407 were sampled in random subsamples in randomly selected bends. More sturgeon chubs were sampled during fish community season (N = 370) than during sturgeon season (N = 228). Sturgeon chubs were sampled throughout the length of segment 3, although their abundance appeared to decrease at the upper most river bends in segment 3 (river miles 1680 to 1700).

Otter and beam trawls were the most effective gears for sampling sturgeon chubs (Figures 18 to 20). The otter trawl had a CPUE of 0.72 and 0.60 fish/100 m during the sturgeon and fish community seasons, respectively. Beam trawl CPUE (0.62 fish/100 m) was similar to that of the otter trawl during the fish community season. No sturgeon chubs were sampled in trammel nets and only one was sampled in mini fyke nets and bag seines.

Sturgeon chubs averaged 58.7 mm total length (TL). Little difference was observed in the average size of sturgeon chubs collected by beam (60.7 mm TL) and otter (61.6 mm TL) trawls during the fish community season when both gears were used. The length frequency histogram in Figure 21 presents the size classes of sturgeon chubs captured in random bends.

In randomly selected bends, more sturgeon chubs were sampled in inside bends (N = 205) than channel crossovers (N = 109), outside bends (N = 111), and small connected side channels (N = 99). However, small connected side channels had a proportionally higher sturgeon chub catch for each gear when compared to the proportion that small connected side channels were sampled (Table 26). In general, the proportion of sturgeon chubs sampled in mesohabitats reflected the proportion that specific mesohabitats were sample (Table 27).

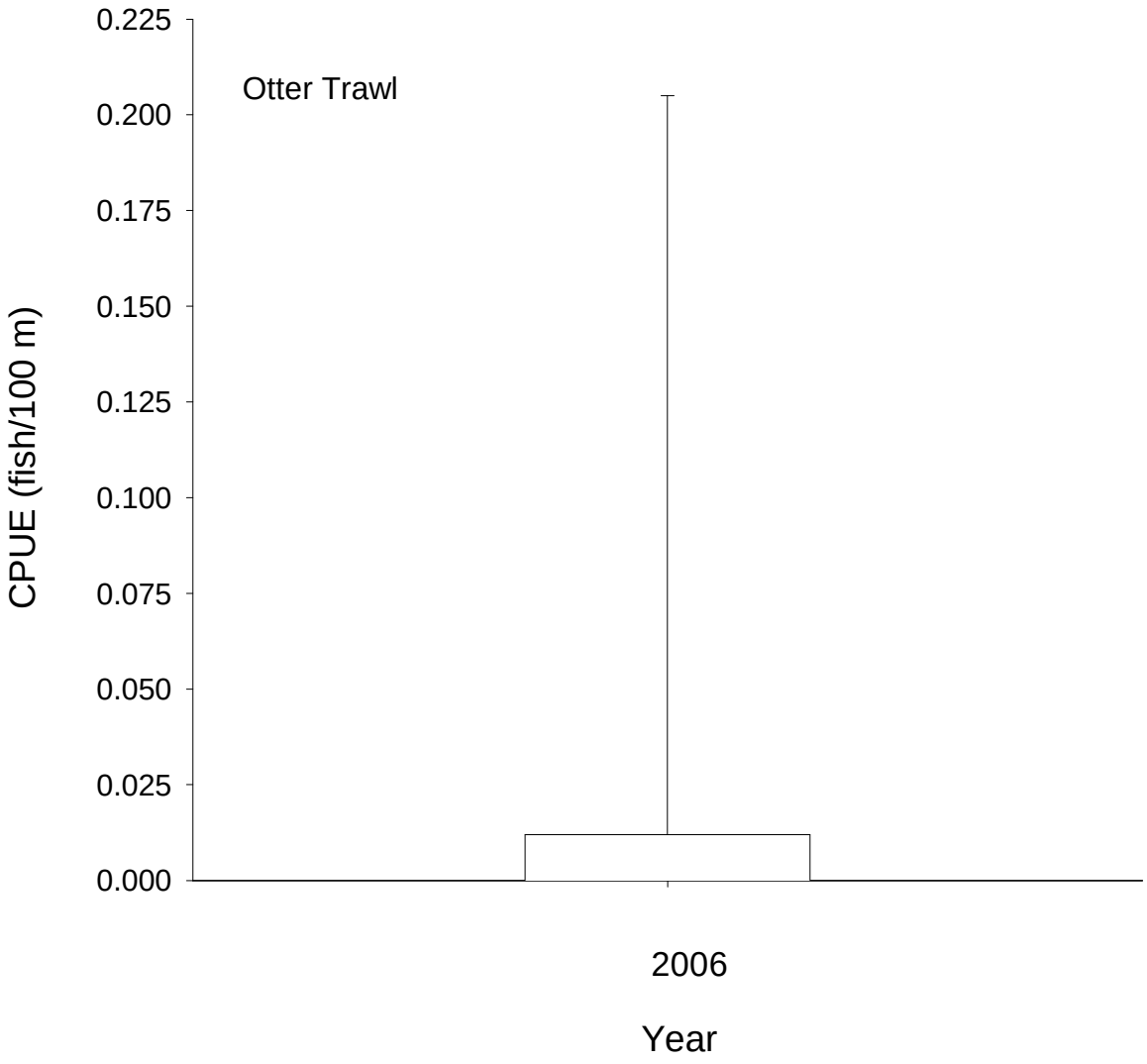

Figure 18. Mean annual catch-per-unit-effort (+/- 2SE) of sturgeon chub using otter trawls and beam trawls in segment 3 of the Missouri River during sturgeon season 2006

Segment 3 - Sturgeon Chub / Fish Community Season

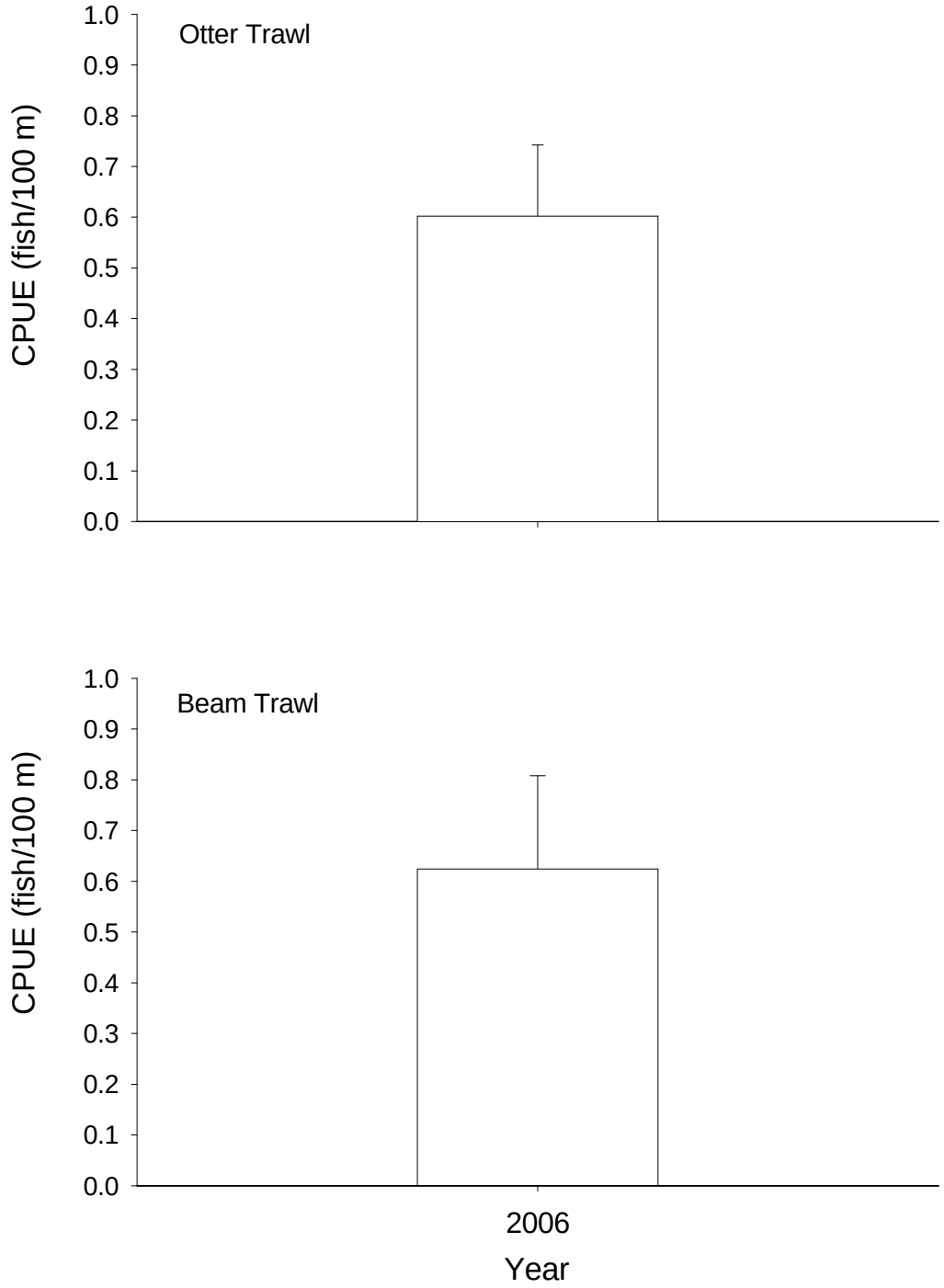

Figure 19. Mean annual catch-per-unit-effort (+/- 2SE) of sturgeon chub using otter trawls and beam trawls in segment 3 of the Missouri River during fish community season 2006.

Segment 3 - Sturgeon Chub / Fish Community Season

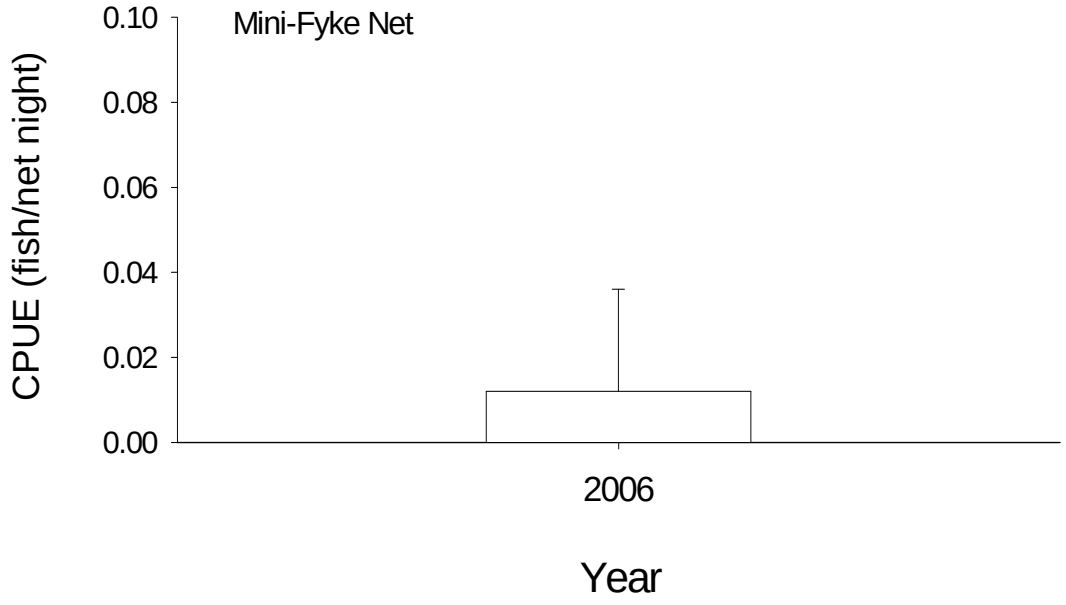

Figure 20. Mean annual catch-per-unit-effort (+/- 2SE) of sturgeon chub using mini-fyke nets and bag seines in segment 3 of the Missouri River during fish community season 2006.

Table 26. Total number of sturgeon chubs captured for each gear during each season and the proportion caught within each macrohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0		(27)				(33)	(27)	(13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	228		18 (24)				39 (33)	20 (26)	24 (17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	0		(29)				(31)	(27)	(13)						
Beam Trawl	121		15 (26)				50 (36)	23 (26)	12 (9)	0 (2)					
Mini-Fyke Net	1		100 (8)				0 (36)	0 (6)	0 (17)	0 (27)	0 (6)				
Otter Trawl	169		29 (28)				33 (36)	22 (25)	17 (11)						

Table 27. Total number of sturgeon chubs captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	0		(92)	(8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	228		92 (93)	8 (7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	0		(97)	(3)		
Beam Trawl	121		98 (98)	2 (2)		
Mini-Fyke Net	1	100 (93)	0 (1)			
Otter Trawl	169		92 (95)	8 (5)		

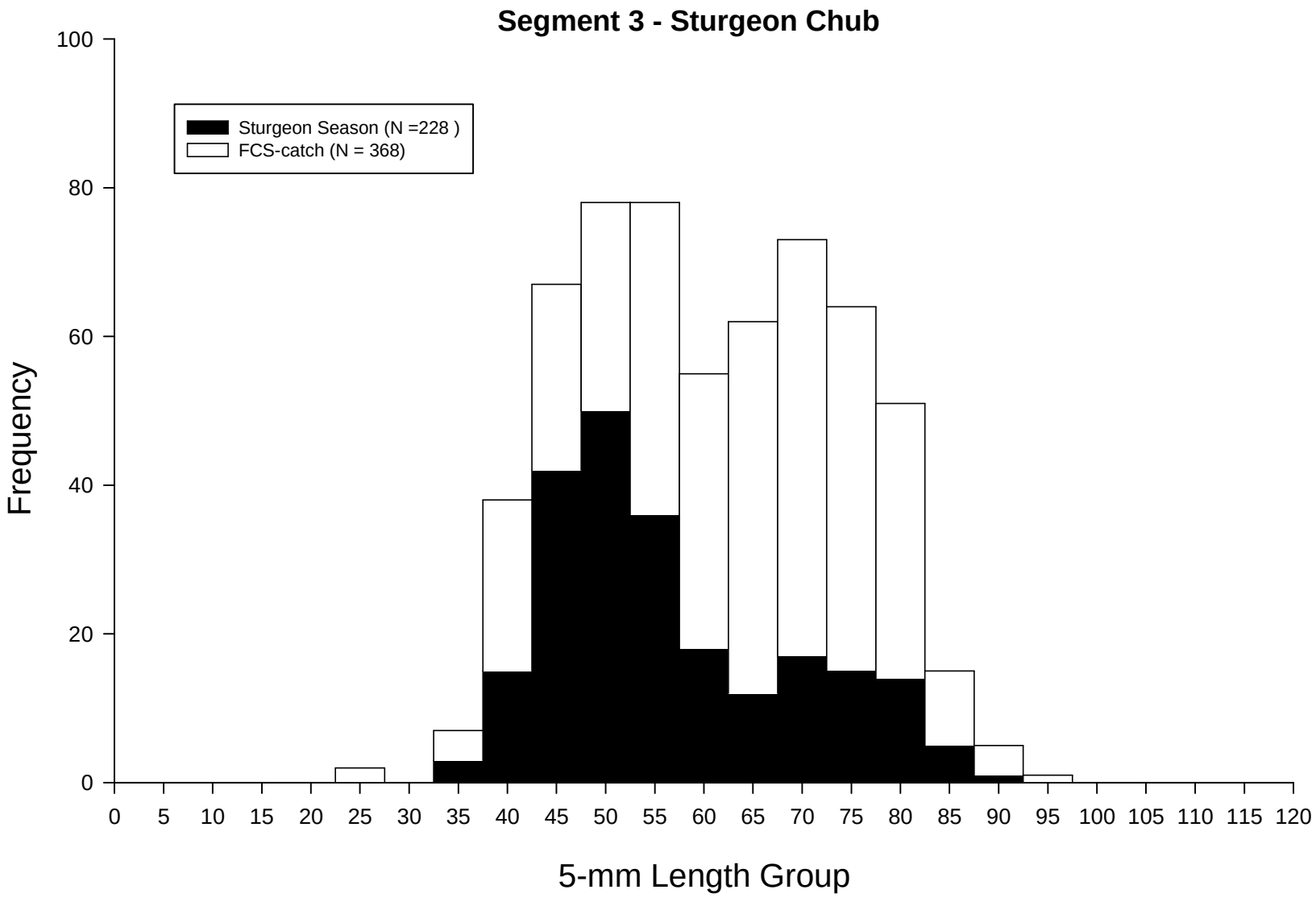

Figure 21. Length frequency of all sturgeon chubs during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 3 of the Missouri River during 2006.

Sicklefin Chub

A total of 122 sicklefin chubs were sampled in segment 3 during 2006. Of the total, 72 and 50 were sampled in random and non-random bends, respectively. Additionally, 61 sicklefin chubs were sampled in random subsamples in randomly selected bends. More sicklefin chubs (N = 96) were collected during fish community season than during the sturgeon season (N = 26).

The size distribution of sicklefin chubs sampled in random bends is shown in Figure 25. Sicklefin chubs in random bends averaged 83.4 mm TL and there was little difference between fish captured during the sturgeon (mean TL = 83.2) and fish community (mean TL = 82.0 mm) seasons. The average size of sicklefin chubs captured in random bends was smaller for the beam trawl (mean TL = 79.9 mm) than for the otter trawl (mean TL = 85.8).

The otter trawl was the most effective gear in sampling sicklefin chubs in segment 3 (Figures 22 to 24). Sicklefin chub CPUE for the otter trawl was 0.079 and 0.114 fish/100 m for the sturgeon and fish community seasons, respectively. Beam trawl CPUE was estimated at 0.067 fish/100 m during the fish community season, the only season in which it was used. No sicklefin chubs were sampled in either trammel or mini fyke nets and two were captured in the bag seine.

In randomly selected bends, sicklefin chubs were sampled in inside bends (N = 27), outside bends (N = 21), channel crossovers (N = 16) and small connected side channels (N = 8). A higher proportion of sicklefin chubs were captured in inside bends during fish community season when compared to the proportion inside bends were sampled (Table 28). Sicklefin chubs were sampled in both channel border and island tip mesohabitats (Table 29).

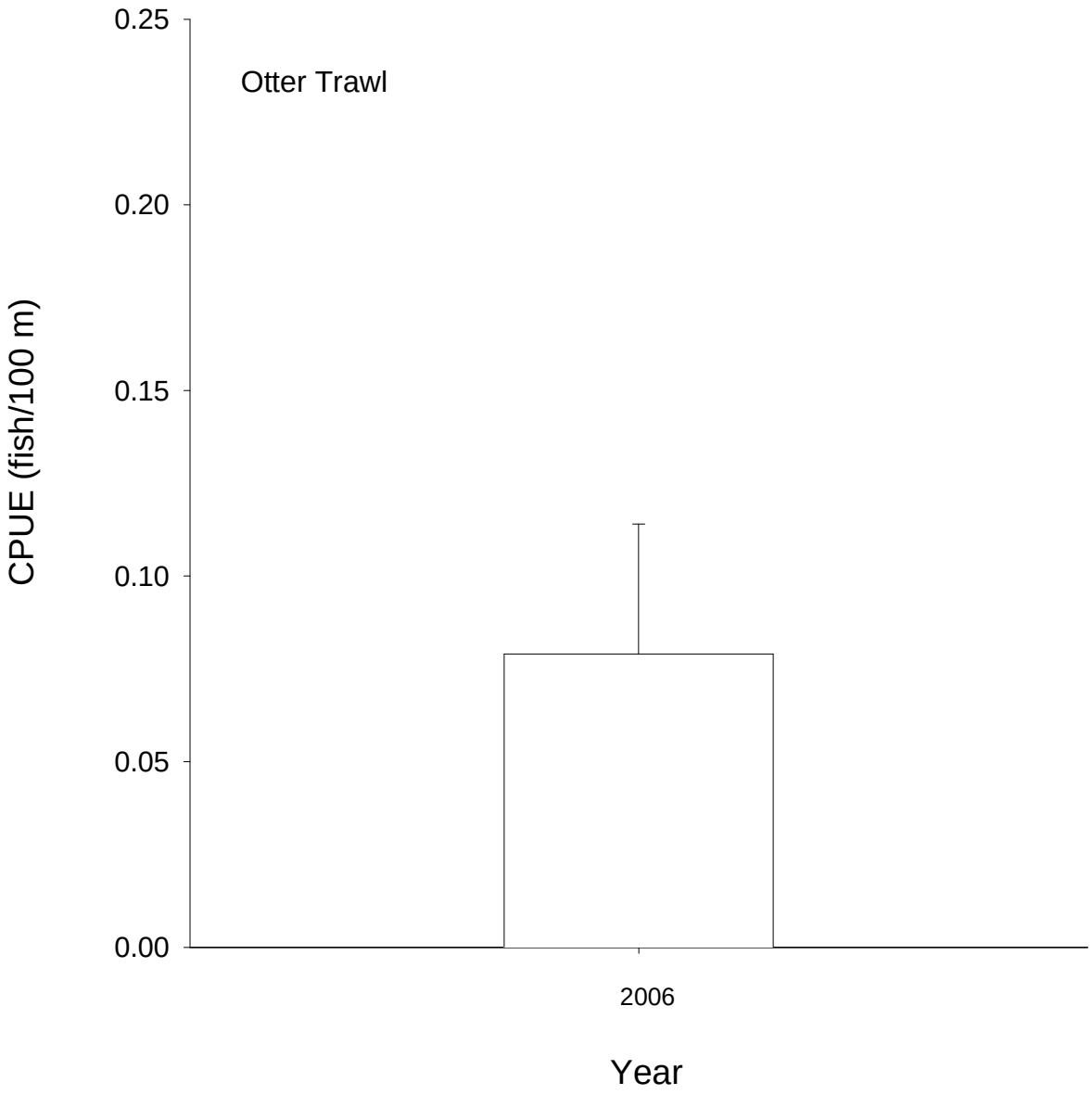

Figure 22. Mean annual catch-per-unit-effort (+/- 2SE) of sicklefin chub using otter trawls in randomly selected bends in segment 3 of the Missouri River during sturgeon season 2006.

Segment 3 - Sicklefin Chub / Fish Community Season

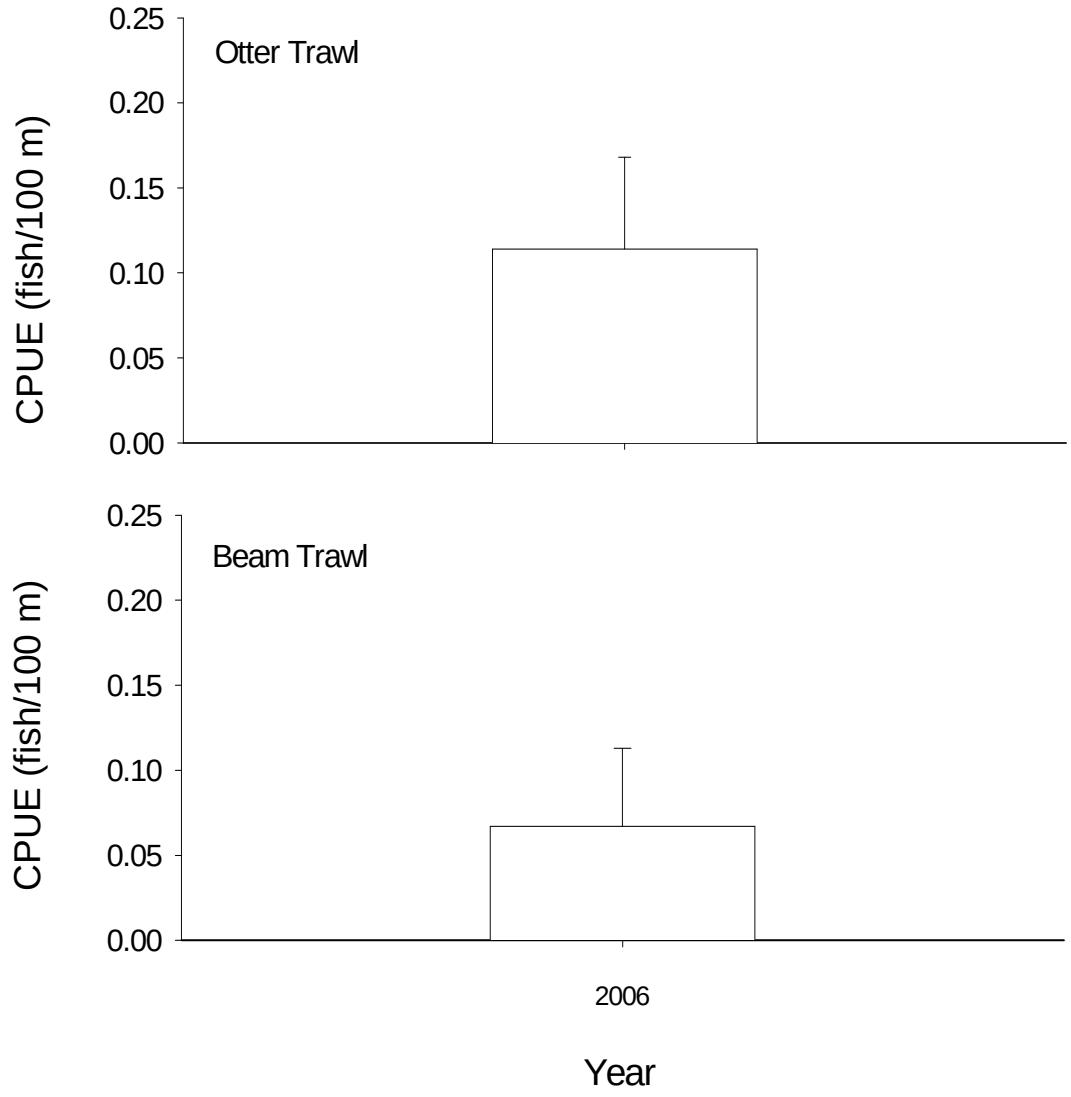

Figure 23. Mean annual catch-per-unit-effort (+/- 2SE) of sicklefin chub using otter trawls and beam trawls in segment 3 of the Missouri River during fish community season 2006.

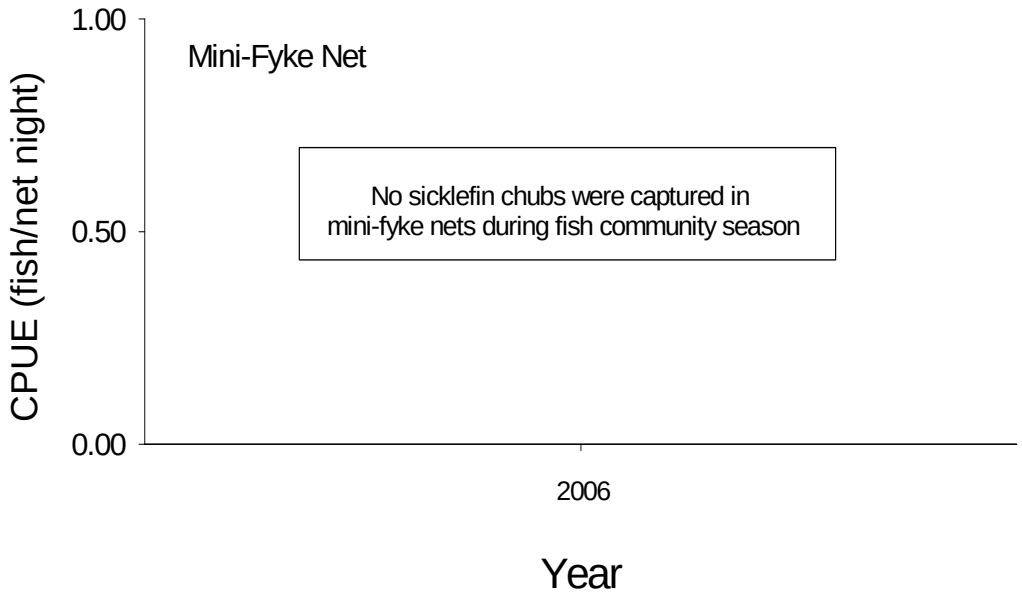

Figure 24. Mean annual catch-per-unit-effort (+/- 2SE) of sicklefin chub using mini-fyke nets in segment 3 of the Missouri River during fish community season 2006.

Table 28. Total number of sicklefin chubs captured for each gear during each season and the proportion caught within each macrohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0		(27)				(33)	(27)	(13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	26		19 (24)				35 (33)	19 (26)	27 (17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	0		(29)				(31)	(27)	(13)						
Beam Trawl	11		36 (26)				9 (36)	45 (26)	9 (9)	0 (2)					
Mini-Fyke Net	0		(8)				(36)	(6)	(17)	(27)	(6)				
Otter Trawl	34		21 (28)				37 (36)	42 (25)	0 (11)						

Table 29. Total number of sicklefin chubs captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	0		(92)	(8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	26		81 (93)	19 (7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	0		(97)	(3)		
Beam Trawl	11		100 (98)	0 (2)		
Mini-Fyke Net	0	(93)	(1)			
Otter Trawl	34		100 (95)	0 (5)		

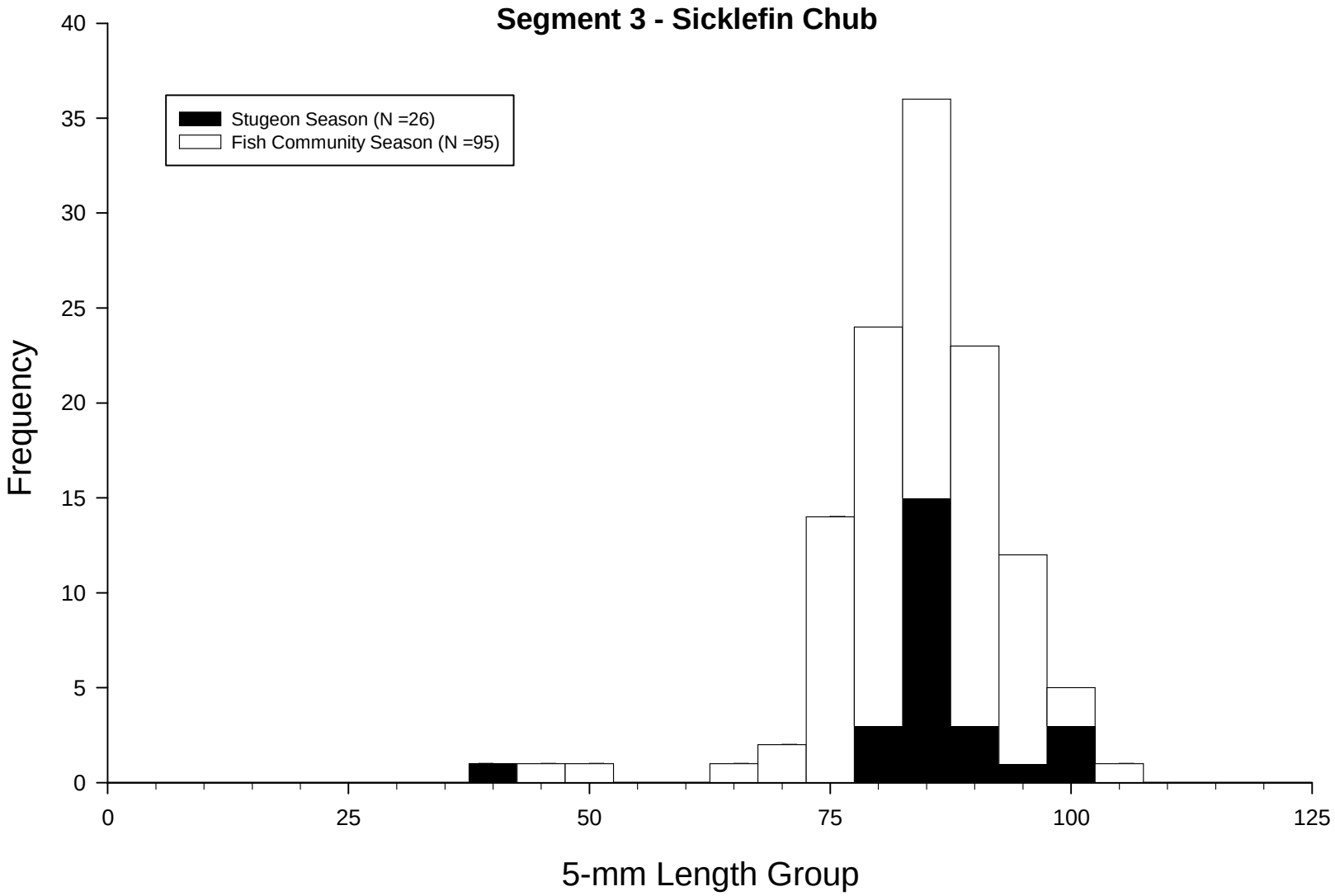

Figure 25. Length frequency of all sicklefin chubs during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 3 of the Missouri River during 2006.

Sand Shiner

Sand shiners were the most abundant target species captured in segment 3 during 2006 with a total of 1,650 sampled. All sand shiners were collected during the fish community season by means of mini fyke nets (N = 1,574), bag seines (N = 75), and beam trawls (N = 1). Sand shiners were not collected in either trammel nets or otter trawls (Figure 31). Of the total, 1,193 and 457 were collected in random and non-random bends respectively.

Sand shiners averaged 34.7 mm in TL with a minimum size of 21.0 mm and maximum of 60.0 mm TL. The length frequency histogram in Figure 33 displays the size structure for randomly sampled sand shiners.

Mini fyke net CPUE for sand shiners was 13.7 fish/net night (Figure 32). The highest catch in an individual mini fyke net subsample was recorded at river mile 1683, where 587 sand shiners were captured. This riverbend also had the third highest catch in another subsample at 122 sand shiners. One sand shiner was captured in the beam trawl, which correlates to a CPUE of 0.004 fish/100 m (Figure 31).

A large proportion (73%) of all randomly sampled sand shiners captured in mini fyke nets were sampled in small connected side channel macrohabitats, even though small connected side channels only made up 27% of the habitats sampled (Table 32). All sand shiners collected by mini fyke nets were sampled in bars mesohabitats (Table 33).

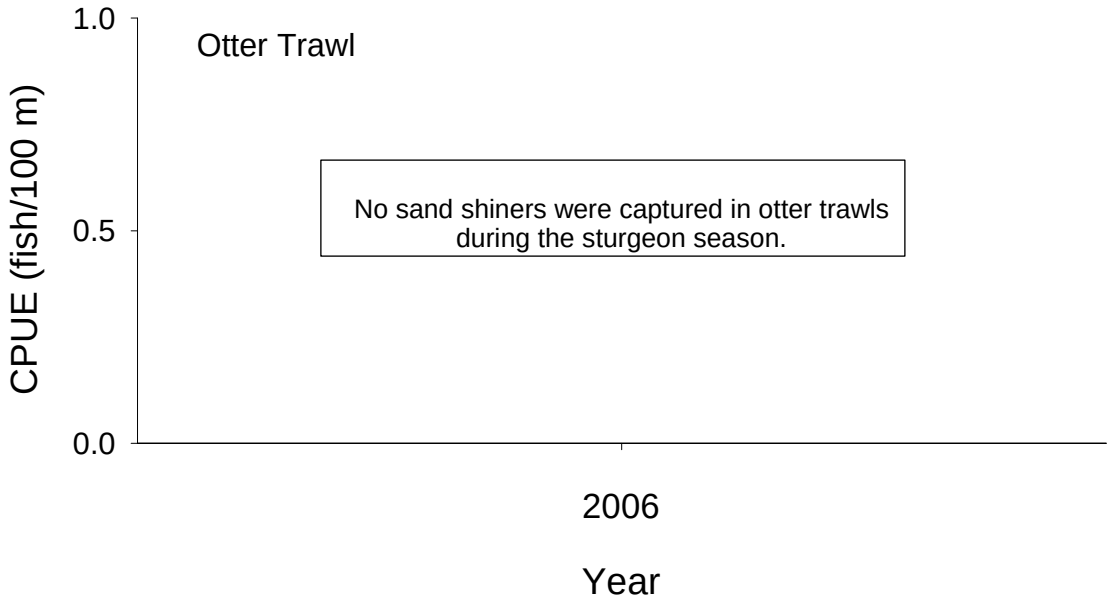

Figure 30. Mean annual catch-per-unit-effort (+/- 2SE) of sand shiner with otter trawls in segment 3 of the Missouri River during sturgeon season 2006.

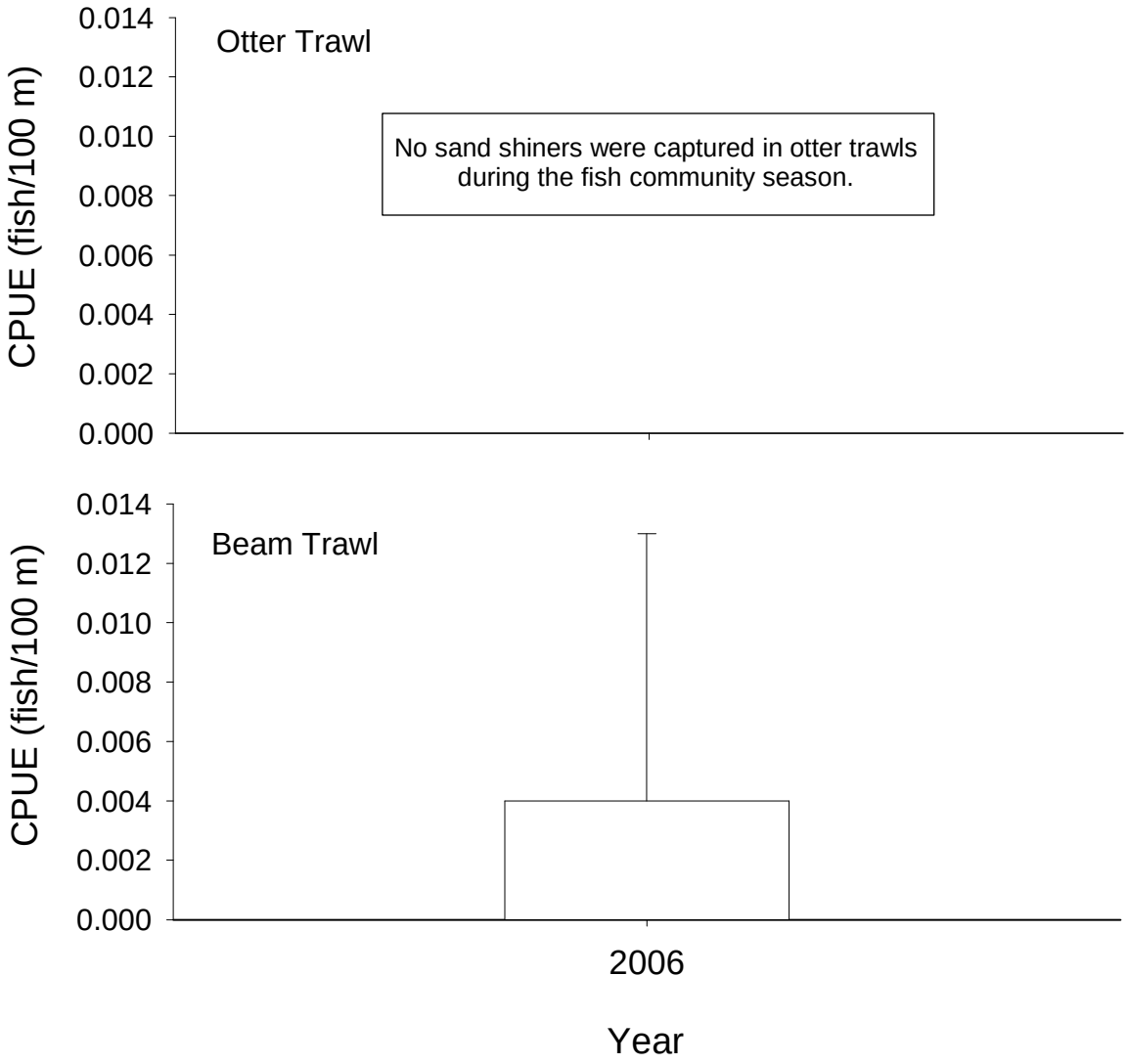

Figure 31. Mean annual catch-per-unit-effort (+/- 2SE) of sand shiner with otter trawls and beam trawls in segment 3 of the Missouri River during fish community season 2006.

Segment 3 - Sand Shiner / Fish Community Season

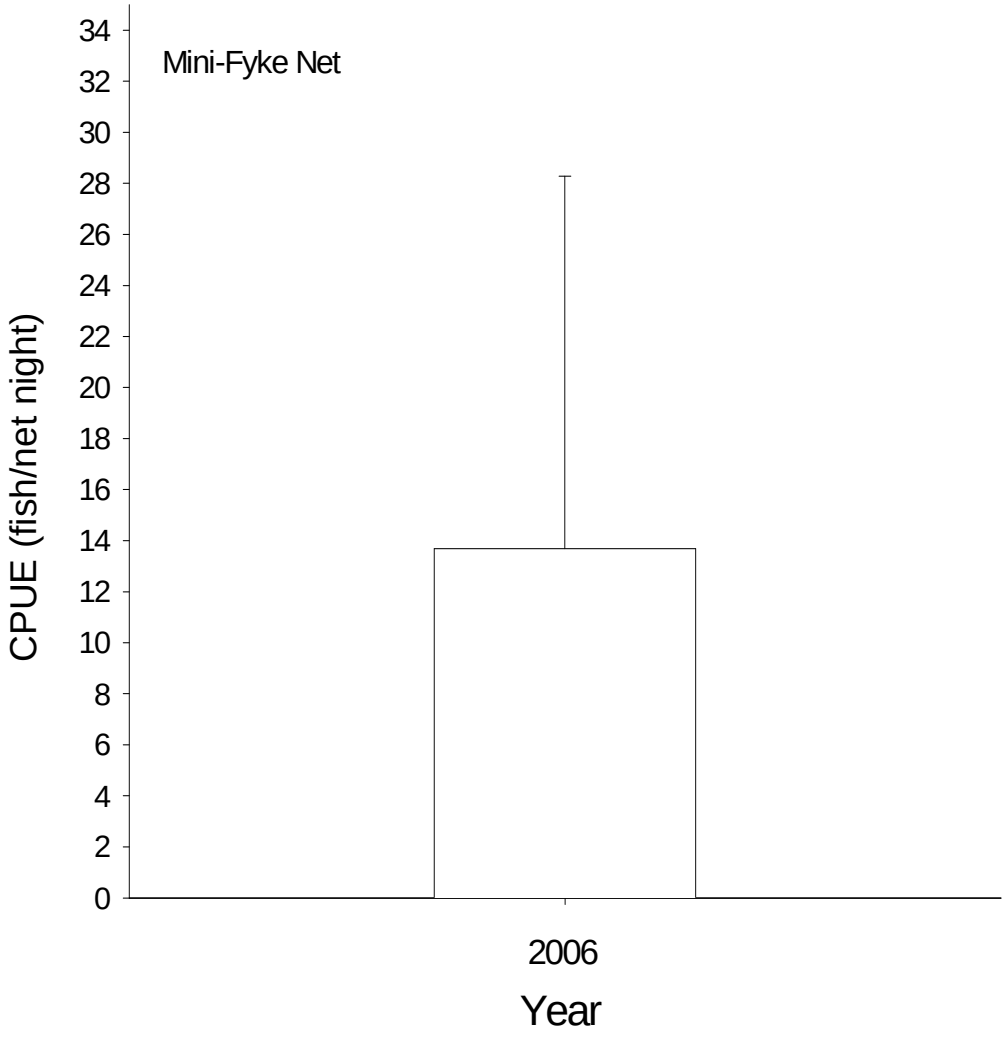

Figure 32. Mean annual catch-per-unit-effort (+/- 2SE) of sand shiner with mini-fyke nets in segment 3 of the Missouri River during fish community season 2006.

Table 32. Total number of sand shiners captured for each gear during each season and the proportion caught within each macrohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0		(27)				(33)	(27)	(13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	0		(24)				(33)	(26)	(17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	0		(29)				(31)	(27)	(13)						
Beam Trawl	1		0 (26)				0 (36)	0 (26)	100 (9)	0 (2)					
Mini-Fyke Net	1136		0 (8)				4 (36)	11 (6)	11 (17)	73 (27)	0 (6)				
Otter Trawl	0		(28)				(36)	(25)	(11)						

Table 33. Total number of sand shiners captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	0		(92)	(8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	0		(93)	(7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	0		(97)	(3)		
Beam Trawl	1		100 (98)	0 (2)		
Mini-Fyke Net	1136	100 (93)	0 (1)			
Otter Trawl	0		(95)	(5)		

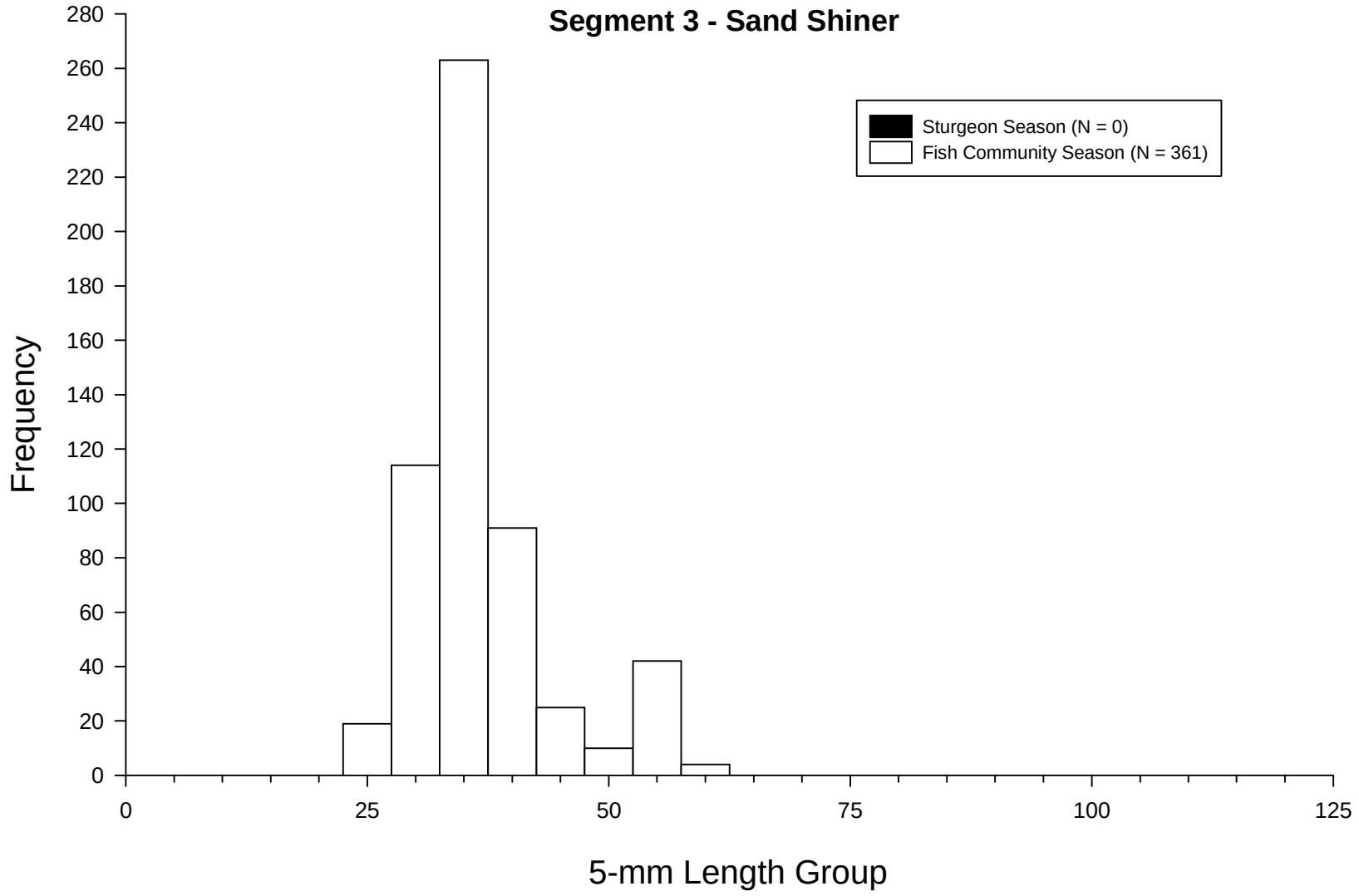

Figure 33. Length frequency of all measured sand shiners during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 3 of the Missouri River during 2006.

Western silvery minnows

A total of 105 and 43 western silver minnows and fish identified only to the *Hybognathus* genus were collected in segment 3 during 2006, respectively. Since specimens of plains minnows were not found anywhere in segments 3 or 2, the two groups were combined for most analysis assuming all were western silvery minnows. Western silvery minnows were collected in both random (N = 102) and non-randomly (N = 46) selected bends. Of the total, 145 were collected during fish community season and 3 were collected during sturgeon season. More western silvery minnows were collected in mini fyke nets (N = 90) than bag seines (N = 51) or otter trawls (N = 7). However, bag seines were used in only 7 bends whereas mini fyke nets were set in 15 bends. No western silver minnows were captured in either the beam trawl or trammel nets.

Western silvery minnows had an average TL of 80.2 mm, with a minimum and maximum size of 30.0 and 126.0 mm TL. On average, western silvery minnows captured in the mini fyke nets (mean TL = 71.5) were smaller than those captured in bag seines (mean TL = 91.5). The size distribution of western silver minnows captured in standard gears in random bends is shown in Figure 37.

Mini fyke nets had a CPUE of 0.578 fish/net night for standard gears in random bends during 2006. Catch-per-unit-effort was similar for the otter trawl in both sturgeon (CPUE = 0.008 fish/net night) and fish community (CPUE = 0.003 fish/net night) seasons, and both were relatively low.

The random mini fyke net catch occurred mainly in small connected side channels (29%), large connected side channels (29%), inside bends (21%), and small non-connected side channels (17%)(Table 34). The majority of western silver minnows were collected in bars mesohabitats (Table 35).

Segment 3 - Western silvery minnows / Sturgeon Season

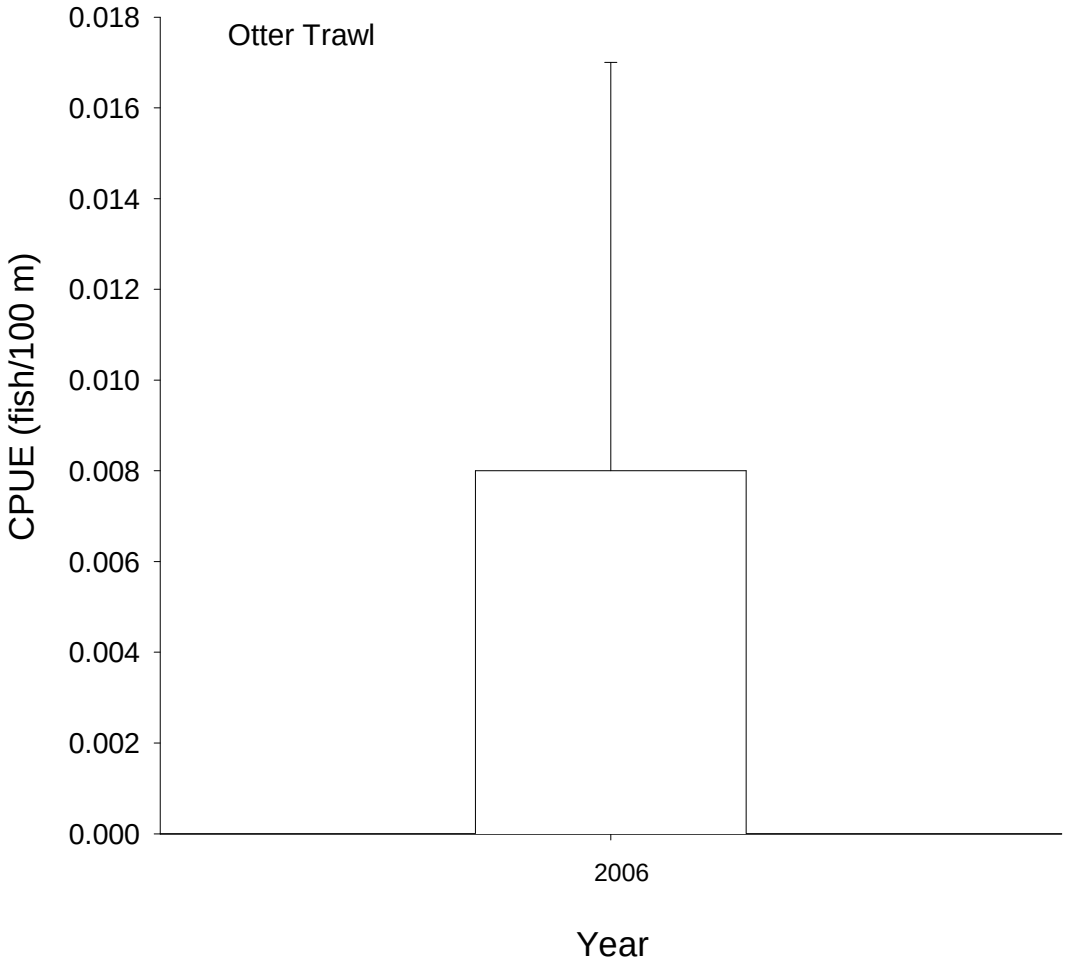

Figure 34. Mean annual catch-per-unit-effort (+/- 2SE) of western silver minnows with otter trawls in segment 3 of the Missouri River during sturgeon season 2006.

Segment 3 - Western silvery minnows / Fish Community Season

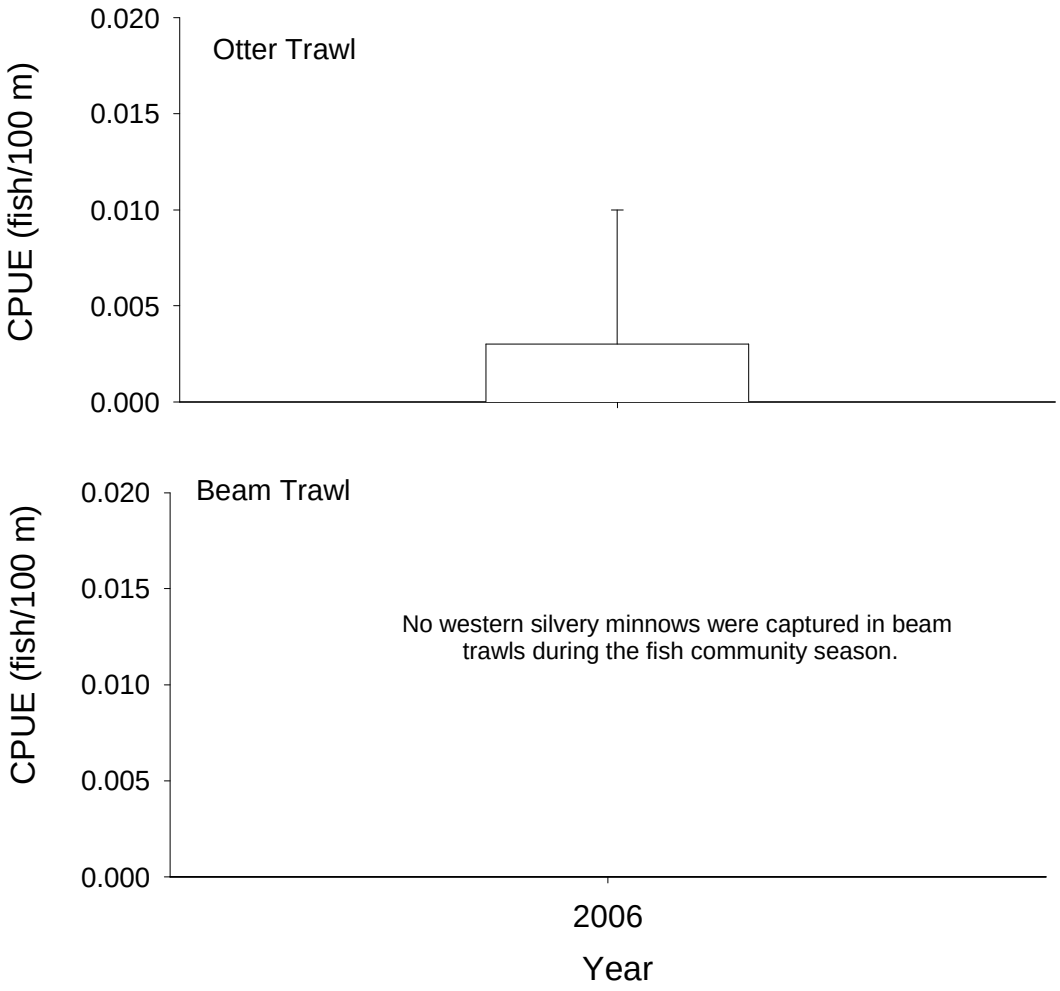

Figure 35. Mean annual catch-per-unit-effort (+/- 2SE) of western silvery minnows with otter trawls and beam trawls in segment 3 of the Missouri River during fish community season 2006.

Segment 3 - Western silvery minnows/ Fish Community Season

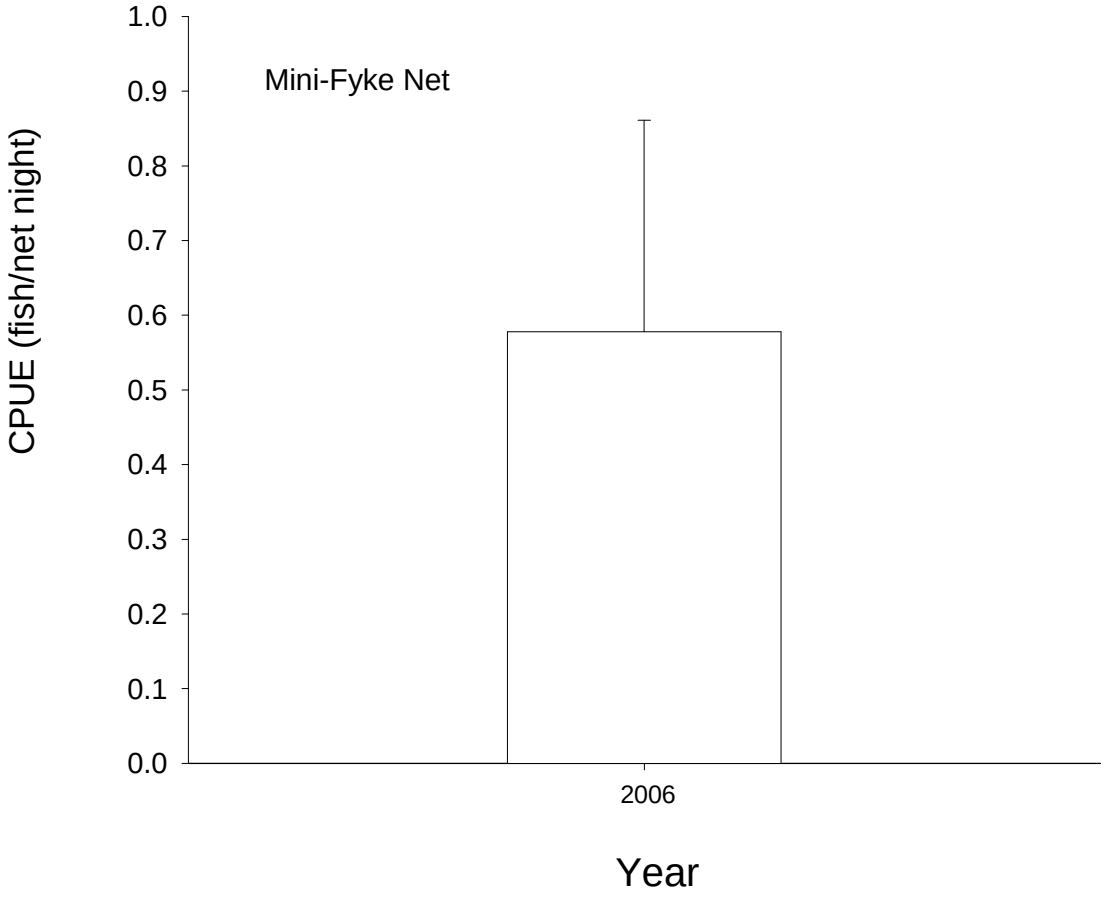

Figure 36. Mean annual catch-per-unit-effort (+/- 2SE) of western silvery minnows with mini-fyke nets in segment 3 of the Missouri River during fish community season 2006.

Table 34. Total number of western silvery minnows captured for each gear during each season and the proportion caught within each macrohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0		(27)				(33)	(27)	(13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	3		33 (24)				67 (33)	0 (26)	0 (17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	0		(29)				(31)	(27)	(13)						
Beam Trawl	0		(26)				(36)	(26)	(9)	(2)					
Mini-Fyke Net	48		4 (8)				21 (36)	0 (6)	29 (17)	29 (27)	17 (6)				
Otter Trawl	2		50 (28)				50 (36)	0 (25)	0 (11)						

Table 35. Total number of western silvery minnows captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	0		(92)	(8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	3		100 (93)	0 (7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	0		(97)	(3)		
Beam Trawl	0		(98)	(2)		
Mini-Fyke Net	48	79 (93)	4 (1)			
Otter Trawl	2		100 (95)	(5)		

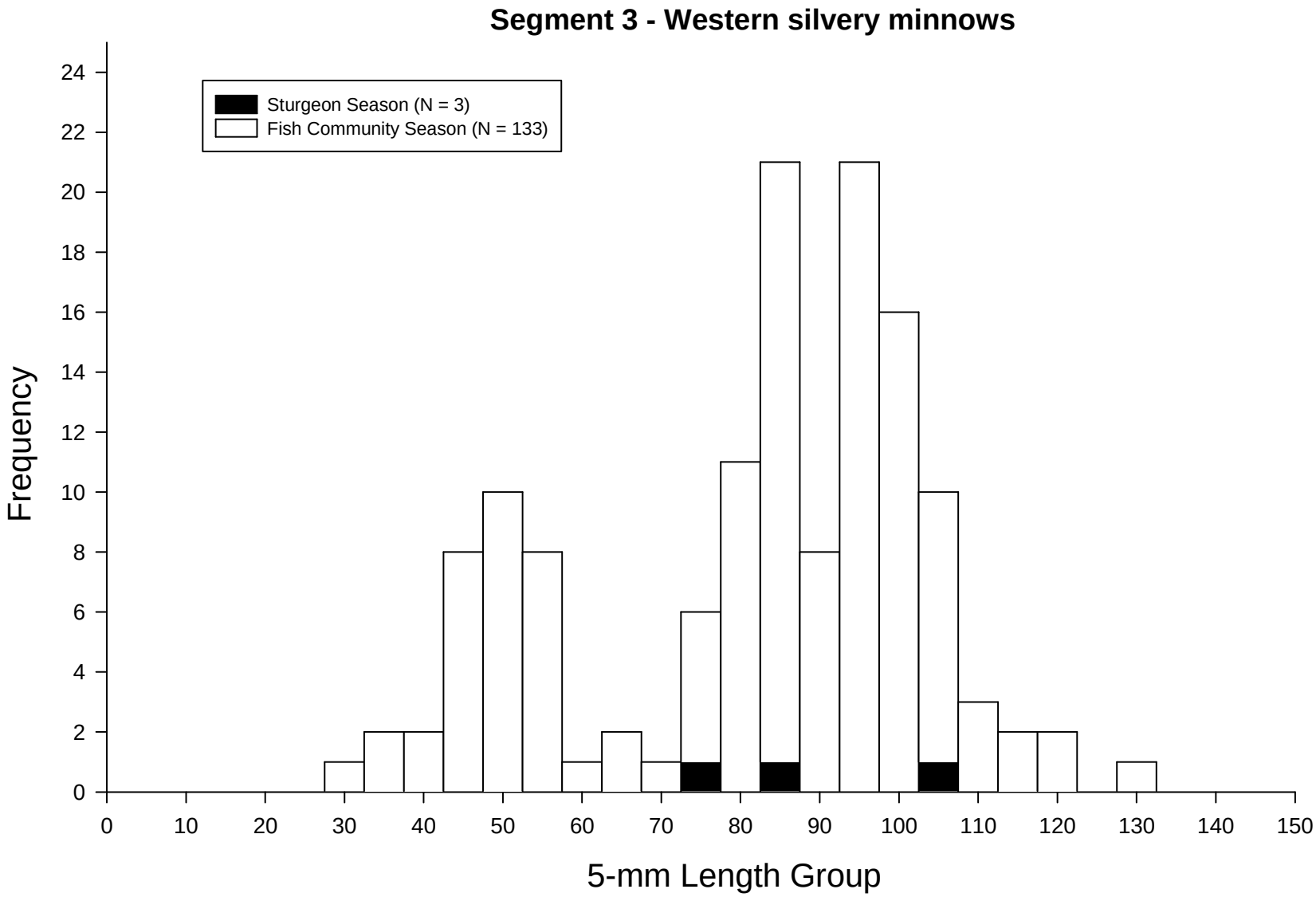

Figure 37. Length frequency of all western silvery minnows caught during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 3 of the Missouri River during 2006.

Blue Sucker

A total of four blue suckers were sampled in segment 3 during 2006. All four were captured in trammel nets three of which were sampled in random bends while one was sampled in a non-random bend. Two blue suckers were captured in each of the sturgeon and fish community seasons and all were sampled at different river miles.

Blue suckers were sampled at a similar rate using trammel nets for both sturgeon (CPUE = 0.009 fish/ 100m) and fish community (CPUE = 0.008 fish/100 m) seasons (Figures 39 and 41). The four fish averaged 689.5 mm TL with the largest at 722 mm TL and the smallest at 655 mm TL. Consequently, all were large adult fish and therefore no signs of blue sucker recruitment was observed in segment 3.

Two of the randomly sampled blue suckers were sampled in inside bends while one was sampled in an outside bend (Table 36). All were sampled in channel border mesohabitats (Table 37).

Segment 3 - Blue Sucker / Sturgeon Season

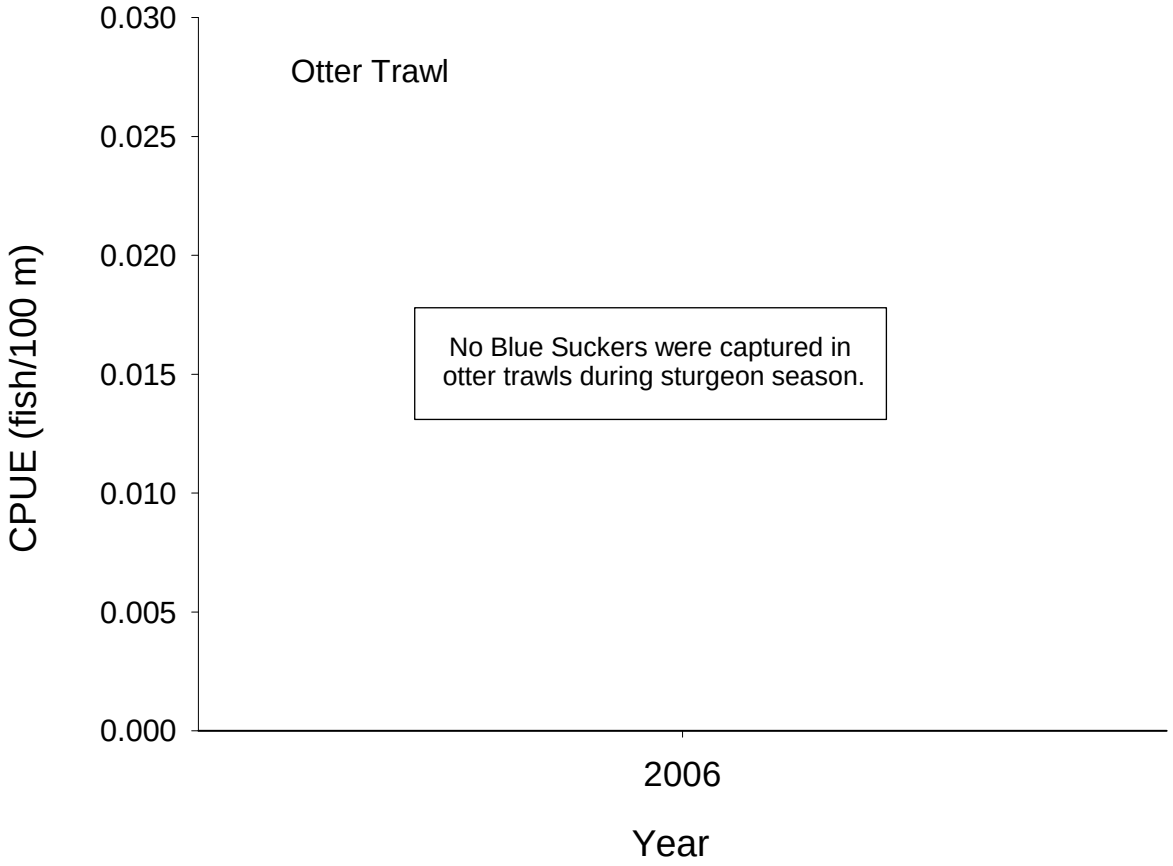

Figure 38. Mean annual catch-per-unit-effort (+/- 2SE) of blue sucker with otter trawls in segment 3 of the Missouri River during sturgeon season 2006.

Segment 3 - Blue Sucker / Sturgeon Season

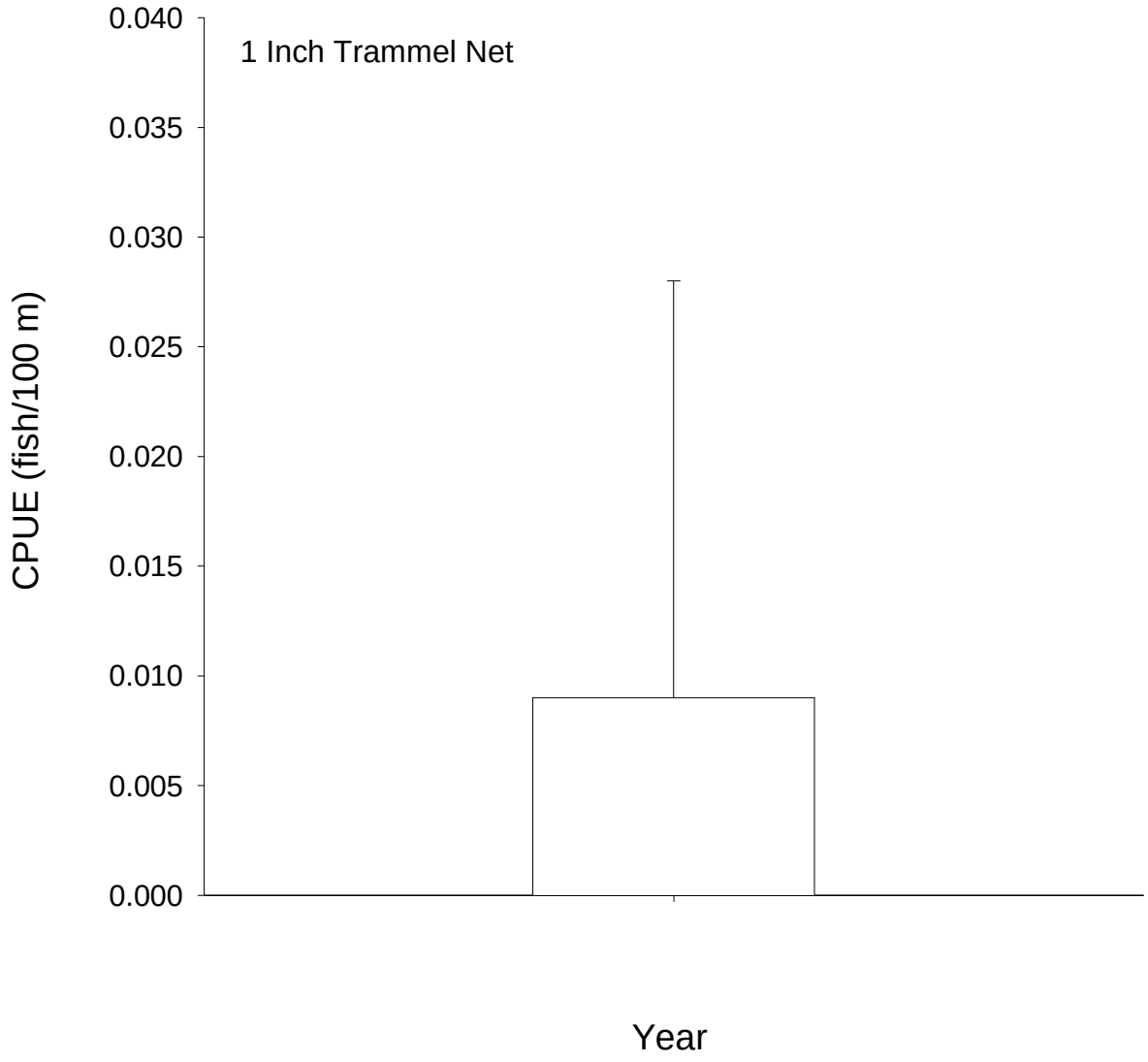

Figure 39. Mean annual catch-per-unit-effort (+/- 2SE) of blue sucker with 1 inch trammel nets in segment 3 of the Missouri River during sturgeon season 2006.

Segment 3 - Blue Sucker / Fish Community Season

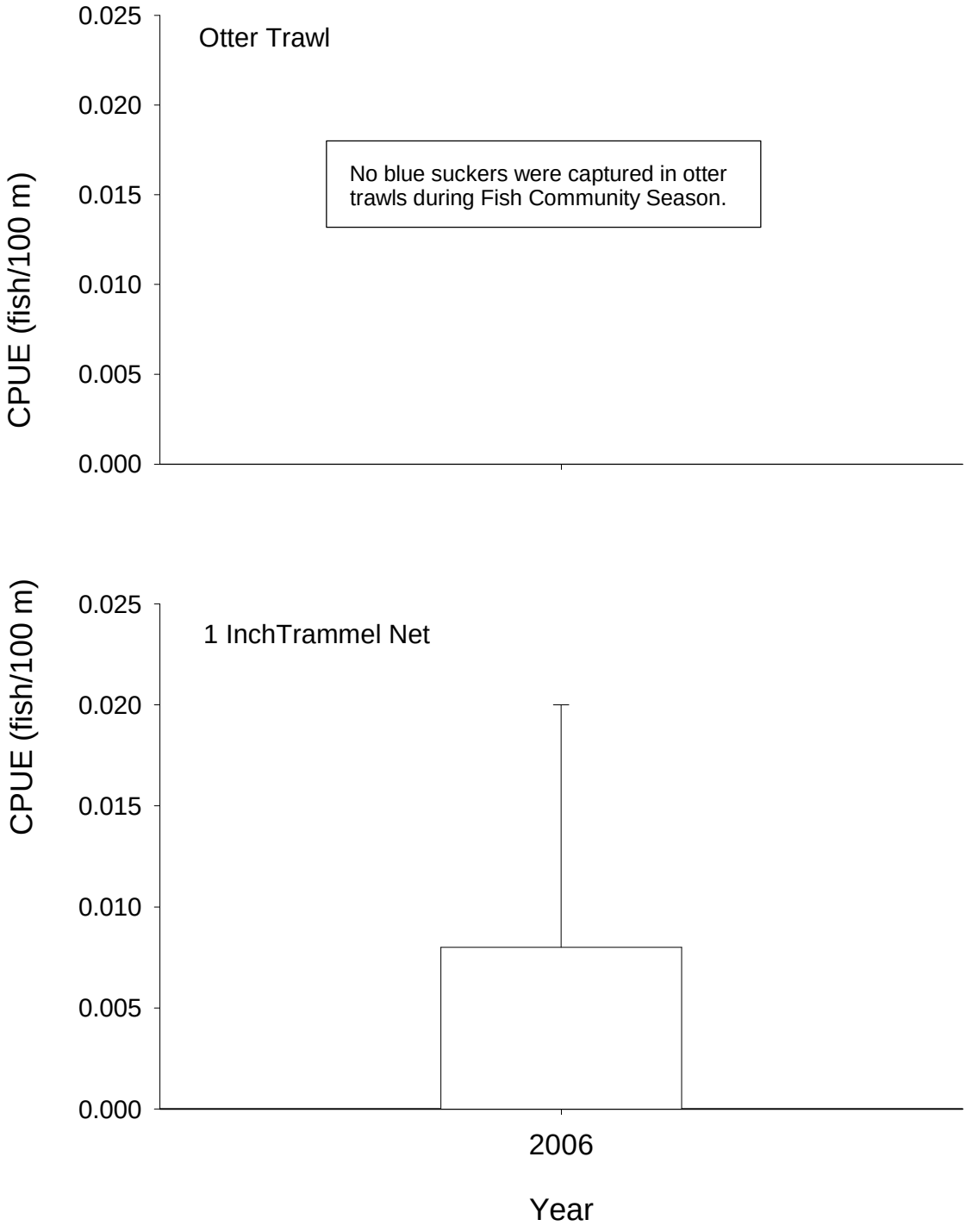

Figure 41. Mean annual catch-per-unit-effort (+/- 2SE) of blue sucker using otter trawls and 1 inch trammel nets in segment 3 of the Missouri River during fish community season 2006.

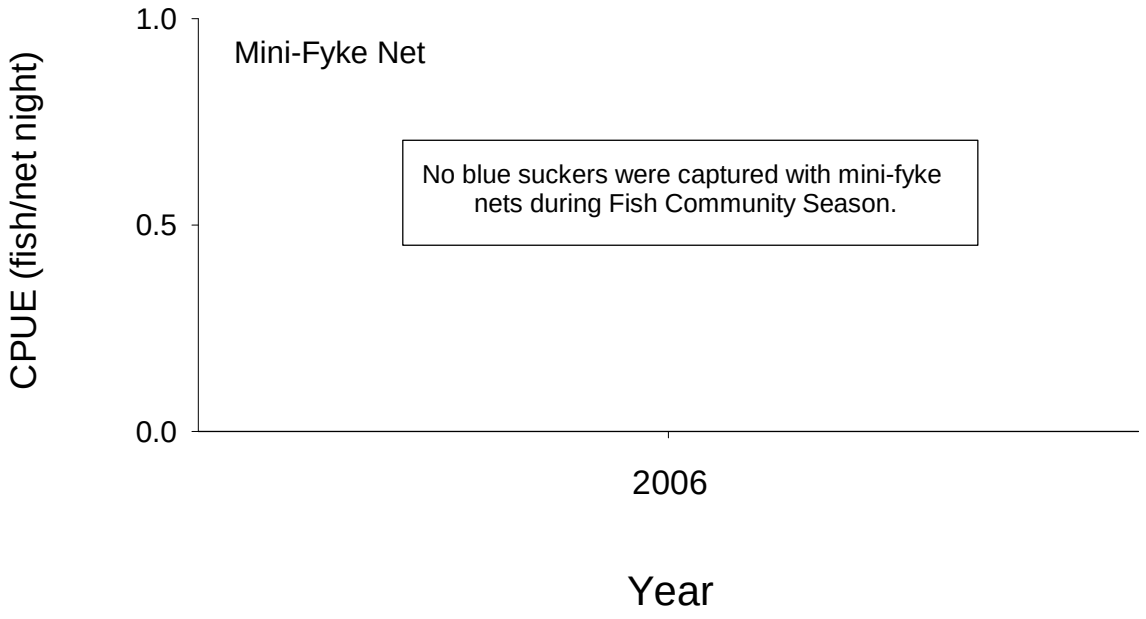

Figure 42. Mean annual catch-per-unit-effort (+/- 2SE) of blue suckers using mini-fyke nets in segment 3 of the Missouri River during fish community season 2006.

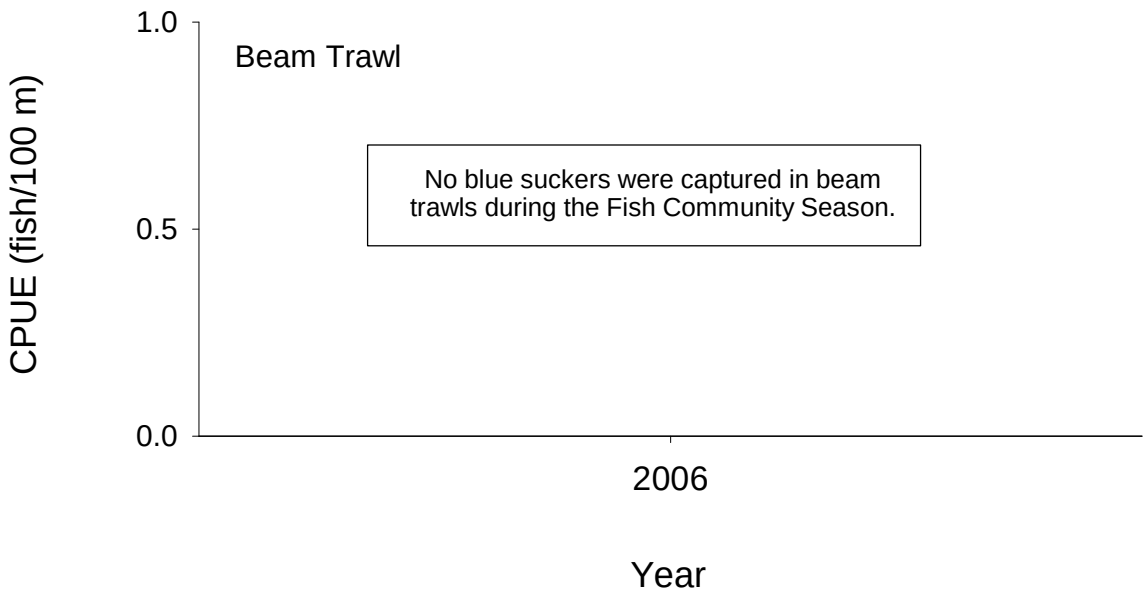

Figure 43. Mean annual catch-per-unit-effort (+/- 2SE) of blue sucker using beam trawls in segment 3 of the Missouri River during fish community season 2006.

Table 36. 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 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	1		0 (27)				100 (33)	0 (27)	0 (13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	0		 (24)				 (33)	 (26)	 (17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	2		0 (29)				50 (31)	50 (27)	0 (13)						
Beam Trawl			 (26)				 (36)	 (26)	 (9)	 (2)					
Mini-Fyke Net			 (8)				 (36)	 (6)	 (17)	 (27)	 (6)				
Otter Trawl			 (28)				 (36)	 (25)	 (11)						

Table 37. Total number of blue suckers captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	**Mesohabitat**				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	1		100 (92)	0 (8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	0		(93)	(7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	2		100 (97)	0 (3)		
Beam Trawl	0		(98)	(2)		
Mini-Fyke Net	0	(93)	(1)			
Otter Trawl	0		(95)	(5)		

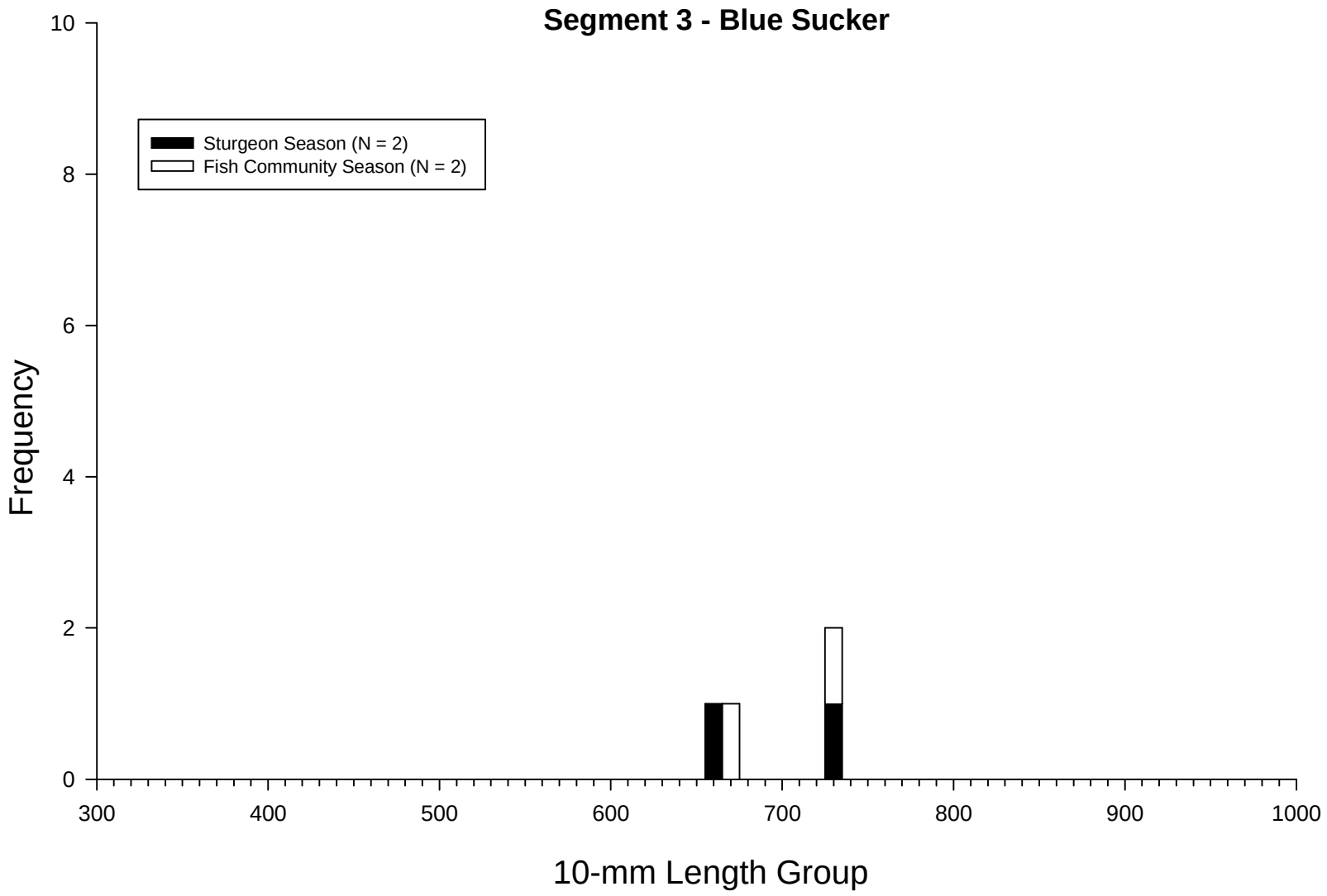

Figure 44. Length frequency of all blue suckers during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 3 of the Missouri River during 2006.

Sauger

A total of 125 saugers were captured in segment 3 during 2006, with 91 being in randomly selected bends and 34 in non-random bends. A total of 78 were sampled in random subsamples in randomly selected bends. Saugers were captured in each gear used as follows, trammel nets (N = 51), otter trawl (N = 39), mini fyke nets (N = 21), bag seine (N = 5), and beam trawl (N = 5). More saugers were captured during the fish community season (N = 91) than in the sturgeon season (N = 30). There were no obvious patterns in the distribution of sauger catch in segment 3, they were captured throughout the length of the segment.

Saugers averaged 290.0 mm TL, although saugers sampled during the sturgeon season were on average larger (mean TL = 335.7 mm) than those captured in the fish community season (mean TL = 272.3). The difference in mean lengths by season was likely due to the differences in the size of catch by gears. On average, trammel nets captured the largest saugers (mean TL = 350.9 mm), while bag seines captured the smallest (mean TL = 109.6 mm). Little difference was seen in the size of saugers between mini fyke nets (mean TL = 269.2 mm) and otter trawls (mean TL = 264.0). The length frequency histogram in Figure 51 displays the different size classes of sauger captured using standard gears in random bends. Based on Pierce et al. (2003) approximately seven age classes of saugers were sampled in segment 3 during 2006. Although not a lot of small saugers (< 150 mm) were sampled, the presence of these small fish during the summer and fall does indicate natural recruitment and rearing of young-of-the-year (YOY) fish.

Trammel nets had a higher CPUE for both sturgeon (0.093 fish/100 m) and fish community (0.076 fish/100 m) than otter trawls (0.030 and 0.032 fish/100 m) (Figures 45, 46 and 48). Beam trawl CPUE (0.031 fish/100 m) was similar to the otter trawl (Figure 50). Mini fyke nets averaged 0.241 fish/net night (Figure 49).

The proportion of saugers sampled in macrohabitats by gear and the proportion those habitats were sampled is shown in Table 38. The majority of saugers were sampled in channel border mesohabitats, although for both the otter and beam trawl the proportion of saugers sampled in island tips was higher than the proportion island tips were sampled (Table 39).

Segment 3 - Sauger / Sturgeon Season

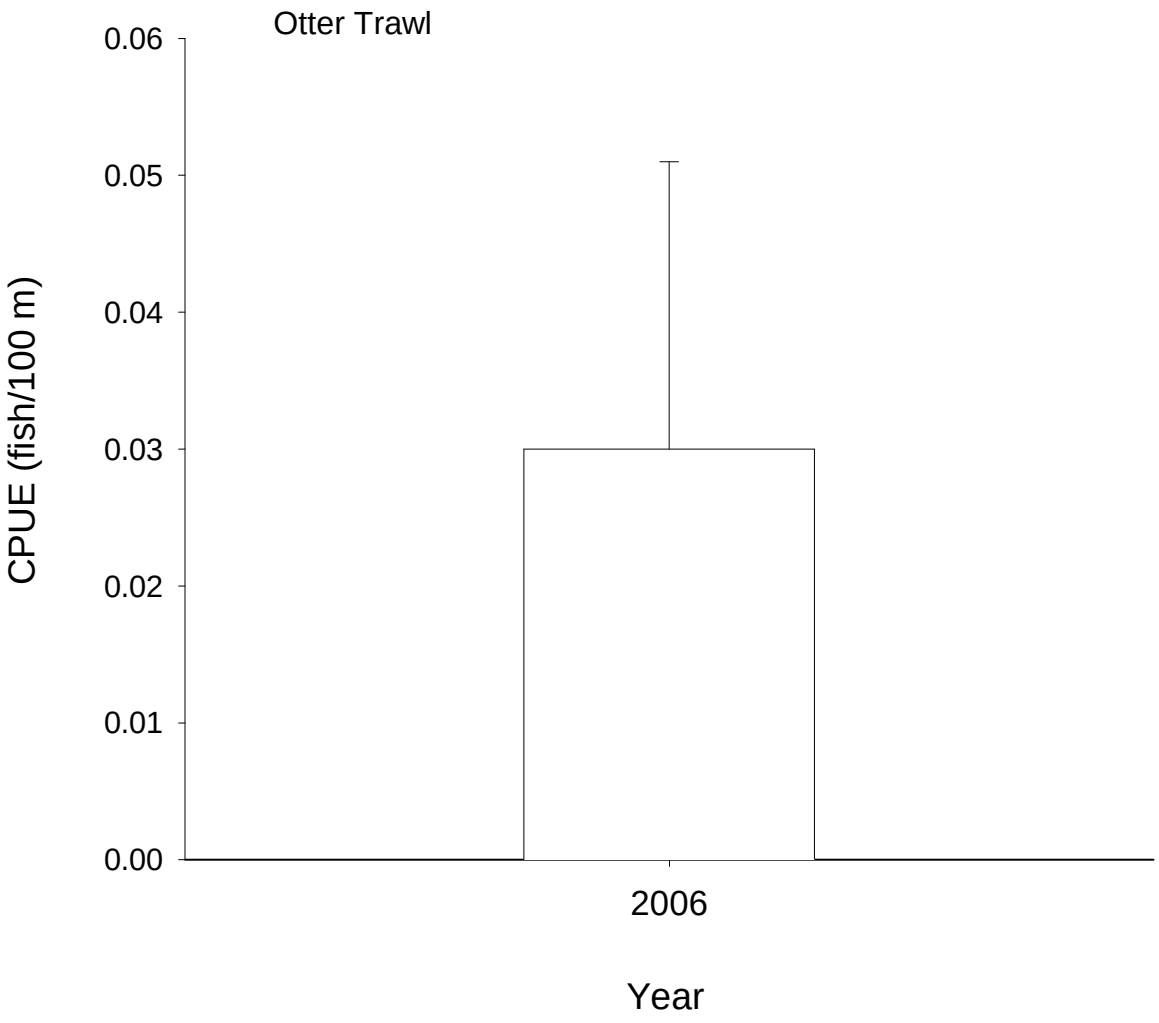

Figure 45. Mean annual catch-per-unit-effort (+/- 2SE) of sauger using otter trawls in segment 3 of the Missouri River during sturgeon season 2006.

Segment 3 - Sauger / Sturgeon Season

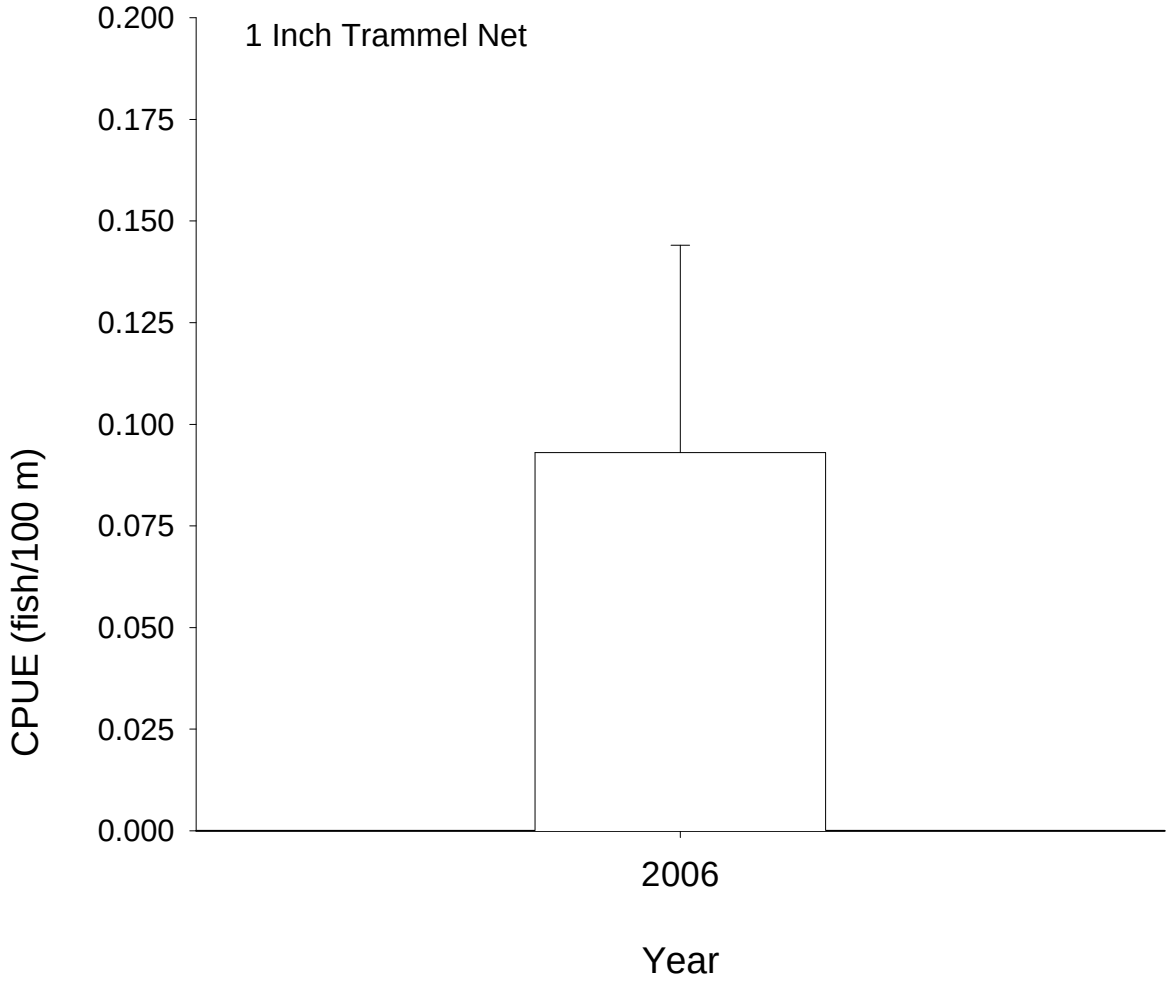

Figure 46. Mean annual catch-per-unit-effort (+/- 2SE) of sauger using 1 inch trammel nets in segment 3 of the Missouri River during sturgeon season 2006.

Segment 3 - Sauger / Fish Community Season

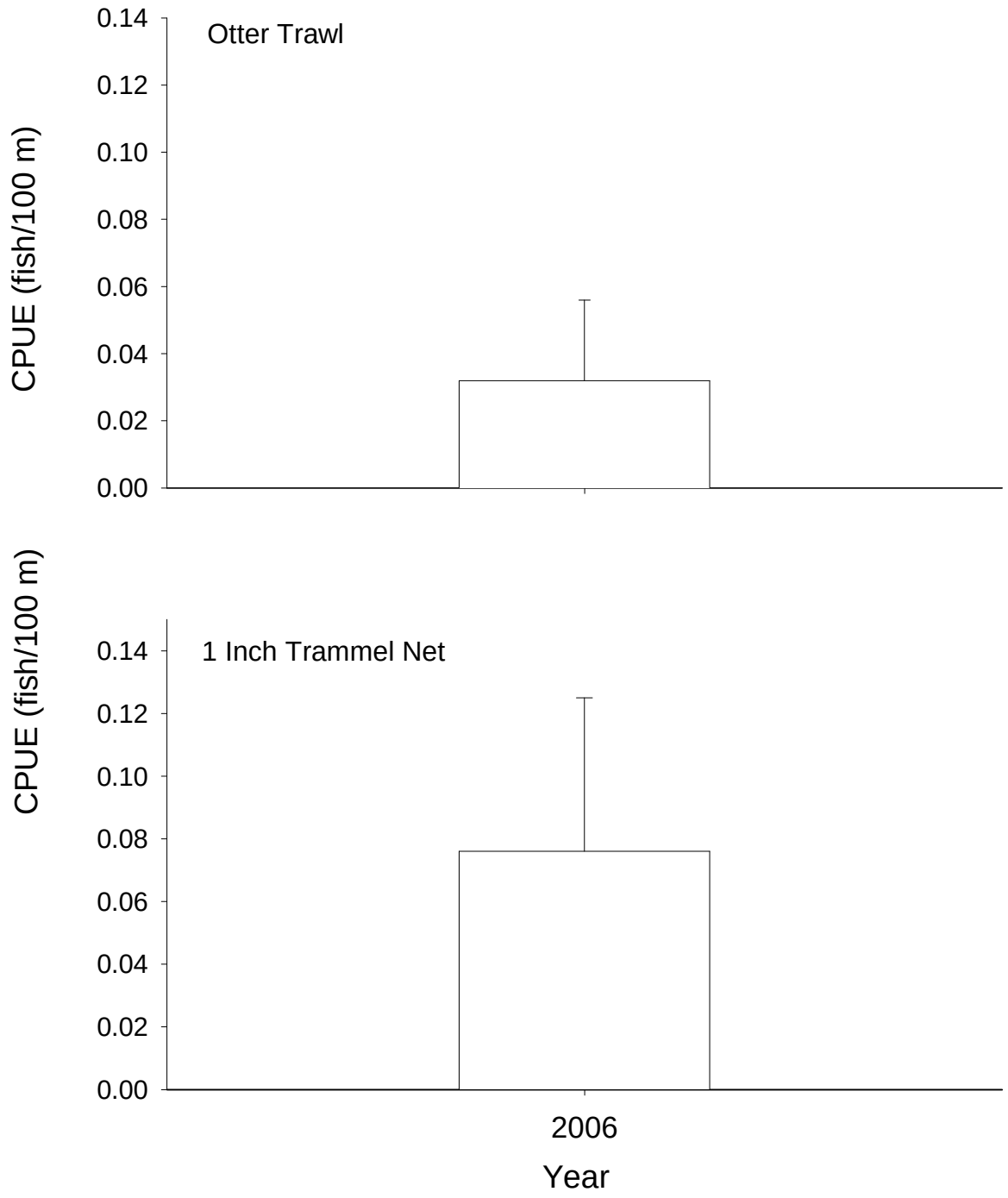

Figure 48. Mean annual catch-per-unit-effort (+/- 2SE) of sauger using otter trawls and 1 inch trammel nets in segment 3 of the Missouri River during fish community season 2006.

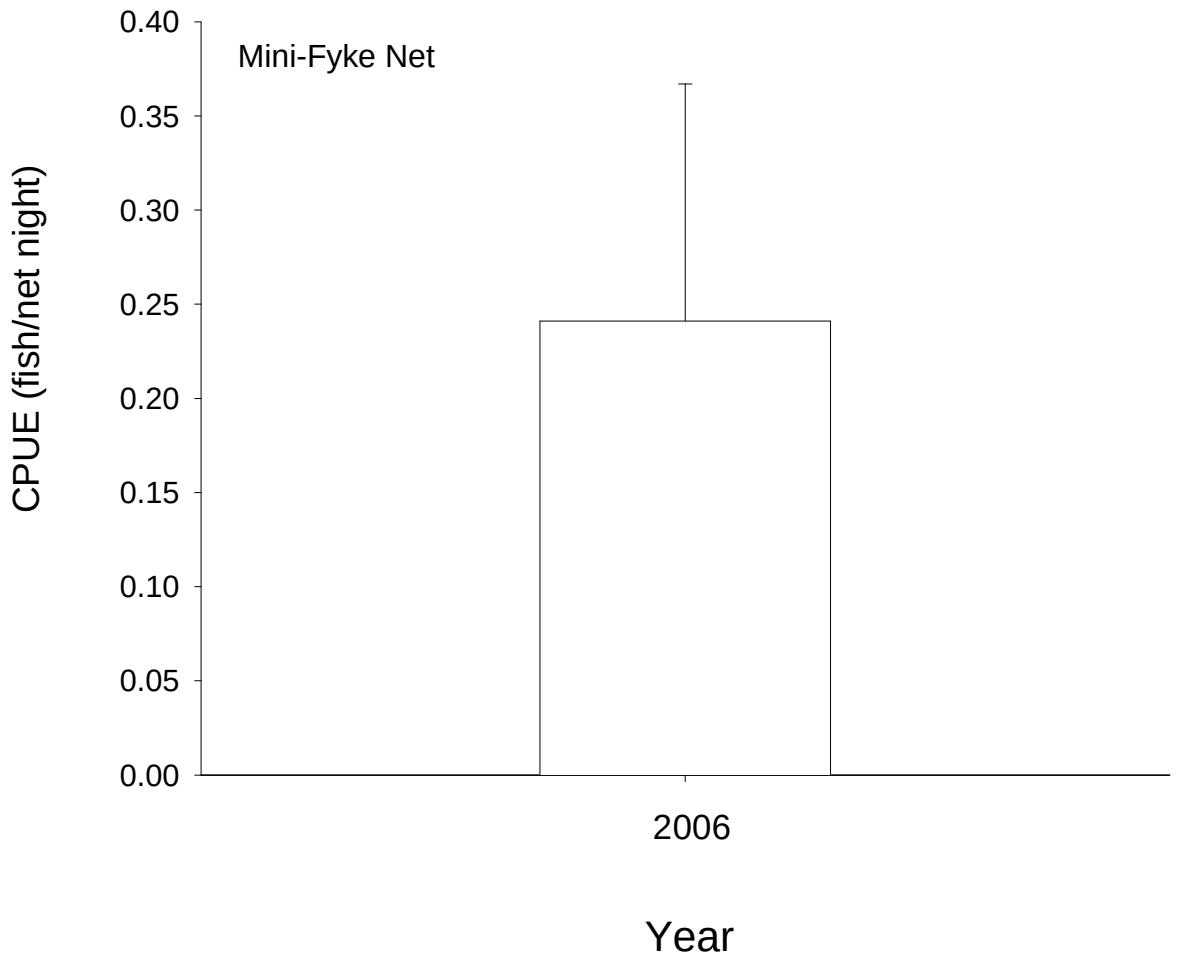

Figure 49. Mean annual catch-per-unit-effort (+/- 2SE) of sauger using mini-fyke nets in segment 3 of the Missouri River during fish community season 2006.

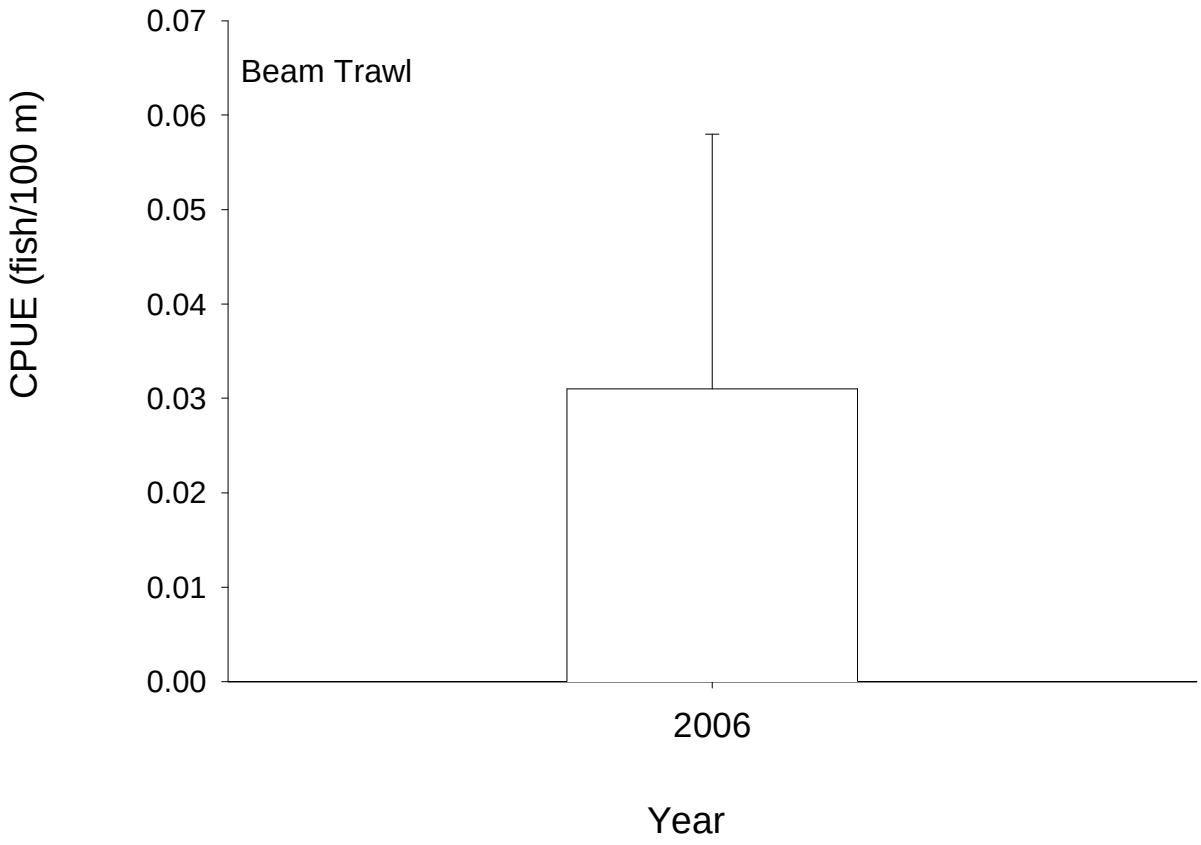

Figure 50. Mean annual catch-per-unit-effort (+/- 2SE) of sauger using beam trawls in segment 3 of the Missouri River during fish community season 2006.

Table 38. 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 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	23		17 (27)				30 (33)	26 (27)	26 (13)						
2.5 Inch Trammel Net															
Beam Trawl															
Gill Net															
Otter Trawl	9		11 (24)				22 (33)	56 (26)	11 (17)						
Fish Community Season (Summer)															
1 Inch Trammel Net	16		6 (29)				25 (31)	12 (27)	56 (13)						
Beam Trawl	5		20 (26)				20 (36)	20 (26)	40 (9)	0 (2)					
Mini-Fyke Net	20		(8)				35 (36)	(6)	20 (17)	25 (27)	20 (6)				
Otter Trawl	9		11 (28)				33 (36)	33 (25)	22 (11)						

Table 39. Total number of saugers captured for each gear during each season and the proportion caught within each mesohabitat type in segment 3 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Blanks indicate the habitat was either not sampled or is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	23		96 (92)	4 (8)		
2.5 Inch Trammel Net						
Beam Trawl						
Gill Net						
Otter Trawl	9		89 (93)	11 (7)		
Fish Community Season (Summer)						
1 Inch Trammel Net	16		100 (97)	0 (3)		
Beam Trawl	5		80 (98)	20 (2)		
Mini-Fyke Net	20	80 (93)	0 (1)			
Otter Trawl	9		78 (95)	22 (5)		

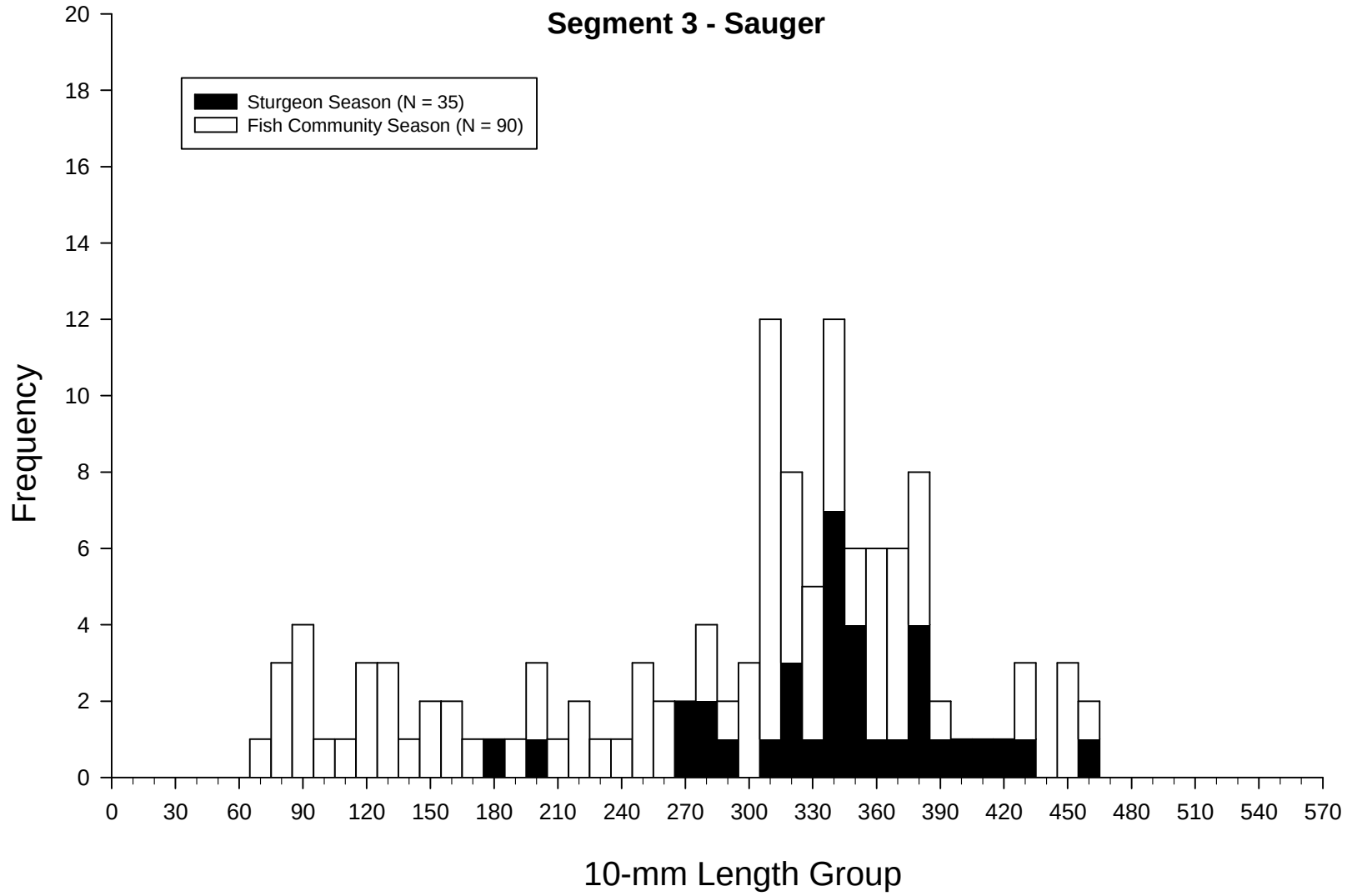

Figure 51. Length frequency of all sauger during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 3 of the Missouri River during 2006.

Missouri River Fish Community

A total of 17,180 fish consisting of 31 species were sampled in segment 3 during 2006. Considerably more fish were sampled during the fish community season (N = 16,477) when compared to the sturgeon season (N = 703). More species were collected in mini fyke nets (N = 21) and bag seines (N = 21) than otter trawls (N = 19), trammel nets (N = 16), or beam trawls (N = 14). Over 1,000 individuals were sampled from six species, which included emerald shiners *Notropis atherinoides* (N = 4,117), white suckers *Catostomus commersoni* (N = 3,199), fathead minnows *Pimephales promelas* (N = 3,167), river carpsuckers *Carpiodes carpio* (N =1,872), sand shiners (N = 1,650) and flathead chubs *Platygobio gracilis* (N = 1,127). An additional 12 species had sample sizes over 50 individuals, those species in order of abundance were sturgeon chubs (N = 598), goldeye *Hiodon alosoides* (N = 223), shovelnose sturgeon (N = 150), western silvery minnows (N = 148), white crappie *Pomoxis annularis* (N= 131), sauger (N = 125), longnose sucker *Catostomus catostomus* (N = 122), sicklefin chub (N = 122), stonecat *Noturus flavus* (N = 84), channel catfish *Ictalurus punctatus* (N =71), shorthead redhorse *Moxostoma macrolepidotum* (N = 56), common carp *Cyprinus carpio* (N = 51).

The beam trawl, otter trawl, and bag seine all collected six target species, while the trammel net and mini fyke nets captured four. The beam trawl had the highest proportion of catch that consisted of target species (69.6%), of which 91.7% were sturgeon and sicklefin chubs. Similarly, the otter trawl catch was comprised of 57.9% target species, consisting of 82.1% sturgeon and sicklefin chubs. The trammel net catch consisted of 35.3% target species, with 56.0% being shovelnose sturgeon. For shallow water gears, target species made up 14.5% of the mini fyke net catch, of which 93.4% were sand shiners. Bag seines had the lowest proportion of catch that consisted of target species at 3.8%.

Otter trawl CPUE was highest for sturgeon chubs (CPUE = 0.67 fish/100 m) and flathead chubs (CPUE = 0.27 fish/100 m) (Appendix F4). These two species were the most abundant fish captured in the otter trawl during both the sturgeon (sturgeon chub: N = 228, flathead chub: N = 60) and fish community (sturgeon chub: N = 247, flathead chub: N = 231) seasons. Similarly, sturgeon chub (CPUE = 0.62 fish/100 m) and flathead chub (CPUE = 0.18 fish/100 m) were the most abundant species sampled using the beam trawl (Appendix F5).

Trammel nets caught more goldeye (N = 165) and shovelnose sturgeon (N = 67) than any other species, with a CPUE of 0.327 and 0.159 fish/100 m, respectively (Appendix F2).

However, during the fish community season, shovelnose sturgeon CPUE (0.235 fish/100 m) was higher than all other species.

Mini fyke nets had CPUE > 13 fish/net night for 3 species, fathead minnows (24.04 fish/net night), river carpsuckers (17.46 fish/net night), and sand shiners (13.69 fish/ net night).

Other species sampled during 2006 included burbot *Lota lota* (N = 20), longnose dace *Rhinichthys cataractae* (N = 17), smallmouth buffalo *Ictiobus bubalus* (N = 11), walleye *Sander vitreus* (N = 5), bigmouth buffalo *Ictiobus cyprinellus* (N = 3), green sunfish *Lepomis cyanellus* (N= 3), freshwater drum *Aplodinotus grunniens* (N = 1), northern redbelly dace *Phoxinus eos* (N = 1), paddlefish *Polyodon spathula* (N =1), pumpkinseed *Lepomis gibbosus* (N = 1), and spottail shiner *Notropis hudsonius* (N = 1).

Nonnative species comprised approximately 1.1 % of the total catch in segment 3 consisting of six species, white crappie (N = 131), common carp (N = 51), walleye (N = 5), green sunfish (N = 3), pumpkinseed (N = 1), and spottail shiner (N = 1).

Discussion

The 2006 field season was the first year of the Population Assessment Program in Montana. We captured a total of 48 hatchery reared pallid sturgeon and one pallid sturgeon of unknown origin. Genetics were taken on the one unknown origin pallid sturgeon (FL = 116 mm) and the results are not currently available. The otter trawl was the most effective gear in sampling juvenile pallids sturgeon, capturing 29 in segment 3, while the trammel net captured 18. Pallid sturgeon sampled in the otter trawl were on average smaller (mean FL = 237.4 mm) than those captured in trammel nets (mean FL = 273.6 mm).

A total of 6,044 2005-year class age-1 pallid sturgeon were stocked into segments 2 and 3 before the end of the 2006 sampling season. This age class (2005) made up the majority (83.7%) of the pallids sturgeon catch in segment 3 during 2006. We did not observe any evidence of pallid sturgeon natural recruitment in segment 3 during 2006.

Sand shiners were the most abundant target species sampled in segment 3, with 1,650 sampled. The majority (95.4%) of sand shiners were captured in mini fyke nets. Mini fyke nets also captured 60.8% of all western silvery minnows. However, bag seines collected 34.5% of the total western silvery minnow catch and were only used in 8 bends compared to mini fyke nets that were deployed in 15 bends.

The otter trawl captured 79.4 and 89.3% of all sturgeon and sicklefin chubs, respectively. Although, effort between the otter and beam trawls were not equal, since we sampled almost four times as much river with the otter trawl (72,618 m) than the beam trawl (18,809 m). We collected 41.0% of all sicklefin chubs at the two downstream most river bends sampled in segment 3 (river mile 1591 and 1592.5), both of which were non-random bends near Nohly, MT. Overall, sturgeon and sicklefin chubs were more abundant in the middle to lower portions of segment 3 than the upper portions.

Both sturgeon and sicklefin chubs were more abundant in segment 3 than upstream in segment 2 (Haddix et al. 2007). Additionally, considerably more flathead chubs and river carpsuckers were sampled in segment 3 than in segment 2. Conversely, shovelnose sturgeon, western silvery minnows, white suckers, shorthead redhorses, and longnose dace were more abundant in segment 2 than segment 3. Turbidity and temperature were both on average higher in segment 3 than segment 2 during 2006 (Haddix et al. 2007).

Young-of-the-year shovelnose sturgeon and blue suckers were not found in segment 3 during 2006. Young-of-the-year sauger and western silvery minnows were collected in segment 3 during 2006.

Several species had either considerably lower abundance or were not sampled during 2006 that were relatively common in 1996-1998 during the Benthic Fishes Study (Berry et al. 2004). These species included freshwater drum, northern pike *Esox lucius*, walleye, bigmouth buffalo, creek chub *Semotilus atromaculatus*, and spottail shiner.

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APPENDICES

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

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

Appendix A. (continued).

Scientific name	Common name	Lettter Code
	ORDER CLUPEIFORMES	
	Clupeidae – herrings	
Alosa alabame	Alabama shad	ALSD
Alosa chrysochloris	Skipjack herring	SJHR
Alosa pseudoharengus	Alewife	ALWF
Dorosoma cepedianum	Gizzard shad	GZSD
Dorosoma petenense	Threadfin shad	TFSD
D. cepedianum X D. petenense	Gizzard-threadfin shad hybrid	GSTS
	ORDER CYPRINIFORMES	
	Cyprinidae – carps and minnows	
Campostoma anomalum	Central stoneroller	CLSR
Campostoma oligolepis	Largescale stoneroller	LSSR
Carassius auratus	Goldfish	GDFH
Carassus auratus X Cyprinius carpio	Goldfish-Common carp hybrid	GFCC
Couesius plumbens	Lake chub	LKCB
Ctenopharyngodon idella	Grass carp	GSCP
Cyprinella lutrensis	Red shiner	RDSN
Cyprinella spiloptera	Spotfin shiner	SFSN
Cyprinus carpio	Common carp	CARP
Erimystax x-punctatus	Gravel chub	GVCB
Hybognathus argyritis	**Western slivery minnow**	**WSMN***
Hybognathus hankinsoni	Brassy minnow	BSMN
Hybognathus nuchalis	Mississippi silvery minnow	SVMW
Hybognathus placitus	**Plains minnow**	**PNMW***
Hybognathus spp.	Unidentified Hybognathus	**HBNS***
Hypophthalmichthys molitrix	Silver carp	SVCP
Hypophthalmichthys nobilis	Bighead carp	BHCP
Luxilus chrysocephalus	Striped shiner	SPSN
Luxilus cornutus	Common shiner	CMSN
Luxilus zonatus	Bleeding shiner	BDSN
Lythrurus unbratilis	Western redfin shiner	WRFS
Macrhybopsis aestivalis	**Speckled chub**	**SKCB***
Macrhybopsis gelida	**Sturgeon chub**	**SGCB***
Macrhybopsis meeki	**Sicklefin chub**	**SFCB***
Macrhybopsis storeriana	Silver chub	SVCB
M. aestivalis X M. gelida	Speckled-Sturgeon chub hybrid	SPST
M. gelida X M. meeki	Sturgeon-Sicklefin chub hybrid	SCSC
Macrhybopsis spp.	Unidentified chub	UHY
Margariscus margarita	Pearl dace	PLDC
Mylocheilus caurinus	Peamouth	PEMT
Nocomis biguttatus	Hornyhead chub	HHCB
Notemigonus crysoleucas	Golden shiner	GDSN
Notropis atherinoides	Emerald shiner	ERSN
Notropis blennius	River shiner	RVSN
Notropis boops	Bigeye shiner	BESN
Notropis buchanani	Ghost shiner	GTSN
Notropis dorsalis	Bigmouth shiner	BMSN
Notropis greenei	Wedgespot shiner	WSSN

Appendix A. (continued).

Scientific name	Common name	Letter Code
	Cyprinidae – carps and minnows	
Notropis heterolepsis	Blacknose shiner	BNSN
Notropis hudsonius	Spottail shiner	STSN
Notropis nubilus	Ozark minnow	OZMW
Notropis rubellus	Rosyface shiner	RYSN
Notropis shumardi	Silverband shiner	SBSN
Notropis stilbius	Silverstripe shiner	SSPS
Notropis stramineus	**Sand shiner**	**SNSN***
Notropis topeka	Topeka shiner	TPSN
Notropis volucellus	Mimic shiner	MMSN
Notropis wickliffi	Channel shiner	CNSN
Notropis spp.	Unidentified shiner	UNO
Opsopoeodus emiliae	Pugnose minnow	PNMW
Phenacobius mirabilis	Suckermouth minnow	SMMW
Phoxinus eos	Northern redbelly dace	NRBD
Phoxinus erythrogaster	Southern redbelly dace	SRBD
Phoxinus neogaeus	Finescale dace	FSDC
Pimephales notatus	Bluntnose minnow	BNMW
Pimephales promelas	Fathead minnow	FHMW
Pimephales vigilax	Bullhead minnow	BHMW
Platygobio gracilis	Flathead chub	FHCB
P. gracilis X M. meeki	Flathead-sicklefin chub hybrid	FCSC
Rhinichthys atratulus	Blacknose dace	BNDC
Rhinichthys cataractae	Longnose dace	LNDC
Richardsonius balteatus	Redside shiner	RDSS
Scardinius erythrophtalmus	Rudd	RUDD
Semotilus atromaculatus	Creek chub	CKCB
	Unidentified Cyprinidae	UCY
	Unidentified Asian Carp	UAC
	Catostomidae - suckers	
Carpiodes carpio	River carpsucker	RVCS
Carpiodes cyprinus	Quillback	QLBK
Carpiodes velifer	Highfin carpsucker	HFCS
Carpiodes spp.	Unidentified Carpiodes	UCS
Catostomus catostomus	Longnose sucker	LNSK
Catostomus commersoni	White sucker	WTSK
Catostomus platyrhynchus	Mountain sucker	MTSK
Catastomus spp.	Unidentified *Catastomus* spp.	UCA
Cycleptus elongatus	**Blue sucker**	**BUSK***
Hypentelium nigricans	Northern hog sucker	NHSK
Ictiobus bubalus	Smallmouth buffalo	SMBF
Ictiobus cyprinellus	Bigmouth buffalo	BMBF
Ictiobus niger	Black buffalo	BKBF
Ictiobus spp.	Unidentified buffalo	UBF
Minytrema melanops	Spotted sucker	SPSK
Moxostoma anisurum	Silver redhorse	SVRH
Moxostoma carinatum	River redhorse	RVRH
Moxostoma duquesnei	Black redhorse	BKRH
Moxostoma erythrurum	Golden redhorse	GDRH
Moxostoma macrolepidotum	Shorthead redhorse	SHRH
Moxostoma spp.	Unidentified redhorse	URH

Appendix A. (continued).

Scientific name	Common name	Letter Code
Catostomidae - suckers	Unidentified Catostomidae	UCT
	ORDER SILURIFORMES	
	Ictaluridae – bullhead catfishes	
Ameiurus melas	Black bullhead	BKBH
Ameiurus natalis	Yellow bullhead	YLBH
Ameiurus nebulosus	Brown bullhead	BRBH
Ameiurus spp.	Unidentified bullhead	UBH
Ictalurus furcatus	Blue catfish	BLCF
Ictalurus punctatus	Channel catfish	CNCF
I. furcatus X I. punctatus	Blue-channel catfish hybrid	BCCC
Ictalurus spp.	Unidentified *Ictalurus* spp.	UCF
Noturus exilis	Slender madtom	SDMT
Noturus flavus	Stonecat	STCT
Noturus gyrinus	Tadpole madtom	TPMT
Noturus nocturnus	Freckled madtom	FKMT
Pylodictis olivaris	Flathead catfish	FHCF
	ORDER SALMONIFORMES	
	Esocidae - pikes	
Esox americanus vermiculatus	Grass pickerel	GSPK
Esox lucius	Northern pike	NTPK
Esox masquinongy	Muskellunge	MSKG
E. lucius X E. masquinongy	Tiger Muskellunge	TGMG
	Umbridae - mudminnows	
Umbra limi	Central mudminnow	MDMN
	Osmeridae - smelts	
Osmerus mordax	Rainbow smelt	RBST
	Salmonidae - trouts	
Coregonus artedi	Lake herring or cisco	CSCO
Coregonus clupeaformis	Lake whitefish	LKWF
Oncorhynchus aguabonita	Golden trout	GDTT
Oncorhynchus clarki	Cutthroat trout	CTTT
Oncorhynchus kisutch	Coho salmon	CHSM
Oncorhynchus mykiss	Rainbow trout	RBTT
Oncorhynchus nerka	Sockeye salmon	SESM
Oncorhynchus tshawytscha	Chinook salmon	CNSM
Prosopium cylindraceum	Bonneville cisco	BVSC
Prosopium williamsoni	Mountain whitefish	MTWF
Salmo trutta	Brown trout	BNTT
Salvelinus fontinalis	Brook trout	BKTT
Salvelinus namaycush	Lake trout	LKTT
Thymallus arcticus	Arctic grayling	AMGL

Appendix A. (continued).

Scientific name	Common name	Letter Code
	ORDER PERCOPSIFORMES	
	Percopsidae – trout-perches	
Percopsis omiscomaycus	Trout-perch	TTPH
	ORDER GADIFORMES	
	Gadidae - cods	
Lota lota	Burbot	BRBT
	ORDER ATHERINIFORMES	
	Cyprinodontidae - killifishes	
Fundulus catenatus	Northern studfish	NTSF
Fundulus diaphanus	Banded killifish	BDKF
Fundulus notatus	Blackstripe topminnow	BSTM
Fundulus olivaceus	Blackspotted topminnow	BPTM
Fundulus sciadicus	Plains topminnow	PTMW
Fundulus zebrinus	Plains killifish	PKLF
	Poeciliidae - livebearers	
Gambusia affinis	Western mosquitofish	MQTF
	Atherinidae - silversides	
Labidesthes sicculus	Brook silverside	BKSS
	ORDER GASTEROSTEIFORMES	
	Gasterosteidae - sticklebacks	
Culaea inconstans	Brook stickleback	BKSB
	ORDER SCORPAENIFORMES	
	Cottidae - sculpins	
Cottus bairdi	Mottled sculpin	MDSP
Cottus carolinae	Banded sculpin	BDSP
	ORDER PERCIFORMES	
	Percichthyidae – temperate basses	
Morone Americana	White perch	WTPH
Morone chrysops	White bass	WTBS
Morone mississippiensis	Yellow bass	YWBS
Morone saxatilis	Striped bass	SDBS
M. saxatilis X M. chrysops	Striped-white bass hybrid	SBWB
	Centrarchidae - sunfishes	
Ambloplites rupestris	Rock bass	RKBS
Archoplites interruptus	Sacremento perch	SOPH
Lepomis cyanellus	Green sunfish	GNSF
Lepomis gibbosus	Pumpkinseed	PNSD
Lepomis gulosus	Warmouth	WRMH
Lepomis humilis	Orangespotted sunfish	OSSF
Lepomis macrochirus	Bluegill	BLGL
Lepomis magalotis	Longear sunfish	LESF
Lepomis microlophus	Redear sunfish	RESF
L. cyanellus X L. macrochirus	Green sunfish-bluegill hybrid	GSBG

Appendix A. (continued).

Scientific name	Common name	Letter Code
	Centrarchidae - sunfishes	
L. cyanellus X L. humilis	Green-orangespotted sunfish hybrid	GSOS
L. macrochirus X L. microlophus	Bluegill-redear sunfish hybrid	BGRE
Lepomis spp.	Unidentified *Lepomis*	ULP
Micropterus dolomieu	Smallmouth bass	SMBS
Micropterus punctulatus	Spotted sunfish	STBS
Micropterus salmoides	Largemouth bass	LMBS
Micropterus spp.	Unidentified *Micropterus* spp.	UMC
Pomoxis annularis	White crappie	WTCP
Pomoxis nigromaculatus	Black crappie	BKCP
Pomoxis spp.	Unidentified crappie	UCP
P. annularis X P. nigromaculatus	White-black crappie hybrid	WCBC
Centrarchidae	Unidentified centrarchid	UCN
	Percidae - perches	
Ammocrypta asprella	Crystal darter	CLDR
Etheostoma blennioides	Greenside darter	GSDR
Etheostoma caeruleum	Rainbow darter	RBDR
Etheostoma exile	Iowa darter	IODR
Etheostoma flabellare	Fantail darter	FTDR
Etheostoma gracile	Slough darter	SLDR
Etheostoma microperca	Least darter	LTDR
Etheostoma nigrum	Johnny darter	JYDR
Etheostoma punctulatum	Stippled darter	STPD
Etheostoma spectabile	Orangethroated darter	OTDR
Etheostoma tetrazonum	Missouri saddled darter	MSDR
Etheostoma zonale	Banded darter	BDDR
Etheostoma spp.	Unidentified Etheostoma spp.	UET
Perca flavescens	Yellow perch	YWPH
Percina caprodes	Logperch	LGPH
Percina cymatotaenia	Bluestripe darter	BTDR
Percina evides	Gilt darter	GLDR
Percina maculata	Blackside darter	BSDR
Percina phoxocephala	Slenderhead darter	SHDR
Percina shumardi	River darter	RRDR
Percina spp.	Unidentified Percina spp.	UPN
	Unidentified darter	UDR
Sander canadense	**Sauger**	**SGER***
Sander vitreus	Walleye	WLEY
S. canadense X S. vitreus	Sauger-walley hybrid/Saugeye	SGWE
Sander spp.	Unidentified *Sander* (formerly *Stizostedion*) spp.	UST
	Unidentified Percidae	UPC
	Sciaenidae - drums	
Aplodinotus grunniens	Freshwater drum	FWDM
	NON-TAXONOMIC CATEGORIES	
	Age-0/Young-of-year fish	YOYF
	Lab fish for identification	LAB
	No fish caught	NFSH
	Unidentified larval fish	LVFS
	Unidentified	UNID
	Net Malfunction (Did Not Fish)	NDNF

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 (Fall-Spring, Summer, or all), 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 inch inner mesh	TN	Standard	All	2006	fish/100 m drift
Otter trawl – 16 ft head rope	OT16	Standard	All	2006	fish/100 m trawled
Beam trawl	BT	Standard	Fish Comm.	2006	fish/100 m trawled
Bag Seine – quarter arc method pulled upstream	BSQU	Wild	Fish Comm.	2006	fish/100 m^2
Bag Seine – quarter arc method pulled downstream	BSQD	Wild	Fish Comm.	2006	fish/100 m^2
Bag Seine – half arc method pulled upstream	BSHU	Wild	Fish Comm.	2006	fish/100 m^2
Bag Seine – half arc method pulled downstream	BSHD	Wild	Fish Comm.	2006	fish/100 m^2
Bag seine – rectangular method pulled upstream	BSRU	Wild	Fish Comm.	2006	fish/100 m^2
Bag seine – rectangular method pulled upstream	BSRD	Wild	Fish Comm.	2006	fish/100 m^2
Mini-fyke net	MF	Standard	Fish Comm.	2006	fish/net night

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	RM
MT	2	Above Intake	AIN	Yellowstone	70 +
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	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	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
NE/MO/KS	4	Kansas River	KSR	Missouri	367.5
NE	4	Platte River	PLR	Platte	5.0
KA/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 RPMA 2 of the Missouri River

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
2004	Milk River	821	2003	4/13/2004	Yearling	Elastomer	
2004	Culbertson	523	2003	8/9/2004	Yearling	PIT Tag	Elastomer
2004	Intake	347	2003	8/9/2004	Yearling	PIT Tag	Elasomer
2004	Sidney	397	2003	8/9/2004	Yearling	PIT Tag	Elastomer

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking[a]	Primary Mark	Secondary Mark
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 fingerling		
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
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

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking[a]	Primary Mark	Secondary Mark
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	
2006	School Trust	436	2006	11/8/2006	Advanced Fingerling	Elastomer	

[a]Age of fish when stocked: Fry, Fingerling, Yearling, 1yo, 2yo, 3yo, etc

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 2006. 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 F2. 1 Inch Trammel Net: overall season and segment summary. Lists CPUE (fish/100 m) and 2 standard errors in brackets.

Species	Total Catch	Overall CPUE	CHXO CHNB	ISB CHNB	OSB CHNB	SCCL CHNB	SCCL ITIP	SCCS ITIP
BKBH	0							
BKSB	0							
BMBF	2	0.004 [0.008]	0	0	0	0.049 [0.098]	0	0
BNTT	0							
BRBT	0							
BSMW	0							
BUSK	3	0.009 [0.011]	0	0.023 [0.034]	0.007 [0.015]	0	0	0
CARP	2	0.003 [0.004]	0.006 [0.011]	0	0	0	0	0
CNCF	15	0.033 [0.019]	0.032 [0.038]	0.053 [0.041]	0.016 [0.031]	0.03 [0.059]	0.022 [0.044]	0
CSCO	0							
ERSN	0							
FHCB	7	0.016 [0.014]	0.014 [0.019]	0.033 [0.037]	0.009 [0.018]	0	0	0
FHMW	0							
FWDM	0							
GDEY	165	0.327 [0.081]	0.182 [0.09]	0.448 [0.189]	0.242 [0.128]	0.585 [0.326]	0.363 [0.29]	0
GNSF	0							
HBNS	0							
LKCB	0							
LKWF	0							
LNDC	0							

Species	Total Catch	Overall CPUE	CHXO CHNB	ISB CHNB	OSB CHNB	SCCL CHNB	SCCL ITIP	SCCS ITIP
LNSK	1	0.002 [0.004]	0	0	0.008 [0.016]	0	0	0
NRBD	0							
PDFH	0							
PDSG	15	0.038 [0.029]	0.016 [0.022]	0.036 [0.052]	0.008 [0.015]	0.246 [0.255]		
PNSD	**0**							
RBTT	0							
RVCS	36	0.069 [0.026]	0.025 [0.024]	0.092 [0.051]	0.086 [0.06]	0.094 [0.106]	0.033 [0.067]	0
SFCB	0							
SGCB	0							
SGER	39	0.084 [0.035]	0.031 [0.027]	0.091 [0.067]	0.054 [0.056]	0.368 [0.231]	0.027 [0.054]	0
SGWE	0							
SHRH	13	0.033 [0.03]	0	0.023 [0.03]	0.068 [0.098]	0.079 [0.086]	0	0
SMBF	8	0.019 [0.015]	0.007 [0.015]	0.032 [0.039]	0.017 [0.024]	0.024 [0.049]	0	0
SNSG	67	0.159 [0.084]	0.056 [0.06]	0.247 [0.146]	0.216 [0.247]	0.059 [0.118]	0.049 [0.068]	0
SNSN	0							
STCT	0							
STSN	0							
WLYE	1	0.002 [0.003]	0	0.005 [0.011]	0	0	0	0
WSMW	0							
WTCP	0							
WTSK	2	0.003 [0.005]	0	0.005 [0.01]	0.006 [0.013]	0	0	0
YWPH	0							

Appendix F4. Otter Trawl: overall season and segment summary. Lists CPUE (fish/100 m) and 2 standard errors in brackets.

Species	Total Catch	Overall CPUE	CHXO CHNB	ISB CHNB	OSB CHNB	SCCL CHNB	SCCL ITIP
BKBH	0						
BKSB	0						
BMBF	0						
BNTT	0						
BRBT	1	0.003 [0.006]	0	0.009 [0.017]	0	0	0
BSMW	0						
BUSK	0						
CARP	0						
CNCF	42	0.083 [0.031]	0.043 [0.044]	0.137 [0.072]	0.056 [0.038]	0	0.149 [0.143]
CSCO	0						
ERSN	67	0.1 [0.155]	0.018 [0.026]	0.266 [0.459]	0.013 [0.027]	0.019 [0.037]	0.019 [0.037]
FHCB	181	0.27 [0.091]	0.121 [0.078]	0.347 [0.15]	0.26 [0.243]	0.164 [0.175]	0.536 [0.394]
FHMW	1	0.001 [0.003]	0	0.004 [0.009]	0	0	0
FWDM	0						
GDEY	8	0.012 [0.008]	0	0.017 [0.017]	0.006 [0.011]	0.037 [0.051]	0.019 [0.037]
GNSF	0						
HBNS	2	0.003 [0.004]	0	0.009 [0.012]	0	0	0
LKCB	0						
LKWF	0						
LNDC	0						

Species	Total Catch	Overall CPUE	CHXO CHNB	ISB CHNB	OSB CHNB	SCCL CHNB	SCCL ITIP
LNSK	4	0.008 [0.008]	0	0.013 [0.019]	0	0.02 [0.041]	0.028 [0.056]
NRBD	0						
PDFH	0						
PDSG	20	0.03 [0.014]	0.012 [0.017]	0.052 [0.031]	0.011 [0.016]	0.058 [0.086]	0.028 [0.056]
PNSD	0						
RBTT	0						
RVCS	14	0.024 [0.018]	0	0.056 [0.049]	0.006 [0.012]	0	0.044 [0.089]
SFCB	60	0.095 [0.031]	0.079 [0.058]	0.119 [0.048]	0.094 [0.081]	0.044 [0.061]	0.099 [0.096]
SGCB	397	0.666 [0.122]	0.608 [0.211]	0.669 [0.195]	0.519 [0.197]	0.958 [0.499]	1.029 [0.78]
SGER	18	0.031 [0.016]	0.012 [0.017]	0.019 [0.019]	0.048 [0.035]	0	0.114 [0.128]
SGWE	0						
SHRH	6	0.011 [0.01]	0.005 [0.01]	0.017 [0.026]	0.017 [0.019]	0	0
SMBF	0						
SNSG	36	0.06 [0.024]	0.012 [0.017]	0.066 [0.035]	0.087 [0.052]	0.13 [0.197]	0.019 [0.037]
SNSN	0						
STCT	49	0.101 [0.065]	0.03 [0.026]	0.45 [0.179]	0.129 [0.082]	0.047 [0.065]	0.072 0.143
STSN	0						
WLYE	2	0.004 [0.006]	0.007 [0.013]	0.008 [0.016]	0	0	0
WSMW	3	0.003 [0.004]	0.012 [0.017]	0	0	0	0
WTCP	0						
WTSK	5	0.007 [0.007]	0.012 [0.017]	0.004 [0.009]	0.012 [0.016]	0	0
YWPH	0						

Appendix F5. Beam Trawl: overall season and segment summary. Lists CPUE (fish/100 m) and 2 standard errors in brackets.

Species	Total Catch	Overall CPUE	CHXO CHNB	ISB CHNB	OSB CHNB	SCCL CHNB	SCCL ITIP	SCCS CHNB	SCCS ITIP
BKBH	0								
BKSB	0								
BMBF	0								
BNTT	0								
BRBT	0								
BSMW	0								
BUSK	0								
CARP	0								
CNCF	3	0.015 [0.018]	0.033 [0.045]	0.02 [0.041]	0	0	0	0	0
CSCO	0								
ERSN	3	0.013 [0.02]	0.032 [0.063]	0	0.016 [0.032]	0	0	0	0
FHCB	34	0.181 [0.084]	0.056 [0.112]	0.197 [0.129]	0.17 [0.148]	0.495 [0.478]	0.667 [1.333]	0	0
FHMW	0								
FWDM	1	0.013 [0.026]	0	0	0.048 [0.095]	0	0	0	0
GDEY	0								
GNSF	0								
HBNS	0								
LKCB	0								
LKWF	0								
LNDC	0								

Species	Total Catch	Overall CPUE	CHXO	ISB	OSB	SCCL		SCCS	
			CHNB	CHNB	CHNB	CHNB	ITIP	CHNB	ITIP
LNSK	0								
NRBD	0								
PDFH	0								
PDSG	1	0.004 [0.009]	0	0.014 [0.028]	0	0	0	0	0
PNSD	0								
RBTT	0								
RVCS	2	0.015 [0.022]	0	0.02 [0.041]	0	0	0.333 [0.667]	0	0
SFCB	11	0.067 [0.046]	0.116 [0.133]	0.014 [0.028]	0.085 [0.083]	0.083 [0.167]	0	0	0
SGCB	121	0.624 [0.184]	0.382 [0.171]	0.874 [0.426	0.557 [0.335]	0.904 [0.686]	0.667 [1.33]	0	0
SGER	5	0.031 [0.027]	0.02 [0.04]	0.017 [0.033]	0.021 [0.043]	0.064 [0.128]	0.333 [0.667]	0	0
SGWE	0								
SHRH	1	0.006 [0.013]	0	0.02 [0.041]	0	0	0	0	0
SMBF	0								
SNSG	5	0.025 [0.021]	0	0.062 [0.058]	0	0.064 [0.128]	0	0	0
SNSN	1	0.004 [0.009]	0	0	0	0.056 [0.111]	0	0	0
STCT	15	0.169 [0.29]	0.028 [0.056]	0.053 [0.059]	0.524 [1.048]	0	0	0	0
STSN	0								
WLYE	0								
WSMW	0								
WTCP	0								
WTSK	4	0.02 [0.023]	0.032 [0.063]	0.034 [0.048]	0	0	0	0	0
YWPH	0								

Appendix F6. Mini-fyke Net: overall season and segment summary. Lists CPUE (fish/net night) and 2 standard errors in brackets.

Species	Total Catch	Overall CPUE	CHXO		ISB		OSB	SCCL	SCCS	SCN
			CHNB	BARS	CHNB	BARS	BARS	BARS	BARS	-
BKBH	0									
BKSB	0									
BMBF	1	0.012 [0.024]	0	0	0	0.033 [0.067]	0	0	0	0
BNTT	0									
BRBT	11	0.133 [0.136]	0	1 [1.633]	0	0.133 [0.159]	0	0	0.045 [0.091]	0
BSMW	0									
BUSK	0									
CARP	31	0.373 [0.196]	1	0	0	0.1 [0.111]	0	0.786 [0.789]	0.545 [0.41]	0.8 [1.166]
CNCF	0									
CSCO	0									
ERSN	576	6.94 [2.51]	27	2.33 [1.606]	0	3.767 [2.474]	9 [8.149]	5.429 [3.058]	12.318 [7.812]	6 [2.608]
FHCB	273	3.289 [2.504]	8	1.667 [1.978]	0	1.833 [1.011]	22.2 [40.012]	2.214 [0.987]	2.636 [1.85]	0
FHMW	1,995	24.036 [15.378]	8	2.167 [2.894]	0	20.367 [22.401]	50.4 [97.817]	54.857 [67.865]	13.182 [10.009]	10.6 [9.024]
FWDM	0									
GDEY	0									
GNSF	3	0.036 [0.041]	0	0.167 [0.333]	0	0	0	0	0.091 [0.125]	0
HBNS	0									
LKCB	0									
LKWF	0									

Species	Total Catch	Overall CPUE	CHXO		ISB		OSB	SCCL	SCCS	SCN
			CHNB	BARS	CHNB	BARS	BARS	BARS	BARS	-
LNDC	3	0.036 [0.041]	0	0	0	0.033 [0.067]	0	0.071 [0.143]	0.045 [0.091]	0
LNSK	12	0.145 [0.119]	1	0.167 [0.333]	0	0	0.2 [0.4]	0	0.409 [0.409]	0
NRBD	1	0.012 [0.024]	0	0	0	0.033 [0.067]	0	0	0	0
PDFH	0									
PDSG	0									
PNSD	1	0.012 [0.024]	0	0	0	0	0.2 [0.4]	0	0	0
RBTT	0									
RVCS	1449	17.458 [8.762]	2	0.833 [1.085]	0	11.367 [16.051]	24.8 [49.6]	19.786 [18.662]	29 [18.494]	12.4 [10.171]
SFCB	0									
SGCB	1	0.012 [0.024]	0	0.167 [0.333]	0	0	0	0	0	0
SGER	20	0.241 [0.126]	0	0	0	0.233 [0.208]	0	0.286 [0.251]	0.227 [0.225]	0.8 [1.166]
SGWE	0									
SHRH	5	0.06 [0.063]	0	0.167 [0.333]	0	0	0	0.071 [0.143]	0.136 [0.199]	0
SMBF	3	0.036 [0.054]	0	0	0	0.033 [0.067]	0	0	0	0.4 [0.8]
SNSG	0									
SNSN	1,136	13.687 [14.601]	0	0.667 [0.843]	0	1.6 [1.368]	24.4 [48.8]	9.286 [7.08]	37.773 [53.293]	0.2 [0.4]
STCT	19	0.229 [0.13]	0	1 [1.366]	0	0.233 [0.157]	0	0.071 [0.143]	0.227 [0.183]	0
STSN	0									
WLYE	0									
WSMW	48	0.578 [0.283]	2	0	0	0.333 [0.293]	0	1 [0.983]	0.036 0.519]	1.6 [2.332]
WTCP	77	0.928 [0.83]	0	0.167 [0.333]	0	0.033 [0.067]	0	0.071 [0.143]	0.273] [0.269]	13.6 [7.813]
WTSK	495	5.964	2	0.5	0	0.533	18.8	17.714	4.318	7.4

Species	Total Catch	Overall CPUE	CHXO		ISB		OSB	SCCL	SCCS	SCN
			CHNB	BARS	CHNB	BARS	BARS	BARS	BARS	-
		[5.138]		[0.683]		[0.342]	[34.678]	[26.381]	[5.032]	[8.686]
YWPH										

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 captured in segment 3 of the Missouri River with total catch-per-unit-effort by gear type for sturgeon season (fall through spring) and fish community season (summer) during 2006. Species codes are located in Appendix A. Asterisks and bold type denote targeted native Missouri River species.

Species Code	**Sturgeon Season (Fall through Spring)**		**Fish Community Season (Summer)**			
	1 Inch Trammel Net	Otter Trawl	1 Inch Trammel Net	Beam Trawl	Otter Trawl	Mini-Fyke Net
BMBF	0.008	0	0	0	0	0.012
BRBT	0	0.005	0	0	0	0.133
BUSK	0.009	0	0.008	0	0	0
CARP	0.006	0	0	0	0	0.373
CNCF	0.03	0.09	0.036	0.015	0.075	0
ERSN	0	0.028	0	0.013	0.183	6.94
FHCB	0.011	0.169	0.021	0.181	0.386	3.289
FHMW	0	0	0	0	0.003	24.036
FWDM	0	0	0	0.013	0	0
GDEY	0.426	0.014	0.229	0	0.009	0
GNSF	0	0	0	0	0	0.036
HBNS	0	0.005	0	0	0	0
LNDC	0	0	0	0	0	0.036
LNSK	0.004	0.008	0	0	0.008	0.145
NRBD	0	0	0	0	0	0.012
PDSG	0.007	0.03	0.069	0.004	0.03	0
PNSD	0	0	0	0	0	0.012
RVCS	0.115	0.019	0.024	0.015	0.029	17.458
SFCB	0	0.079	0	0.067	0.114	0
SGCB	0	0.721	0	0.624	0.602	0.012
SGER	0.093	0.03	0.076	0.031	0.032	0.241
SHRH	0.024	0.016	0.041	0.006	0.006	0.06
SMBF	0.028	0	0.009	0	0	0.036
SNSG	0.081	0.071	0.235	0.025	0.047	0
SNSN	0	0	0	0.004	0	13.687
STCT	0	0.158	0	0.169	0.035	0.229

Species Code	Sturgeon Season (Fall through Spring)		Fish Community Season (Summer)			
	1 Inch Trammel Net	Otter Trawl	1 Inch Trammel Net	Beam Trawl	Otter Trawl	Mini-Fyke Net
WLYE	0.003	0.005	0	0	0.003	0
WSMW	0	0.003	0	0	0.003	0.578
WTCP	0	0	0	0	0	0.928
WTSK	0.007	0	0	0.02	0.016	5.964

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 (FCS) for 2006.

Bend Number	Bend River Mile	2006
1	1701.5	ST
2	1700	FC
3	1698.5	FC
4	1697.5	FC
5	1696	
6	1695	
7	1693.5	FC
8	1692	
9	1690.5	
10	1689	
11	1687.5	
12	1685.5	
13	1684.5	
14	1683	ST, FC
15	1681.5	
16	1680	ST, FC
17	1678.5	
18	1677	
19	1675.5	
20	1674	
21	1672.5	
22	1671	
23	1670	
24	1668.5	
25	1667	
26	1666	
27	1665	
28	1664	
29	1663	
30	1661.5	
31	1660	

Bend Number	Bend River Mile	2006
32	1659	ST, FC
33	1657	ST, FC
34	1656	
35	1655	
36	1654	
37	1653	
38	1651	
39	1650	
40	1648.5	
41	1647	
42	1646	
43	1644.5	
44	1643	
45	1641.5	
46	1640.5	
47	1639.5	
48	1638.5	ST, FC
49	1637.5	
50	1636.5	ST, FC
51	1635.5	
52	1634.5	
53	1633.5	
54	1632.5	
55	1631.5	
56	1630.5	ST, FC
57	1629.5	
58	1628.5	
59	1627	
60	1625.5	
61	1624	
62	1623	ST, FC
63	1622	
64	1620.5	
65	1619.5	
66	1618.5	ST
67	1617.5	
68	1616.5	ST, FC

Bend Number	Bend River Mile	2006
69	1615	
70	1613.5	ST
71	1612	
72	1611	
73	1610	
74	1608.5	ST
75	1606.5	ST, FC
76	1604.5	ST, FC
77	1603	
78	1598.5	ST, FC
79	1597.5	
80	1596	
81	1595	
82	1594	
83	1593	
84	1592	FC
85	1591	FC
86	1590.5	
87	1589.5	
88	1588.5	
89	1587	
90	1585.5	
91	1583.5	