

## 2007 Annual Report

### Pallid Sturgeon Population Assessment and Associated Fish Community Monitoring for the Missouri River: Segment 4



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

By:

Ryan Wilson, Zac Sandness, Everett Nelson and Steve Krentz

U.S. Fish and Wildlife Service  
Missouri River Fish and Wildlife Conservation Office  
3425 Miriam Avenue  
Bismarck, North Dakota 58501

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## EXECUTIVE SUMMARY

The Missouri River below the confluence of the Yellowstone River is a highly dynamic system and features a diverse assemblage of habitats that typify the historic conditions of the river. The influence of the Yellowstone River and the seasonal fluctuations in the hydrograph, including the immense sediment load, greatly influence the fish community, including the pallid sturgeon.

Sampling for segment 4 started in the early May. This was the second year of sampling under the standardized sampling regime devised for the Missouri River. A full complement of standard gears were deployed during both the sturgeon and fish community seasons.

Pallid sturgeon (*Scaphrynchus albus*) is the primary target of this sampling effort. Although the population within this segment of the Missouri River is typified by older individuals with very little indication of wild fish recruitment, the stocking efforts have provided an opportunity to gain further insight into this earlier life stage.

The following is a breakdown of the 45 pallid sturgeon sampled during the 2007 sampling season:

- Twenty seven pallids were captured using standard protocols and gears
  - Seven pallids were captured during sturgeon season
    - One adult was collected in the otter trawl
    - Six juveniles were sampled with the otter trawl
  - Twenty pallids were captured during the fish community season.
    - Thirteen were captured in the otter trawl
    - Seven were collected in trammel nets
- Eighteen pallid sturgeon were sampled during nonrandom sampling in the Yellowstone River in 2007
  - Four adults were captured in large mesh trammel nets during spring broodstock collection
  - Eight juveniles were collected in standard trammel nets
  - Six juveniles were sampled in the otter trawl

In 2007, the percentage of randomly captured pallids originating from previous stocking events was about 96% (N = 26), whereas in 2006, 88% and 2005, 81% of the pallids captured were hatchery stocked. Two juvenile pallid sturgeon sampled in 2007 had no previous tags or marks and are suspected to be hatchery fish stocked without tags in 2004 or 2005. Results from analysis of tissue samples sent to Abernathy Fish Technology Center will determine genetically whether these fish are hatchery or wild origin.

Seven of the eight year classes that have been stocked were sampled during 2007. The only year class of stocked pallid sturgeon that were not sampled was the 1999 year class. The standard otter trawl accounted for 74% (N = 20) of the pallid captures while trammel nets caught 26% (N = 7). Results from 2006 and 2005 sampling was the opposite, with 75% of the pallids captured using trammel nets and 25% captured in otter trawls. Thirty eight young of the year sturgeon were sampled. All of these were identified as shovelnose sturgeon. Relative condition factors for all pallid sturgeon captured during this effort ranged from 0.104 to 0.825. Growth rates for recaptured juvenile sturgeon ranged from 0.011 to 0.213 mm/day. Pallid sturgeon are widely distributed throughout this segment as they were sampled in eleven of the twelve bends. Large connected secondary channel macrohabitats produced the most pallid sturgeon followed by outside bends and channel crossovers. Channel border and island tip mesohabitats produced most of the pallid sturgeon captures.

Shovelnose sturgeon *S. platyrhynchus* were captured in trammel nets (N = 160), otter trawls (N = 97), and beam trawls (N = 2). Quality shovelnose sturgeon (FL  $\geq$  380 mm) made up 47% of the catch in trammel nets and 16% in otter trawls.

In 2007, seven of the eight native Missouri River species that were targeted for this assessment were sampled. The majority of sturgeon chub were sampled in otter trawls (N = 548) with mini-fyke nets (N = 1) and push trawls (N = 63) capturing the remaining specimens. A total of 384 sicklefin chubs *M. meeki* were collected in segment 4 with most sicklefin chubs being captured in the otter trawl (N = 299). Speckled chubs *M. aestivalis* were the only targeted native species not captured in any gear. Ten sand shiners, *Notropis stramineus* were sampled in 2007. Eight were captured in a mini-fyke net, one in the otter

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## **Introduction**

Since 1990 when the pallid sturgeon (*Scaphirhynchus albus*) was listed as an endangered species and 1993 when the Pallid Sturgeon Recovery Plan was implemented, the primary emphasis of restoration and recovery efforts has been to restore habitat conditions, prevent the immediate extirpation of the species, and increase our knowledge of this ancient fish. Unlike other sturgeon species in the world, very limited information has been available from the historical perspective for the pallid sturgeon, primarily due to the rare status and the lack of historic research work on the big rivers of the central United States. In the last decade, emphasis has been shifting to the development of a more thorough understanding of the species that rely and reside in these ecosystems. However, a great amount of uncertainty still exists about what is needed to prevent the pallids' extinction and how to effectively improve habitat conditions with the multitude of uses for the limited resource. Increased and sometimes conflicting uses of water in big river systems is requiring that communities, states and the federal government collaboratively develop management strategies that balance the multiple uses and provide adequate habitats for the aquatic communities. This monitoring program is designed to assist in that decision process by providing trend information on the pallid sturgeon and related aquatic communities.

The strategy as outlined in the Missouri River Standard Operating Procedures for Sampling and Data Collection (SOP's) (Drobish 2008) details the methodology and information to be collected under this program. This monitoring effort is a collaborative effort of State and Federal biologists all working toward the same goals. It is considered a long term monitoring effort due to the need to develop trend information that describes population conditions and a relationship with the environmental conditions that exist. A great deal of variation exists within the aquatic populations, habitats and conditions throughout the Missouri River.

## **Sampling Season and Species**

This program has been developed with two sampling seasons (sturgeon and fish community) based primarily on water temperatures. The primary objective of the two seasons is to focus efforts that are conducive to capturing sturgeon using gears that are temperature limited and utilize other gears toward the fish community during the summer and fall months.

Although gill nets appear to be an effective method for capturing sturgeon for downstream segments, with agreement from the Governance Committee, we have declined to use that method during the sturgeon season, primarily due to the lack of habitats where this gear is effective and the propensity of the gear to cause mortality. The habitats within segment 4 do not contain sufficient areas of slack water that would allow a gill net to fish effectively and would likely fill with debris to the point that either the net would be lost or causing undue mortality on captured fish.

The fish community season sampling began on July 1 and continued until late October when water temperatures reached about 9 C. Five gear types were deployed during the fish community season; mini-fyke nets, trammel nets, large mesh trammel nets, push trawl, and the otter trawl.

Under this program, sampling is conducted at the bend level with bends randomly selected. A total of 12 bends were selected and sampled randomly with standard gears and one additional random bend in the Yellowstone River was sampled with trammel nets and otter trawl.

During the fish community season, in addition to targeting sturgeon, the monitoring program has also selected eight native fish species to monitor to gain a greater understanding of the influences of flows and habitat usage. These species are shovelnose sturgeon, blue sucker, sauger, sturgeon chub, sicklefin chub, speckled chub, plains and western silvery minnow, and the sand shiner.

**Success Criteria:**

In response to the 2000 Missouri River Biological Opinion, the COE is developing monitoring and restoration projects to avoid jeopardizing pallid sturgeon populations. As part of their Implementation Plan, the COE is working with the U. S. Fish and Wildlife Service (USFWS) and State Resource Agencies to develop and conduct a pallid sturgeon monitoring and assessment program. Evaluation of the ultimate success will be tied directly to the biological assessment and the resulting information that these assessments provide.

The following 4 statements may be used to determine whether success is achieved:

1. Develop a monitoring plan to provide the ability to detect population changes.
2. Develop a monitoring plan that identifies survival of hatchery reared and stocked pallid sturgeon in the river.
3. Develop a monitoring plan that identifies reproduction of pallid sturgeon in the Missouri River.
4. Develop a monitoring plan that identifies recruitment of wild pallid sturgeon in the Missouri River system.

The objectives of this program are as follows:

**Objectives:**

1. Document current 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 usage of wild pallid sturgeon and hatchery stocked pallid sturgeon by season and by life stage.
3. Document the population structure and dynamics of pallid sturgeon in the Missouri River system.
4. Document 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.

## **Study Area**

This program encompasses the Missouri River from Fort Peck Dam (RM 1771.5) downstream to the confluence of the Missouri and Mississippi Rivers (RM 0). During development of the methodology that would be used during monitoring efforts, the Pallid Sturgeon Population Assessment Team categorized the study area into 14 mainstem segments (Drobish, editor 2008).

Segment 4 is defined as that area of the Missouri River from the Yellowstone River Confluence (RM 1582) downstream to the headwaters of Lake Sakakawea (RM 1574) (Figure 1a). The amount of riverine habitat available for sampling in segment 4 is entirely dependant on reservoir levels. For example, in 2005 through 2007 the river reached below rivermile 1535. At full pool, the reservoir will extend as far up as rivermile 1574, however the normal reach of river is around rivermile 1550. Although the Yellowstone River is not part of the segment, it does provide a significant amount of influence on this reach of the Missouri River. Seasonal flows, sediment load and natural temperature fluctuations provide a semblance of the historic conditions that existed prior to development of the Missouri under Pick Sloan plan.

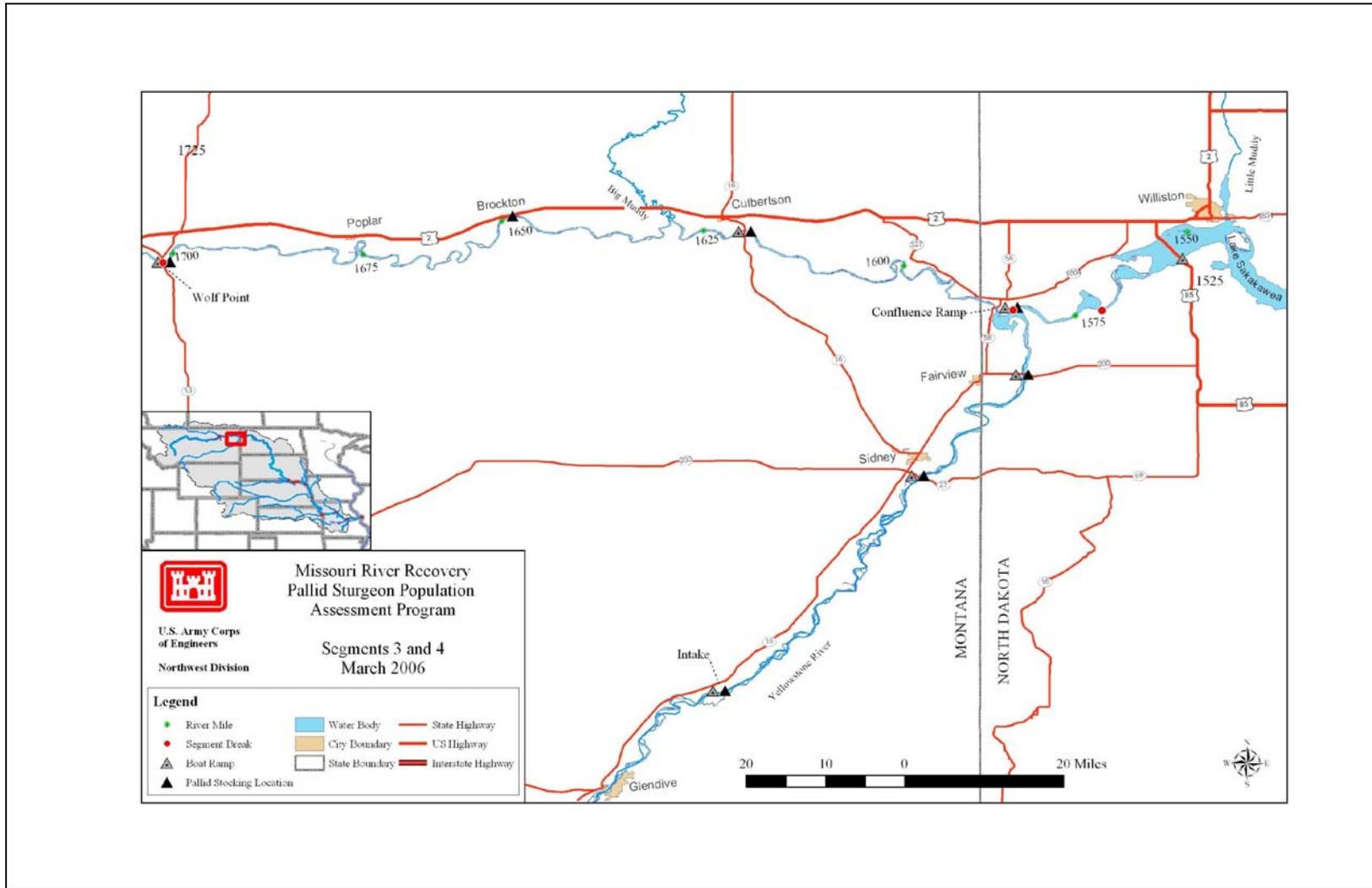


Figure 1a. Map of segments 3 and 4 of the Missouri River with major tributaries, common landmarks, and historic stocking locations for pallid sturgeon. Segment 4 encompasses the Missouri River from the confluence with the Yellowstone River (River Mile 1582) through the headwaters of Lake Sakakawea (River Mile 1568).

## **Methods**

Sampling for segment 4 was conducted in accordance with Standard Operating Procedures established by a panel of representatives from various State and Federal agencies involved with pallid recovery on the Missouri River (Drobish, 2008). The handling protocol for pallid sturgeon was followed using the guidelines established by the USFWS (Jordan 2005).

### **Sampling Site Selection and Description**

A habitat classification system was developed by the Pallid Sturgeon Assessment Team that consist of three continuous macrohabitats found in every bend, main channel cross over, main channel outside bend, and main channel inside bend. An additional 10 discrete macrohabitats have been identified that may not be present in every bend: large tributary mouths, small tributary mouths, confluence areas, large and small secondary connected channels, non-connected secondary channels, deranged channels, braided channels, dendritic channels, and dam tailwaters. Mesohabitats have been established and defined to further classify areas within macrohabitats. Mesohabitat classifications include bars, pools, channel borders, thalweg, and island tips. Bars are sandbars or shallow bankline habitat at the area of terrestrial/aquatic interface, where water depth is less than 1.2 m deep. Pools are areas immediately downstream from sandbars, dikes, snag-piles or other obstructions that have formed a scour hole greater than 1.2 m deep. Channel borders lies between the maximum depth and 1.2 m depth. Thalweg is the main channel between channel borders conveying the majority of flow which includes the deepest part of the main channel. Island tips are the areas immediately downstream of a bar or island where two channels converge and water depth is greater than 1.2 m. Microhabitats are used to further describe structures within mesohabitats.

Each segment was divided up into sampling units called bends where each bend begins with a channel crossover and contains both an inside bend and outside bend and ends with the beginning of the next downstream channel crossover. Each bend can contain several macrohabitats and mesohabitats. In 2007, there were 23 bends in segment 4.

## Sampling Gear

### Trammel Net (TN)

The standard trammel net has a length of 38.1 m (125 ft.), with an inner mesh 2.4 m (8 ft.) deep and two outer walls 1.8 m (6 ft.) deep. The inner mesh is made up of #139 multifilament twine with a bar mesh size of 25.4 mm (1.0 inch). The outer walls are #9 multifilament twine with a bar mesh size of 203.2 mm (8.0 inch). The float line is a 12.7 mm (1/2 inch) foam core and the lead line is 22.7 kg (50 lbs.). Trammel nets are deployed from the bow of the boat and are drifted a maximum of 300 m and a minimum of 75 m after full deployment.

### Otter Trawl (OT)

The standard otter trawl has a width of 4.9 m (16 ft.), height of 0.9 m (3 ft.), and a length of 7.6 m (25 ft.). The otter trawl has an inner mesh (6.35 mm (1/4 inch) bar, #18 polyethylene twine) and an outer mesh (38.1 mm (1.5 inch) bar, #9 polyethylene twine), with a cod-end opening of 406.4 mm (16 inch). The inner mesh has a 50.8 mm (2 inch) sleeve sewn along the top section for the insertion of a hoop to keep the net open, allowing fish to reach the cod end of the net. Trawl doors are 762 mm (30 inches) long by 381 mm (15 inches) high by 19.1 mm (3/4 inch) thick with 12.7 mm (1/2 inch) thick heavy steel runners. The doors are made from marine grade plywood and are used to keep the trawl open and on the river bottom. A 7.9 m (26 ft.) long 3.2 m (1/8 inch) tickler chain is attached to the bottom front of the trawl for added strength and to disturb the river bottom. Two 30.5 m (100 ft.) 19.1 mm (3/4 inch) thick braided Tenex ropes are attached to each door and tied to the bow railings of the boat. The otter trawl is deployed from the bow of the boat and fished downstream at a rate slightly faster than the current. Each trawl sample covers a minimum of 75 m (246 ft.) and a maximum of 300 m (984 ft.) depending on the habitat being sampled.

### Push Trawl (POTO2)

The experimental push trawl was deployed during the 2007 fish community season. The trawl is 2.4 m (8 ft) wide, 0.61 m (2 ft) high and 1.8 m (6 ft) long. The push trawl has a mesh size of 0.4 mm (3/16 in) with a zipper sewn into the cod end for easy access to the catch.

The mouth of the trawl is attached to two 762 mm (30 inches) long by 381 mm (15 inches) high by 19.1 mm (3/4 inch) thick trawl doors with 12.7 mm (1/2 inch) thick heavy steel runners. The push trawl is deployed ahead of the downstream moving boat by mechanical means using forward facing outriggers of sufficient length to allow the net to fish ahead of the point where the bow of the boat breaks the water. Minimum trawling distance is 25 m with a maximum of 300 m.

### **Mini-Fyke Nets (MF)**

The standard mini-fyke nets consist of two rectangular frames 1.2 m (4 ft.) wide by 0.6 m (2 ft.) long and two 0.6 m (2 ft.) hoops made of 0.63 cm (1/4 inch) black oil-tempered spring steel. A 4.5 m (15 ft.) long and 0.6 m (2 ft.) lead is connected to the second rectangular frame. The mesh for the frame and lead is made up of 3 mm (1/8 inch) “ace” mesh that is coated for protection. The lead has foam floats on the top and bulleted lead weights on the bottom. Mini-fyke nets are set as perpendicular to shore when possible but a slight downstream set is used more frequently to prevent the net from rolling over in the current. Mini-fyke nets are set in the evening and pulled the next morning with the optimum duration of a set being 18 hours.

## **Data Collection and Analysis**

### **Associated Environmental Data**

GPS locations were taken for each sample using a WAAS enabled GPS receiver with submeter accuracy. Temperature and depth were also recorded at each sampling location. Substrate, velocity, and turbidity were collected randomly for 25% of the mesohabitat types within each macrohabitat. Substrate was sampled using a Hesse sampler and reported as a percentage of silt/sand/gravel within each sample. Velocity was taken at three depths in the water column, bottom, 80%, and 20% of the depth using a Marsh-McBirney Flo-Mate 2000 velocity meter. Turbidity was collected using a Hach 2100P turbidimeter and recorded as NTU (Nephelometric Turbidity Units). Additionally these measurements were collected whenever a pallid sturgeon was sampled.

### **Genetic Validation**

Genetic samples were taken from all unmarked pallids and potential hybrid sturgeon following the protocol outlined in the SOP's (Drobish 2008). Two fin clips (approximately 1 cm<sup>2</sup> each) were removed from each fish using surgical scissors and forceps. The samples were placed in two separate tubes with 95% non-denatured ethanol and sealed in a plastic bag along with a sturgeon genetic card that contained all the pertinent information for that fish. All genetic samples were sent to the U.S. Fish and Wildlife Service's, Abernathy Fish Technology Center for analysis and archiving.

### **Relative Condition**

The relative condition of recaptured hatchery reared pallid sturgeon was calculated using  $K_n = (W / W')$ , where  $W$  is weight of the individual and  $W'$  is the length-specific mean weight predicted by the weight-length equation calculated for that population. Keenlyne and Evanson (1993) provided a weight-length regression [ $\log_{10} W = -6.378 + 3.357 \log_{10} L$  ( $r^2 = 0.9740$ )] for pallid sturgeon throughout its range which was used to calculate a relative condition factor.

## **Relative Stock Densities**

A length frequency index measures changes in fish population structure. Length categories based on the percentage of the largest known pallid sturgeon are as follows (Gablehouse 1984): sub-stock fork length <330 mm (20%), stock fork length = 330 – 629 mm (20-36%), quality fork length = 630 – 839 mm (36-45%), preferred fork length = 840 – 1039 mm (45-59%), memorable fork length = 1040 – 1269 mm (59-74%), and trophy fork length >1270 mm (>74%) (Shuman et al, 2006).

Length categories based on the percentage of the largest known shovelnose sturgeon are as follows: sub-stock fork length <250 mm (20%), stock fork length = 250 – 379 mm (20-36%), quality fork length = 380 – 509 mm (36-45%), preferred fork length = 510 – 639 mm (45-59%), memorable fork length = 640 – 809 mm (59-74%) and trophy fork length >810 mm (>74%). Proportional Stock Density (PSD) is the proportion of fish of quality size in a stock. Relative Stock Density (RSD) is the proportion of fish of a size group in a stock (Quist 1998).

## **Analyses**

A sample target for each gear was defined as follows: 300 m drift (TN), 300 m tow (OT and BT), and one overnight set (MF). A minimum effort of 75 m for TN, OT and BT was accepted in some habitats because certain areas have so much debris that long drifts/tows are not possible. Also due to the length of some habitats available in a bend and the distance required to deploy and retrieve the trawls, it was not possible to sample 300 m without sampling an adjacent habitat. Effort was calculated for trammel nets and trawls as fish per 100 m sampled. Effort was calculated for MF nets as catch per net night. Samples that occurred outside of the “standard” gear or habitat effort or samples that occurred in “non-random” bends were excluded from CPUE calculations. These data were included into length frequencies, relative condition, and population structure calculations.

## Results

### Pallid Sturgeon

A total of 27 pallid sturgeon were randomly captured in segment 4 for the sampling conducted during the 2007 sturgeon and fish community seasons. Of these, 24 were marked originating from previous hatchery stocking while one of these was a wild adult that was taken to a hatchery for spawning (Figure 9). Two juvenile pallid sturgeon that were sampled were unmarked and deemed unknown pending genetic verification.

Fork lengths (FL) of pallid sturgeon sampled in segment 4 ranged from 260 – 1360 mm. This segment is typified by an aging adult population with recruitment resulting from previous augmentation efforts as shown by the length frequency histogram (Figure 8). Almost all the previous year classes of augmented pallids were sampled during 2007 with the exception of the 1999 year class of which only 478 were stocked in RPMA 2 (Appendix E). Comparing recapture information with the information from the time of stocking is showing that these stocked fish are growing at a range of rates (0.110 – 0.213 mm/day) (Table 6.). Data was very limited for calculating relative weights and condition factor on each year class (Table 6). Relative Stock Density was calculated for pallid sturgeon (Table 7).

All untagged juvenile sturgeon (N = 2) that were suspected as being a possible pallid were genetically sampled for submission to the Abernathy Fish Technology Center (FTC) for analysis and archiving.

Tag retention has always been an extremely important aspect of the evaluation of pallid sturgeon augmentation efforts. Of the 27 pallids captured, one pallid was a wild adult with a PIT tag implanted from a previous sampling effort, 12 were recaptures from previous stocking events that retained their PIT tags while 5 were stocked without PIT tags and 6 were stocked with PIT tags but had shed the tags. From the year classes, we can outline some of the retention rates. For the 1997 year class (N=1), the fish had a PIT tag and elastomer was

present; for the 2001 year class (N=4), two had retained their PIT tags and the other two did not (based on elastomer); and for the 2002 year class (N=5), three fish retained a PIT tag. The 2003 and the 2004 year classes do not allow this type of documentation primarily due to the 2003 year class being stocked with similar elastomer and some fish being stocked without a PIT tag. The pallids originating from the 2004 year class were stocked without PIT tags. Six pallids sampled from the 2005 year class were stocked as fingerlings in the fall of 2005 and were too small to PIT tag prior to stocking.

Utilization of a ratio of pallid sturgeon to shovelnose sturgeon to quantify abundance dates back to early commercial records and field studies (Bailey and Cross, 1954, Fisher, 1962). The 2007 sampling resulted in a ratio of pallid to shovelnose of 1 to 10.5. No known hybrids were collected during this effort.

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 4 on the Missouri River during fall through spring (sturgeon season) and summer (fish community season) in 2006 – 2007. N-E indicates the habitat 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
<b>Fall through Spring - Sturgeon Season</b>																
<b>1 Inch Trammel Net</b>	12	8.75	N-E	24	0	N-E	N-E	32	32	17	0	0	0	0	0	N-E
<b>Gill Net</b>																
<b>Otter Trawl</b>	12	10.58	N-E	24	0	N-E	N-E	30	34	39	0	0	0	0	0	N-E
<b>Summer – Fish Community Season</b>																
<b>1 Inch Trammel Net</b>	12	9.50	N-E	30	0	N-E	N-E	33	27	23	0	1	0	0	0	N-E
<b>Mini-Fyke Net</b>	12	8.08	N-E	8	0	N-E	N-E	47	10	25	0	7	0	0	0	N-E
<b>Otter Trawl</b>	12	11.00	N-E	30	0	N-E	N-E	35	42	25	0	0	0	0	0	N-E

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 4 on the Missouri River during fall through spring (sturgeon season) and summer (fish community season) in 2006 – 2007. N-E indicates the habitat is non-existent in the segment.

Gear	Number of bends	Mean Effort	Mesohabitat					
			BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Fall through Spring – Sturgeon Season</b>								
<b>1 Inch Trammel Net</b>	12	8.75	0	95	N-E	10	N-E	N-E
<b>Gill Net</b>								
<b>Otter Trawl</b>	12	10.58	0	109	N-E	18	N-E	N-E
<b>Summer – Fish Community Season</b>								
<b>1 Inch Trammel Net</b>	12	9.50	0	97	N-E	17	N-E	N-E
<b>Mini-Fyke Net</b>	12	8.08	95	0	N-E	2	N-E	N-E
<b>Otter Trawl</b>	12	11.00	0	119	N-E	13	N-E	N-E

### Segment 4 - Pallid Sturgeon Captures by River Mile

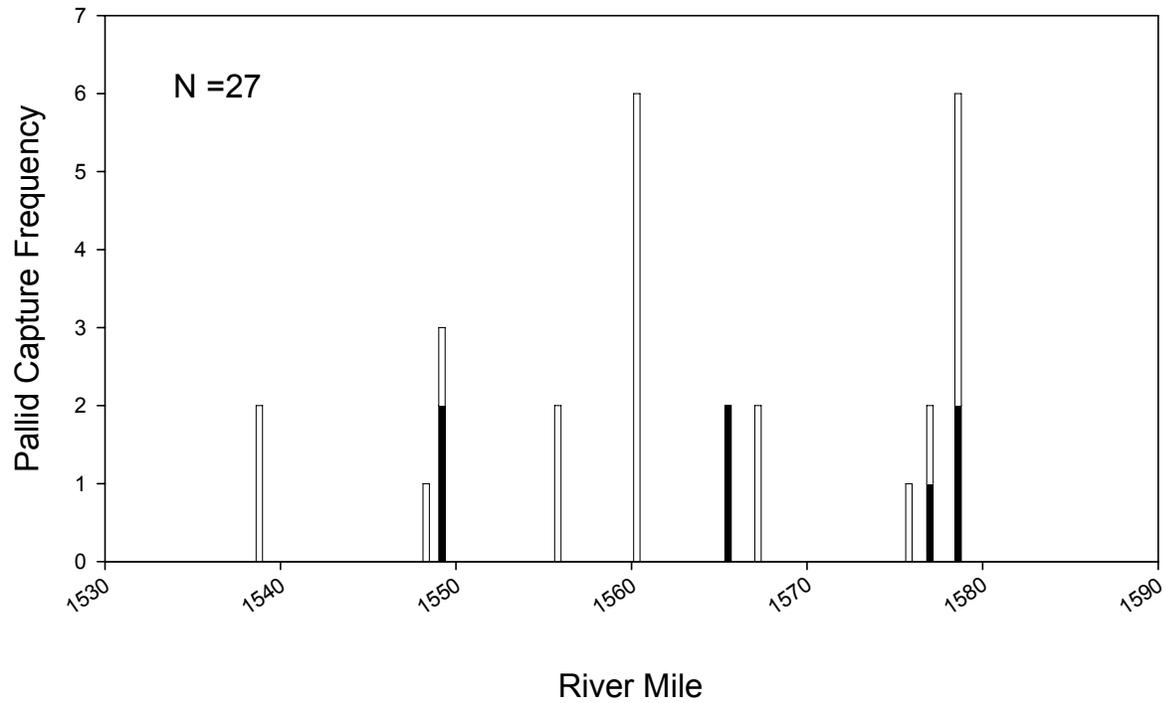


Figure 1b. Distribution of pallid sturgeon captures by river mile for segment 4 of the Missouri River during 2006-2007. Black bars represent pallid captures during Sturgeon Season and white bars during Fish Community Season. Figure includes all pallid captures including non-random and wild samples.

Table 3. Pallid sturgeon (PDSG) capture summaries for all gears relative to habitat type and environmental variables on the Missouri River during 2006-2007. Means (minimum and maximum) are presented. Habitat definitions and codes presented in Appendix B. N-E indicates the habitat 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. °C (Effort)	Temp. °C (Catch)	Turbidity (ntu) (Effort)	Turbidity (ntu) (Catch)	Total Pallids caught
BRAD	BAR	N-E								
	CHNB	N-E								
	DTWT	N-E								
	ITIP	N-E								
	POOL	N-E								
	TLWG	N-E								
CHXO	BAR	0.7 (0.3-1.4)		0.06 (0.02-0.10)		17.9 (9.7-26.1)		78 (51-108)		.
	CHNB	3.7 (0.7-8.8)	3.3 (1.9-4.4)	0.59 (0.28-0.96)	0.57 (0.32-0.83)	17.7 (10.7-27.3)	18.8 (12.5-27.3)	566 (36-2993)	61 (40-77)	6
	DTWT	N-E								
	ITIP									
	POOL	N-E								
	TLWG	N-E								
CONF	BAR									
	CHNB	2.6 (2.6-2.6)				10.1 (10.1-10.1)				.
	DTWT	N-E								
	ITIP									
	POOL	N-E								
	TLWG	N-E								

Table 3 (continued).

Macro-	Meso-	Depth (m) (Effort)	Depth (m) (Catch)	Bottom Velocity (m/s) (Effort)	Bottom Velocity (m/s) (Catch)	Temp. °C (Effort)	Temp. °C (Catch)	Turbidity (ntu) (Effort)	Turbidity (ntu) (Catch)	Total Pallids caught
DEND	BAR	N-E								
	CHNB	N-E								
	DTWT	N-E								
	ITIP	N-E								
	POOL	N-E								
DRNG	BAR	N-E								
	CHNB	N-E								
	DTWT	N-E								
	ITIP	N-E								
	POOL	N-E								
	TLWG	N-E								
ISB	BAR	0.7 (0.3-1.7)		0.08 (0.00-0.22)		17.9 (9.7-27.3)		75 (36-112)		.
	CHNB	2.4 (0.4-7.4)	1.3 (0.7-2.2)	0.57 (0.26-1.03)	0.63 (0.54-0.72)	17.9 (9.7-27.4)	23.2 (21.4-24.2)	585 (35-2800)	122 (69-225)	3
	DTWT	N-E								
	ITIP									
	POOL	N-E								
	TLWG	N-E								
OSB	BAR	0.9 (0.3-1.7)		0.13 (0.01-0.23)		13.0 (9.7-26.2)		77 (67-93)		.
	CHNB	3.7 (0.6-7.4)	4.0 (2.2-6.4)	0.66 (0.25-1.14)	0.65 (0.25-0.84)	17.4 (10.7-26.6)	19.2 (14.9-25.9)	592 (39-2600)	118 (59-376)	8
	DTWT	N-E								

Macro-	Meso-	Depth (m) (Effort)	Depth (m) (Catch)	Bottom Velocity (m/s) (Effort)	Bottom Velocity (m/s) (Catch)	Temp. °C (Effort)	Temp. °C (Catch)	Turbidity (ntu) (Effort)	Turbidity (ntu) (Catch)	Total Pallids caught
	ITIP									
	POOL	N-E								
	TLWG	N-E								
SCCL	BAR	0.7 (0.3-1.2)		0.17 (0.08-0.30)		20.3 (10.4-26.9)		87 (37-133)		.
	CHNB	2.3 (1.0-6.0)	2.4 (1.2-6.0)	0.60 (0.20-0.88)	0.63 (0.54-0.75)	17.7 (13.8-27.3)	15.7 (14.8-16.5)	514 (49-2300)	114 (49-235)	4
	DTWT									.
	ITIP	2.5 (0.5-5.8)	2.6 (0.6-4.6)	0.54 (0.02-1.12)	0.39 (0.23-0.48)	17.9 (12.7-27.6)	14.9 (12.7-16.2)	589 (30-2600)	582 (71-1432)	6
	POOL	N-E								
	TLWG	N-E								
SCCS	BAR									
	CHNB									
	DTWT	N-E								
	ITIP									
	POOL	N-E								
	TLWG	N-E								
SCCN	BAR	0.7 (0.4-1.0)		0.14 (0.14-0.14)		21.2 (15.4-28.8)		97 (82-122)		
	POOL	N-E								
	CHNB									
	TLWG	N-E								
	ITIP	0.7 (0.7-0.7)		0.56 (0.56-0.56)		21.5 (21.5-21.5)		272 (272-272)		

Macro-	Meso-	Depth (m) (Effort)	Depth (m) (Catch)	Bottom Velocity (m/s) (Effort)	Bottom Velocity (m/s) (Catch)	Temp. °C (Effort)	Temp. °C (Catch)	Turbidity (ntu) (Effort)	Turbidity (ntu) (Catch)	Total Pallids caught
TRIB	BAR									
	POOL	N-E								
	CHNB									
	TLWG	N-E								
	ITIP									
TRML	BAR									
	POOL	N-E								
	CHNB	2.8 (2.8-2.8)				10.1 (10.1-10.1)				
	TLWG	N-E								
	ITIP									
TRMS	BAR									
	POOL	N-E								
	CHNB									
	TLWG	N-E								
	ITIP									
WILD	BAR									
	POOL	N-E								
	CHNB									
	TLWG	N-E								
	ITIP									
	DTWT	N-E								
	OTHE									

Table 6. Mean fork length, weight, relative condition factor (Kn), growth rates, and water temperature for hatchery-reared pallid sturgeon captures by year class at the time of stocking and recapture during 2007 from segment 4 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)
1997	1	.	.	.	689	1140.0	0.807	.	.
		.	.	.				.	.
2001	4	300	.	.	469	365.0	0.864	0.113	.
		.	.	.	80	211.4	0.040	.	.
2002	5	292	.	.	436	259.4	0.822	0.110	.
		11	.	.	54	87.4	0.066	0.011	.
2005	14	187	.	.	306	75.8	0.811	0.213	.
		46	.	.	11	9.9	0.062	0.060	.
2006	2	.	.	.	351	125.0	0.852	.	.
		.	.	.	.	.	.	.	.
2007									

Table 7. Incremental relative stock density (RSD)<sup>a</sup> and relative condition factor (Kn) for all pallid sturgeon captured with all gear by a length category during 2006-2007 in the Missouri River. Length categories<sup>b</sup> 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)
<b>Sturgeon Season</b>			
Sub-stock (0-199)	0	.	0
Sub-stock (200-329)	5	.	0.818 (0.107)
Stock	1	50	0.842
Quality	0	.	0
Preferred	0	.	0
Memorable	0	.	0
Trophy	1	50	0.104
Overall Kn	.	.	0.720 (0.218)
<b>Fish Community Season</b>			
Sub-stock (0-199)	0	.	0
Sub-stock (200-329)	8	.	0.834 (0.078)
Stock	11	92	0.825 (0.046)
Quality	1	8	0.807
Preferred	0	.	0
Memorable	0	.	0
Trophy	0	.	0
Overall Kn	.	.	0.828 (0.039)

<sup>a</sup> RSD = (# of fish of a specified length class / # of fish  $\geq$  minimum stock length fish) \* 100.

<sup>b</sup> 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  $\geq$  1270 mm (>74 %).

### *Year comparisons, Gear evaluation and Habitat associations*

Sampling efforts during the 2007 sturgeon season resulted in the captured of seven pallid sturgeon. Twenty pallids were collected during fish community season. The previous years sturgeon season sampling resulted in two pallid captured in 2005 and seven in 2006, while 29 were sampled during the fish community season in 2005 and 18 pallids were captured in 2006. Random sampling in 2007 resulted in one wild adult pallid sturgeon whereas during 2005 and 2006 five and three wild adults were sampled. Otter trawls accounted for 20 (74%) pallid captures while seven (26%) were captured in trammel nets. Trammel nets accounted for 18 (72%) pallids in 2006 and 24 (77%) pallids in 2005 with the remaining captured in the otter trawl. Catch per unit effort (CPUE) for pallid sturgeon in 2007 was higher using the otter trawl during fish community season (0.038 fish per 100 m) than the sturgeon season (0.023 fish per 100m) (Figure 2 and 5). During the 2007 sturgeon season, no pallid sturgeon were sampled with trammel nets. Catch per unit effort of pallids in trammel nets during the 2005 sturgeon season was 0.005 fish per 100 m and in 2006 the CPUE was 0.012 fish per 100 m (Figure 3). Trammel nets produced 0.0342 pallids per 100 m during the 2007 fish community season which was slightly lower than 2006 (0.040 fish per 100 m) and 2005 (0.0620 fish per 100 m) (Figure 5). Mini-fyke nets and push trawls did not catch any pallid sturgeon during the fish community season.

The twenty seven pallid sturgeon captured in 2007 were the result of random sampling in random bends. Fourteen hatchery stocked pallids were collected while sampling the first random bend in the Yellowstone River. In 2007 pallid sturgeon were sampled in 11 of the 12 random bends (Figure 1b). During 2005 and 2006 sampling, pallids were captured in 11 of 12 randomly selected bends each year. In 2007, most pallid sturgeon (N=10) were captured in large connected secondary channel macrohabitats, followed by outside bends (N=8), channel crossovers (N=6) and inside bend macrohabitats (N=3). The majority of pallids were found in channel border mesohabitats (N=21) followed by island tips (N=6) (Tables 9-16).

The habitat conditions in this segment are extremely variable and diverse. The turbidity experienced from the sampled macrohabitats ranged from 30 to 2993 nephelometric turbidity

units (ntu), while the turbidity during captures of pallid sturgeon ranged from 40 to 1432 ntu. Water velocities also varied with measured velocities ranging from 0.01 to 1.12 meters/second (m/s), while pallid captures experienced water velocities that ranged from 0.23 to 0.84 m/s. This segment of the monitoring effort experiences significant swings in temperature (9.7-28.8 C). Pallids were captured at a range of temperatures from 12.5 to 27.3 Celsius. Measured depths at the point of capture for pallid sturgeon ranged from 0.7 to 6.0 meters (m). (Table 3)

## Segment 4 - Pallid Sturgeon / Sturgeon Season

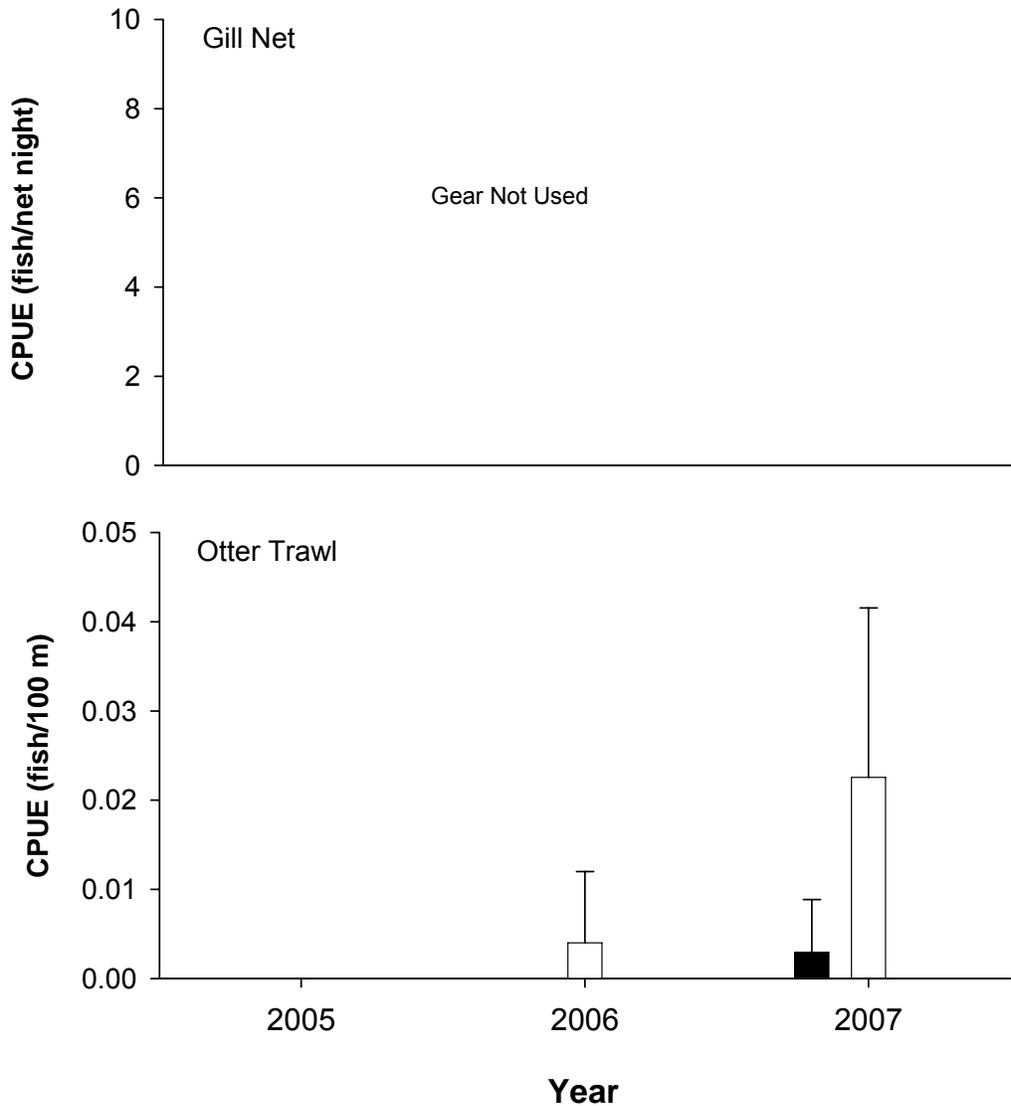


Figure 2. Mean annual catch-per-unit-effort ( $\pm$  2 SE) of wild (black bars), hatchery reared (white bars), and unknown origin (cross-hatched bars) pallid sturgeon using gill nets and otter trawls in segment 4 of the Missouri River during sturgeon season 2005-2007. Unknown origin pallid sturgeon are awaiting genetic verification.

## Segment 4 - Pallid Sturgeon / Sturgeon Season

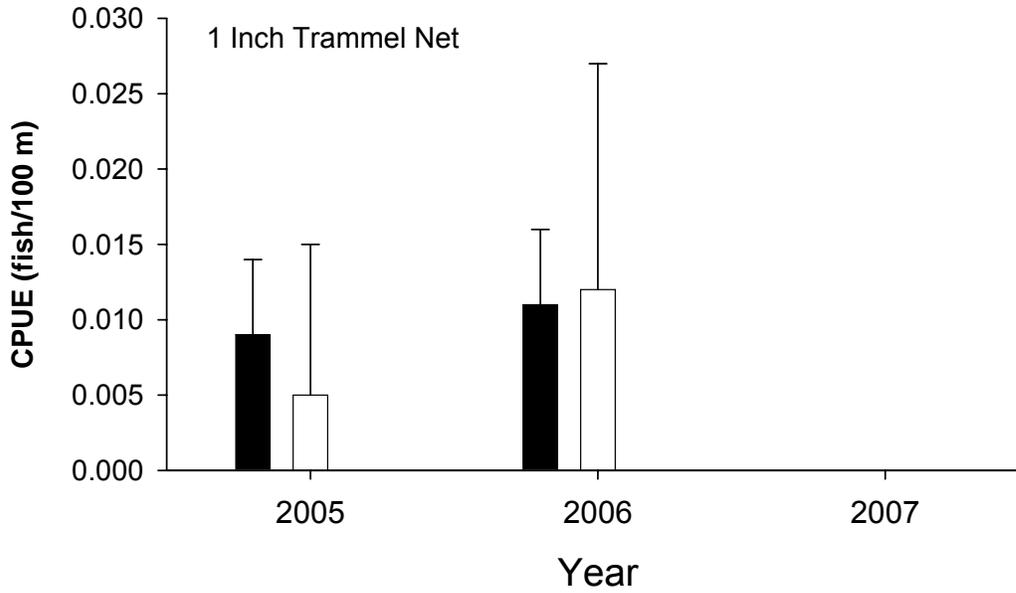


Figure 3. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of wild (black bars), hatchery reared (white bars), and unknown origin (cross-hatched bars) pallid sturgeon using 1 trammel nets in segment 4 of the Missouri River during sturgeon season 2005-2007. Unknown origin pallid sturgeon are awaiting genetic verification.

## Segment 4 - Pallid Sturgeon / Fish Community Season

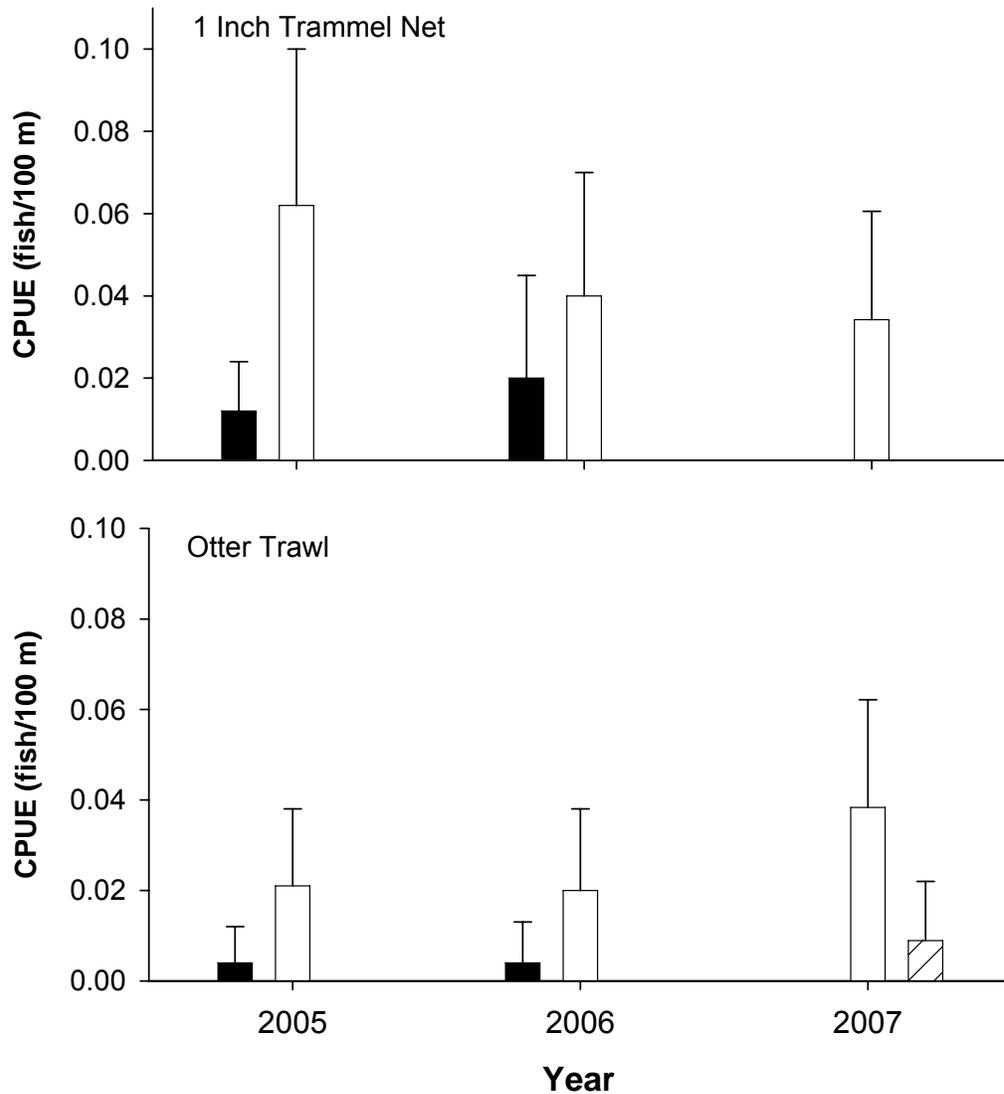


Figure 5. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of wild (black bars), hatchery reared (white bars), and unknown origin (cross-hatched bars) pallid sturgeon using 1 inch trammel nets and otter trawls in segment 4 of the Missouri River during fish community season 2005-2007. Unknown origin pallid sturgeon are awaiting genetic verification.

## Segment 4 - Pallid Sturgeon / Fish Community Season

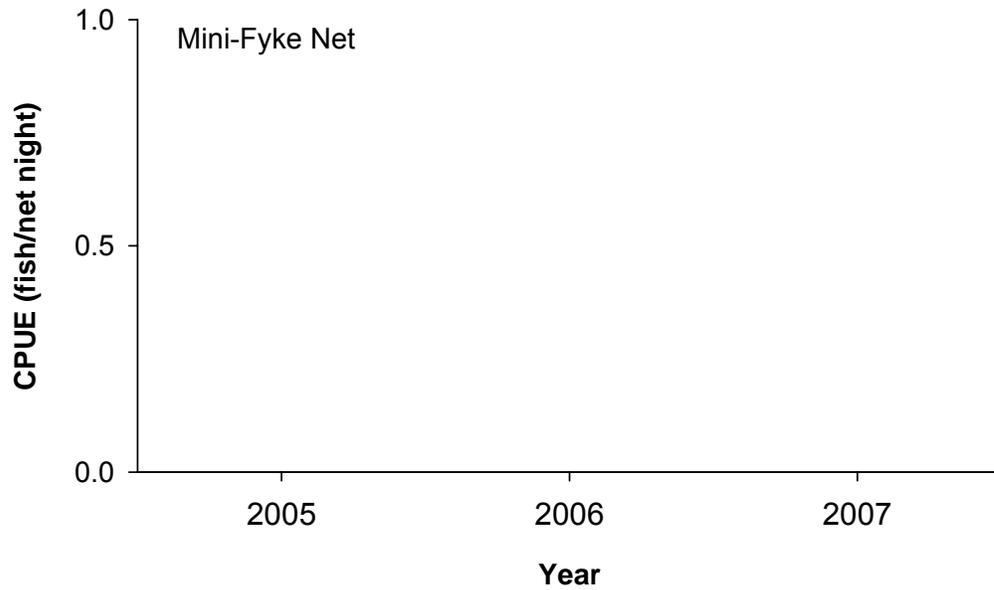


Figure 7. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of wild (black bars), hatchery reared (white bars), and unknown origin (cross-hatched bars) pallid sturgeon using mini-fyke nets in segment 4 of the Missouri River during fish community season 2005-2007. Unknown origin pallid sturgeon are awaiting genetic verification.

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 4 of the Missouri River during 2006-2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	0 .	N-E	0 24	0 0	N-E	N-E	0 31	0 32	0 13	0 0	0 0	0 0	0 0	0 0	0 0
Gill Net															
Otter Trawl	0 .	N-E	0 20	0 0	N-E	N-E	0 25	0 29	0 26	0 0	0 0	0 0	0 0	0 0	0 0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	0 .	N-E	0 28	0 0	N-E	N-E	0 31	0 24	0 17	0 0	0 0	0 0	0 0	0 0	0 0
Mini-Fyke Net	0 .	N-E	0 8	0 0	N-E	N-E	0 48	0 10	0 26	0 0	0 7	0 0	0 0	0 0	0 0
Otter Trawl	0 .	N-E	0 24	0 0	N-E	N-E	0 27	0 34	0 14	0 0	0 0	0 0	0 0	0 0	0 0

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 4 of the Missouri River during 2006 - 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	0 .	0 0	0 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	0 .	0 0	0 90	N-E	0 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	0 .	0 0	0 89	N-E	0 11	N-E	N-E
Mini-Fyke Net	0 .	0 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	0 .	0 0	0 95	N-E	0 5	N-E	N-E

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 4 of the Missouri River during 2006 - 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	0 .	N-E 0 24	0 0	0 0	N-E N-E	N-E N-E	0 31	0 32	0 13	0 0	0 0	0 0	0 0	0 0	0 0
Gill Net															
Otter Trawl	5 .	N-E 0 20	0 0	0 0	N-E N-E	N-E N-E	0 25	20 29	80 26	0 0	0 0	0 0	0 0	0 0	0 0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	2 .	N-E 0 28	0 0	0 0	N-E N-E	N-E N-E	0 31	50 24	50 17	0 0	0 0	0 0	0 0	0 0	0 0
Mini-Fyke Net	0 .	N-E 0 8	0 0	0 0	N-E N-E	N-E N-E	0 48	0 10	0 26	0 0	0 7	0 0	0 0	0 0	0 0
Otter Trawl	6 .	N-E 17 24	0 0	0 0	N-E N-E	N-E N-E	33 27	17 34	33 14	0 0	0 0	0 0	0 0	0 0	0 0

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 4 of the Missouri River during 2006 - 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	0 .	0 0	0 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	5 .	0 0	40 90	N-E	60 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	2 .	0 0	100 89	N-E	0 11	N-E	N-E
Mini-Fyke Net	0 .	0 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	6 .	0 0	83 95	N-E	17 5	N-E	N-E

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 4 of the Missouri River during 2006 – 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	0 .	N-E 0 24	0 0	0 0	N-E N-E	N-E N-E	0 31	0 32	0 13	0 0	0 0	0 0	0 0	0 0	0 0
Gill Net															
Otter Trawl	1 .	N-E 0 20	0 0	0 0	N-E N-E	N-E N-E	0 25	100 29	0 26	0 0	0 0	0 0	0 0	0 0	0 0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	4 .	N-E 50 28	0 0	0 0	N-E N-E	N-E N-E	25 31	0 24	25 17	0 0	0 0	0 0	0 0	0 0	0 0
Mini-Fyke Net	0 .	N-E 0 8	0 0	0 0	N-E N-E	N-E N-E	0 48	0 10	0 26	0 0	0 7	0 0	0 0	0 0	0 0
Otter Trawl	7 .	N-E 29 24	0 0	0 0	N-E N-E	N-E N-E	0 27	57 34	14 14	0 0	0 0	0 0	0 0	0 0	0 0

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 4 of the Missouri River during 2006 – 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	0 .	0 0	0 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	1 .	0 0	100 90	N-E	0 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	4 .	0 0	75 89	N-E	25 11	N-E	N-E
Mini-Fyke Net	0 .	0 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	7 .	0 0	86 95	N-E	14 5	N-E	N-E

Table 15. Total number of quality size and greater ( $\geq 630$  mm) pallid sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in segment 4 of the Missouri River during 2006 – 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	0 .	N-E 0 24	0 0	0 0	N-E N-E	N-E N-E	0 31	0 32	0 13	0 0	0 0	0 0	0 0	0 0	0 0
Gill Net															
Otter Trawl	1 .	N-E 0 20	0 0	0 0	N-E N-E	N-E N-E	0 25	0 29	100 26	0 0	0 0	0 0	0 0	0 0	0 0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	1 .	N-E 100 28	0 0	0 0	N-E N-E	N-E N-E	0 31	0 24	0 17	0 0	0 0	0 0	0 0	0 0	0 0
Mini-Fyke Net	0 .	N-E 0 8	0 0	0 0	N-E N-E	N-E N-E	0 48	0 10	0 26	0 0	0 7	0 0	0 0	0 0	0 0
Otter Trawl	0 .	N-E 0 24	0 0	0 0	N-E N-E	N-E N-E	0 27	0 34	0 14	0 0	0 0	0 0	0 0	0 0	0 0

Table 16. Total number of quality size and greater ( $\geq 630$  mm) pallid sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 4 of the Missouri River during 2006 – 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	0 .	0 0	0 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	1 .	0 0	100 90	N-E	0 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	1 .	0 0	100 89	N-E	0 11	N-E	N-E
Mini-Fyke Net	0 .	0 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	0 .	0 0	0 95	N-E	0 5	N-E	N-E

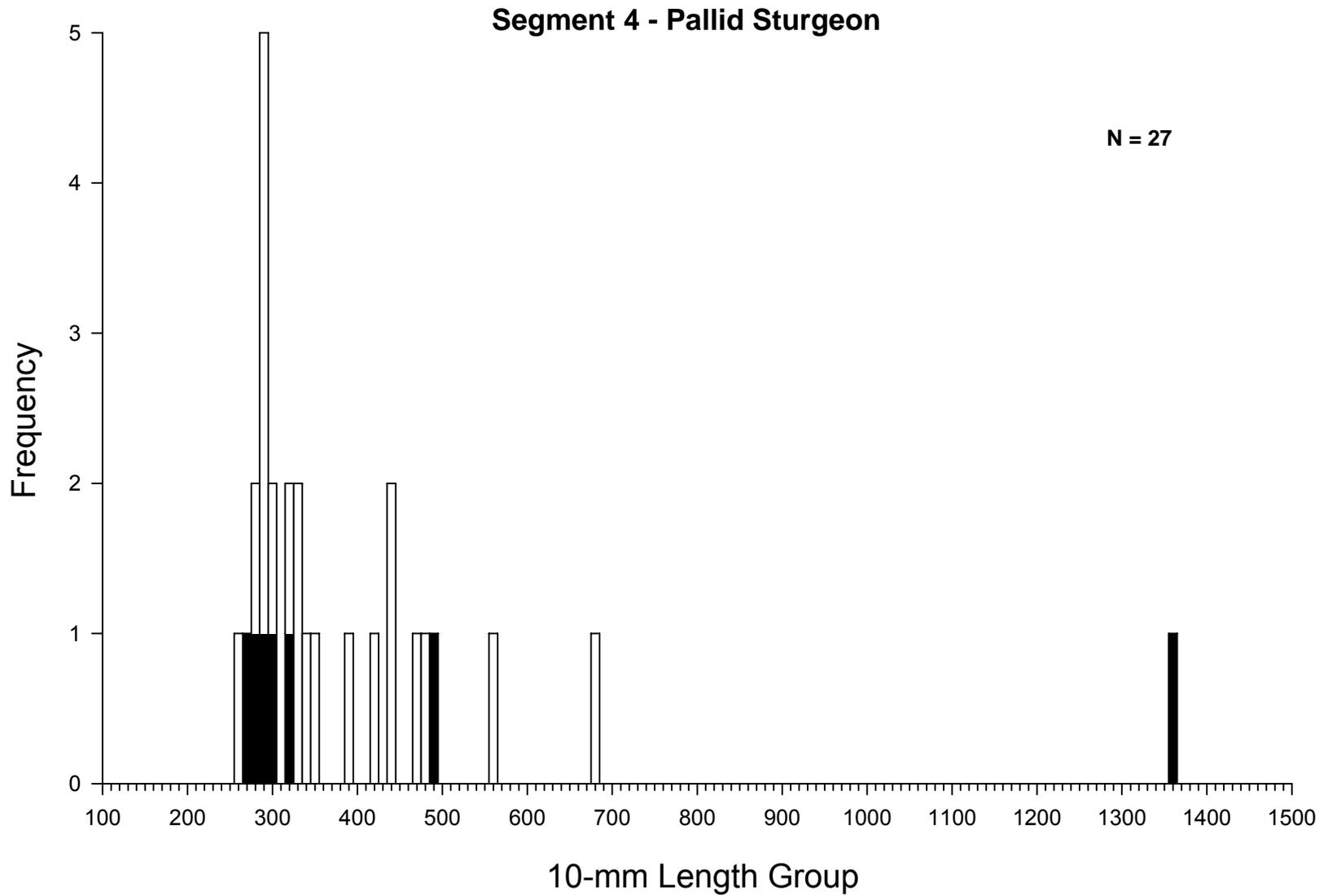


Figure 8. Length frequency of pallid sturgeon captured during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 4 of the Missouri River during 2006-2007 including non-random and wild samples.

## Segment 4 - Annual Pallid Sturgeon Capture History

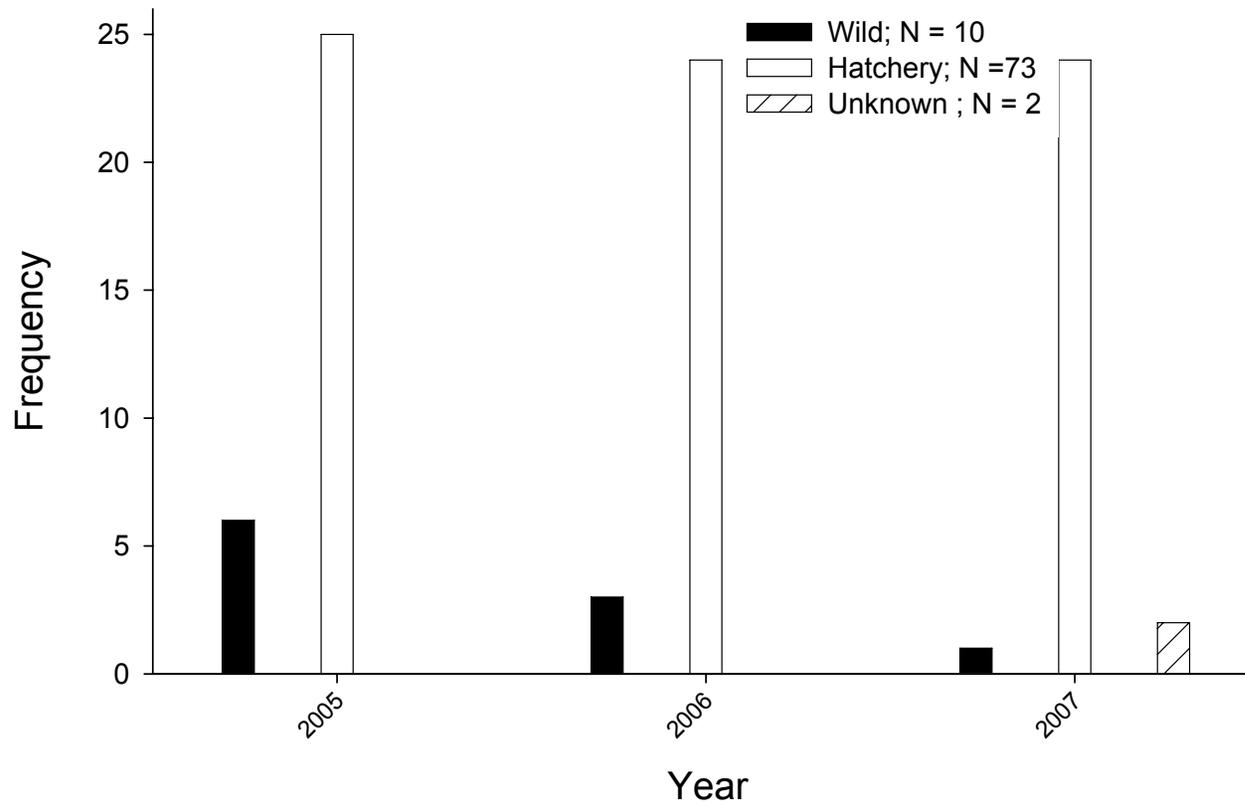


Figure 9. Annual capture history of wild (black bars), hatchery reared (white bars), and unknown origin (cross-hatched bars) pallid sturgeon collected in segment 4 of the Missouri River from 2005 to 2007. Figure is designed to compare overall pallid sturgeon captures from year to year and may be biased by variable effort between years.

### **Shovelnose X Pallid Sturgeon Hybrids**

There were no shovelnose X pallid sturgeon hybrids sampled in segment 4 of the Missouri River during the 2007 sampling year.

## Targeted Native River Species

### Shovelnose Sturgeon

A total of 259 shovelnose sturgeon were captured in segment 4 for the sampling conducted during the 2007 sturgeon and fish community seasons. The standard trammel net accounted for 160 (62%) of the captured shovelnose, with 97 (37%) captured with the otter trawl and 2 captured in the experimental push trawl.

Catch per unit effort of substock size class (FL 150-249 mm) shovelnose sturgeon in trammel nets during the sturgeon season in 2007 was 0.004 fish/100 m compared to a CPUE of 0.015 fish/100 m in 2006 and none in 2005. Stock size (FL 250-379 mm) CPUE in trammel nets was 0.034 fish/100 m in 2007, 0.044 fish/100 m in 2006 and 0.032 fish/100 m in the 2005 sturgeon season. The CPUE for quality and above shovelnose sturgeon in trammel nets during the 2007 sturgeon season was 0.066 fish/100 m, whereas during the 2006 sturgeon season the CPUE for quality and above was 0.069 fish/100 m and 2005 was 0.042 fish/100 m (Figure 12).

In 2007 CPUE of substock shovelnose sturgeon (FL 0-149mm) in trammel nets was 0.013 fish/100 m. Conversely, during the 2005 and 2006 fish community seasons, there were no substock shovelnose sturgeon sampled in trammel nets. During the 2007 fish community season, the CPUE of substock size (FL 150-249mm) shovelnose in trammel nets was 0.008 fish/100 m. Catch per unit effort of the same size class last year was 0.024 fish/100 m and in 2005 it was 0.01 fish/100 m in 2005. Stock size (FL 250-379 mm) shovelnose were captured at a rate of 0.124 fish/100 m in 2007 compared to 0.141 and 0.071 fish per 100 m during the 2006 and 2005 fish community season, respectively. Quality size and greater (FL>380 mm) catch of shovelnose sturgeon in 2007 was 0.498 fish/100 m and in 2006 was 0.856 fish/100 m. During the 2005 fish community season, CPUE of quality and greater shovelnose sturgeon in trammel nets was 0.466 fish/100 m (Figure 14).

The otter trawl was deployed during both the sturgeon and fish community seasons in 2006 and 2007 but was only used during the 2005 fish community season. Catch per unit effort of substock (FL 0-149 mm) shovelnose sturgeon during the 2007 sturgeon season was 0.007 fish/100 m. During the 2006 sturgeon season, CPUE of the same size class in the otter trawl was

0.004 fish/100 m. Substock (FL 150-249 mm) shovelnose sturgeon were captured in the otter trawl at a rate of 0.017 fish/100 m in 2007 compared to 0.079 fish/100 m in 2006. Catch per unit effort of stock size shovelnose sturgeon in the otter trawl during the sturgeon season was 0.017 fish/100 m in 2007 and 0.019 fish /100 m in 2006. Quality and above size class CPUE effort for shovelnose sturgeon in 2007 was 0.039 fish/100 m whereas in 2006 the rate was slightly higher at 0.047 fish/100 m (Figure 11).

Catch per unit effort of shovelnose sturgeon in the otter trawl during 2007 fish community was highest for the quality and above size class (0.109 fish/100 m). In 2005 and 2006 the CPUE for this size class was 0.132 fish/100, and 0.086 fish/100 m respectively. For substock (0-149 mm) shovelnose sturgeon, CPUE in 2007 was 0.091 fish/100 m compared to 0.037 fish/100 m in 2006 and 0.198 fish/100 m in 2005. Catch per unit effort of substock (150-249 mm) shovelnose sturgeon in 2007 was 0.0059 fish/100 m, 0.025 fish/m in 2006 and 0.016 fish/m in 2005. Shovelnose sturgeon in the stock size category were captured at a higher rate in 2007 (0.049 fish/100m) than in 2006 (0.046 fish/100 m) or 2005 (0.029 fish/100 m) (Figure 14).

Fork lengths (FL) of shovelnose sturgeon ranged from 32 – 890 mm for segment 4 during the 2007 sampling season. Aging strictures were collected from shovelnose sturgeon during the fish community season in 2005, 2006 and 2007. Steffenson and Hamel (2008) found that mean back calculated fork length of age-1 shovelnose sturgeon in segment 4 was 178 mm, 265 mm for age-2 and 351 mm for age-3. Age-0 shovelnose sturgeon in the Missouri River were generally less than 179 mm. Lengths for age-1 (180-259 mm), age-2 (260-349 mm), age-3 (350-449 mm) and age-4 (450-530 mm) shovelnose sturgeon were based on the overall mean fork length (Steffensen and Hamel 2008). Relative Stock Density (RSD) values suggest that recruitment is occurring as fish in all size classes were captured (Table 25).

## Segment 4 - Shovelnose Sturgeon / Sturgeon Season

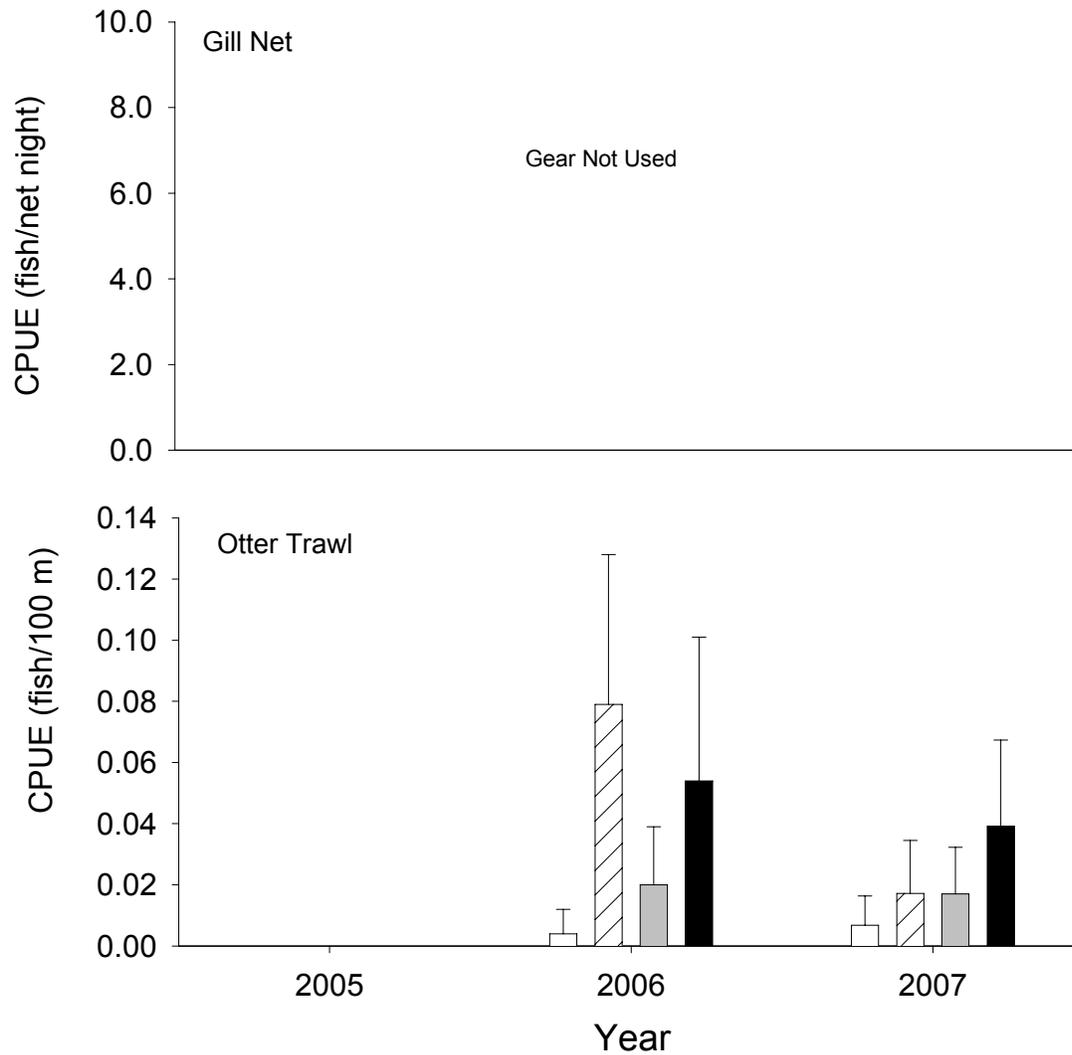


Figure 11. Mean annual catch-per-unit-effort (+/- 2 SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249 mm; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size ( $\geq 380$  mm; black bars) shovelnose sturgeon using gill nets and otter trawls in segment 4 of the Missouri River during sturgeon season 2005-2007.

## Segment 4 - Shovelnose Sturgeon / Sturgeon Season

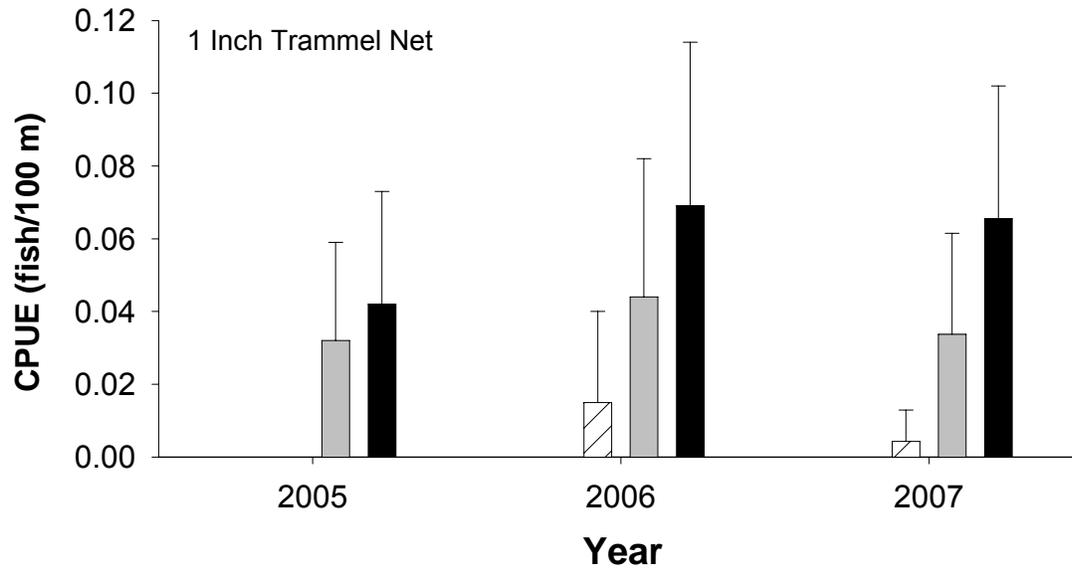


Figure 12. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249 mm; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size ( $\geq 380$  mm; black bars) shovelnose sturgeon using 1 inch trammel nets in segment 4 of the Missouri River during sturgeon season 2005-2007.

## Segment 4 - Shovelnose Sturgeon / Fish Community Season

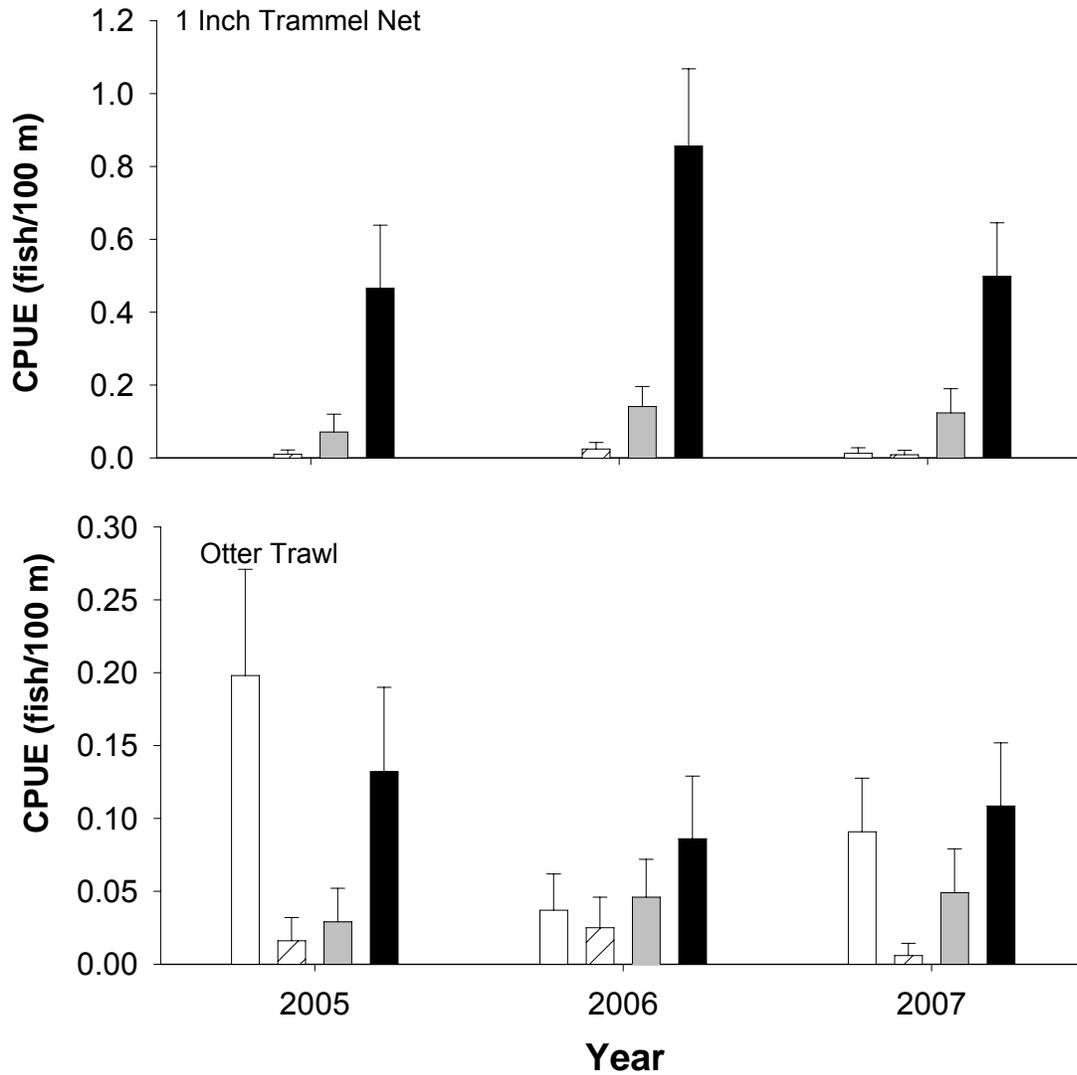


Figure 14. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249 mm; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size ( $\geq 380$  mm; black bars) shovelnose sturgeon using 1 inch trammel nets and otter trawls in segment 4 of the Missouri River during fish community season 2005-2007.

## Segment 4 - Shovelnose Sturgeon / Fish Community Season

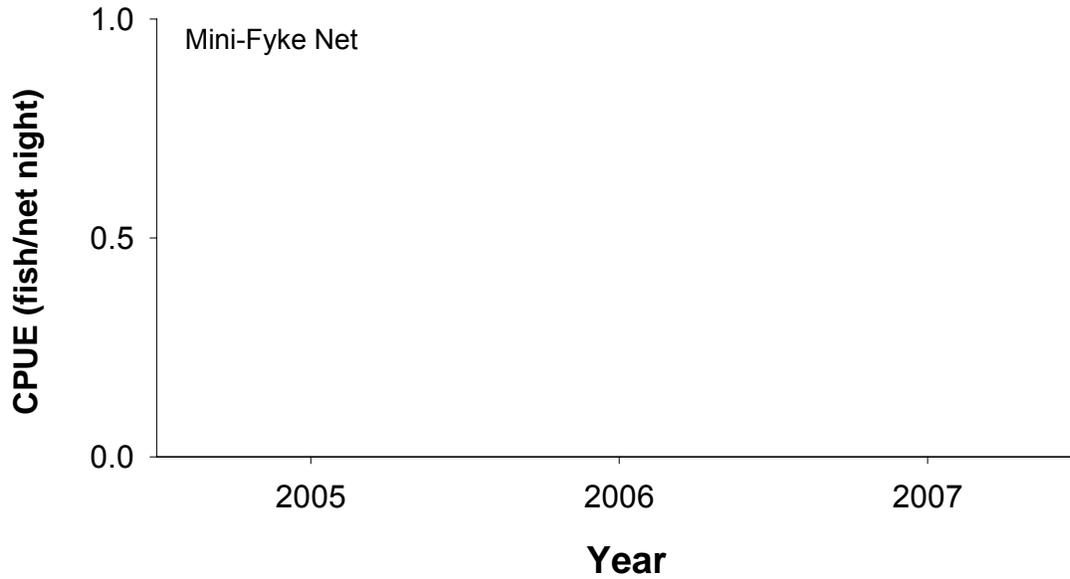


Figure 15. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249 mm; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size ( $\geq 380$  mm; black bars) shovelnose sturgeon using mini-fyke nets in segment 4 of the Missouri River during fish community season 2005-2007.

## *Habitat Use*

Macrohabitats where shovelnose sturgeon were primarily captured included inside and outside bends, channel crossovers, and large connected secondary channels. For sub-stock sized (0-149 mm) shovelnose (N=34), outside bend macrohabitats were dominant habitats where these fish were collected followed by channel crossovers and inside bend macrohabitats (Table 17). Sub-stock (150-249) size class shovelnose (N=10) were sampled in the inside and outside bends and large connected secondary channel macrohabitats (Table 19). While the habitats associated with the stock size (250-379 mm) shovelnose (N=52) captures were mainly channel crossovers, inside and outside bends and large connected secondary channels (Table 21). The quality and above size class (>380 mm) shovelnose sturgeon (N=161) were associated with inside and outside bends, channel crossovers and large connected secondary channels (Table 23). The mesohabitats associated with shovelnose sturgeon captures were primarily classified as channel border and island tips (Tables 18, 20, 22, 24). Sand substrate dominated the sampling area and is the predominant substrate found within the segment.

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 4 of the Missouri River during 2006 – 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	0 .	N-E	0 24	0 0	N-E	N-E	0 31	0 32	0 13	0 0	0 0	0 0	0 0	0 0	0 0
Gill Net															
Otter Trawl	2 .	N-E	0 20	0 0	N-E	N-E	50 25	50 29	0 26	0 0	0 0	0 0	0 0	0 0	0 0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	3 .	N-E	0 28	0 0	N-E	N-E	33 31	33 24	33 17	0 0	0 0	0 0	0 0	0 0	0 0
Mini-Fyke Net	0 .	N-E	0 8	0 0	N-E	N-E	0 48	0 10	0 26	0 0	0 7	0 0	0 0	0 0	0 0
Otter Trawl	29 .	N-E	28 24	0 0	N-E	N-E	10 27	48 34	14 14	0 0	0 0	0 0	0 0	0 0	0 0

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 4 of the Missouri River during 2006 – 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	0 .	0 0	0 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	2 .	0 0	100 90	N-E	0 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	3 .	0 0	100 89	N-E	0 11	N-E	N-E
Mini-Fyke Net	0 .	0 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	29 .	0 0	100 95	N-E	0 5	N-E	N-E

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 4 of the Missouri River during 2006 – 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	1 .	N-E 0 24	0 0	0 0	N-E N-E	N-E N-E	100 31	0 32	0 13	0 0	0 0	0 0	0 0	0 0	0 0
Gill Net															
Otter Trawl	5 .	N-E 0 20	0 0	0 0	N-E N-E	N-E N-E	20 25	60 29	20 26	0 0	0 0	0 0	0 0	0 0	0 0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	2 .	N-E 0 28	0 0	0 0	N-E N-E	N-E N-E	0 31	100 24	0 17	0 0	0 0	0 0	0 0	0 0	0 0
Mini-Fyke Net	0 .	N-E 0 8	0 0	0 0	N-E N-E	N-E N-E	0 48	0 10	0 26	0 0	0 7	0 0	0 0	0 0	0 0
Otter Trawl	2 .	N-E 0 24	0 0	0 0	N-E N-E	N-E N-E	50 27	0 34	50 14	0 0	0 0	0 0	0 0	0 0	0 0

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 4 of the Missouri River during 2006 – 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	1 .	0 0	100 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	5 .	0 0	80 90	N-E	20 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	2 .	0 0	100 89	N-E	0 11	N-E	N-E
Mini-Fyke Net	0 .	0 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	2 .	0 0	100 95	N-E	0 5	N-E	N-E

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 4 of the Missouri River during 2006 – 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	6	N-E	33	0	N-E	N-E	17	33	17	0	0	0	0	0	0
	.		24	0			31	32	13	0	0	0	0	0	0
Gill Net															
Otter Trawl	5	N-E	20	0	N-E	N-E	20	40	20	0	0	0	0	0	0
	.		20	0			25	29	26	0	0	0	0	0	0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	27	N-E	52	0	N-E	N-E	11	22	11	0	4	0	0	0	0
	.		28	0			31	24	17	0	0	0	0	0	0
Mini-Fyke Net	0	N-E	0	0	N-E	N-E	0	0	0	0	0	0	0	0	0
	.		8	0			48	10	26	0	7	0	0	0	0
Otter Trawl	14	N-E	36	0	N-E	N-E	29	14	21	0	0	0	0	0	0
	.		24	0			27	34	14	0	0	0	0	0	0

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 4 of the Missouri River during 2006 – 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	6	0	83	N-E	17	N-E	N-E
	.	0	93		7		
Gill Net							
Otter Trawl	5	0	80	N-E	20	N-E	N-E
	.	0	90		10		
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	27	0	96	N-E	4	N-E	N-E
	.	0	89		11		
Mini-Fyke Net	0	0	0	N-E	0	N-E	N-E
	.	98	0		2		
Otter Trawl	14	0	86	N-E	14	N-E	N-E
	.	0	95		5		

Table 23. Total number of quality size and greater ( $\geq 380$  mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in segment 4 of the Missouri River during 2006 – 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	12 .	N-E	17 24	0 0	N-E	N-E	50 31	25 32	8 13	0 0	0 0	0 0	0 0	0 0	0 0
Gill Net															
Otter Trawl	10 .	N-E	0 20	0 0	N-E	N-E	10 25	40 29	50 26	0 0	0 0	0 0	0 0	0 0	0 0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	109 .	N-E	17 28	0 0	N-E	N-E	33 31	31 24	18 17	0 0	0 0	0 0	0 0	0 0	0 0
Mini-Fyke Net	0 .	N-E	0 8	0 0	N-E	N-E	0 48	0 10	0 26	0 0	0 7	0 0	0 0	0 0	0 0
Otter Trawl	30 .	N-E	23 24	0 0	N-E	N-E	27 27	23 34	27 14	0 0	0 0	0 0	0 0	0 0	0 0

Table 24. Total number of quality size and greater ( $\geq 380$  mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 4 of the Missouri River during 2006 – 2007. 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. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	12 .	0 0	100 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	10 .	0 0	90 90	N-E	10 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	109 .	0 0	93 89	N-E	7 11	N-E	N-E
Mini-Fyke Net	0 .	0 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	30 .	0 0	87 95	N-E	13 5	N-E	N-E

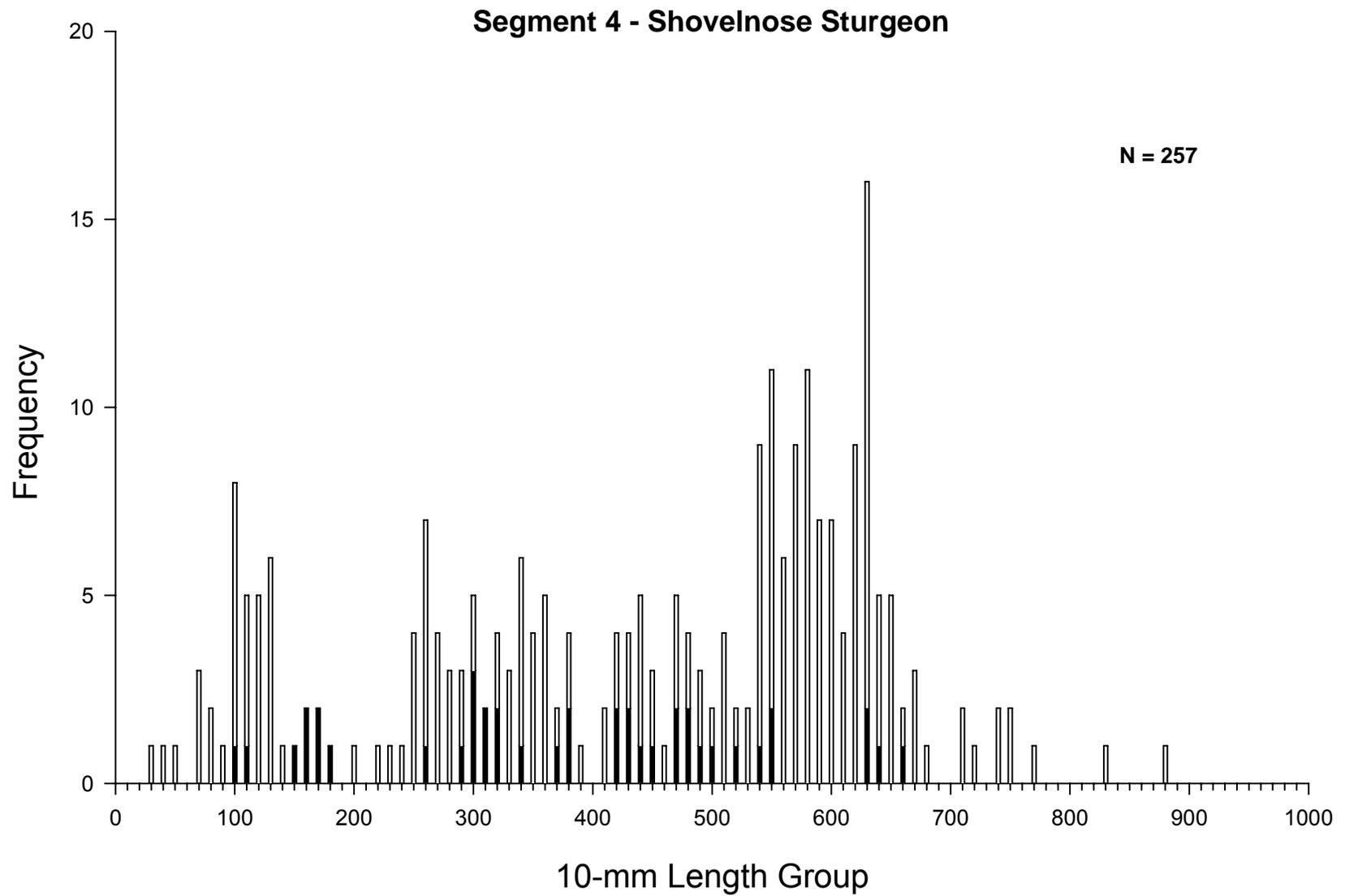


Figure 17. Length frequency of shovelnose sturgeon from fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 4 of the Missouri River during 2006-2007.

Table 25. Incremental relative stock density (RSD)<sup>a</sup> and mean relative weight (Wr) by a length category for shovelnose sturgeon in segment 4 of the Missouri River captured during 2006 – 2007. Length categories<sup>b</sup> determined using methods proposed by Quist (1998).

<b>Length category</b>	<b>N</b>	<b>RSD</b>	<b>Wr (+/- 2SE)</b>
<b>Sturgeon Season</b>			
Sub-stock (0-149 mm)	2	.	124.4 (27.48)
Sub-stock (150-249 mm)	6	.	119.4 (6.745)
Stock	11	33	87.32 (8.340)
Quality	14	42	80.34 (4.152)
Preferred	6	18	84.78 (8.357)
Memorable	2	6	95.36 (15.17)
Trophy	0	.	0
Overall Wr	.	.	91.45 (5.655)
<b>Fish Community Season</b>			
Sub-stock (0-149 mm)	32	.	135.4 (16.08)
Sub-stock (150-249 mm)	4	.	100.2 (15.49)
Stock	41	23	75.86 (3.722)
Quality	24	13	81.71 (4.100)
Preferred	91	51	91.65 (2.063)
Memorable	22	12	88.20 (4.513)
Trophy	2	1	95.10 (3.565)
Overall Wr	.	.	93.09 (3.475)

<sup>a</sup> RSD = (# of fish of a specified length class / # of fish ≥ minimum stock length fish) \* 100.

<sup>b</sup> 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**

During the 2007 sampling year more sturgeon chub sampled in all gears (N=612) than 2006 (N=541) and three times higher than 2005 (N=187). Catch per unit effort of sturgeon chub in the otter trawl during the 2007 sturgeon season was 0.648 fish/100 m compared to 0.492 fish/100 m in 2006 (Figure 18). During the fish community season in 2007, the CPUE increased to 1.368 fish/100 m compared to 0.457 fish/100 m in 2006 and 0.681 fish/100 m in 2005 (Figure 19). A large portion of sturgeon chub that were sampled with the otter trawl were found in large connected secondary channel macrohabitats (51%), followed by inside bends (21%), outside bends (15%) and channel crossover macrohabitats (13%) (Table 26). In 2006 the majority of sturgeon chub were sampled on inside bend macrohabitats (46%), followed by channel crossovers (26%), outside bends (16%) and large secondary channel macrohabitats (7%). Sixty three sturgeon chub were sampled using the experimental push trawl (CPUE 1.758 fish/100 m).

Length frequency histogram of sturgeon chub captured in 2007 shows the majority of fish sampled during the sturgeon season were between 30 and 60 mm (Figure 21). During the fish community season the majority of sturgeon chub were between 30 and 60 mm followed by fish under 30 mm. Mean length at capture calculations from segment 4 sturgeon chub found that age-0 fish were 31 mm, age-1 were 47 mm, age-2 were 68 mm and age-3 were 83 mm (Herman et al).

## Segment 4 - Sturgeon Chub / Sturgeon Season

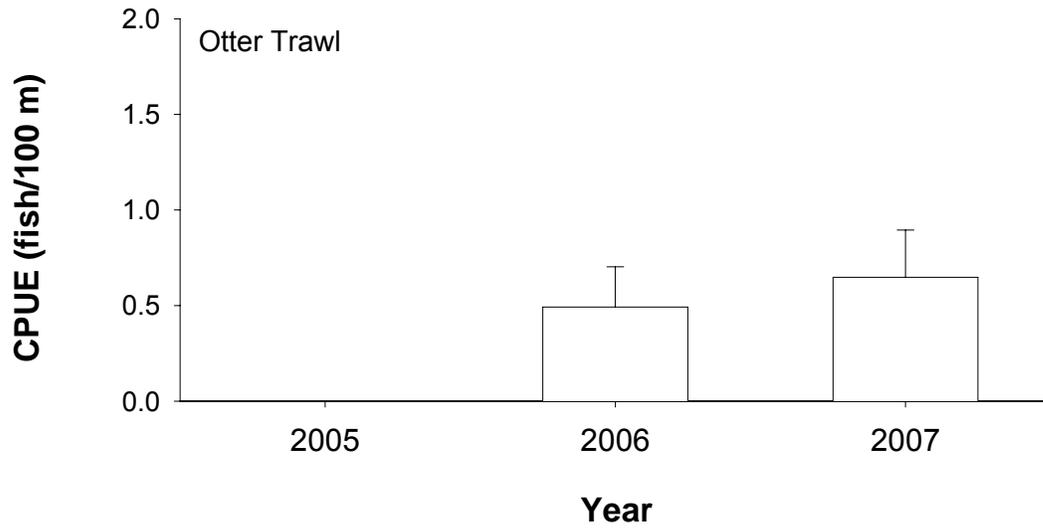


Figure 18. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sturgeon chub using otter trawls in segment 4 of the Missouri River during sturgeon season 2005-2007.

## Segment 4 - Sturgeon Chub / Fish Community Season

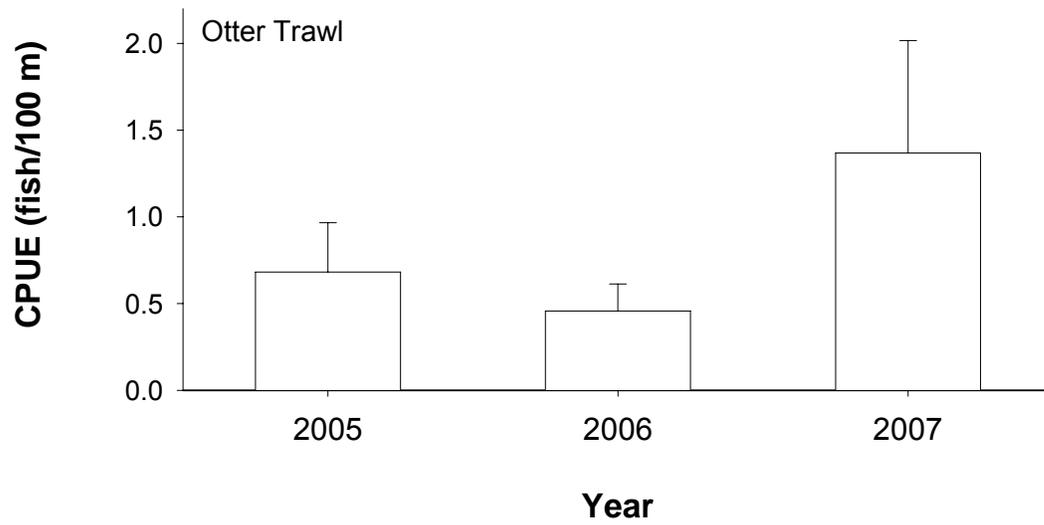


Figure 19. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sturgeon chub using otter trawls in segment 4 of the Missouri River during fish community season 2005-2007.

## Segment 4 - Sturgeon Chub / Fish Community Season

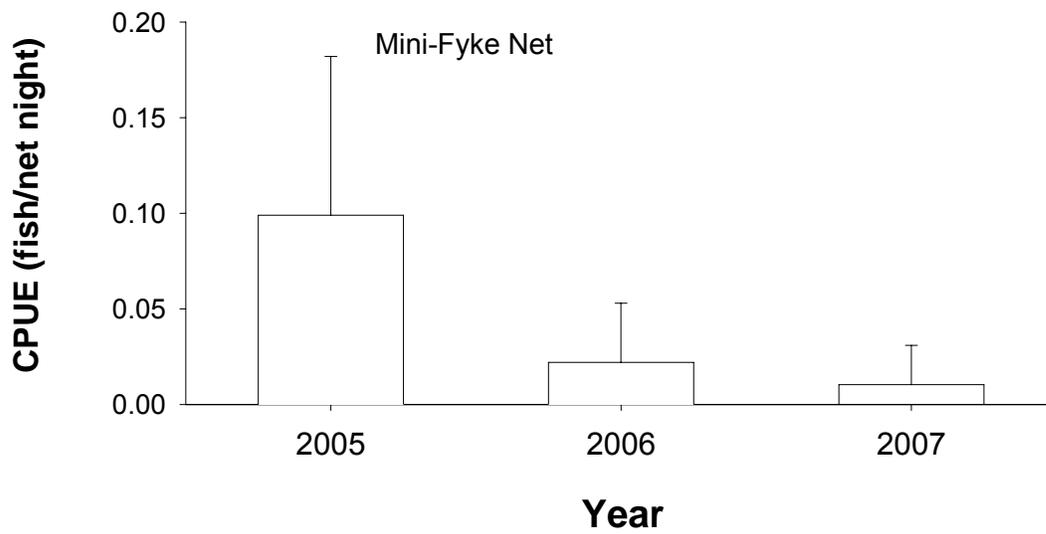


Figure 20. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sturgeon chub using mini-fyke nets and bag seines in segment 4 of the Missouri River during fish community season 2005-2007.

Table 26. Total number of sturgeon chubs captured for each gear during each season and the proportion caught within each macrohabitat type in segment 4 of the Missouri River during 2006 – 2007. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	0 .	N-E	0 24	0 0	N-E	N-E	0 31	0 32	0 13	0 0	0 0	0 0	0 0	0 0	0 0
Gill Net															
Otter Trawl	189 .	N-E	6 20	0 0	N-E	N-E	19 25	12 29	63 26	0 0	0 0	0 0	0 0	0 0	0 0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	0 .	N-E	0 28	0 0	N-E	N-E	0 31	0 24	0 17	0 0	0 0	0 0	0 0	0 0	0 0
Mini-Fyke Net	1 .	N-E	0 8	0 0	N-E	N-E	0 48	0 10	0 26	0 0	100 7	0 0	0 0	0 0	0 0
Otter Trawl	359 .	N-E	17 24	0 0	N-E	N-E	22 27	17 34	45 14	0 0	0 0	0 0	0 0	0 0	0 0

Table 27. Total number of sturgeon chubs captured for each gear during each season and the proportion caught within each mesohabitat type in segment 4 of the Missouri River during 2006 – 2007. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	0 .	0 0	0 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	189 .	0 0	83 90	N-E	17 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	0 .	0 0	0 89	N-E	0 11	N-E	N-E
Mini-Fyke Net	1 .	100 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	359 .	0 0	87 95	N-E	13 5	N-E	N-E

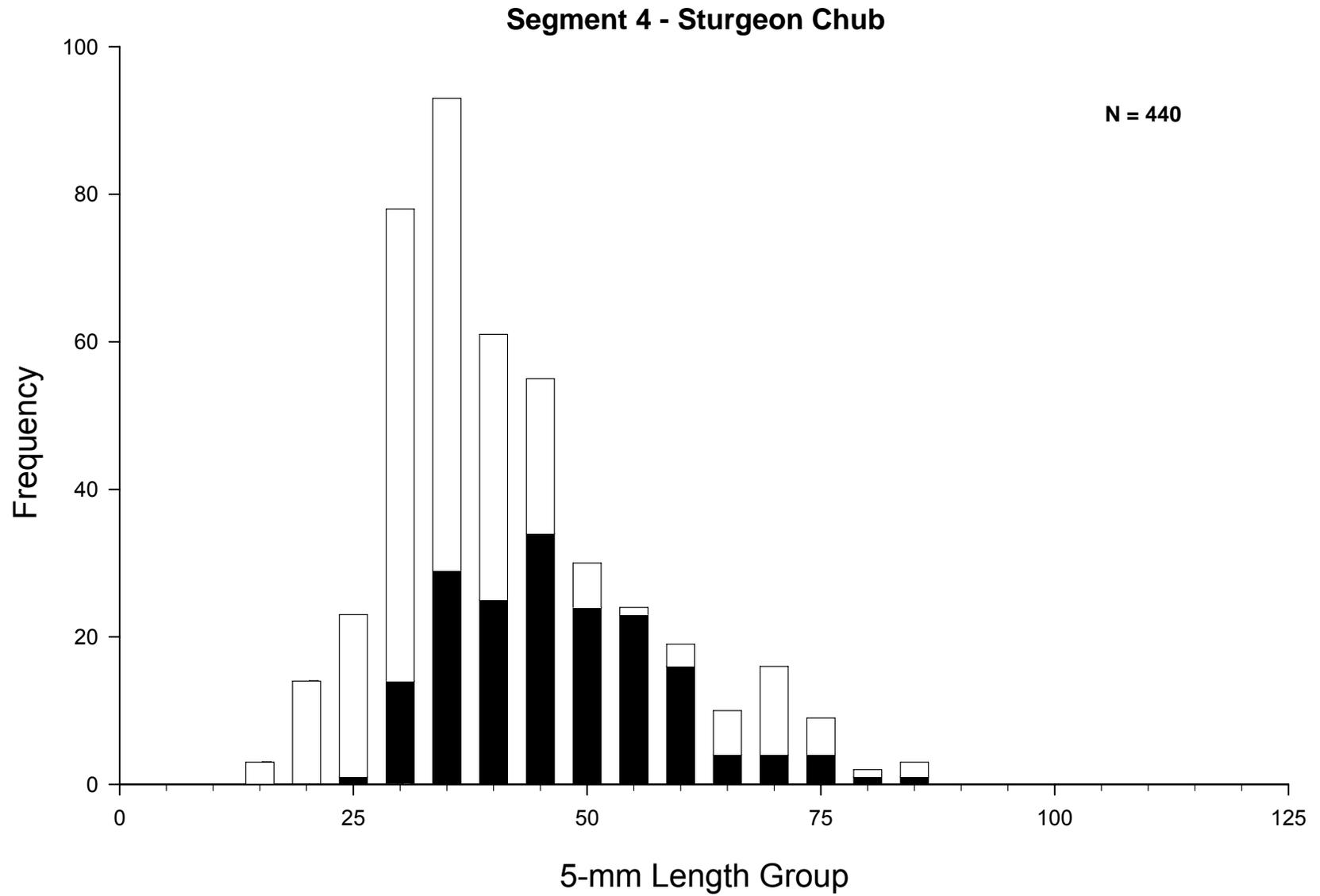


Figure 21. Length frequency of sturgeon chub during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 4 of the Missouri River during 2006-2007.

## **Sicklefin Chub**

Catch per unit effort of sicklefin chub in the otter trawl during the 2007 sturgeon season was 0.234 fish/100 m compared to 0.313 fish/100 m during the 2006 sturgeon season (Figure 22). During the fish community season, sicklefin chub were only captured in the otter trawl (CPUE 1.001 fish/100 m). During the 2005 and 2006 fish community seasons, sicklefin chub were captured in the otter trawl (1.257 fish/100 m and 0.505 fish/100m, respectively) and the mini-fyke nets (0.012 fish/net night and 0.56 fish/net night, respectively) (Figures 23 and 24). One hundred thirty eight (37%) sicklefin chubs were sampled in outside bend macrohabitats followed by 113 (30%) found in inside bends, 70 (19%) collected in channel crossovers and 51 (14%) found in secondary channel macrohabitats (Table 28).

Length frequency histogram of sicklefin chub captured in 2007 shows the majority (90%) of fish sampled during the sturgeon season were between 70 and 85 mm (Figure 25). During the fish community season the majority (90%) of sicklefin chub were between 65 and 85 mm followed by fish under 40 mm. Mean length at capture calculations from segment 4 sicklefin chub found that age-1 were 65 mm, age-2 were 75 mm and age-3 were 89 mm (Herman et al).

## Segment 4 - Sicklefin Chub / Sturgeon Season

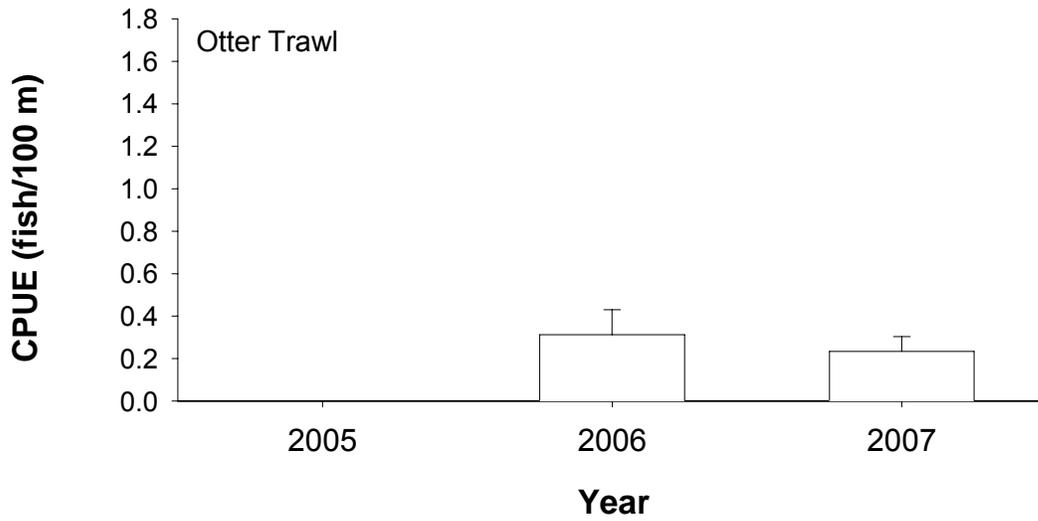


Figure 22. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sicklefin chub using otter trawls in segment 4 of the Missouri River during sturgeon season 2005-2007.

## Segment 4 - Sicklefin Chub / Fish Community Season

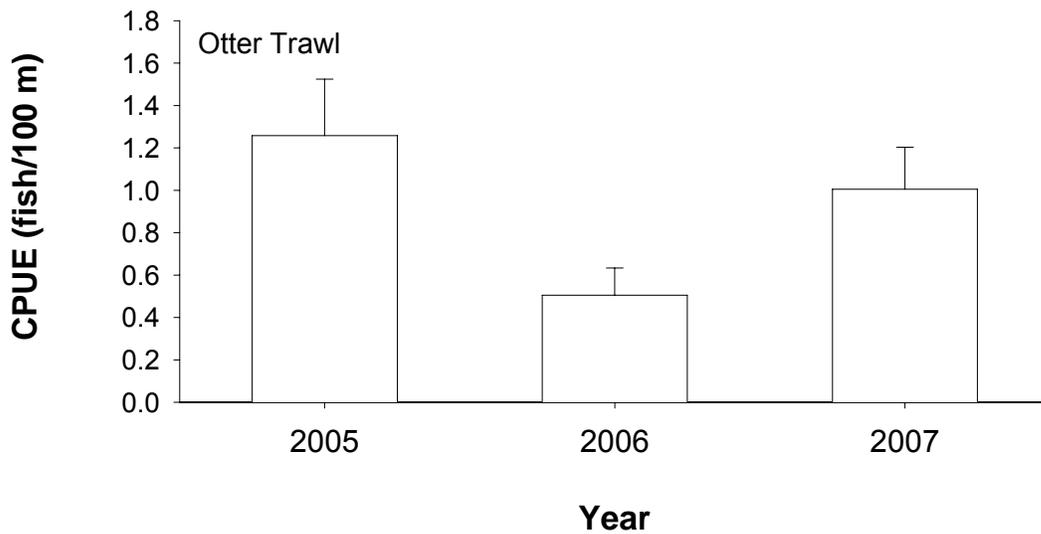


Figure 23. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sicklefin chub using otter trawls in segment 4 of the Missouri River during fish community season 2005-2007.

## Segment 4 - Sicklefin Chub / Fish Community Season

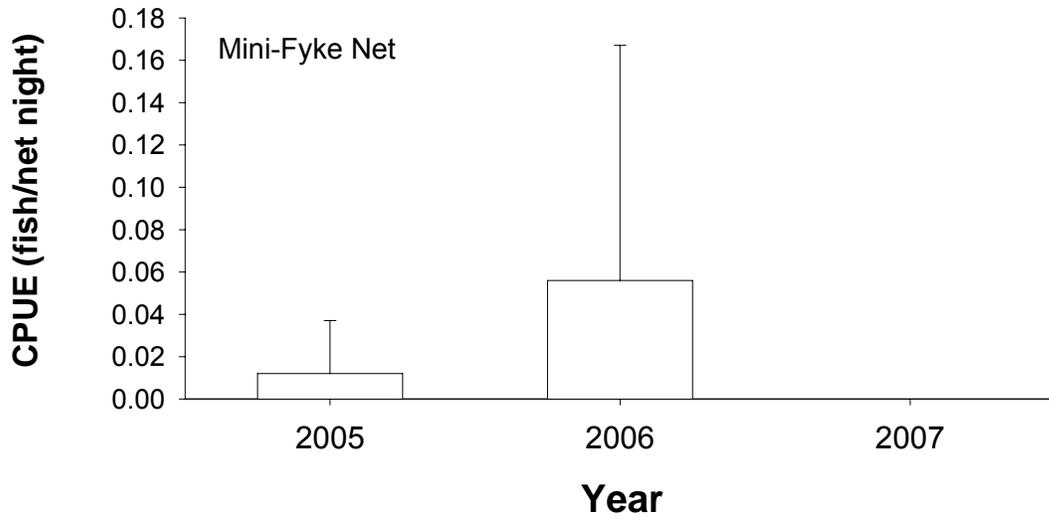


Figure 24. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sicklefin chub using mini-fyke nets in segment 4 of the Missouri River during fish community season 2005-2007.

Table 28. Total number of sicklefin chubs captured for each gear during each season and the proportion caught within each macrohabitat type in segment 4 of the Missouri River during 2006 – 2007. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	0 .	N-E 24	0 0	0 0	N-E N-E	N-E N-E	0 31	0 32	0 13	0 0	0 0	0 0	0 0	0 0	0 0
Gill Net															
Otter Trawl	75 .	N-E 20	13 0	0 0	N-E N-E	N-E N-E	39 25	16 29	32 26	0 0	0 0	0 0	0 0	0 0	0 0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	0 .	N-E 28	0 0	0 0	N-E N-E	N-E N-E	0 31	0 24	0 17	0 0	0 0	0 0	0 0	0 0	0 0
Mini-Fyke Net	0 .	N-E 8	0 0	0 0	N-E N-E	N-E N-E	0 48	0 10	0 26	0 0	0 7	0 0	0 0	0 0	0 0
Otter Trawl	299 .	N-E 24	20 0	0 0	N-E N-E	N-E N-E	28 27	42 34	9 14	0 0	0 0	0 0	0 0	0 0	0 0

Table 29. Total number of sicklefin chubs captured for each gear during each season and the proportion caught within each mesohabitat type in segment 4 of the Missouri River during 2006 – 2007. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	0 .	0 0	0 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	75 .	0 0	89 90	N-E	11 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	0 .	0 0	0 89	N-E	0 11	N-E	N-E
Mini-Fyke Net	0 .	0 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	299 .	0 0	93 95	N-E	7 5	N-E	N-E

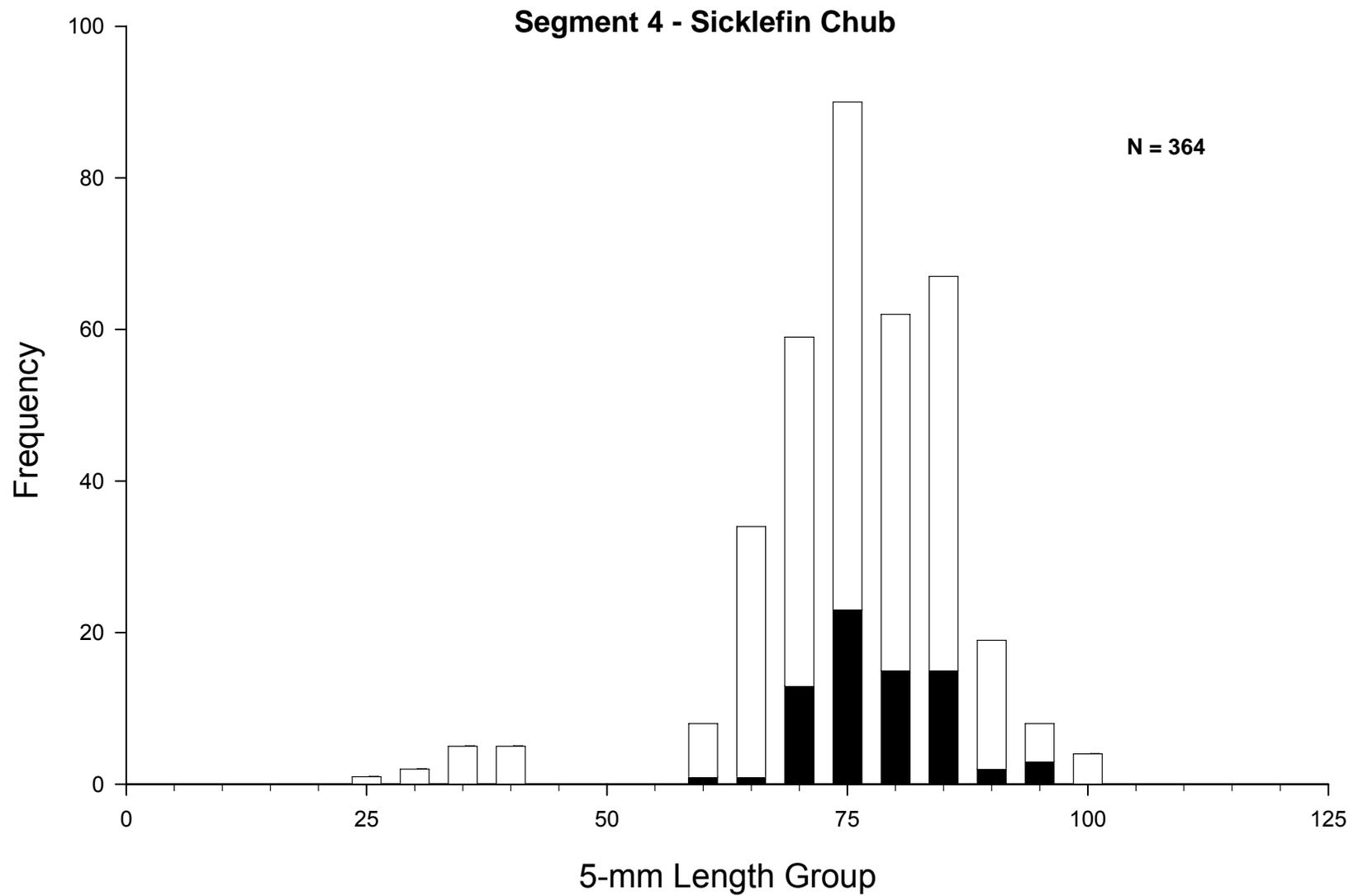


Figure 25. Length frequency of sicklefin chub during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 4 of the Missouri River during 2006-2007.

## **Speckled Chub**

No speckled chub were captured during the 2007 sampling season in segment 4

## **Sand Shiner**

A total of nine sand shiners were captured in segment 4 of the Missouri River in 2007. One was captured in the otter trawl during the sturgeon season while the remaining eight were sampled in the mini-fyke nets during the fish community season.

## Segment 4 - Sand Shiner / Sturgeon Season

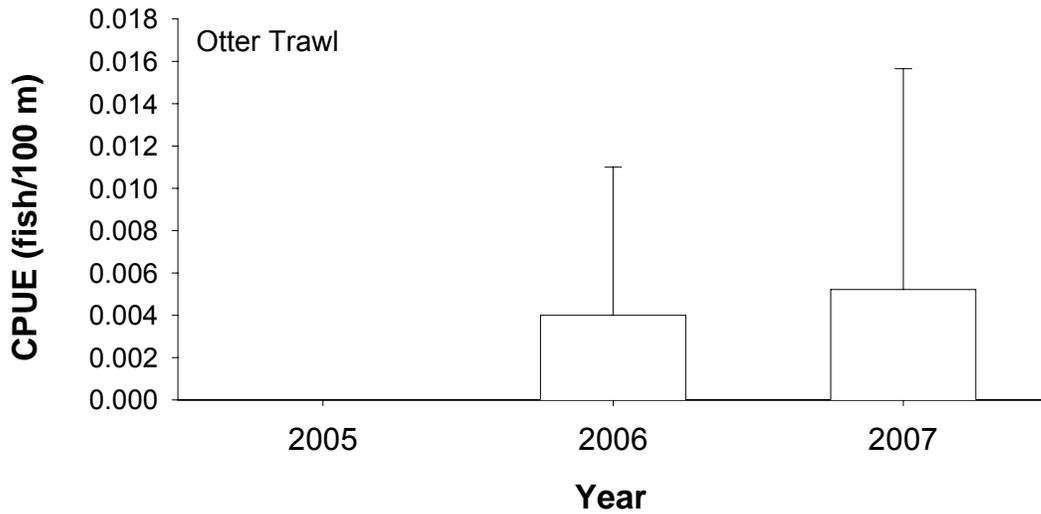


Figure 30. Mean annual catch-per-unit-effort (+/- 2 SE) of sand shiner with otter trawls in segment 4 of the Missouri River during sturgeon season 2005-2007.

## Segment 4 - Sand Shiner / Fish Community Season

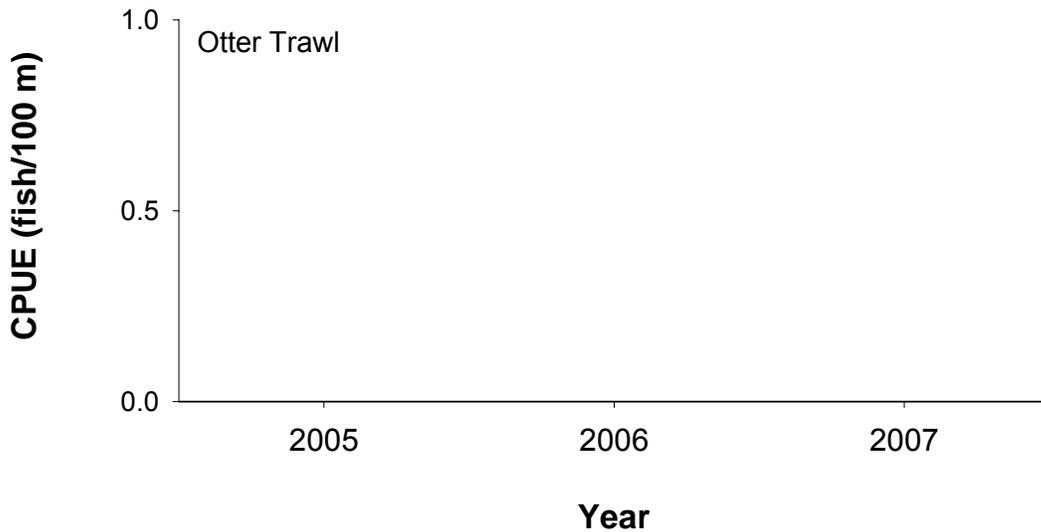


Figure 31. Mean annual catch-per-unit-effort (+/- 2 SE) of sand shiner with otter trawls in segment 4 of the Missouri River during fish community season 2005-2007.

## Segment 4 - Sand Shiner / Fish Community Season

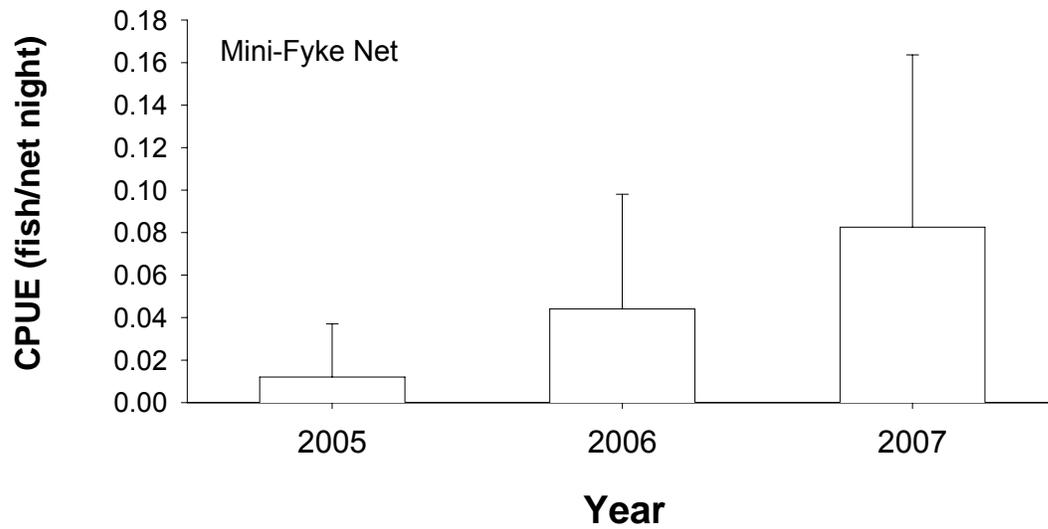


Figure 32. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sand shiner with mini-fyke nets in segment 4 of the Missouri River during fish community season 2005-2007.

Table 32. Total number of sand shiners captured for each gear during each season and the proportion caught within each macrohabitat type in segment 4 of the Missouri River during 2006 – 2007. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	0 .	N-E 0 24	0 0	0 0	N-E N-E	N-E N-E	0 31	0 32	0 13	0 0	0 0	0 0	0 0	0 0	0 0
Gill Net															
Otter Trawl	1 .	N-E 0 20	0 0	0 0	N-E N-E	N-E N-E	0 25	0 29	100 26	0 0	0 0	0 0	0 0	0 0	0 0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	0 .	N-E 0 28	0 0	0 0	N-E N-E	N-E N-E	0 31	0 24	0 17	0 0	0 0	0 0	0 0	0 0	0 0
Mini-Fyke Net	8 .	N-E 0 8	0 0	0 0	N-E N-E	N-E N-E	25 48	0 10	25 26	0 0	50 7	0 0	0 0	0 0	0 0
Otter Trawl	0 .	N-E 0 24	0 0	0 0	N-E N-E	N-E N-E	0 27	0 34	0 14	0 0	0 0	0 0	0 0	0 0	0 0

Table 33. Total number of sand shiners captured for each gear during each season and the proportion caught within each mesohabitat type in segment 4 of the Missouri River during 2006 – 2007. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	0 .	0 0	0 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	1 .	0 0	0 90	N-E	100 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	0 .	0 0	0 89	N-E	0 11	N-E	N-E
Mini-Fyke Net	8 .	100 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	0 .	0 0	0 95	N-E	0 5	N-E	N-E

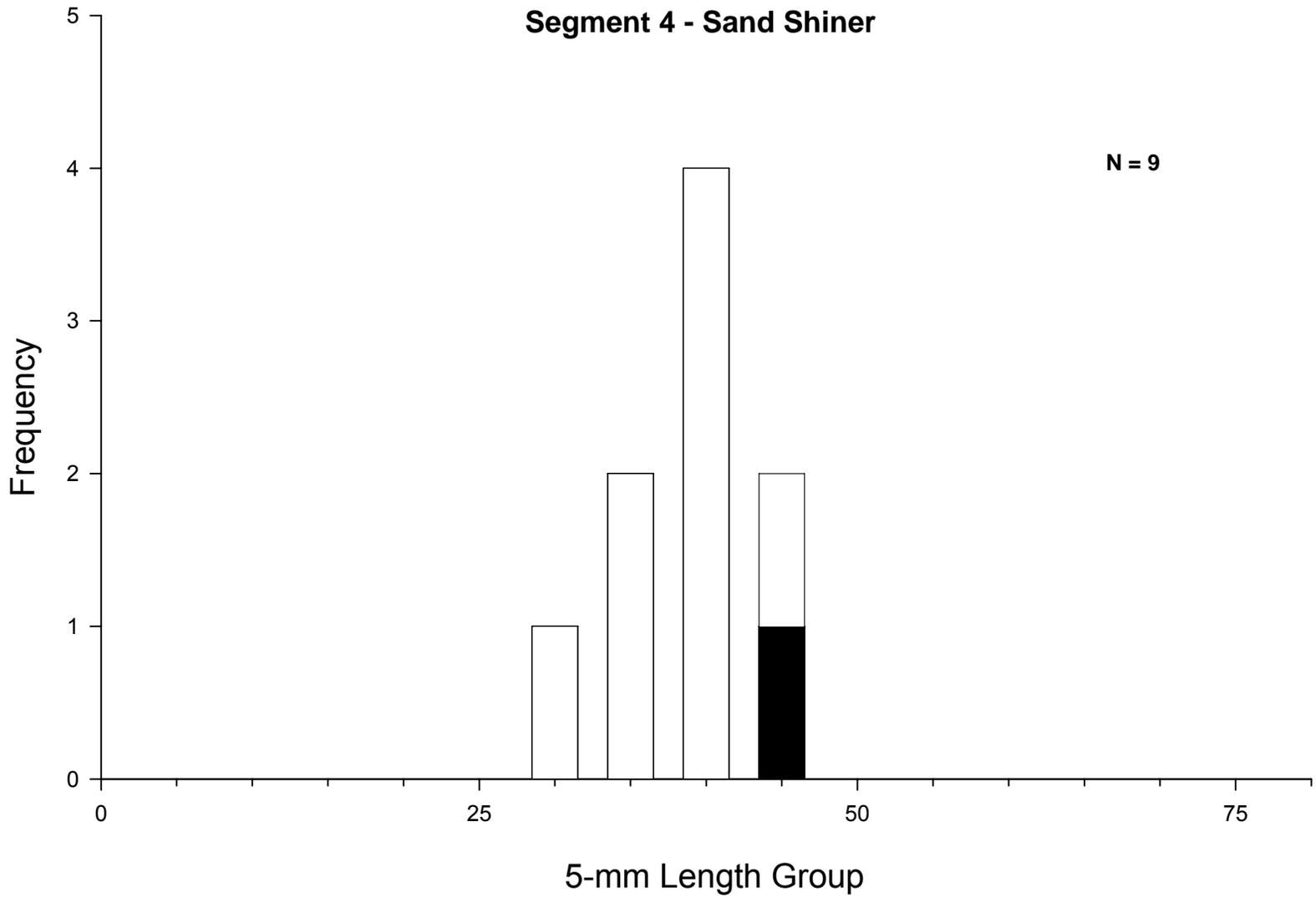


Figure 33. Length frequency of sand shiner during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 4 of the Missouri River during 2006-2007.

### ***Hybognathus spp.***

A total of 1490 *hybognathus spp.* were collected during the 2007 sampling season. Random specimens were sacrificed in order to determine species. All specimens collected were found to be western silvery minnows (*Hybognathus argyritis*). Only five western silvery minnows were captured in the otter trawl (CPUE 0.015 fish/100 m) during the sturgeon season (Figure 34). Mini-fyke nets captured the majority of western silvery minnows (CPUE 15.289 fish/net night) followed by the otter trawl (0.006 fish/100 m) (Figures 35 and 36). During the 2005 and 2006 fish community seasons, catch per unit effort of western silvery minnows was highest in mini-fyke nets (68.975 fish/net night and 3.189 fish/net night, respectively). The majority of western silvery minnows were sampled in nonconnected secondary channel macrohabitats (79%), followed by inside bend (16%) and large secondary channel (3%) macrohabitats (Table 34).

Length frequency histogram of western silvery minnows captured in 2007 shows the majority (63%) of fish sampled during the fish community season were between 30 and 55 mm (Figure 37) followed by fish between 70 and 90 mm (25%). Mean length at capture calculations from western silvery minnows captured in segment 4 found that age-0 were 58 mm, age-1 were 88 mm and age-2 were 100 mm (Dattilo et al).

### Segment 4 - *Hybognathus* spp. / Sturgeon Season

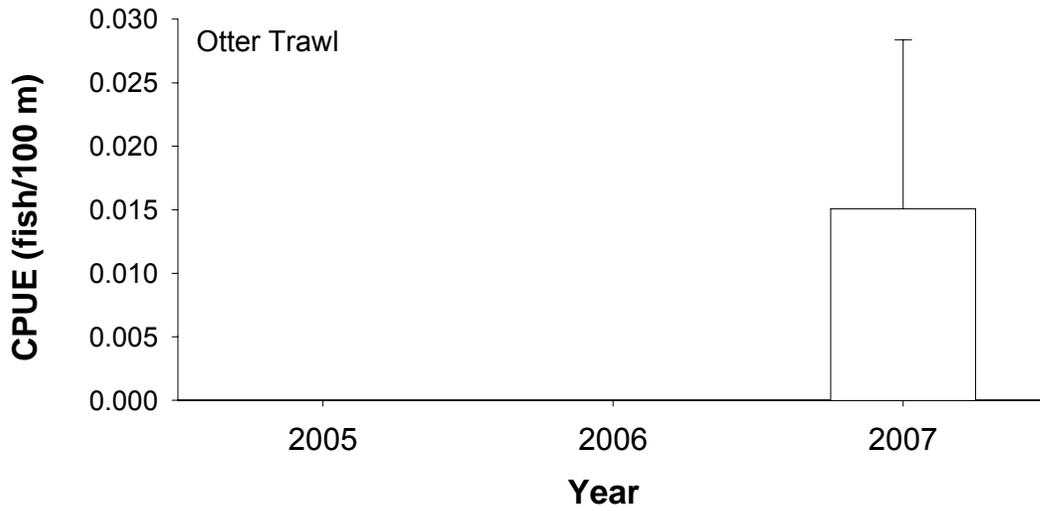


Figure 34. Mean annual catch-per-unit-effort ( $\pm$  2 SE) of *Hybognathus* spp. with otter trawls in segment 4 of the Missouri River during sturgeon season 2005-2007.

### Segment 4 - *Hybognathus* spp. / Fish Community Season

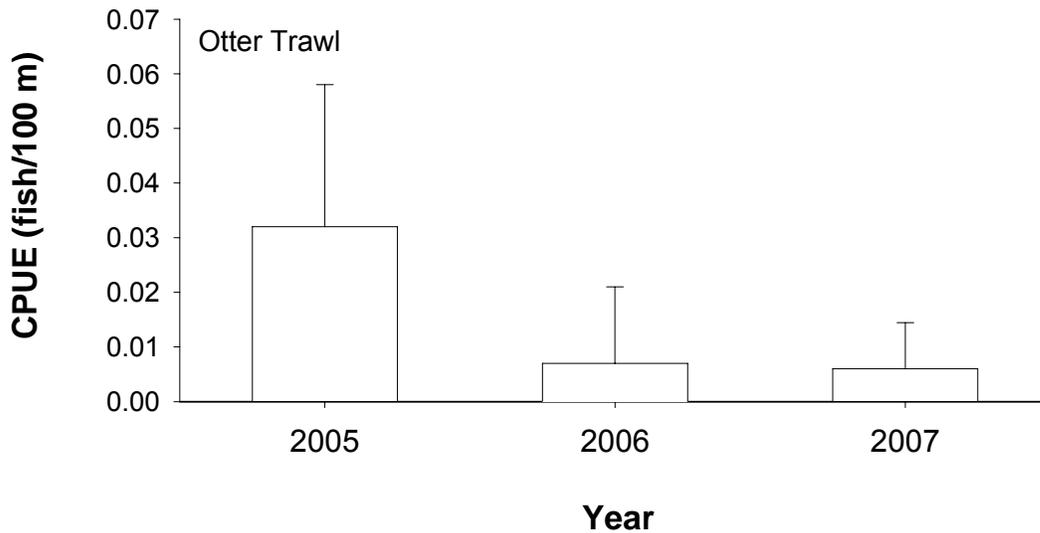


Figure 35. Mean annual catch-per-unit-effort ( $\pm$  2 SE) of *Hybognathus* spp. with otter trawls in segment 4 of the Missouri River during fish community season 2005-2007.

## Segment 4 - *Hybognathus* spp. / Fish Community Season

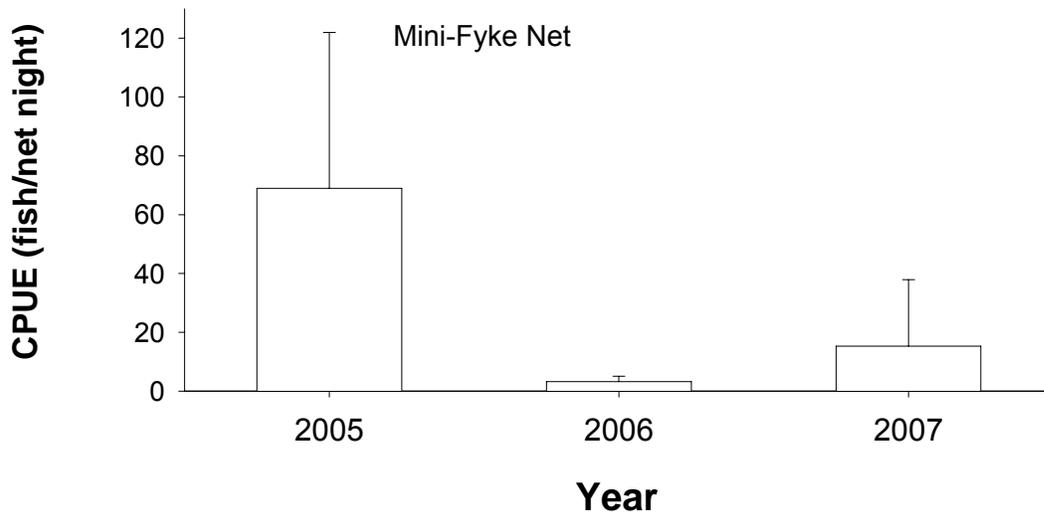


Figure 36. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of *Hybognathus* spp. with mini-fyke nets in segment 4 of the Missouri River during fish community season 2005-2007.

Table 34. Total number of *Hybognathus* spp. captured for each gear during each season and the proportion caught within each macrohabitat type in segment 4 of the Missouri River during 2006 – 2007. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	0 .	N-E	0 24	0 0	N-E	N-E	0 31	0 32	0 13	0 0	0 0	0 0	0 0	0 0	0 0
Gill Net															
Otter Trawl	5 .	N-E	0 20	0 0	N-E	N-E	40 25	40 29	20 26	0 0	0 0	0 0	0 0	0 0	0 0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	0 .	N-E	0 28	0 0	N-E	N-E	0 31	0 24	0 17	0 0	0 0	0 0	0 0	0 0	0 0
Mini-Fyke Net	1483 .	N-E	1 8	0 0	N-E	N-E	16 48	0 10	3 26	0 0	79 7	0 0	0 0	0 0	0 0
Otter Trawl	2 .	N-E	50 24	0 0	N-E	N-E	0 27	50 34	0 14	0 0	0 0	0 0	0 0	0 0	0 0

Table 35. Total number of *Hybognathus* spp. captured for each gear during each season and the proportion caught within each mesohabitat type in segment 4 of the Missouri River during 2006 – 2007. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	0 .	0 0	0 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	5 .	0 0	80 90	N-E	20 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	0 .	0 0	0 89	N-E	0 11	N-E	N-E
Mini-Fyke Net	1483 .	100 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	2 .	0 0	100 95	N-E	0 5	N-E	N-E

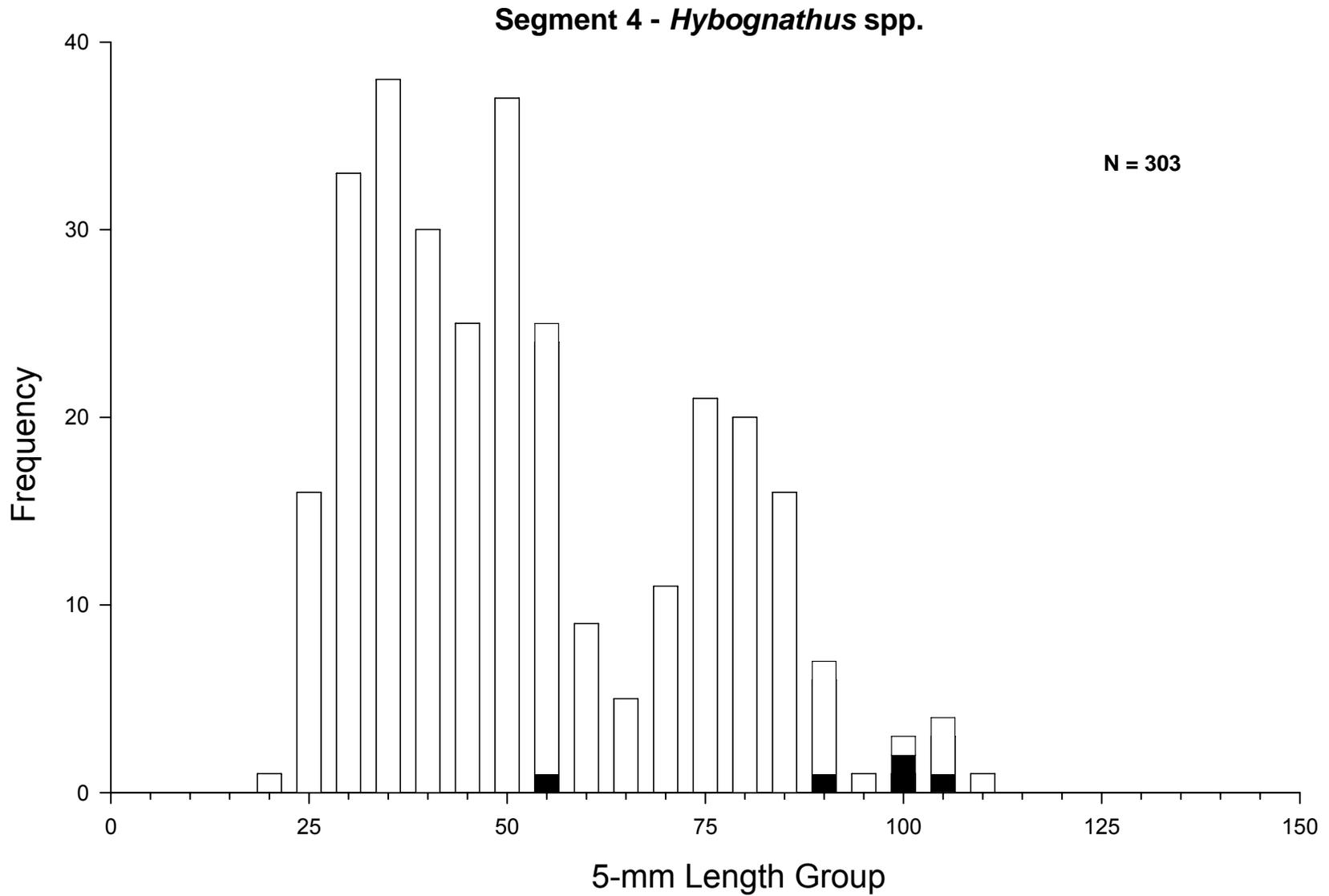


Figure 37. Length frequency of *Hybognathus* spp. caught during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 4 of the Missouri River during 2006-2007

## **Blue Sucker**

Sixteen blue suckers were captured in segment 4 of the Missouri River during the 2007 sampling season. During the sturgeon season, eight blue suckers were captured in trammel nets (CPUE 0.0302 fish/100 m) and one in the otter trawl (CPUE 0.0027 fish/100 m) (Figures 38 and 39). Seven blue suckers were sampled in the trammel net (CPUE 0.0207 fish/100 m) during the fish community season. The otter trawl captured two (CPUE 0.0065 fish/100 m) during the fish community season (Figure 41). The majority of blue suckers (44%) were captured in inside bend macrohabitats, followed by outside bend (25%) and large connected secondary channel macrohabitats.

Blue suckers ranged in length from 380 mm to 810 mm (Figure 44). The majority (N=10) of fish were between 670 mm and 730 mm. No aging structures were collected from the larger blue suckers.

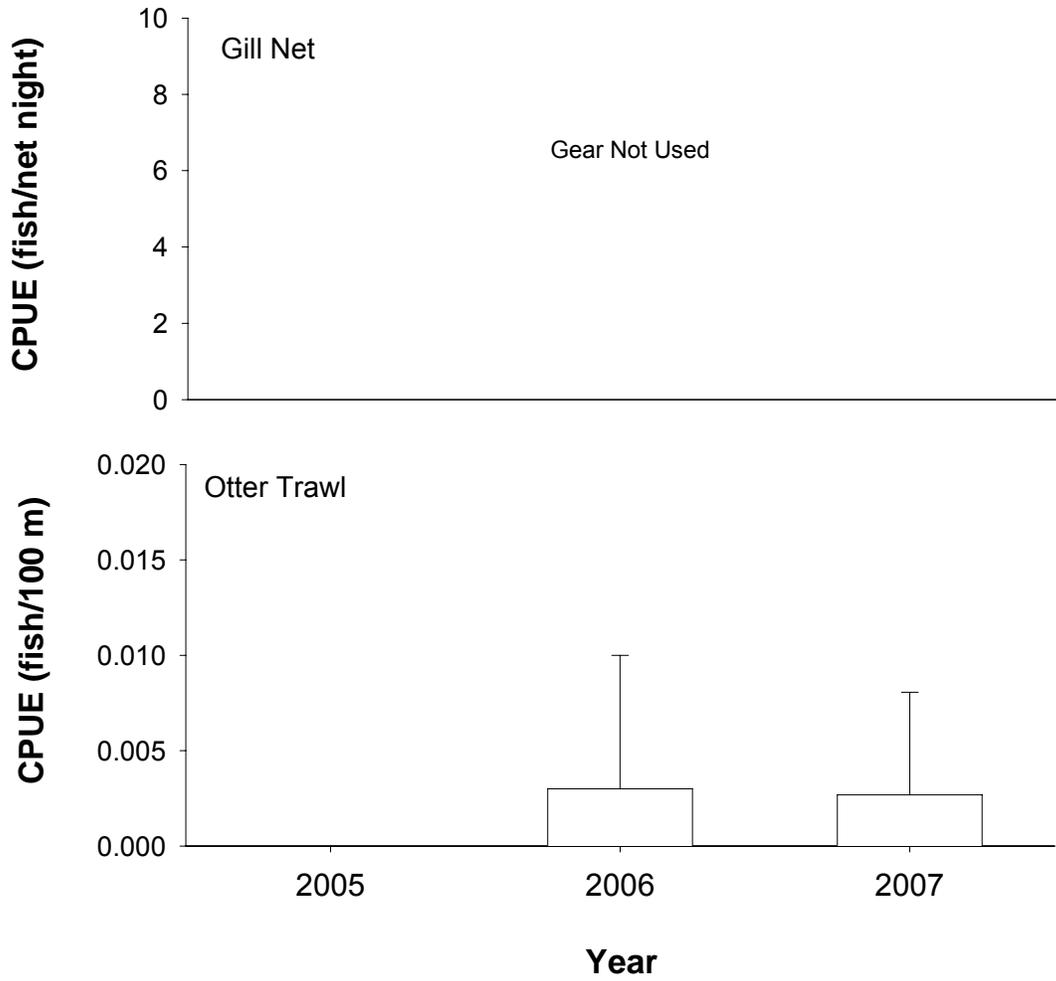


Figure 38. Mean annual catch-per-unit-effort (+/- 2 SE) of blue sucker with gill nets and otter trawls in segment 4 of the Missouri River during sturgeon season 2005-2007.

## Segment 4 - Blue Sucker / Sturgeon Season

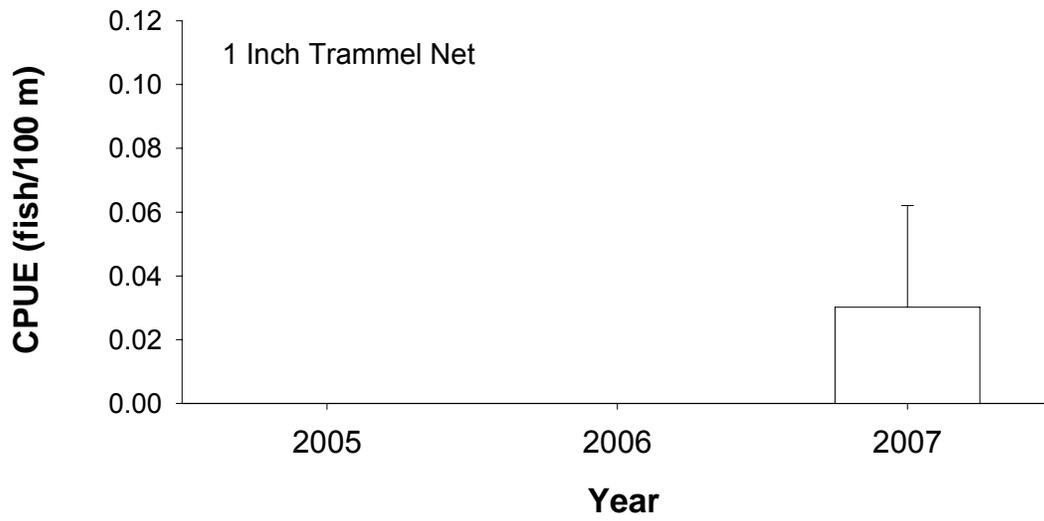


Figure 39. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of blue sucker with 1 inch trammel nets in segment 4 of the Missouri River during sturgeon season 2005-2007.

## Segment 4 - Blue Sucker / Fish Community Season

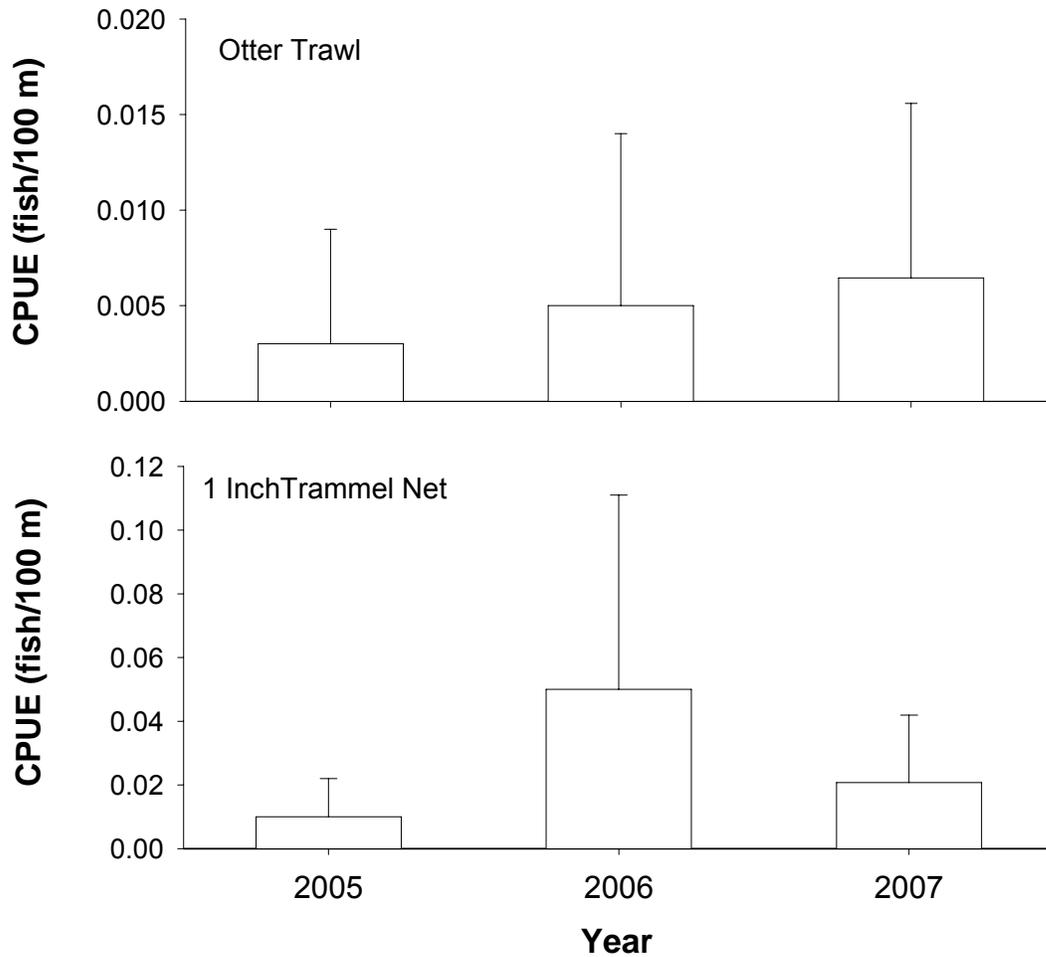


Figure 41. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of blue sucker using otter trawls and 1 inch trammel nets in segment 4 of the Missouri River during fish community season 2005-2007.

## Segment 4 - Blue Sucker / Fish Community Season

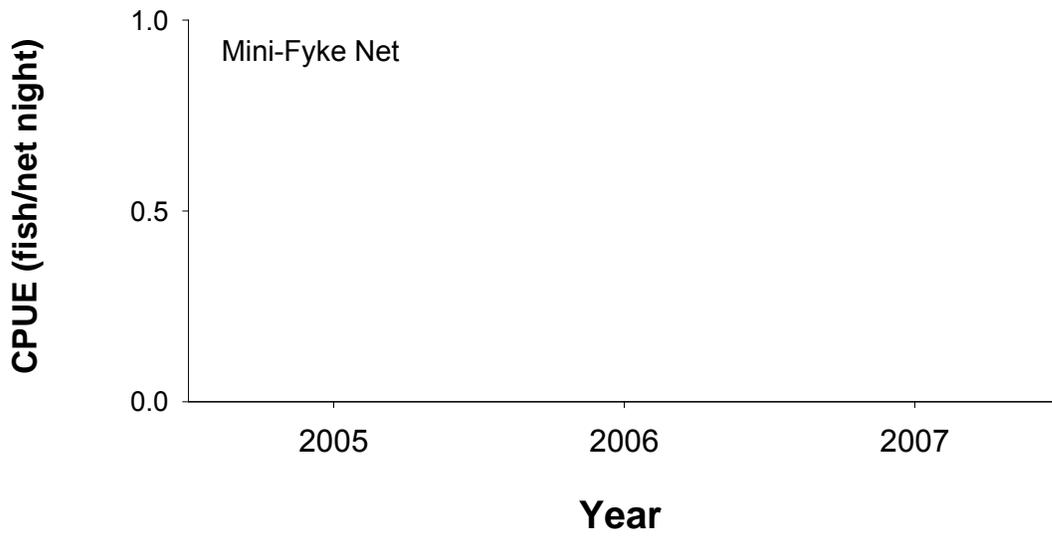


Figure 42. Mean annual catch-per-unit-effort ( $\pm$  2SE) of blue suckers using mini-fyke nets in segment 4 of the Missouri River during fish community season 2005 - 2007.

Table 36. Total number of blue suckers captured for each gear during each season and the proportion caught within each macrohabitat type in segment 4 of the Missouri River during 2006 – 2007. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	8 .	N-E 0 24	0 0	0 0	N-E N-E	N-E N-E	75 31	13 32	13 13	0 0	0 0	0 0	0 0	0 0	0 0
Gill Net															
Otter Trawl	1 .	N-E 0 20	0 0	0 0	N-E N-E	N-E N-E	0 25	0 29	100 26	0 0	0 0	0 0	0 0	0 0	0 0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	5 .	N-E 20 28	0 0	0 0	N-E N-E	N-E N-E	0 31	40 24	40 17	0 0	0 0	0 0	0 0	0 0	0 0
Mini-Fyke Net	0 .	N-E 0 8	0 0	0 0	N-E N-E	N-E N-E	0 48	0 10	0 26	0 0	0 7	0 0	0 0	0 0	0 0
Otter Trawl	2 .	N-E 0 24	0 0	0 0	N-E N-E	N-E N-E	50 27	50 34	0 14	0 0	0 0	0 0	0 0	0 0	0 0

Table 37. Total number of blue suckers captured for each gear during each season and the proportion caught within each mesohabitat type in segment 4 of the Missouri River during 2006 – 2007. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	8 .	0 0	100 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	1 .	0 0	100 90	N-E	0 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	5 .	0 0	80 89	N-E	20 11	N-E	N-E
Mini-Fyke Net	0 .	0 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	2 .	0 0	100 95	N-E	0 5	N-E	N-E

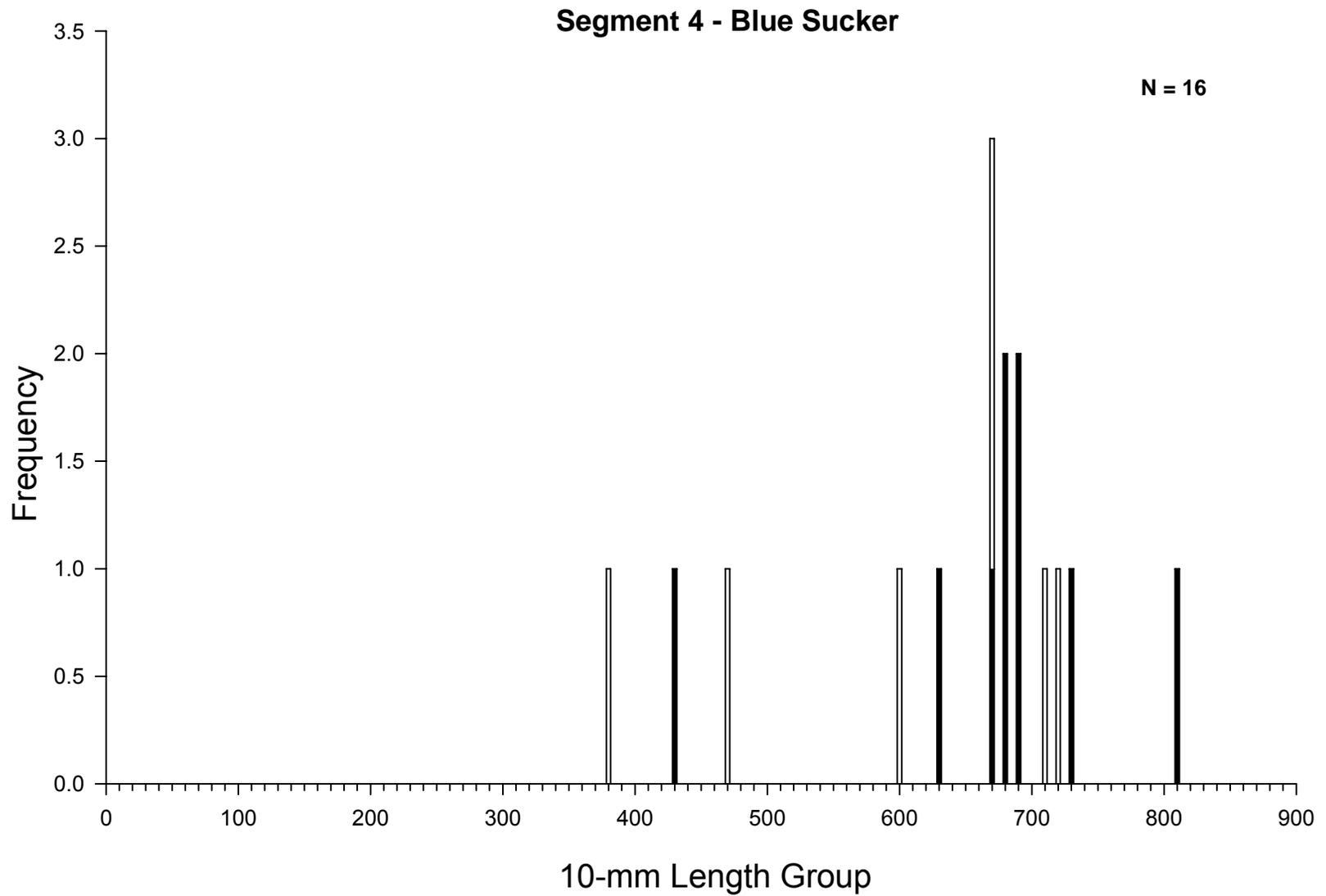


Figure 44. Length frequency of blue sucker during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 4 of the Missouri River during 2006-2007.

## Sauger

A total of 161 sauger were captured in all gears in both sturgeon and fish community seasons in 2007. Catch per unit effort of sauger in trammel nets during the sturgeon season was higher in 2007 (0.210 fish/100 m) than in 2005 and 2006 (0.057 fish/100 m and 0.160 fish/100 m, respectively) (Figure 46). Sauger were more frequently captured in the otter trawl during the 2007 sturgeon season (CPUE 0.0335 fish/ 100 m) than during the 2006 sturgeon season (CPUE 0.0140 fish/100 m) (Figure 45). During the fish community season, 54 sauger were sampled in mini-fyke nets (CPUE 0.557 fish/net night) which was lower than in 2006 (0.756 fish/net night) and 2005 (1.284 fish/net night) (Figure 49). Thirty four sauger were captured in trammel nets (0.164 fish/100 m) and 20 in the otter trawl (0.0676 fish/100 m) during the fish community season (Figure 48). Over 39% (N=63) of sauger captured in 2007 were associated with inside bend macrohabitats, followed by 27% (N=43) sauger sampled in inside bends, 16% (N=26) in large connected secondary channels and 15 % (N=24) in channel crossover macrohabitats (Table 38).

Length frequency histogram of sauger captured in 2007 shows the majority of fish (94%) captured during the sturgeon season ranged in fork length from 250 mm to 420 mm (Figure 51). During the fish community season, 63% of sauger captured were between 250 mm and 420 mm followed by sauger under 150 mm (21%) and sauger between 150 mm and 250 mm (16%). Mean length at capture calculations from sauger captured in segment 4 found that age-0 fish were 118 mm, age-1 were 238 mm, age-2 were 295 mm, age-3 were 295 mm and age-4 were 256 mm (Dattilo et al 2008).

## Segment 4 - Sauger / Sturgeon Season

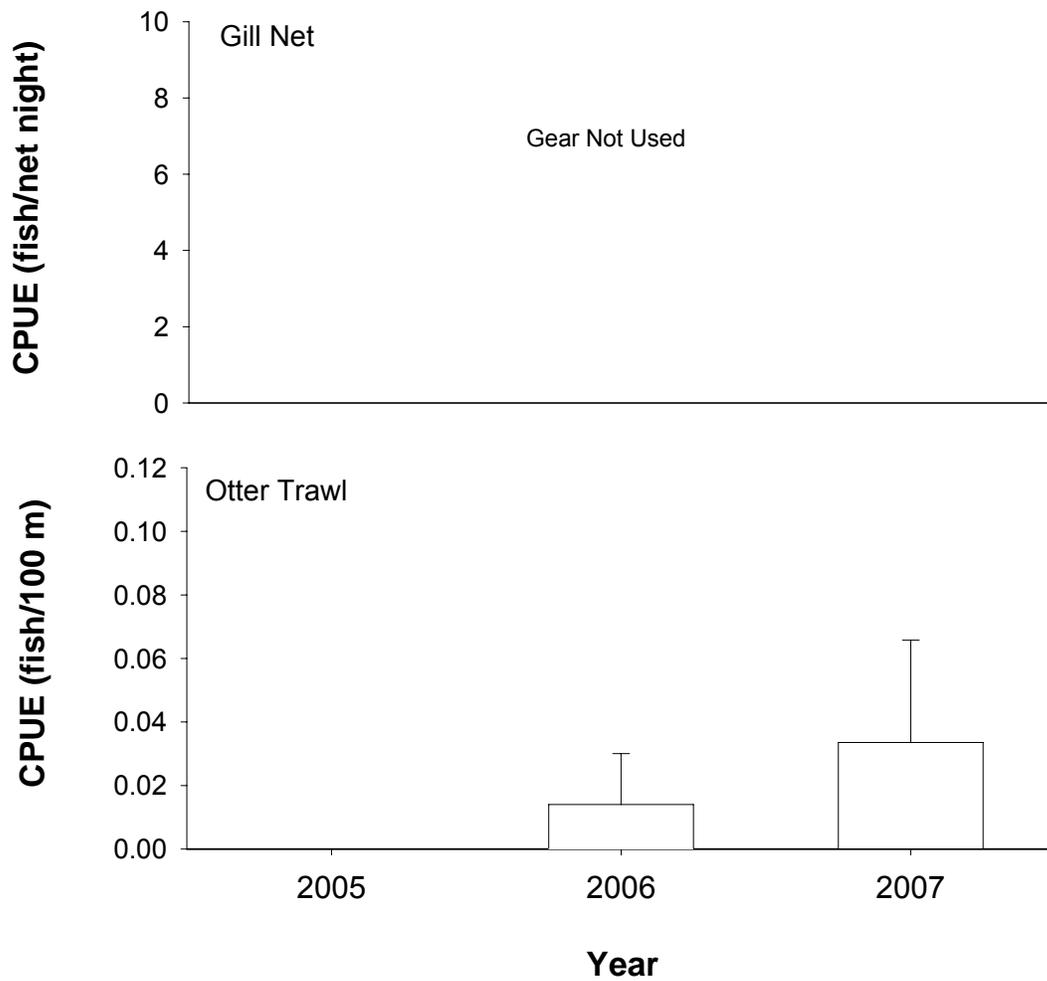


Figure 45. Mean annual catch-per-unit-effort ( $\pm$  2 SE) of sauger using gill nets and otter trawls in segment 4 of the Missouri River during sturgeon season 2005-2007.

## Segment 4 - Sauger / Sturgeon Season

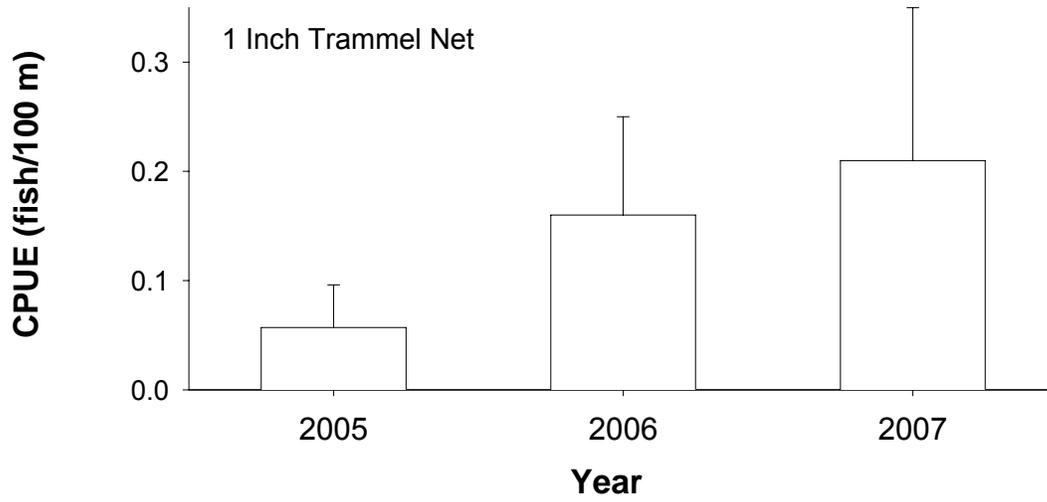


Figure 46. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sauger using 1 inch trammel nets in segment 4 of the Missouri River during sturgeon season 2005-2007.

## Segment 4 - Sauger / Fish Community Season

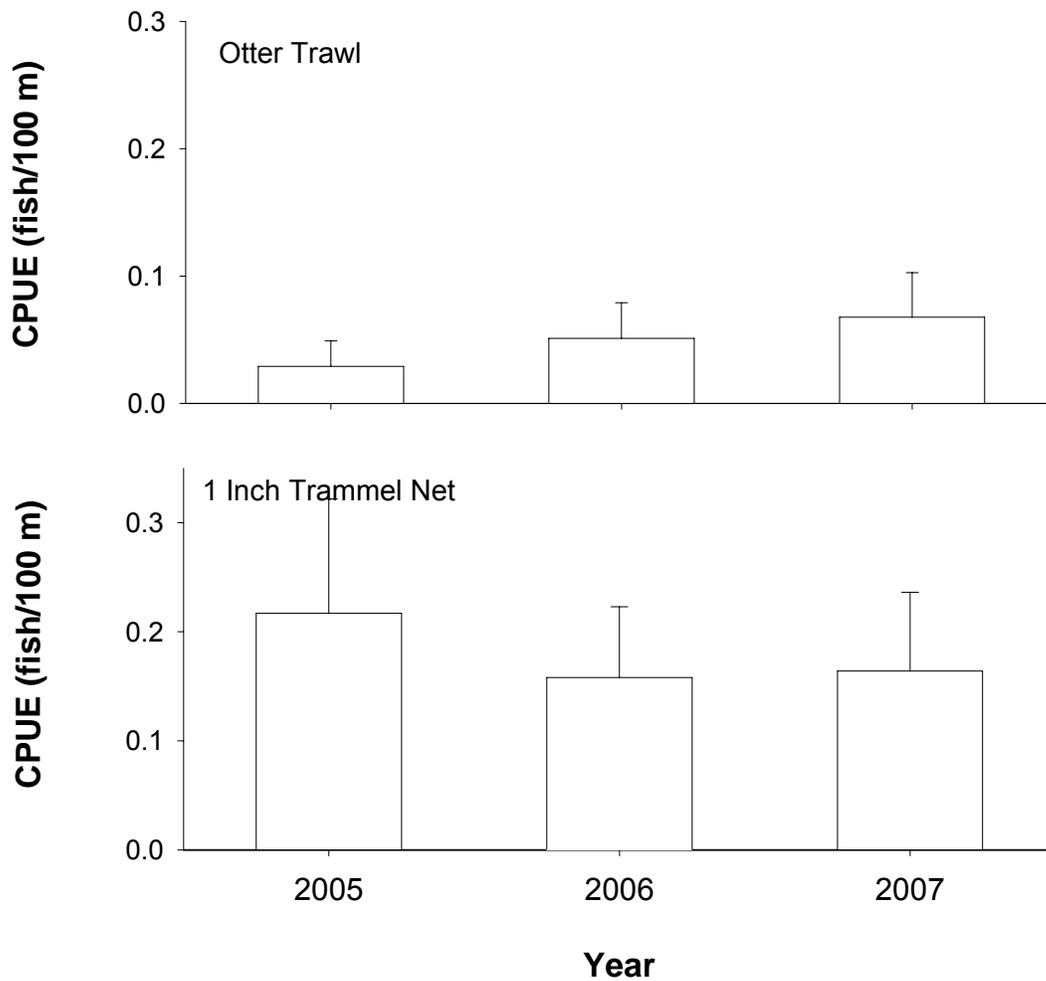


Figure 48. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sauger using otter trawls and 1 inch trammel nets in segment 4 of the Missouri River during fish community season 2005- 2007.

## Segment 4 - Sauger / Fish Community Season

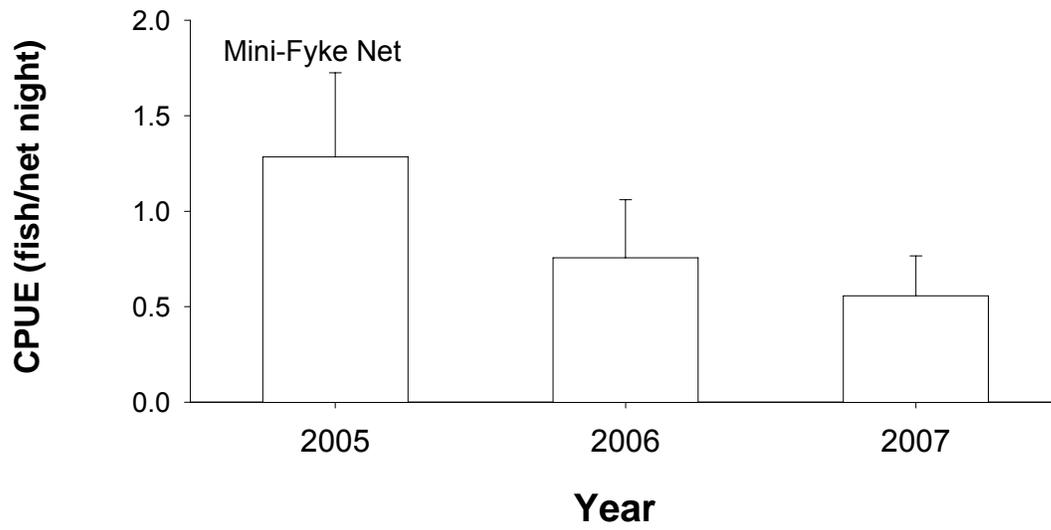


Figure 49. Mean annual catch-per-unit-effort ( $\pm 2$  SE) of sauger using mini-fyke nets in segment 4 of the Missouri River during fish community season 2005-2007.

Table 38. Total number of sauger captured for each gear during each season and the proportion caught within each macrohabitat type in segment 4 of the Missouri River during 2006 – 2007. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
<b>Sturgeon Season (Fall through Spring)</b>															
1 Inch Trammel Net	42	N-E	12	0	N-E	N-E	21	60	7	0	0	0	0	0	0
	.		24	0			31	32	13	0	0	0	0	0	0
Gill Net															
Otter Trawl	11	N-E	27	0	N-E	N-E	9	18	45	0	0	0	0	0	0
	.		20	0			25	29	26	0	0	0	0	0	0
<b>Fish Community Season (Summer)</b>															
1 Inch Trammel Net	34	N-E	18	0	N-E	N-E	35	29	18	0	0	0	0	0	0
	.		28	0			31	24	17	0	0	0	0	0	0
Mini-Fyke Net	54	N-E	15	0	N-E	N-E	57	4	15	0	9	0	0	0	0
	.		8	0			48	10	26	0	7	0	0	0	0
Otter Trawl	20	N-E	10	0	N-E	N-E	50	20	20	0	0	0	0	0	0
	.		24	0			27	34	14	0	0	0	0	0	0

Table 39. Total number of sauger captured for each gear during each season and the proportion caught within each mesohabitat type in segment 4 of the Missouri River during 2006 – 2007. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat					
		BAR	CHNB	DTWT	ITIP	POOL	TLWG
<b>Sturgeon Season (Fall through Spring)</b>							
1 Inch Trammel Net	42 .	0 0	100 93	N-E	0 7	N-E	N-E
Gill Net							
Otter Trawl	11 .	0 0	91 90	N-E	9 10	N-E	N-E
<b>Fish Community Season (Summer)</b>							
1 Inch Trammel Net	34 .	0 0	94 89	N-E	6 11	N-E	N-E
Mini-Fyke Net	54 .	100 98	0 0	N-E	0 2	N-E	N-E
Otter Trawl	20 .	0 0	85 95	N-E	15 5	N-E	N-E

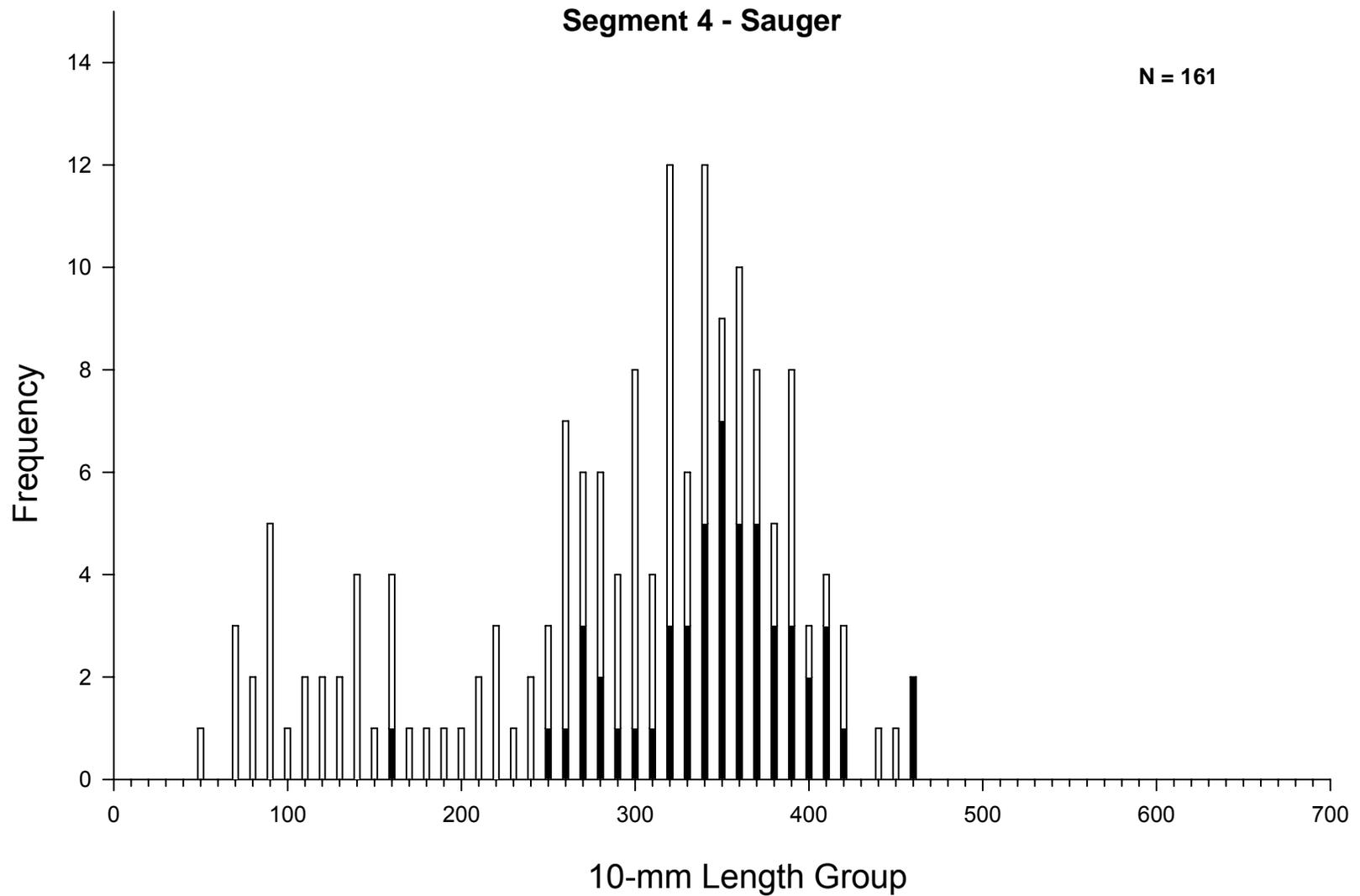


Figure 51. Length frequency of sauger during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 4 of the Missouri River during 2006-2007.

## Missouri River Fish Community

During the 2007 sampling season 17,403 fish were sampled with standard gears in segment 4 of the Missouri River. Standard gears captured 36 different species of fish with emerald shiners contributing the largest percentage of total catch (65%, N = 11,387). Western silvery minnows were the next most abundant species (N = 1489) followed by channel catfish (N = 1327), followed by sturgeon chubs (N = 678), flathead chubs (N = 412) and sicklefin chubs (N = 389). More than 50 individuals were collected for 14 different species of fish. Twenty seven species were captured in multiple gears.

Trammel nets and otter trawls were the only gears deployed during the sturgeon season in 2007. A total of 1133 (181 in trammel nets, 952 in otter trawls) fish representing 26 species were captured in 55,988 meters of sampling (23,362 m TN, 32,626 m OT) (Appendices F2 and F4). Channel catfish (N = 46) were the most abundant species collected in trammel nets during the sturgeon season, followed by sauger (N = 42) and shovelnose sturgeon (N = 19). Additionally, trammel nets also collected goldeye (N = 19), small mouth buffalo (N = 16), river carpsucker (N = 14), blue sucker (N = 8), common carp (N = 7), shorthead redhorse (N = 5), bigmouth buffalo (N = 2), walleye (N = 2), saugeye (N = 1), paddlefish (N = 1) and stonecat (N = 1). The otter trawl sampled similar species of fish as trammel nets including channel catfish (N = 488), stonecat (N = 69), shovelnose sturgeon (N = 22), sauger (N = 11), river carpsucker (N = 7), goldeye (N = 4), common carp (N = 3), shorthead redhorse (N = 2), smallmouth buffalo (N = 2), bigmouth buffalo (N = 1) and blue sucker (N = 1). The otter trawl also sampled species of fish not collected with the trammel net including sturgeon chub (N = 195), sicklefin chub (N = 76), flathead chub (N = 53), pallid sturgeon (N = 7) and western silvery minnow (N = 4). Only one specimen from the following species were sampled in the otter trawl during the sturgeon season: emerald shiner, fathead minnow, freshwater drum, longnose dace, sand shiner, and white sucker (Appendix F).

During the fish community season, trammel nets captured 347 fish representing 14 species. There were 169 shovelnose sturgeon collected in 25,310 meters of drifting. Channel catfish were the next most abundant species (N = 44), followed by sauger (N = 41), river carpsucker (N = 31), goldeye (N = 26), pallid sturgeon (N = 15), blue sucker (N = 5), common carp (N = 4),

smallmouth buffalo (N = 4), shorthead redhorse (N = 3), bigmouth buffalo (N = 2), flathead chub (N = 1), freshwater drum (N = 1), and northern pike (N = 1).

Otter trawls captured 1766 fish representing 19 species during the fish community season in 32,654 m of sampling. Channel catfish (N = 674) were the most abundant species collected in otter trawls followed by sturgeon chubs (N = 482), sicklefin chubs (N = 313) and shovelnose sturgeon (N = 80). Seven species were sampled in the otter trawl that were not sampled in the trammel net: sicklefin and sturgeon chubs, stonecat (N = 19), emerald shiner (N = 4), western silvery minnow (N = 2), white crappie (N = 1) and white bass (N = 1) (Appendix F4).

Mini-fyke nets collected more fish than any other gear used in segment 4. In 2007, there were 14,157 fish representing 28 species of fish. Emerald shiners (N = 11,382) were the most abundant species sampled, followed by western silvery minnow (N = 1483), flathead chubs (N = 324), river carpsucker (N = 287), white crappie (N = 192), goldeye (N = 109), fathead minnow (N = 95), channel catfish (N = 75), white bass (N = 58) and sauger (N = 54). Mini-fyke nets collected seven species that were unique to that gear: green sunfish (N = 6), common shiner (N = 4), black bullhead (N = 3), burbot (N = 3), yellow perch (N = 3), brook stickleback (N = 1) and shortnose gar (N = 1) (Appendix F6).

In 2007, the push trawl was implemented during the fish community season on an experimental basis. In 6969 m of sampling the push trawl caught 325 fish representing 13 species. Emerald shiner (N = 215) were the most abundant species sampled in the push trawl followed by sturgeon chub (N = 63), goldeye (N = 11), sicklefin chub (N = 11), flathead chub (N = 9), channel catfish (N = 8), river carpsucker (N = 2) and shovelnose sturgeon (N = 2) (Appendix F7).

Species composition has remained relatively constant since sampling began in 2005. Emerald shiners have made up the largest percentage of total catch in each of the past three years (51% in 2005, 91% in 2006 and 65% in 2007). The large percentage of total catch of emerald shiners in 2006 can be attributed to eight mini-fyke nets with over 1000 emerald shiners in them including one net with over 12,000 emerald shiners. The majority of emerald shiners were captured during the fish community season in mini-fyke nets. Fifty or more specimens have been collected from the same eleven species each year since 2005: emerald shiner, channel catfish, western silvery

minnow, flathead chub, sturgeon chub, shovelnose sturgeon, white crappie, river carpsucker, sauger, sicklefin chub and goldeye.

## Discussion

Twenty seven pallid sturgeon were sampled in 2007. One adult was collected while the remaining 26 are of hatchery origin. With the exception of 40 fish in 1998 at the confluence, all pallid sturgeon stocked in RPMA 2 have been stocked upriver of segment 4. From capture data and stocking records, it appears that dispersal of pallid sturgeon stocked upstream of segment 4 into segment 4 is about six months. In three years of sampling, we have not sampled a pallid sturgeon the same year it was stocked. The older year classes of pallids seem to only use the lower end of segment 4. Since sampling began in 2005, eight known 1997-1998 year class pallid sturgeon have been sampled. All of these have been sampled below river mile 1570, with seven of these being captured below Highway 85 Bridge (RM 1552).

Pallid sturgeon have been found in all macrohabitats sampled. During 2007 sampling, the majority of pallids were captured in large connected secondary channels whereas in 2006, the greatest number of pallid sturgeon were captured in inside bend macrohabitats and in 2005, pallids were sampled more often in outside bend macrohabitats. In all years pallid sturgeon were most frequently captured in channel border mesohabitats, followed by island tips.

Otter trawls were the most effective gear for catching pallid sturgeon in 2007 ( $N = 20$ ). Conversely in 2006 and 2005 trammel nets were the most effective gear for sampling pallid sturgeon (20 and 24 respectively). Trammel nets appear to be the most effective gear for catching larger ( $FL > 250$  mm) shovelnose sturgeon, whereas the otter trawl catches more sub-stock size ( $FL < 250$  mm) shovelnose sturgeon.

It appears that pallid sturgeon use the whole reach of river from the confluence with the Yellowstone River to Lake Sakakawea as they have been sampled in every bend. There is also evidence that pallid sturgeon tend to aggregate in areas of the river due to the fact that over the past three years of sampling, several pallids have been captured in subsequent subsamples after one pallid is sampled. These aggregations have been found in large connected secondary channels as well as inside and outside bend macrohabitats.

The lack of pallid sturgeon in the 700-1000 mm size is indicative of the aging adult population and the recruitment of past stocking efforts in RPMA 2. It is important to continue monitoring these stocked fish as they reach sexual maturity as well as future stockings to determine survival and success of these stocking efforts.

Shovelnose sturgeon catch was down slightly in 2007 compared to 2006 (N = 292 vs N = 389) but higher than in 2005 (N = 262). Although the overall number of shovelnose sturgeon sampled was lowest in 2005, young of the year catch was highest in 2005 (N = 55) compared to 2007 (N = 33) and 2006 (N = 18). It appears this age class is recruiting into the population as age-1 shovelnose sturgeon catch increased from 2005 (N = 44) to 2006 (N = 67).

Sicklefin and sturgeon chub were captured with both the otter trawl and the experimental push trawl in 2007. Only one sturgeon chub was sampled in mini-fyke nets. Total catch of sturgeon chub in the otter trawl was about four times greater in 2007 (N = 678) than in 2005 (N = 184) or 2006 (N = 159). Sicklefin chub captured in the otter trawl in 2007 (N = 379) increased slightly from 2005 (N = 330) and 2006 (N = 227). The push trawl was more effective than the otter trawl in capturing sturgeon chub (CPUE 1.758 fish/100m PT vs 1.015 fish/100 m OT). However the push trawl was less efficient than the otter trawl sampling sicklefin chubs (CPUE 0.265 fish/100 m PT vs 0.626 fish/100 m OT). Sturgeon and sicklefin chubs were collected in all macrohabitats that were sampled.

The total number of sauger caught in standard gears has remained relatively unchanged for all three years of sampling. In 2005, 166 sauger were captured during the sampling year and 158 sauger were sampled in 2006. During the 2007 sampling year, 171 sauger were sampled in all gears combined. Young of the year sauger captures in 2007 (N = 22) were significantly less than in 2006 (N = 60) and 2005 (N = 76). However, age-1 sauger captures were similar in 2005 (N = 12), 2006 (N = 16) and 2007 (N = 14). Sauger were the only species of interest to be sampled in all gears during the sturgeon and fish community season.

Emerald shiners once again dominated the total catch this year accounting for 65% of all fish captured. In 2005 emerald shiners comprised 51% of the catch and in 2006 they made up 91% of all fish sampled. Four species were captured in all gears in both the sturgeon and fish community season: sauger, channel catfish, goldeye and shorthead redhorse.

The flexibility of the population assessment program allows crews to conduct additional sampling beyond the standardized random sampling. During the past three years of sampling we have been able to conduct additional nonrandom sampling in the Yellowstone River. Standard trammel nets and otter trawls were deployed following the sampling protocols found in the Standard Operating Procedures (Drobish, 2008). In 2005, one adult and two hatchery released pallid sturgeon were sampled in 2,869 m of drifting trammel nets (CPUE 0.1289 fish/100 m, hatchery, 0.0297 fish/100 m, wild). Both otter trawl and trammel nets were used in 2006. In 1,201 m of drifting trammel nets, two hatchery released pallids were captured (CPUE 0.1619 fish/100 m). In 1,451 m of trawling, no pallid sturgeon were sampled. Sampling with trammel nets in the Yellowstone River in 2007 produced eight juvenile pallid sturgeon in 1,678 m of drifting (CPUE 0.3577 fish/100 m). In 2,680 m of trawling, six juvenile pallid sturgeon were captured (CPUE 0.2008 fish/100 m). In 2007 catch per unit effort of pallid sturgeon in the Yellowstone River was higher than in the Missouri River for both trammel nets (0.476 fish/100 m vs 0.0342 fish/100 m) and otter trawl (0.2239 fish/100 m vs 0.0383 fish/100 m). The CPUE of pallids in the Yellowstone River is partially due to the difference in flow of the two rivers and the efficiency of otter trawls and trammel nets in lower discharge. Discharge in the Yellowstone River during the time of sampling was 20% of the discharge in the Missouri River below the confluence.

## **Acknowledgments**

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## **APPENDICES**

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

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

Appendix A. (continued).

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

Appendix A. (continued).

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

Appendix A. (continued).

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

Appendix A. (continued).

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

Appendix A. (continued).

Scientific name	Common name	Letter Code
<b>Centrarchidae - sunfishes</b>		
<i>L. cyanellus</i> X <i>L. humilis</i>	Green-orangespotted sunfish hybrid	GSOS
<i>L. macrochirus</i> X <i>L. microlophus</i>	Bluegill-redear sunfish hybrid	BGRE
<i>Lepomis</i> spp.	Unidentified <i>Lepomis</i>	ULP
<i>Micropterus dolomieu</i>	Smallmouth bass	SMBS
<i>Micropterus punctatus</i>	Spotted sunfish	STBS
<i>Micropterus salmoides</i>	Largemouth bass	LMBS
<i>Micropterus</i> spp.	Unidentified <i>Micropterus</i> spp.	UMC
<i>Pomoxis annularis</i>	White crappie	WTCP
<i>Pomoxis nigromaculatus</i>	Black crappie	BKCP
<i>Pomoxis</i> spp.	Unidentified crappie	UCP
<i>P. annularis</i> X <i>P. nigromaculatus</i>	White-black crappie hybrid	WCBC
Centrarchidae	Unidentified centrarchid	UCN
<b>Percidae - perches</b>		
<i>Ammocrypta asprella</i>	Crystal darter	CLDR
<i>Etheostoma blennioides</i>	Greenside darter	GSDR
<i>Etheostoma caeruleum</i>	Rainbow darter	RBDR
<i>Etheostoma exile</i>	Iowa darter	IODR
<i>Etheostoma flabellare</i>	Fantail darter	FTDR
<i>Etheostoma gracile</i>	Slough darter	SLDR
<i>Etheostoma microperca</i>	Least darter	LTDR
<i>Etheostoma nigrum</i>	Johnny darter	JYDR
<i>Etheostoma punctulatum</i>	Stippled darter	STPD
<i>Etheostoma spectabile</i>	Orangethroated darter	OTDR
<i>Etheostoma tetrazonum</i>	Missouri saddled darter	MSDR
<i>Etheostoma zonale</i>	Banded darter	BDDR
<i>Etheostoma</i> spp.	Unidentified <i>Etheostoma</i> spp.	UET
<i>Perca flavescens</i>	Yellow perch	YWPH
<i>Percina caproides</i>	Logperch	LGPH
<i>Percina cymatotaenia</i>	Bluestripe darter	BTDR
<i>Percina evides</i>	Gilt darter	GLDR
<i>Percina maculate</i>	Blackside darter	BSDR
<i>Percina phoxocephala</i>	Slenderhead darter	SHDR
<i>Percina shumardi</i>	River darter	RRDR
<i>Percina</i> spp.	Unidentified <i>Percina</i> spp.	UPN
	Unidentified darter	UDR
<b><i>Sander canadense</i></b>	<b>Sauger</b>	<b>SGER*</b>
<i>Sander vitreus</i>	Walleye	WLEY
<i>S. canadense</i> X <i>S. vitreus</i>	Sauger-walleye hybrid/Saugeye	SGWE
<i>Sander</i> spp.	Unidentified <i>Sander</i> (formerly <i>Stizostedion</i> ) spp.	UST
	Unidentified Percidae	UPC
<b>Sciaenidae - drums</b>		
<i>Aplodinotus grunniens</i>	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
Dendric	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 <sup>3</sup> /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 <sup>3</sup> /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
Dam Tailwaters	Meso	Area below dam	DTWT
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 4 for the long-term pallid sturgeon and associated fish community sampling program. Long-term monitoring began in 2005 for segment 4.

Gear	Code	Type	Season	Years	CPUE units
Gillnet – 4 meshes, small mesh set upstream	GN14	Wild	Sturgeon	Not Used	fish/net night
Gillnet – 4 meshes, large mesh set upstream	GN41	Wild	Sturgeon	Not Used	fish/net night
Gillnet – 8 meshes, small mesh set upstream	GN18	Wild	Sturgeon	Not Used	fish/net night
Gillnet – 8 meshes, large mesh set upstream	GN81	Wild	Sturgeon	Not Used	fish/net night
Mini-fyke net	MF	Standard	Fish Comm.	2003 - Present	fish/net night
Push Trawl – 8 ft 4mm x 4mm	POT02	Evaluation	Fish Comm.	2006 - Present	fish/ m trawled
Trammel net – 1 inch inner mesh	TN	Standard	All	2003 - Present	fish/100 m drift
Trot Line – Circle hooks**	TLC_	Wild	Sturgeon	2007 - Present	fish/hook night
Trot Line – Octopus hooks**	TLO_	Wild	Sturgeon	2007 - Present	fish/hook night
Trot Line – O’Shaughnessy hooks**	TLS_	Wild	Sturgeon	2007 - Present	fish/hook night
Otter trawl – 16 ft head rope	OT16	Standard	All	2003 - Present	fish/100 m trawled
Otter trawl – 16 ft SKT 4mm x 4mm HB2 MOR	OT01	Wild	Fish Comm.	Not Used	fish/100 m trawled

\* Standard only in upper Missouri River segments

\*\* Code ends with line length in feet (1 = 105 ft, 2 = 205 ft, 3 = 305 ft, 4 = 405 ft). Hooks are placed between 5 and 10 feet apart.

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

State(s)	RPMA	Site Name	Code	River	RM
MT	2	Forsyth	FOR	Yellowstone	253.2
MT	2	Cartersville	CAR	Yellowstone	235.3
MT	2	Miles City	MIC	Yellowstone	181.8
MT	2	Fallon	FAL	Yellowstone	124.0
MT	2	Intake	INT	Yellowstone	70.0
MT	2	Sidney	SID	Yellowstone	31.0
MT	2	Big Sky Bend	BSB	Yellowstone	17.0
ND	2	Fairview	FRV	Yellowstone	9.0
MT	2	Milk River	MLK	Milk	11.5
MT	2	Mouth of Milk	MOM	Missouri	1761.5
MT	2	Wolf Point	WFP	Missouri	1701.5
MT	2	Poplar	POP	Missouri	1649.5
MT	2	Brockton	BRK	Missouri	1678.0
MT	2	Culbertson	CBS	Missouri	1621.0
MT	2	Nohly Bridge	NOB	Missouri	1590.0
ND	2	Confluence	CON	Missouri	1581.5
SD/NE	3	Sunshine Bottom	SUN	Missouri	866.2
SD/NE	3	Verdel Boat Ramp	VER	Missouri	855.0
SD/NE	3	Standing Bear Bridge	STB	Missouri	845.0
SD/NE	3	Running Water	RNW	Missouri	840.1
SD/NE	4	St. Helena	STH	Missouri	799.0
SD/NE	4	Mullberry Bend	MUL	Missouri	775.0
NE/IA	4	Ponca State Park	PSP	Missouri	753.0
NE/IA	4	Sioux City	SIO	Missouri	732.6
NE/IA	4	Sloan	SLN	Missouri	709.0
NE/IA	4	Decatur	DCT	Missouri	691.0
NE/IA	4	Boyer Chute	BYC	Missouri	637.4
NE/IA	4	Bellevue	BEL	Missouri	601.4
NE/IA	4	Rulo	RLO	Missouri	497.9
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

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MO	4	Washington	WAS	Missouri	68.5
MO	4	St. Charles	STC	Missouri	28.5

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Appendix E. Juvenile and adult pallid sturgeon stocking summary for segment 4 of the Missouri River (RPMA 2)

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking <sup>a</sup>	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

Appendix E. (continued)

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking <sup>a</sup>	Primary Mark	Secondary Mark
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	Elastomer
2004	Sidney	397	2003	8/9/2004	Yearling	PIT Tag	Elastomer
2004	Wolf Point	379	2003	8/9/2004	Yearling	PIT Tag	Elastomer
2004	Larval Drift	30000	2004	7/2/2004	Fry		
2004	Larval Drift	50000	2004	7/8/2004	Fry		
2004	Larval Drift	25000	2004	7/20/2004	Fry		
2004	Larval Drift	25000	2004	7/23/2004	Fry		
2004	Larval Drift	25000	2004	7/27/2004	Fry		
2004	Culbertson	3819	2004	9/10/2004	Fingerling	CWT	Elastomer
2004	Sidney	2991	2004	9/10/2004	Fingerling	CWT	Elastomer
2004	Wolf Point	4040	2004	9/10/2004	Fingerling	CWT	Elastomer
2004	Mouth of Milk	3482	2004	10/15/2004	Advanced Fingerling	CWT	Elastomer
2004	Intake	2477	2004	11/18/2004	Advanced Fingerling	CWT	Elastomer
2005	Culbertson	288	2004	4/12/2005	Yearling	CWT	Elastomer
2005	Intake	309	2004	4/12/2005	Yearling	CWT	Elastomer
2005	Wolf Point	271	2004	4/12/2005	Yearling	CWT	Elastomer
2005	Intake	175	2004	8/19/2005	Yearling	PIT Tag	Elastomer
2005	Brockton	229	2005	10/5/2005	Advanced Fingerling	CWT	Elastomer
2005	Culbertson	226	2005	10/5/2005	Advanced Fingerling	CWT	Elastomer
2005	Intake	456	2005	10/5/2005	Advanced Fingerling	CWT	Elastomer
2005	Milk River	232	2005	10/5/2005	Advanced Fingerling	CWT	Elastomer
Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking <sup>a</sup>	Primary Mark	Secondary Mark

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
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
Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stockinga	Primary Mark	Secondary Mark

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	
2007	Culbertson	651	2006	4/5/2007	Yearling	PIT Tag	Scute Removed
2007	Fallon	491	2006	4/3/2007	Yearling	PIT Tag	Scute Removed
2007	Forsyth	492	2006	4/3/2007	Yearling	PIT Tag	Scute Removed
2007	Sidney	983	2006	4/3/2007	Yearling	PIT Tag	Scute Removed
2007	School Trust	639	2006	4/5/2007	Yearling	PIT Tag	Scute Removed
2007	Wolf Point	651	2006	4/5/2007	Yearling	PIT Tag	Scute Removed
2007	Wolf Point	428285	2007	7/9/2007	Fry		
2007	Grand Champs	5558	2007	7/13/2007	Fry		
2007	Miles City	13125	2007	7/18/2007	Fry		
2007	Intake	20763	2007	8/9/2007	Fry		
2007	Miles City	13675	2007	8/9/2007	Fry		
2007	Intake	336	2007	8/27/2007	Fingerling		
2007	Miles City	336	2007	8/27/2007	Fingerling		
2007	Wolf Point	672	2007	8/27/2007	Fingerling		
2007	Forsyth	690	2007	8/31/2007	Fingerling	CWT	
Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stockinga	Primary Mark	Secondary Mark
2007	Intake	615	2007	8/31/2007	Fingerling	CWT	

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2007	School Trust	1160	2007	9/6/2007	Fingerling	CWT
2007	Intake	293	2007	9/12/2007	Fingerling	
2007	Miles City	293	2007	9/12/2007	Fingerling	
2007	Wolf Point	586	2007	9/12/2007	Fingerling	
2007	Culbertson	6455	2007	9/14/2007	Fingerling	Elastomer
2007	Fallon	4827	2007	9/14/2007	Fingerling	Elastomer
2007	Forsyth	5370	2007	9/14/2007	Fingerling	Elastomer
2007	Intake	7812	2007	9/14/2007	Fingerling	Elastomer
2007	School Trust	6096	2007	9/14/2007	Fingerling	Elastomer
2007	Sidney	1934	2007	9/14/2007	Fingerling	Elastomer
2007	Wolf Point	6455	2007	9/14/2007	Fingerling	Elastomer

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<sup>a</sup>Age of fish when stocked: Fry, Fingerling, Yearling, 1yo, 2yo, 3yo, etc...

## **Appendix F**

Total catch, overall mean catch per unit effort [ $\pm 2$  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 04 of the Missouri River during 2006-07. Species captured are listed alphabetically and their codes are presented in Appendix A. Asterisks with bold type indicate targeted native Missouri River species and habitat abbreviations are presented in Appendix B. Standard Error was not calculated when  $N < 2$ .

Appendix F1. Gill Net: Gear not used in segment 4 of the Missouri River

Appendix F2. 1 Inch Trammel Net: overall season and segment summary. Lists CPUE (fish/100 m) and 2 standard errors on second line.

Species	Total Catch	Overall CPUE	CHXO	ISB	OSB	SCCL	
			CHNB	CHNB	CHNB	CHNB	ITIP
BKBH	0	0	0	0	0	0	0
		0	0	0	0	0	0
BKSB	0	0	0	0	0	0	0
		0	0	0	0	0	0
BMBF	4	0.008	0.018	0.013	0	0	0
		0.01	0.035	0.018	0	0	0
BRBT	0	0	0	0	0	0	0
		0	0	0	0	0	0
<b>BUSK*</b>	<b>13</b>	<b>0.025</b>	<b>0.008</b>	<b>0.038</b>	<b>0.02</b>	<b>0.061</b>	<b>0.025</b>
		<b>0.019</b>	<b>0.015</b>	<b>0.049</b>	<b>0.03</b>	<b>0.084</b>	<b>0.049</b>
CARP	11	0.027	0.035	0.03	0.018	0.042	0.018
		0.018	0.05	0.031	0.025	0.085	0.035
CMSN	0	0	0	0	0	0	0
		0	0	0	0	0	0
CNCF	87	0.215	0.177	0.304	0.219	0.07	0.145
		0.084	0.1	0.215	0.15	0.14	0.222
ERSN	0	0	0	0	0	0	0
		0	0	0	0	0	0
FHCB	1	0.003	0	0	0.011	0	0
		0.006	0	0	0.022	0	0
FHMW	0	0	0	0	0	0	0
		0	0	0	0	0	0
FWDM	0	0	0	0	0	0	0
		0	0	0	0	0	0
GDEY	40	0.101	0.103	0.105	0.07	0.243	0.076
		0.039	0.079	0.07	0.059	0.285	0.088
GNSF	0	0	0	0	0	0	0
		0	0	0	0	0	0
<b>HBNS*</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
LNDC	0	0	0	0	0	0	0
		0	0	0	0	0	0
NTPK	1	0.002	0	0	0	0.034	0
		0.004	0	0	0	0.068	0

Species	Total Catch	Overall CPUE	CHXO	ISB	OSB	SCCL	
			CHNB	CHNB	CHNB	CHNB	ITIP
PDFH	1	0.002	0.007	0	0	0	0
		0.004	0.015	0	0	0	0
<b>PDSG*</b>	<b>7</b>	<b>0.018</b>	<b>0.025</b>	<b>0.008</b>	<b>0.008</b>	<b>0.042</b>	<b>0.036</b>
		<b>0.014</b>	<b>0.029</b>	<b>0.016</b>	<b>0.016</b>	<b>0.085</b>	<b>0.073</b>
RVCS	42	0.091	0.109	0.099	0.103	0	0.051
		0.037	0.085	0.063	0.085	0	0.072
<b>SFCB*</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>SGCB*</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>SGER*</b>	<b>76</b>	<b>0.187</b>	<b>0.101</b>	<b>0.175</b>	<b>0.323</b>	<b>0.253</b>	<b>0.05</b>
		<b>0.077</b>	<b>0.069</b>	<b>0.099</b>	<b>0.245</b>	<b>0.234</b>	<b>0.07</b>
SGWE	1	0.002	0	0	0.007	0	0
		0.004	0	0	0.013	0	0
SHRH	6	0.015	0.009	0.005	0	0.027	0.079
		0.017	0.018	0.011	0	0.054	0.13
SMBF	21	0.047	0.02	0.044	0.046	0.214	0.022
		0.025	0.028	0.048	0.041	0.216	0.045
SNGR	0	0	0	0	0	0	0
		0	0	0	0	0	0
<b>SNSG*</b>	<b>160</b>	<b>0.386</b>	<b>0.371</b>	<b>0.377</b>	<b>0.411</b>	<b>0.639</b>	<b>0.252</b>
		<b>0.098</b>	<b>0.208</b>	<b>0.177</b>	<b>0.189</b>	<b>0.539</b>	<b>0.191</b>
<b>SNSN*</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
STCT	1	0.002	0	0	0	0.035	0
		0.004	0	0	0	0.07	0
UNID	0	0	0	0	0	0	0
		0	0	0	0	0	0
WLYE	3	0.006	0.007	0.01	0.007	0	0
		0.008	0.014	0.019	0.013	0	0
<b>WSMW*</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
WTBS	0	0	0	0	0	0	0
		0	0	0	0	0	0
WTCP	0	0	0	0	0	0	0
		0	0	0	0	0	0

CHXO      ISB      OSB      SCCL

Species	Total Catch	Overall CPUE	CHNB	CHNB	CHNB	CHNB	ITIP
WTSK	0	0	0	0	0	0	0
		0	0	0	0	0	0
YWPH	0	0	0	0	0	0	0
		0	0	0	0	0	0

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

Species	Total Catch	Overall CPUE	CHXO	ISB	OSB	SCCL	
			CHNB	CHNB	CHNB	CHNB	ITIP
BKBH	0	0	0	0	0	0	0
		0	0	0	0	0	0
BKSB	0	0	0	0	0	0	0
		0	0	0	0	0	0
BMBF	1	0.001	0.007	0	0	0	0
		0.003	0.013	0	0	0	0
BRBT	0	0	0	0	0	0	0
		0	0	0	0	0	0
<b>BUSK*</b>	<b>3</b>	<b>0.005</b>	<b>0</b>	<b>0.007</b>	<b>0.005</b>	<b>0.01</b>	<b>0</b>
		<b>0.005</b>	<b>0</b>	<b>0.014</b>	<b>0.011</b>	<b>0.021</b>	<b>0</b>
CARP	4	0.008	0	0	0	0.009	0.058
		0.008	0	0	0	0.018	0.067
CMSN	0	0	0	0	0	0	0
		0	0	0	0	0	0
CNCF	994	1.811	1.233	1.593	1.653	2.425	3.011
		0.491	0.469	1.074	0.632	2.094	1.926
ERSN	2	0.003	0.007	0	0.005	0	0
		0.004	0.015	0	0.01	0	0
FHCB	84	0.153	0.014	0.275	0.087	0.055	0.402
		0.06	0.02	0.157	0.061	0.054	0.315
FHMW	1	0.002	0	0	0	0.012	0
		0.003	0	0	0	0.024	0
FWDM	14	0.026	0.016	0.067	0	0.048	0
		0.029	0.032	0.109	0	0.055	0
GDEY	47	0.105	0	0.165	0.009	0.089	0.413
		0.062	0	0.114	0.013	0.158	0.414
GNSF	0	0	0	0	0	0	0
		0	0	0	0	0	0
<b>HBNS*</b>	<b>1</b>	<b>0.001</b>	<b>0</b>	<b>0</b>	<b>0.005</b>	<b>0</b>	<b>0</b>
		<b>0.003</b>	<b>0</b>	<b>0</b>	<b>0.01</b>	<b>0</b>	<b>0</b>
LNDC	1	0.001	0	0	0	0.012	0
		0.003	0	0	0	0.023	0
NTPK	0	0	0	0	0	0	0
		0	0	0	0	0	0

CHXO      ISB      OSB      SCCL

Species	Total Catch	Overall CPUE	CHNB	CHNB	CHNB	CHNB	ITIP
PDFH	0	0	0	0	0	0	0
		0	0	0	0	0	0
<b>PDSG*</b>	<b>20</b>	<b>0.037</b>	<b>0.022</b>	<b>0.014</b>	<b>0.035</b>	<b>0.034</b>	<b>0.113</b>
		<b>0.017</b>	<b>0.025</b>	<b>0.02</b>	<b>0.026</b>	<b>0.038</b>	<b>0.098</b>
RVCS	15	0.027	0.028	0.012	0.011	0.051	0.068
		0.015	0.039	0.017	0.016	0.049	0.078
<b>SFCB*</b>	<b>374</b>	<b>0.626</b>	<b>0.542</b>	<b>0.736</b>	<b>0.724</b>	<b>0.305</b>	<b>0.645</b>
		<b>0.117</b>	<b>0.203</b>	<b>0.227</b>	<b>0.23</b>	<b>0.157</b>	<b>0.498</b>
<b>SGCB*</b>	<b>548</b>	<b>1.015</b>	<b>0.543</b>	<b>0.759</b>	<b>0.42</b>	<b>2.952</b>	<b>1.772</b>
		<b>0.354</b>	<b>0.264</b>	<b>0.22</b>	<b>0.154</b>	<b>2.436</b>	<b>0.936</b>
<b>SGER*</b>	<b>31</b>	<b>0.051</b>	<b>0.036</b>	<b>0.068</b>	<b>0.03</b>	<b>0.059</b>	<b>0.083</b>
		<b>0.024</b>	<b>0.046</b>	<b>0.042</b>	<b>0.028</b>	<b>0.097</b>	<b>0.105</b>
SGWE	0	0	0	0	0	0	0
		0	0	0	0	0	0
SHRH	6	0.011	0	0.015	0.021	0.012	0
		0.013	0	0.03	0.033	0.023	0
SMBF	2	0.004	0	0.007	0	0	0.019
		0.006	0	0.014	0	0	0.037
SNGR	0	0	0	0	0	0	0
		0	0	0	0	0	0
<b>SNSG*</b>	<b>97</b>	<b>0.169</b>	<b>0.163</b>	<b>0.138</b>	<b>0.182</b>	<b>0.168</b>	<b>0.214</b>
		<b>0.04</b>	<b>0.082</b>	<b>0.071</b>	<b>0.07</b>	<b>0.137</b>	<b>0.143</b>
<b>SNSN*</b>	<b>1</b>	<b>0.003</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.021</b>
		<b>0.005</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.043</b>
STCT	84	0.157	0.024	0.024	0.062	0.523	0.512
		0.092	0.049	0.023	0.047	0.529	0.471
UNID	3	0.007	0	0	0	0	0.056
		0.013	0	0	0	0	0.112
WLYE	1	0.002	0.008	0	0	0	0
		0.003	0.016	0	0	0	0
<b>WSMW*</b>	<b>6</b>	<b>0.009</b>	<b>0.007</b>	<b>0.012</b>	<b>0.01</b>	<b>0</b>	<b>0.014</b>
		<b>0.007</b>	<b>0.014</b>	<b>0.016</b>	<b>0.014</b>	<b>0</b>	<b>0.028</b>
WTBS	1	0.004	0	0	0	0	0.033
		0.008	0	0	0	0	0.066
WTCP	1	0.002	0	0	0	0.016	0
		0.004	0	0	0	0.032	0
			<u>CHXO</u>	<u>ISB</u>	<u>OSB</u>	<u>SCCL</u>	

Species	Total Catch	Overall CPUE	CHNB	CHNB	CHNB	CHNB	ITIP
WTSK	1	0.002	0	0	0	0.012	0
		0.003	0	0	0	0.025	0
YWPH	0	0	0	0	0	0	0
		0	0	0	0	0	0

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

Species	Total Catch	Overall CPUE	CHXO	ISB	OSB	SCCL			SCN
			BAR	BAR	BAR	BAR	CHNB	ITIP	BAR
BKBH	3	0.031 0.035	0 0	0.043 0.06	0 0	0 0	0 0	0 0	0.143 0.286
BKSB	1	0.01 0.021	0.125 0.25	0 0	0 0	0 0	0 0	0 0	0 0
BMBF	0	0 0							
BRBT	3	0.031 0.046	0 0	0 0	0.2 0.4	0 0	0 0	0 0	0.143 0.286
<b>BUSK*</b>	<b>0</b>	<b>0</b> <b>0</b>							
CARP	12	0.124 0.098	0 0	0.085 0.102	0 0	0.045 0.091	0 0	2 0	0.429 0.857
CMSN	4	0.041 0.05	0.125 0.25	0.064 0.094	0 0	0 0	0 0	0 0	0 0
CNCF	75	0.773 0.475	1.375 1.461	0.872 0.893	0.1 0.2	0.455 0.286	2 4	2 4	0.857 1.714
ERSN	11382	117.34 71.897	68.625 105.204	164.277 127.886	20 15.126	41.727 26.468	0 13	57.5	268.429 480.996
FHCB	324	3.34 1.294	11.75 11.037	2.149 0.884	2.2 1.904	2.409 2.067	0 0	5 0	6.286 6.586
FHMW	95	0.979 0.462	0.75 1.052	0.787 0.599	0.1 0.2	0.545 0.641	0 4	2 4	5 3.117
FWDM	29	0.299 0.332	0.625 1.25	0.383 0.64	0 0	0.091 0.182	0 0	0 0	0.571 0.738
GDEY	109	1.124 0.616	4.75 6.378	0.83 0.418	0.1 0.2	0.955 0.858	0 0	2 0	0.857 0.918
GNSF	6	0.062 0.049	0.125 0.25	0.021 0.043	0 0	0.045 0.091	0 0	0 0	0.429 0.404
<b>HBNS*</b>	<b>0</b>	<b>0</b> <b>0</b>							
LNDC	4	0.041 0.041	0 0	0.021 0.043	0.1 0.2	0 0	0 0	0 0	0.286 0.369
NTPK	5	0.052 0.054	0 0	0.043 0.085	0 0	0.136 0.15	0 0	0 0	0 0

Species	Total Catch	Overall CPUE	CHXO	ISB	OSB	SCCL			SCN
			BAR	BAR	BAR	BAR	CHNB	ITIP	BAR
PDFH	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0
<b>PDSG*</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
RVCS	287	2.959	9.25	1.723	0.5	1.5	3	4.5	11.714
		1.397	12.54	1.051	0.615	0.909		3	7.556
<b>SFCB*</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>SGCB*</b>	<b>1</b>	<b>0.01</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.143</b>
		<b>0.021</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.286</b>
<b>SGER*</b>	<b>54</b>	<b>0.557</b>	<b>1</b>	<b>0.66</b>	<b>0.2</b>	<b>0.364</b>	<b>0</b>	<b>0</b>	<b>0.714</b>
		<b>0.209</b>	<b>0.756</b>	<b>0.346</b>	<b>0.267</b>	<b>0.361</b>	<b>0</b>	<b>0</b>	<b>0.841</b>
SGWE	6	0.062	0	0.106	0	0.045	0	0	0
		0.105	0	0.213	0	0.091	0	0	0
SHRH	1	0.01	0	0	0	0.045	0	0	0
		0.021	0	0	0	0.091	0	0	0
SMBF	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0
SNGR	1	0.01	0	0	0	0.045	0	0	0
		0.021	0	0	0	0.091	0	0	0
<b>SNSG*</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>SNSN*</b>	<b>8</b>	<b>0.082</b>	<b>0</b>	<b>0.043</b>	<b>0</b>	<b>0.091</b>	<b>0</b>	<b>0</b>	<b>0.571</b>
		<b>0.081</b>	<b>0</b>	<b>0.06</b>	<b>0</b>	<b>0.182</b>	<b>0</b>	<b>0</b>	<b>0.857</b>
STCT	8	0.082	0	0.106	0.2	0	0	0.5	0
		0.081	0	0.139	0.4	0		1	0
UNID	1	0.01	0.125	0	0	0	0	0	0
		0.021	0.25	0	0	0	0	0	0
WLYE	2	0.021	0	0.043	0	0	0	0	0
		0.029	0	0.06	0	0	0	0	0
<b>WSMW*</b>	<b>1483</b>	<b>15.289</b>	<b>2.5</b>	<b>5.128</b>	<b>0.7</b>	<b>1.727</b>	<b>0</b>	<b>2.5</b>	<b>167.429</b>
		<b>22.607</b>	<b>2.976</b>	<b>3.306</b>	<b>0.846</b>	<b>0.865</b>		<b>1</b>	<b>309.946</b>
WTBS	58	0.598	0.125	0.489	0.1	1.5	0	0	0
		0.519	0.25	0.442	0.2	2.067	0	0	0

Species	Total Catch	Overall CPUE	BAR	BAR	BAR	BAR	CHNB	ITIP	BAR
WTCP	192	1.979	0.25	1.617	0.9	3.545	0	0.5	3.714
		1.52	0.327	1.826	1.59	5.25		1	4.487
WTSK	1	0.01	0	0.021	0	0	0	0	0
		0.021	0	0.043	0	0		0	0
YWPH	3	0.031	0.125	0.021	0	0.045	0	0	0
		0.035	0.25	0.043	0	0.091		0	0

Appendix F7. Push Trawl: overall season and segment summary. Lists CPUE (fish/100 m) and 2 standard errors on second line.

Species	Total Catch	Overall CPUE	CHXO		ISB		OSB	SCCL		SCN
			BAR	CHNB	BAR	CHNB	BAR	BAR	ITIP	BAR
BKBH	0	0	0	0	0	0	0	0	0	0
BKSB	0	0	0	0	0	0	0	0	0	0
BMBF	0	0	0	0	0	0	0	0	0	0
BRBT	0	0	0	0	0	0	0	0	0	0
<b>BUSK*</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
CARP	0	0	0	0	0	0	0	0	0	0
CMSN	0	0	0	0	0	0	0	0	0	0
CNCF	8	0.209	0.35	0.169	0.286	0	0	0	0	0
ERSN	215	5.852	1.46	2.03	1.076	0	0.693	0.476	0	115.955
FHCB	9	0.282	0	0	0.392	1.786	0	0.476	0	0
FHMW	1	0.028	0	0	0	0	0	0	0	0.676
FWDM	0	0	0	0	0	0	0	0	0	0
GDEY	11	0.23	0.152	0	0.237	0.714	0	0	0	1.482
GNSF	0	0	0	0	0	0	0	0	0	0
<b>HBNS*</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

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CHXO
ISB
OSB
SCCL
SCN



Species	Total Catch	Overall CPUE	BAR	CHNB	BAR	CHNB	BAR	BAR	ITIP	BAR
WTBS	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0
WTCP	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0
WTSK	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0
YWPH	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0

Appendix G. Hatchery names, locations, and abbreviations.

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<b>Hatchery</b>	<b>State</b>	<b>Abbreviation</b>
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

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Appendix H. Alphabetic list of Missouri River fishes with total catch-per-unit-effort by gear type for sturgeon season (fall through spring) and fish community season (summer) during 2006 – 2007 for segment 04 of the Missouri River. 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	Gill Net	Otter Trawl	1 Inch Trammel Net	Mini-Fyke Net	Otter Trawl	Push Trawl
BKBH	0.000		0.000	0.000	0.031	0.000	0.000
BKSB	0.000		0.000	0.000	0.010	0.000	0.000
BMBF	0.008		0.003	0.008	0.000	0.000	0.000
BRBT	0.000		0.000	0.000	0.031	0.000	0.000
<b>BUSK*</b>	<b>0.030</b>		<b>0.003</b>	<b>0.021</b>	<b>0.000</b>	<b>0.006</b>	<b>0.000</b>
CARP	0.033		0.010	0.022	0.124	0.006	0.000
CMSN	0.000		0.000	0.000	0.041	0.000	0.000
CNCF	0.251		1.761	0.181	0.773	1.860	0.209
ERSN	0.000		0.003	0.000	117.340	0.003	5.852
FHCB	0.000		0.175	0.006	3.340	0.132	0.282
FHMW	0.000		0.003	0.000	0.979	0.000	0.028
FWDM	0.000		0.005	0.000	0.299	0.047	0.000
GDEY	0.087		0.012	0.112	1.124	0.194	0.230
GNSF	0.000		0.000	0.000	0.062	0.000	0.000
<b>HBNS*</b>	<b>0.000</b>		<b>0.003</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>
LNDC	0.000		0.003	0.000	0.041	0.000	0.027
NFSH	0.000		0.000	0.000	0.000	0.000	0.000
NTPK	0.000		0.000	0.004	0.052	0.000	0.000

## Appendix H. (continued).

Species Code	Sturgeon Season (Fall through Spring)			Fish Community Season (Summer)			
	1 Inch Trammel Net	Gill Net	Otter Trawl	1 Inch Trammel Net	Mini-Fyke Net	Otter Trawl	Push Trawl
PDFH	0.004		0.000	0.000	0.000	0.000	0.000
<b>PDSG*</b>	<b>0.000</b>		<b>0.026</b>	<b>0.034</b>	<b>0.000</b>	<b>0.047</b>	<b>0.000</b>
RVCS	0.064		0.023	0.114	2.959	0.031	0.065
<b>SFCB*</b>	<b>0.000</b>		<b>0.234</b>	<b>0.000</b>	<b>0.000</b>	<b>1.004</b>	<b>0.265</b>
<b>SGCB*</b>	<b>0.000</b>		<b>0.648</b>	<b>0.000</b>	<b>0.010</b>	<b>1.368</b>	<b>1.758</b>
<b>SGER*</b>	<b>0.210</b>		<b>0.034</b>	<b>0.164</b>	<b>0.557</b>	<b>0.068</b>	<b>0.000</b>
SGWE	0.004		0.000	0.000	0.062	0.000	0.000
SHRH	0.026		0.012	0.004	0.010	0.010	0.025
SMBF	0.075		0.008	0.021	0.000	0.000	0.000
SNGR	0.000		0.000	0.000	0.010	0.000	0.000
<b>SNSG*</b>	<b>0.103</b>		<b>0.080</b>	<b>0.644</b>	<b>0.000</b>	<b>0.254</b>	<b>0.044</b>
<b>SNSN*</b>	<b>0.000</b>		<b>0.005</b>	<b>0.000</b>	<b>0.082</b>	<b>0.000</b>	<b>0.017</b>
STCT	0.005		0.255	0.000	0.082	0.063	0.000
UNID	0.000		0.000	0.000	0.010	0.013	0.000
WLYE	0.013		0.000	0.000	0.021	0.003	0.000
<b>WSMW*</b>	<b>0.000</b>		<b>0.012</b>	<b>0.000</b>	<b>15.289</b>	<b>0.006</b>	<b>0.024</b>
WTBS	0.000		0.000	0.000	0.598	0.008	0.000
WTCP	0.000		0.000	0.000	1.979	0.004	0.000
WTSK	0.000		0.003	0.000	0.010	0.000	0.000
YWPH	0.000		0.000	0.000	0.031	0.000	0.000

Appendix I. Comprehensive list of bend numbers and locations for segment 4 of the Missouri River comparing bend selection for both sturgeon season (ST) and fish community season (FCS) between years from 2005 – 2007.

<b>Bend Number</b>	<b>Bend River Mile</b>	<b>Coordinates* Latitude, Longitude</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>
1	1582.1	47.97707, -103.98685	ST, FCS		
2	1580.8	47.98656, -103.97039		ST, FCS	
3	1578.6	47.96662, -103.93341	ST, FCS	ST, FCS	ST, FCS
4	1577.0	47.95642, -103.91374			ST, FCS
5	1575.8	47.96368, -103.88049	ST, FCS	ST, FCS	ST, FCS
6	1574.9	47.97192, -103.86762	ST, FCS		
7	1574.2	47.98147, -103.85693	ST, FCS		
8	1569.1	47.98144, -103.83391		ST, FCS	
9	1567.2	47.98418, -103.81292		ST, FCS	ST, FCS
10	1565.5	48.01526, -103.79234	ST, FCS	ST, FCS	ST, FCS
11	1563.2	48.03870, -103.78990			
12	1562.3	48.04931, -103.79697	ST, FCS		
13	1560.3	48.05326, -103.76556			ST, FCS
14	1558.0	48.07060, -103.71619		ST, FCS	
15	1555.8	48.08229, -103.73819		ST, FCS	ST, FCS
16	1553.1	48.10640, -103.72116	ST, FCS		
17	1551.3	48.11560, -103.69950	ST, FCS	ST, FCS	
18	1549.2	48.11797, -103.65463	ST, FCS	ST, FCS	ST, FCS
19	1548.3	48.11252, -103.63037			ST, FCS
20	1544.5	48.09220, -103.59088	ST, FCS	ST, FCS	
21	1541.2	48.08491, -103.55181			ST, FCS
22	1540.2	48.06467, 103.57298			ST, FCS
23	1538.8	48.06290, -103.57434	ST, FCS	ST, FCS	ST, FCS

\* Coordinates represent the upper most point of the bend (i.e., the top of the bend going upstream).