

2005 Annual Report

Pallid Sturgeon Population Assessment Project and Associated Fish Community Monitoring for the Missouri River: Segment 8



Prepared for the U.S. Army Corps of Engineers – Northwest Division
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EXECUTIVE SUMMARY

The Nebraska Game and Parks Commission (NGPC) is participating with the U.S. Army Corps of Engineers in the Pallid Sturgeon Population Assessment Project. During 2005 NGPC started sampling segment 8, the reach from Lower Ponca Bend (R.M. 753.0), where river channelization begins, downstream to the mouth of the Platte River (R.M. 595.0)

The sturgeon season started during mid-October and continued until late November, when ice flows started. Sampling then resumed in early March, after ice flows had subsided, and continued until 30 June. During the sturgeon season, a total of five hundred and sixty-seven samples were completed using gill nets, otter trawls, 1.0" and 2.5" trammel nets. The fish community season started 1 July and continued until mid-October when water temperature fell below 12.7°C. During the fish community season, a total of six hundred and seven samples were completed using otter trawls, 1.0" trammel nets, bag seines, and mini-fyke nets.

A total of 15 pallid sturgeon were captured during the 2005 sampling season. Hatchery reared pallid sturgeon recaptures accounted for nine fish while the remaining six are presumed to be of wild origin. Two of eight hatchery reared pallid sturgeon were thought to have shed their original PIT tags with one pallid not having a PIT tag at time of stocking. This results in a 75% pit tag retention in segment 8. Recaptured hatchery reared pallid sturgeon represented three year classes (2001, 2002 and 2004) that have been stocked into RPMA #4. Year classes that have been stocked but are missing from our samples include 1997, 1999, 2003, and 2005. Standardized gears collected all pallid sturgeon during 2005. Otter trawls captured six fish, gill nets and 1.0" trammel nets captured four fish each, and 2.5" trammel nets captured one. Bag seines and mini-fyke nets were the only standard gears that did not collect any pallid sturgeon. No young-of-the-year pallid sturgeon were collected with any gear during 2005.

Relative condition of recaptured hatchery reared pallid sturgeon could not be calculated at time of stocking because of lack of weight data but K_n averaged 1.09 and ranged from 0.80 to 1.52 at time of recapture. Mean growth per day was calculated for fish with sufficient data and was 0.12 mm/day. Pallid sturgeon were caught throughout segment 8 with 4 pallids being sampled from Omadi bend (RM 722.0). No other single bend produced more than two pallids. Most pallid sturgeon ($n = 11$) were captured on the inside bend channel borders. A total of 1,201 shovelnose sturgeon were captured in 2005: 582 with gill nets, 428 with 1.0" trammel nets,

181 with otter trawls, and 10 with 2.5" trammel nets. The ratio of pallid sturgeon to shovelnose sturgeon was 1:80.1.

The Pallid Sturgeon Assessment Team identified eight target species to serve as surrogate species to detect changes to the overall fish community. These target species include: shovelnose sturgeons, sturgeon chubs, sicklefin chubs, speckled chubs, sand shiners, *Hybognathus* species, blue suckers and sauger. A total of 1,201 shovelnose sturgeon were captured in 2005. Gill nets were the most effective gear for collecting shovelnose (48%), followed by 1.0" trammel nets (36%). Otter trawls were most effective in collecting *Macrhybopsis* spp. All sturgeon chubs (n = 13) and sicklefin chubs (n = 33) and 57 of 59 speckled chubs were collected by otter trawls throughout both seasons. Seining and mini-fyke nets were the most effective method to sample sand shiners collecting 98 % of the 252 individuals. A total of 19 *Hybognathus* species were captured in 2005. Only bag seines and mini-fyke nets captured *Hybognathus* species. 675 blue suckers were captured in 2005 with gill nets comprising 50% of the catch. Gill nets were also most effective in catching sauger. A total of 43 sauger were captured in 2005, 20 of them were sampled with gill nets. Overall, a total of 11,404 fish representing 50 species were captured during 2005 in segment 8.

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Introduction

The pallid sturgeon being native to the Missouri and Mississippi River systems, has evolved with and adapted to large river conditions. Due to population declines, pallid sturgeon (*Scaphirynchus albus*) were federally listed as endangered in 1990. Modification of the pallid sturgeon's habitat by human activities has blocked fish movement, destroyed or altered spawning areas, reduced food sources or ability to obtain food, altered water temperature, reduced turbidity, and changed the hydrograph (USFWS 1993). In response to obvious declines in population and lack of recruitment, the United States Fish and Wildlife Service developed the Biological Opinion on the Operation of the Missouri River Main System Reservoir System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project and Operation of the Kansas River Reservoir System (Bi-Op) in 2000. This report made recommendations to the U.S. Army Corp of Engineers (USACE) to modify flows of the Missouri River to a more natural regime, to increase pallid sturgeon propagation and augmentation efforts, and to assist and provide funding for a basin-wide pallid sturgeon assessment. In response to the Bi-Op, the USACE formed the Pallid Sturgeon Population Assessment Team with representatives from federal and state agencies and universities. The team developed standard operating procedures (SOP) for long-term pallid sturgeon and associated fish community assessment for the Missouri River. This included creating standard habitat definitions, selecting and describing standard sampling gears thought to be suitable for use in the Missouri River, creating sampling protocols for sampling fish and habitat parameters and developing standard data sheets and reporting procedures.

The 2005 sampling season extended from the fall of 2004 through the fall of 2005 and was divided into two seasons: the sturgeon season and the fish community season. The reason for a split in seasons was that during the sturgeon season, the capture of sturgeon was more efficient due to increased sturgeon movement and the ability to use gill nets, an effective gear for sampling sturgeon when water temperatures permit. The sturgeon season was defined as the period when water temperatures fell below 12.7° C (55° F), until 30 June. While water temperatures were below 12.7° C, experimental gill nets were used, and above

this temperature, three additional gears were fished: 1.0” trammel nets, 2.5 “ trammel nets, and otter trawls. Sampling was on the bend level with all bends being randomly selected.

The Pallid Sturgeon Assessment Team selected 8 target species that represent the native warm water benthic fish community (Appendix A). The eight target species are: shovelnose sturgeon *Scaphirhynchus platyrhynchus*, blue sucker *Cycleptus elongatus*, sauger *Stizostedion canadense*, sturgeon chub *Macrhybopsis gelida*, sicklefin chub *Macrhybopsis meeki*, speckled chub *Macrhybopsis aestivalis*, plains minnow *Hybognathus placitus*, and sand shiner *Notropis stramineus*. During the fish community season, these native species including pallid sturgeon are targeted. The fish community season began 1 July and continued until water temperatures dropped below 12.7° C. Four gear types were used during the fish community season: 1” trammel nets, otter trawls, seines and mini-fyke nets. Sampling was on the bend level with all bends being randomly selected. The fish community season is the best time to identify natural reproduction of pallid sturgeon and other native target species. Because sturgeon are less active and gill nets can not be used because of temperature restrictions, efforts focus on sampling the associated fish community, including chubs and minnows, which are more readily sampled during this time. These species serve as indicators of changes for this fish community.

The objectives and measurable hypotheses for the Pallid Sturgeon Population Assessment Team are as follows:

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

- 1.1. H₀: Annual trends in wild and stocked pallid sturgeon population abundance for all life stages remains constant over time.
H_a: Annual trends in wild and stocked pallid sturgeon population abundance for all life stages increase or decrease over time.
- 1.2 H₀: Annual trends in wild and stocked pallid sturgeon geographic distribution for all life stages remain constant over time
H_a: Annual trends in wild and stocked pallid sturgeon geographic distribution for all life stages increase or decrease over time.
- 1.3 H₀: Long-term trends in wild and stocked pallid sturgeon population abundance for all life stages remains constant over time.

H_a: Long-term trends in wild and stocked pallid sturgeon population abundance for all life stages increase or decrease over time.

- 1.4 H₀: Long-term trends in wild and stocked pallid sturgeon geographic distribution for all life stages remains constant over time
H_a: Long-term trends in wild and stocked pallid sturgeon geographic distribution for all life stages increases or decreases over time.

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

- 2.1 H₀: Stocked and wild pallid sturgeon use the same habitat during all life stages annually.
H_a: Stocked and wild pallid sturgeon do not use the same habitat during all life stages annually.
- 2.2 H₀: Stocked and wild pallid sturgeon use the same habitat during all life stages over the long term.
H_a: Stocked and wild pallid sturgeon do not use the same habitat during all life stages over the long term.

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

- 3.1 H₀: The population structure of stocked and wild pallid sturgeon remains constant over time.
H_a: The population structure of stocked and wild pallid sturgeon changes over time.
- 3.2 H₀: The population dynamics of stocked and wild pallid sturgeon remain constant over time.
H_a: The population dynamics of stocked and wild pallid sturgeon change over time.

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

- 4.1 H₀: Annual trends in native target species abundance are stable throughout the year.
H_a: Annual trends in native target species abundance increase or decrease throughout the year.
- 4.2 H₀: Annual trends in native target species geographic distribution remains stable throughout the year.
H_a: Annual trends in native target species geographic distribution increases or decreases throughout the year.

- 4.3 H₀: Long-term trends in native target species population abundance are stable over time.
H_a: Long-term trends in native target species population abundance increases or decreases over time.
- 4.4 H₀: Long-term trends in the native target species geographic distribution remain constant over time.
H_a: Long-term trends in the native target species geographic distribution increases or decreases over time.

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

- 5.1 H₀: Native target species use the same habitat during all life stages annually.
H_a: Native target species do not use the same habitat during all life stages annually.
- 5.2 H₀: Native target species use the same habitat during all life stages over the long term.
H_a: Native target species do not use the same habitat during all life stages over the long term.

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

- 6.1 H₀: Annual trends in non-target species abundance are stable throughout the year.
H_a: Annual trends in non-target species abundance are increasing or decreasing throughout the year.
- 6.2 H₀: Annual trends in non-target species geographic distribution remains stable throughout the year.
H_a: Annual trends in non-target species geographic distribution increases or decreases throughout the year.
- 6.3 H₀: Long-term trends in non-target species population abundance are stable over time.
H_a: Long-term trends in non-target species population abundance increases or decreases over time.
- 6.4 H₀: Long-term trends in the non-target species geographic distribution remain constant over time.
H_a: Long term trends in the non-target species geographic distribution increases or decreases over time.

Study Area

The project area includes the Missouri River from Fort Peck Dam (R.M. 1771.5) to the confluence of the Missouri and Mississippi Rivers (R.M. 0) and the lower reach of the Kansas River from the Johnson County Weir (R.M. 15.4) to the confluence with the Missouri River (R.M. 0.0). The Biological Opinion divided the Missouri River into river and reservoir reaches and categorized these areas as high, moderate or low priority management areas. The areas which were given high priority designation by the Bi-Op for the pallid sturgeon include Segment Area 2 (Fort Peck Dam, Montana to the headwaters of Lake Sakakawea, North Dakota), Area 8 (Fort Randall Dam, South Dakota to the Mouth of the Niobrara River, Nebraska), and Areas 10 through 15 (Gavins Point Dam, Nebraska/South Dakota to the mouth of the Missouri River at St. Louis, MO).

The Pallid Sturgeon Population Assessment Team identified 14 river segments based on changes in physical attributes such as degrading or aggrading stream bed, flow fluctuation, natural hydrograph, stream gradient, geology, water temperature, turbidity, substrate, discrete habitat changes (tributary or tributary influence) and modifications (presence of restoration projects) (Drobish, editor 2006). There are also several areas sampled that were not designated as high priority areas in the Bi-Op. These are being sampled because of known pallid sturgeon use and include the Kansas River from Johnson County Weir to the mouth and Bi-Op Segment Area 9 (Niobrara River, Nebraska to the headwaters of Lewis and Clark Lake Nebraska/South Dakota).

The Nebraska Game and Parks Commission Pallid Sturgeon Population Assessment crews sampled Segment 8, R.M. 753.0 from Lower Ponca Bend downstream to R.M. 595.0 near the confluence of the Platte and Missouri Rivers (Figure 1). This 158.0 mile long segment consists of 61 named bends.

Methods

Sampling was conducted in accordance with the current Standard Operating Procedures (Drobish, 2005) established by a panel of representatives from various State and Federal agencies involved with pallid recovery on the Missouri River. Descriptions of these procedures follow.

Sampling Site Selection and Description

Nebraska Game and Parks Commission was contracted to monitor Segment 8 from Lower Ponca Bend (R.M. 753.0) downstream to the mouth of the Platte River (R.M. 595.0). Fifteen bends were randomly selected to be sampled for the sturgeon season while 17 bends were selected for the fish community season.

The Pallid Sturgeon Assessment Team developed a standard set of habitat classifications for the Missouri River (Appendix B) to describe areas of sampling efforts. These classifications are broken down into three distinct levels with macrohabitats at the top. Each river bend contains three continuous macrohabitats, main channel outside bend (OSB), main channel inside bend (ISB) and main channel cross over (CHXO). Additional discrete macrohabitats have been identified that may not be present in every bend. These include: large tributary mouth (TRML), small tributary mouth (TRMS), tributary confluence (CONF), large secondary channel-connected (SCCL), small secondary channel-connected (SCCS), tributary (TRIB) and non-connected secondary channel (SCN). Mesohabitats have been established and defined to further classify areas within macrohabitats. Mesohabitat classifications include bars (BARS), pools (POOL), channel borders (CHNB), thalweg (TLWG) and island tips (ITIP). 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 lie along a bankline or sandbar area between the thalweg and the 1.2 m depth interval. Thalweg is the main channel between the channel borders and is the area of maximum depth. 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 mesohabitats including unique structural modifications.

Sampling Gear

Gear and methods were developed by the Pallid Sturgeon Assessment Team and described in Long-term Pallid Sturgeon and Associated Fish Community Assessment for the Missouri River and Standardized Guidelines for Sampling and Data Collection, (Draft), (Drobish, editor 2006). Standard gear types and methods used are as follows.

Gill Net

The standard gill net was a four panel experimental gill net 30.5 m (100 ft.) long with a height of 2.4 m (8 ft.). The standard gill net had four 7.6 m (25 ft.) panels consisting of 38.1 mm (1.5") (Panel 1), 50.8 mm (2.0") (Panel 2), 76.2 mm (3.0") (Panel 3), and 101.6 mm (4.0") (Panel 4) multifilament bar mesh. Twine size was #104 for the 38.1 mm and 50.8 mm panels and #139 for the 76.2 mm and 101.6 mm panels. The float line was a braided poly-foam core of 13 mm (1/2") diameter and the lead line was 7.1 mm (9/32") (22.7 kg./600 ft.). A double length gill net (61 m or 200 ft.) could be used when needed to sample a particular location and consisted of two standard gill nets attached together but counted as twice the effort. Panel numbering continued for 61 m nets, so the second 38.1 mm mesh was panel 5, the second 50.8 mm mesh was panel 6, the second 76.3 mm mesh was panel 7 and the second 101.6 mm mesh was panel 8. The first panel set (38.1 mm (Panel 1) or 101.6 mm mesh (Panel 4 or 8)) was selected randomly and recorded. Gill net samples were overnight sets with a maximum set time of 24 hours.

Otter Trawl

The standard otter trawl had a width of 4.9 m (16 ft.), height of 0.9 m (3 ft.) and length of 7.6 m (25 ft.). The trawl had an inner mesh (6.35 mm (1/4") bar) and an outer mesh (38.1 mm (1.5") bar, #9 sapphire twine), with a cod-end opening of 406.4 mm (16"). Trawl doors made from 19.1 mm (3/4") marine plywood, measuring 762 mm (30") by 381 mm (15"), were used to keep the trawl deployed on the river bottom. A 7.9 m (26 ft.) tickler chain (3.2 mm (0.125") galvanized) was attached to the back corner of the trawl doors and ran approximately three feet in front of the footrope. The tickler chain aided in dragging the river bed and provided some additional protection for the lower mouth of the otter trawl. Otter trawls were fished downstream with the length of the trawl dependent upon the size of the macrohabitat and mesohabitat being sampled. Otter trawl samples covered a minimum of 75 m (246 ft.) and a maximum of 300 m (984 ft.).

1" Trammel Net

The standard 1" trammel net had a length of 38.1m (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 was composed of #139 multifilament twine with a bar mesh size of 25.4 mm (1.0"). The outer walls were #9 multifilament twine with a bar mesh size of 203.2 mm (8.0"). The float line was a 12.7 mm

(1/2") foam core and the lead line was 22.7 kg (50 lb.). Trammel nets were drifted a maximum of 300 m and a minimum of 75 m.

2.5" Trammel Net

The 2.5" trammel net had a length of 38.1m (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 was composed of #208 multifilament twine with a bar mesh size of 63.5 mm (2.5"). The outer walls were #9 multifilament twine with a bar mesh size of 304.8 mm (12.0"). The float line was a 12.7 mm (1/2") foam core and the lead line was 22.7 kg (50 lb.). Trammel nets were drifted a maximum of 300 m and a minimum of 75 m.

Seine

The standard seine was 9.1 m (30 ft.) long by 1.8 m (6 ft.) high with a bag that measured 1.8 m x 1.8 m x 1.8 m. The seine had 6.4 mm (1/4") ace mesh with a 29.5 kg (65 lb.) lead core line. Seines were pulled upstream in a quarter arc, half arc, or rectangular fashion. The area sample (length and width) was measured to the nearest tenth of a meter using a 100 m (328 ft.) field tape.

Mini-Fyke Net

The standard mini-fyke net had two rectangular frames (1.2 m (4.0 ft.) by 0.6 m (2.0 ft.)) and two hoops (0.6 m (2.0 ft.)) made of oil tempered spring steel. A 4.5 m (15 ft.) by 0.6 m (2.0 ft.) lead was connected to the second rectangular frame. The mini-fyke net had 3 mm (1/8") ace mesh with a 29.5 kg (65lb.) lead core line. Mini-fyke net samples were overnight sets with a maximum set time of 24 hours.

Data Collection and Analysis

Fish Data Collection

When a pallid sturgeon was sampled, morphometric measurements were recorded along with pictures, habitat parameters, and all tagging information. If the pallid sturgeon had not been previously PIT tagged, a PIT tag was placed in accordance with the protocols. Other target species were measured to the nearest millimeter and weighed to the nearest gram. All non-target species collected were measured to nearest millimeter and released. An exception to this was during the community sampling season, when seine and mini-fyke net samples were preserved in 10% formalin and brought back to the lab for identification. Seine

and mini-fyke net samples were identified to species, stored in 70% alcohol, and labeled by species by sample.

Associated Environmental Data

Habitat samples were collected at the site of every pallid sturgeon capture and were randomly collected at 25% of the remaining sampling sites by mesohabitat. The predetermined parameters for habitat sampling were GPS coordinates (latitude and longitude in decimal degrees), water depth (m), water velocity ((mps) at bottom, 0.2, and 0.8 of water column), water temperature (°C), turbidity (NTU) and a sediment profile (based on percent of gravel, sand and silt).

Genetic Validation

Collection methods, including the handling of pallid sturgeon, conformed with methods described in Biological Procedures and Protocol for Collecting, Tagging, Sampling, Holding, Culture, Transporting, and Data Recording for Researchers and Managers Handling Pallid Sturgeon (Krentz 2001). Fin clips for DNA analysis were taken from pallid sturgeon and suspected hybrids and sent to William Ardren at the Abernathy Fish Technology Center for validation.

Analyses

All datasheets were checked and submitted to Yan Hong and staff of the Missouri Department of Conservation. All data was processed and analyzed using Microsoft Access and figures were generated via SigmaPlot. After receiving the analyzed data, verification was conducted using Microsoft Access and SAS.

Catch per Unit Effort

All fish collections are reported as catch per unit effort (CPUE) with the associated standard error. CPUE for gill nets is reported as the number of fish per 100 feet per net-night. CPUE for otter trawls are reported as number of fish per 100 linear meters trawled. CPUE for trammel nets is reported as number of fish per 100 meters drifted. CPUE for mini-fyke nets are reported as number of fish per net-night. CPUE for seining is reported as number of fish per 100 meters squared seined. CPUE is calculated for each subsample instead of overall catch per overall effort in order to get a measure of variance. These individual CPUEs are then averaged to get a total CPUE for an individual gear, bend or segment.

Character Index

Pallid sturgeon, shovelnose sturgeon and hybrids can be distinguished using meristic and morphometric characteristics. Sheehan et al. (1997) developed the character index (CI) using two meristics (dorsal and anal fin ray counts) and five morphometric ratios. This equation categorized *Scaphirhynchus* specimens into three categories. Character index values for pallid sturgeon range from -1.48 to -0.09, hybrid sturgeon from -0.45 to 0.51 and shovelnose sturgeon from 0.37 to 1.33.

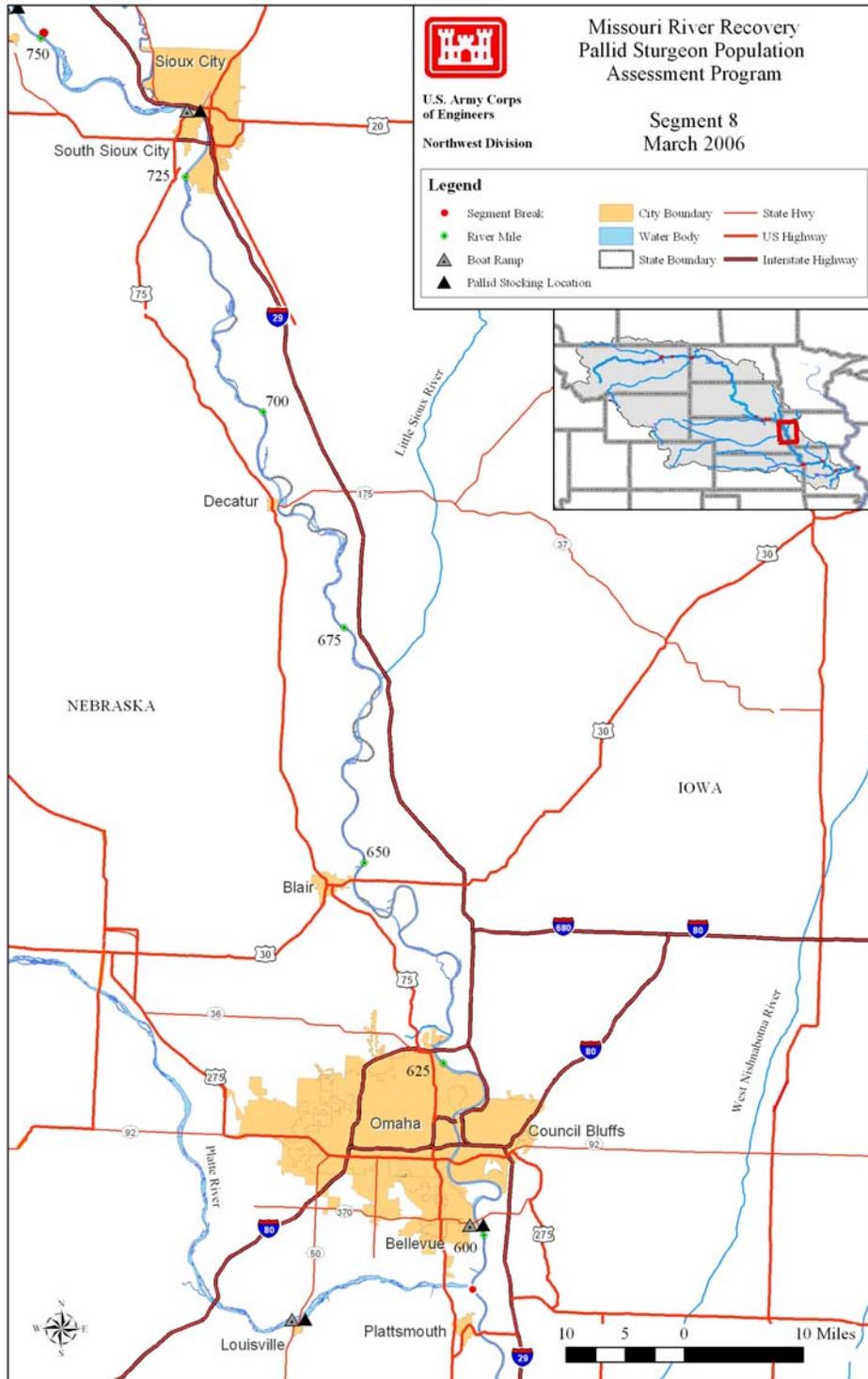
Relative Condition

The relative condition of recaptured hatchery reared pallid sturgeon was calculated using the formula $Kn = (W / W')$, 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 can be used to determine changes in a population structure. Length categories were based on the percentage of the largest known pallid sturgeon are as followed (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%). 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 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.

Figure 1a. Map of segment 8 of the Missouri River with major tributaries and common landmarks. Segment 8 encompasses the Missouri River from Lower Ponca Bend (River Mile 753.0) to the Platte River (River Mile 595.0).



Results

Effort

The 100' and 200' standard gill nets were only used to sample fish during the sturgeon season due to temperature restrictions (Appendix C). Gill nets were set on the CHNB and POOL mesohabitats within the ISB and CHXO macrohabitats (Table 1 and 2). A total of 268 net nights of effort were expended in segment 8 with gill nets during 2005.

The standard 16' otter trawl were used during both the sturgeon and fish community season. Otter trawls were used to sample the CHNB mesohabitat within the ISB, CHXO, and TRML macrohabitats. A total of 338 otter trawl samples were collected in segment 8 during 2005 covering 42,422 meters. Effort for the sturgeon season was the equivalent of 228.1 one hundred meter trawl deployments compared to 196.1 for the fish community season.

The 1.0" trammel nets were used for sampling during both the sturgeon and fish community season. They were used to sample the CHNB mesohabitat within the ISB, CHXO, and TRMS macrohabitats. A total of 330 trammel net drifts were conducted in segment 8 during 2005 covering 31,528 meters. Effort for the sturgeon season was the equivalent of 154.7 one hundred meter trammel net deployments compared to 160.6 for the fish community season.

During the 2005 sampling season the standard 2.5" trammel nets were developed in to the project design for the sturgeon season. The nets were used to sample the CHNB mesohabitat within the ISB and CHXO macrohabitats. A total of 97 drifts were made covering 8,492 meters in segment 8 resulting in an effort of 84.9 one hundred meter trammel net deployments.

The standard bag seine was used during the fish community season only. Seines were used to sample the BARS mesohabitat within the OSB, ISB, and CHXO macrohabitats. A total of 136 seine samples were collected in segment 8 during 2005 resulting in an effort of 255.8 one hundred meter squared seine hauls.

The standard mini-fyke net was only used during the fish community season. Mini-fyke nets were used to sample the BARS mesohabitat within the OSB, ISB, and CHXO, macrohabitats. A total of 130 mini-fyke sets were made in segment 8 during 2005 resulting in an effort of 130 net nights.

Table 1. Number of bends sampled, mean effort per bend, and total effort by macrohabitat for segments 8 on the Missouri River during fall through spring (sturgeon season) and summer (fish community season) in 2005. Effort is defined as net nights for gill and mini-fyke nets, 100 m drifted for trammel nets and trawls, and 100 m squared for bag seines. N-E indicates the habitat is nonexistent in the segment.

Gear	Number of bends	Mean effort	Macrohabitat													
			BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCN	TRIB	TRML	TRMS	WILD
Fall through Spring - Sturgeon Season																
1 Inch Trammel Net	20	7.7	N-E	37.56		N-E	N-E	117.15				N-E				
2.5 Inch Trammel Net	12	7.1		20.77				64.15								
Gill Net	15	17.9		56				212								
Otter Trawl	21	10.9		52.21				175.91								
Beam Trawl	Not a standard gear in segment 8															
Summer – Fish Community Season																
1 Inch Trammel Net	20	8.0	N-E	38.46		N-E	N-E	121.36				N-E			0.75	
Bag Seine	17	15.0		55.31				191.43	9.09							
Mini-Fyke Net	17	7.6		33				92	5							
Otter Trawl	20	9.8		46.61				145.42						4.07		
Beam Trawl	Not a standard gear in segment 8															

Table 2. Number of bends sampled, mean effort per bend, and total effort by mesohabitat for segment 8 on the Missouri River during fall through spring (sturgeon season) and summer (fish community season) in 2005. Effort is defined as net nights for gill and mini-fyke nets, 100 m drifted for trammel nets and trawls, and 100 m squared for bag seines. N-E indicates the habitat is non-existent in the segment.

Gear	Number of bends	Mean effort	Mesohabitat				
			BARS	CHNB	DTWT	ITIP	POOL
Fall through Spring – Sturgeon Season							
1 Inch Trammel Net	20	7.7		154.71	N-E	N-E	
2.5 Inch Trammel Net	12	7.1		84.92			
Gill Net	15	17.9		126			142
Otter Trawl	21	10.9		228.12			
Beam Trawl	Not a standard gear in segment 8						
Summer – Fish Community Season							
1 Inch Trammel Net	20	8.0		160.57	N-E	N-E	
Bag Seine	17	15.0	255.83	0			
Mini-Fyke Net	17	7.6	130	0			
Otter Trawl	20	9.8		196.10			
Beam Trawl	Not a standard gear in segment 8						

Pallid Sturgeon

A total of 15 pallid sturgeon were sampled in segment 8 during the 2005 sampling season. Nine of the fish were of known hatchery origin while six were deemed wild. Sturgeon season was the most productive for pallid captures with nine fish sampled compared to six during the fish community season.

Pallid sturgeon were captured throughout segment 8 ranging from McCook Lake bend (RM 742.4) downstream to The Narrows (RM 622.8). Omadi bend (RM 722.0) was sampled during the sturgeon and fish community season and yielded 4 pallid sturgeon. No other single bend had more than 2 pallid sturgeon sampled from it in 2005 (Figure 1b).

Most pallid sturgeon (14 of 15) were captured in the inside bend macrohabitat in segment 8 in 2005 (Table 3). Within the inside bend, most pallid sturgeon were sampled from channel border mesohabitats (N=11). The mean depth and velocities of channel border habitats where pallid sturgeon were sampled was very similar to the overall mean samples. Average turbidity was much higher where pallid sturgeon were caught (213 NTU) compared to the average turbidity of all samples (68 NTU). Pallid sturgeon captured in pool mesohabitats within the inside bend were found in greater mean depths (6.2 m vs. 4.1 m) and slightly greater mean velocities (0.49 mps vs. 0.41 mps) than what was sampled.

The mean morphometric character index for wild pallid sturgeon sampled in segment 8 during 2005 was -1.13 with a range of -0.725 to -1.699 (Table 4). Genetic samples were taken from wild pallid sturgeon and submitted to Abernathy Fish Technology Center for wild/hatchery origin verification. All but one recaptured pallid sturgeon was traced back to the Garrison Dam National Fish Hatchery. Most fish were either from the 2002 or 2004 year class. Four of the fish were stocked at Sioux City, IA in 2005 while three were stocked at Mulberry Bend, NE in 2002 and 2003.

Individual pallid sturgeon catch summaries can be seen in Table 5. Overall pallid sturgeon were sampled in water temperatures ranging from 8.0 to 28.1°C (Table 5). Turbidity ranged from 14 to 624 NTU and had a mean of 168 NTU. Pallid sturgeon were sampled in locations with a mean water depth of 3.2 m and an average bottom velocity of 0.5 mps. Sand was the dominant substrate where pallid sturgeon were captured ranging from 98 to 100%. The only other substrate present during any pallid captures was gravel (2% for one fish).

The mean relative condition factor (K_n) for recaptured fish ranged from 0.80 to 1.52 (Table 6). No comparisons could be made to the condition of fish at time of stocking due to the lack of length and weight data at that time.

Hatchery and wild pallid sturgeon occupied two different slots of the population structure. There were no hatchery pallid sturgeon that were of quality size or better by RSD length category proposed by Shuman et al. (2006) (Table 7). All were stock size or smaller. However, all wild fish were of stock size or larger with one individual in the memorable category.

A total of 1,201 shovelnose sturgeon were collected during 2005. The ratio of stocked pallid sturgeon to wild was 1.5:1 while the ratio for all pallid to shovelnose sturgeon was 1:80.1 (Table 8). There were no shovelnose sturgeon x pallid sturgeon hybrids captured in segment 8 during the 2005 sampling season.

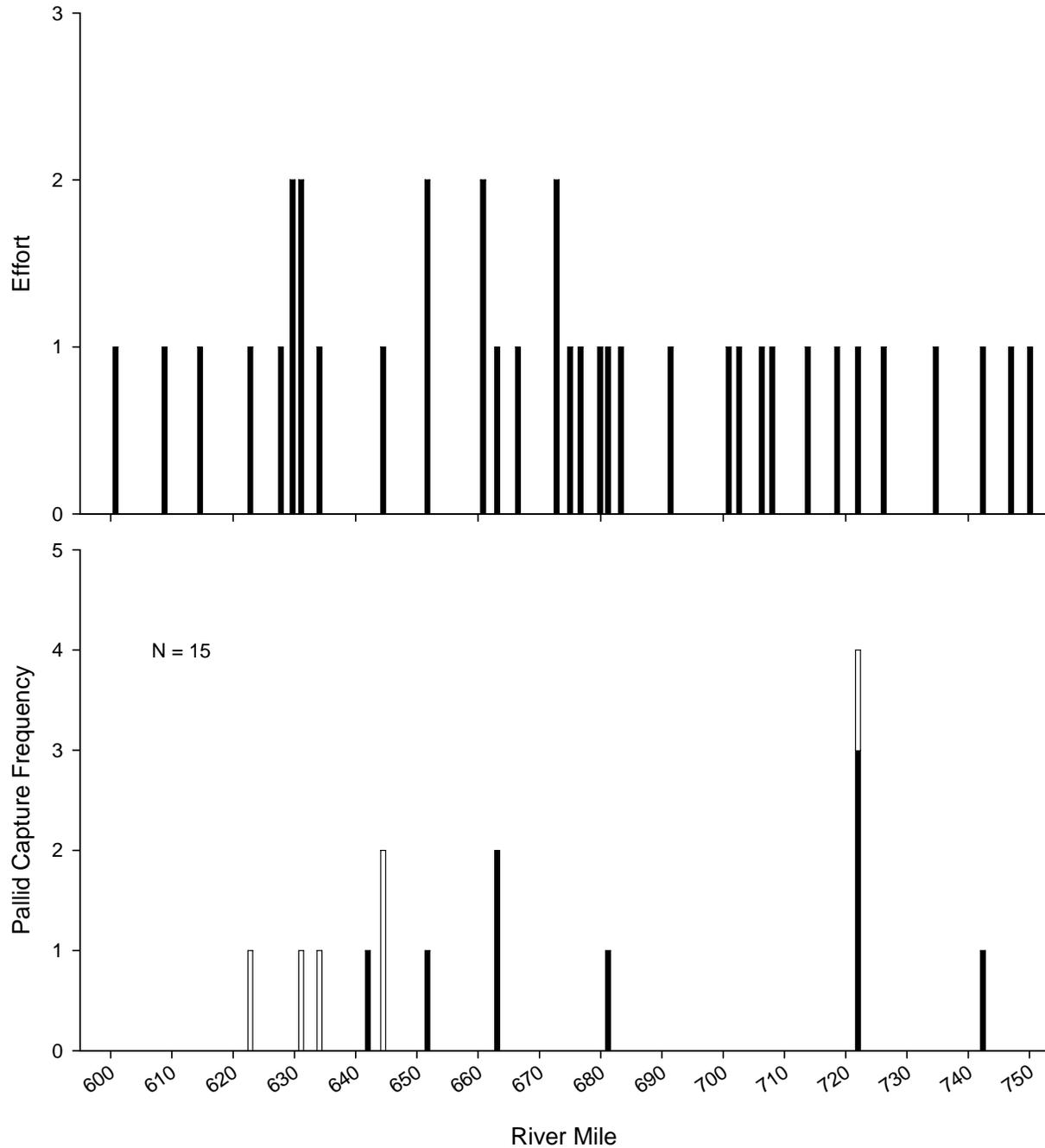


Figure 1b. Distribution of: A) seasonal sampling effort and B) pallid sturgeon captures by river mile for segment 8 in randomly selected bends of the Missouri River during 2005. Sampling effort of 2 indicates bend sampled in both sturgeon and fish community seasons. Sampling effort of 1 indicates bend sampled in only one season. Black bars represent pallid captures during sturgeon season and white bars during fish community season.

Table 3. Pallid sturgeon (PDSG) capture summaries relative to habitat type and environmental variables on the Missouri River during 2005. 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.

	OSB					ISB				
	BAR	POOL	CHNB	TLWG	ITIP	BAR	POOL	CHNB	TLWG	ITIP
Depth (m) (Effort)	0.6 (0.3-1.0)					0.7 (0.2-1.2)	4.1 (1.2-9.1)	2.5 (1.0 -10.7)		
Depth (m) (Catch)							6.2 (4.6-9.1)	2.6 (1.2-3.9)		
Velocity (m/s) (Effort)	0.09 (0.02-0.17)					0.11 (0.00-0.35)	0.41 (0.04-0.75)	0.49 (0.20-0.97)		
Velocity (m/s) (Catch)							0.49 (0.15-0.75)	0.50 (0.33-0.88)		
Temp. °C (Effort)	27.1 (25.4-28.0)					26.0 (20.5-29.0)	8.8 (2.0-12.0)	20.3 (2.0-30.0)		
Temp. °C (Catch)							10.7 (8.0-12.0)	21.6 (9.0-28.1)		
Turbidity (ntu) (Effort)	53 (40-73)					43 (24-111)	34 (14-128)	68 (14-704)		
Turbidity (ntu) (Catch)							33 (17-44)	213 (14-624)		
Total Pallids caught							3	11		
	CHXO					TRML				
	BAR	POOL	CHNB	TLWG	ITIP	BAR	POOL	CHNB	TLWG	ITIP
Depth (m) (Effort)	0.7 (0.2-1.3)	2.5 (1.2-5.0)	2.7 (1.2-6.0)					1.3 (1.2-3.7)		
Depth (m) (Catch)			1.3 (1.3-1.3)							
Velocity (m/s) (Effort)	0.07 (0.00-0.31)	0.34 (0.09-0.60)	0.47 (0.02-1.19)					0.16 (0.15-0.17)		
Velocity (m/s) (Catch)										
Temp. °C (Effort)	26.1 (20.5-29.0)	8.9 (2.0-12.0)	20.2 (2.0-30.0)					25.6 (19.0-26.0)		
Temp. °C (Catch)			20.0 (20.0-20.0)							
Turbidity (ntu) (Effort)	48 (24-111)	31 (14-88)	52 (14-624)					81 (79-87)		
Turbidity (ntu) (Catch)			85 (85-85)							
Total Pallids caught			1							

Table 3 (continued).

	TRMS				
	BAR	POOL	CHNB	TLWG	ITIP
Depth (m) (Effort)			2.1 (2.1-2.1)		
Depth (m) (Catch)					
Velocity (m/s) (Effort)			0.00 (0.00-0.00)		
Velocity (m/s) (Catch)					
Temp. °C (Effort)			22.2 (22.2-22.2)		
Temp. °C (Catch)					
Turbidity (ntu) (Effort)			67 (67-67)		
Turbidity (ntu) (Catch)					
Total Pallids caught					

Table 4. Individual pallid sturgeon fork length (mm), weights (g), morphometric character index (CI) (Sheehan et al. 1999), status (H = Hatchery, W = Wild^d), tags found, elastomer tags (color, position, orientation), if tags were inserted in field, stocking locations, and hatchery information on the Missouri River during 2005.

ID	Recapture Data							Stocking Data					
	FL (mm)	Wt (g)	CI	Status	Tags found ^a	Elastomer ^b	Marked in field?	Year class	FL (mm)	Wt (g)	Site	Source ^c	Stocking Date
NE-1-8-14-7	1068	3282	-1.56	W			yes						
NE-1-8-36-16	935	3450	-1.70	W			yes						
NE-1-8-104-23	387	184		W			yes						
NE-1-8-116-1	373	158	-0.21	H	P		no	2002	316		Bellevue, NE	Garrison	7/16/2003
NE-1-8-400-1	396	158		H	P		no	2002	345		Mulberry Bend, NE	Garrison	7/16/2003
NE-1-8-538-3	246	82		H	P,E	Red-LH	no	2004			Sioux City, IA	Garrison	4/22/2005
NE-1-8-539-2	230	50		H	P,E	Red-LH	no	2004			Sioux City, IA	Garrison	4/22/2005
NE-1-8-539-3	198	40		H	E	Red-LH	no	2004			Sioux City, IA	Garrison	4/22/2005
NE-1-8-553-1	392	152	-0.73	W			yes						
NE-1-8-601-2	508		-0.84	W			yes						
NE-1-8-714-1	407	194	-0.78	H	P		no	2002	321		Mulberry Bend, NE	Garrison	7/16/2003
NE-1-8-786-2	319	100	-0.62	H	E	Green-RV	yes						
NE-1-8-866-2	416	220	-0.84	W			yes						
NE-1-8-940-1	360	150		H	P		no	2001	190		Mulberry Bend, NE	Garrison	4/30/2002
NE-1-8-1158-1	305	88		H	E,CWT	Red-LH	yes	2004			Sioux City, IA	Garrison	4/22/2005

^a Tag types include: coded wire tag (C), elastomer tag (E) and passive induced transponder tag, i.e. PIT tag (P).

^b Positions and orientations listed after each color can include: fish's right (R), fish's left (L), center of rostrum (C), vertical (V), and horizontal (H).

^c Hatchery sources: source abbreviations reported in Appendix G.

^d All pallids that were captured with no evidence of previously being tagged were deemed wild pending genetic verification.

Table 5. Pallid sturgeon (PDSG) and hybrid pallid X shovelnose sturgeon (SNPD) capture locations and habitat characteristics for segment 8 of the Missouri River during 2005. ID number links pallid sturgeon habitat information with individual fish length, weight, and tagging data in Table 4. Gear codes presented in Appendix C. Habitat definitions and codes presented in Appendix B.

Species	ID#	Date	Gear	River Mile	Macro-	Habitat Meso-	Micro-	Water Temp (°C)	Turb ^a (NTU)	Depth ^b (m)	Bottom velocity (m/s)	Substrate ^c (silt/sand/ gravel)
PDSG	NE-1-8-14-7	10/25/2004	GN81S	665.5	ISB	POOL	211140	12.0	44	4.6	0.58	0 / 100 / 0
PDSG	NE-1-8-36-16	10/27/2004	GN81S	653.6	ISB	POOL	411140	12.0	39	9.1	0.15	0 / 100 / 0
PDSG	NE-1-8-104-23	11/15/2004	GN81S	643.0	ISB	POOL	521100	8.0	17	4.9	0.75	0 / 100 / 0
PDSG	NE-1-8-116-1	11/17/2004	GN18S	681.6	ISB	CHNB	221320	9.0	14	1.8	0.33	0 / 100 / 0
PDSG	NE-1-8-400-1	5/9/2005	TN25S	663.3	ISB	CHNB	221320	16.9	43	3.9	0.77	0 / 100 / 0
PDSG	NE-1-8-539-2	6/6/2005	OT16S	722.0	ISB	CHNB	221310	21.0	624	2.6	0.4	0 / 100 / 0
PDSG	NE-1-8-539-3	6/6/2005	OT16S	722.0	ISB	CHNB	221310	21.0	624	2.6	0.4	0 / 100 / 0
PDSG	NE-1-8-538-3	6/6/2005	OT16S	722.0	ISB	CHNB	221310	21.0	624	2.6	0.4	0 / 100 / 0
PDSG	NE-1-8-553-1	6/7/2005	OT16S	746.5	CHXO	CHNB	221310	20.0	85	1.3		0 / 98 / 2
PDSG	NE-1-8-601-2	7/22/2005	TNS	634.3	ISB	CHNB	521330	28.1	80	1.2	0.36	0 / 100 / 0
PDSG	NE-1-8-714-1	7/26/2005	TNS	625.0	ISB	CHNB	221330	27.5	116	2.9	0.55	0 / 100 / 0
PDSG	NE-1-8-786-2	7/27/2005	TNS	632.0	ISB	CHNB	221320	26.0	75	2.9	0.88	0 / 100 / 0
PDSG	NE-1-8-866-2	8/25/2005	TNS	646.0	ISB	CHNB	221330	22.7	52	2.9	0.51	0 / 100 / 0
PDSG	NE-1-8-940-1	9/8/2005	OT16S	646.0	ISB	CHNB	221310	25.0	29	2.4	0.59	0 / 100 / 0
PDSG	NE-1-8-1158-1	10/5/2005	OT16S	721.0	ISB	CHNB	221330	19.0	61	2.8	0.34	0 / 100 / 0

^aTurb = turbidity.

^bDepths presented are the average of the starting, middle, and ending depths measured during gear deployment.

^cSubstrates are percents determined visually and by feel in the field

Table 6. Mean fork length, weight, relative condition factor (Kn), and growth rates of hatchery-reared pallid sturgeon by year class at the time of stocking and recapture in 2001-2005 in 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	Stocking Data			Recapture Data			Growth Data	
		Length (mm)	Weight (g)	Kn	Length (mm)	Weight (g)	Kn	Growth (mm/d)	Growth (g/d)
2001	1	190			360	150.0	0.94	0.14	
	S.E.	-			-	-	-	-	
2002	3	327			392	170.0	0.80	0.10	
	S.E.	18			20	24.0	0.09	0.03	
2004	4				245	65.0	1.52		
	S.E.				45	24	0.43		

Table 7. Relative stock density (RSD)^a by a length category for wild and stocked pallid sturgeon in the Missouri River captured during 2005. Length categories^b determined using the methods proposed by Shuman et al. (2006).

Length Category	Wild ^c		Stocked	
	N	RSD	N	RSD
Sturgeon Season				
Sub-stock (0-199)			1	
Sub-stock (200-329)			2	
Stock	4		2	
Quality	2	50		
Preferred	2	50		
Memorable	1	25		
Trophy				
Fish Community Season				
Sub-stock (0-199)				
Sub-stock (200-329)			2	
Stock	2		2	
Quality				
Preferred				
Memorable				
Trophy				

^a RSD = number of fish of a specified length ÷ number minimum stock length fish x 100.

^b Length categories based on the percentage of the largest known pallid sturgeon: Sub-stock FL < 330 mm (20 %), Stock FL = 330 - 629 mm (20 - 36 %), Quality FL = 630 - 839 mm (36 - 45 %), Preferred FL = 840 - 1039 mm (45 - 59 %), Memorable FL = 1040 - 1269 mm (59 - 74 %), Trophy FL > 1270 mm (>74 %).

^c All pallids that were captured with no evidence of previously being tagged were deemed wild pending genetic verification.

Table 8. Ratios of wild pallid sturgeon to shovelnose sturgeon, wild pallid sturgeon to hybrid sturgeon (pallid X shovelnose), and stocked pallid sturgeon to wild pallid sturgeon captured in the Missouri River during 2005 including non-random and wild samples.

Year	All Pallids : Shovelnose	Wild Pallids: Shovelnose	Wild Pallids: Hybrids	Stocked Pallids: Wild Pallids
2005	1 : 80.1	1 : 200.3	6 : 0	1.5 : 1

* All pallids that were captured with no evidence of previously being tagged were deemed wild pending genetic verification.

Gear evaluation and Habitat associations

A total of 15 pallid sturgeon were captured in otter trawls (n = 6), gill nets (n = 4), 1.0" trammel nets (n = 4), and 2.5" trammel nets (n = 1) during the 2005 sampling season. Gill nets and otter trawls had the highest overall mean annual catch-per-unit-effort (CPUE = 0.015 fish per net night for gill nets and fish per 100 m trawled) (Appendix F). During sturgeon season gill nets also had the highest CPUE for wild pallid sturgeon while CPUE for stocked pallid sturgeon was highest with otter trawls (Figures 2 and 3). During the fish community season 1" trammel nets and otter trawls had the highest CPUE for wild and stocked pallid sturgeon respectively (Figure 5). No pallid sturgeon were sampled with 1" trammel nets during sturgeon season and neither bag seines nor mini-fyke nets captured a pallid during the fish community season (Appendix H).

All sub-stock size (0-199mm) and (200-329 mm) pallid sturgeon (N=5) were found within the inside bend macrohabitat for both the sturgeon and fish community seasons. These fish were also only captured in the channel border mesohabitat even though over half the gill nets deployed during sturgeon season were in pools (Tables 9-12). Four stock sized fish were captured during each season (Table 13). All but one of these fish were captured within inside bend habitat and only one was found in a mesohabitat besides a channel border (Tables 13 and 14). Two quality sized pallid sturgeon were found during sturgeon season while none were sampled during fish community season. Both quality sized pallid sturgeon caught were in inside bend pool habitat (Tables 15 and 16).

The average fork length of pallid sturgeon sampled in segment 8 during 2005 was 436 mm with a range of 198 to 1068 mm (Table 4). Fish collected during sturgeon season ranged from 198 to 1068 mm while a narrower size range of pallid sturgeon were caught during fish community season (305-508 mm) (Figure 8). Hatchery reared pallid sturgeon were sampled more frequently than wild pallid sturgeon (Figure 9) and in general wild pallid sturgeon (387-1068 mm) were larger than hatchery reared pallid sturgeon (198-407 mm) (Figure 10).

Segment 8 - Pallid Sturgeon / Sturgeon Season

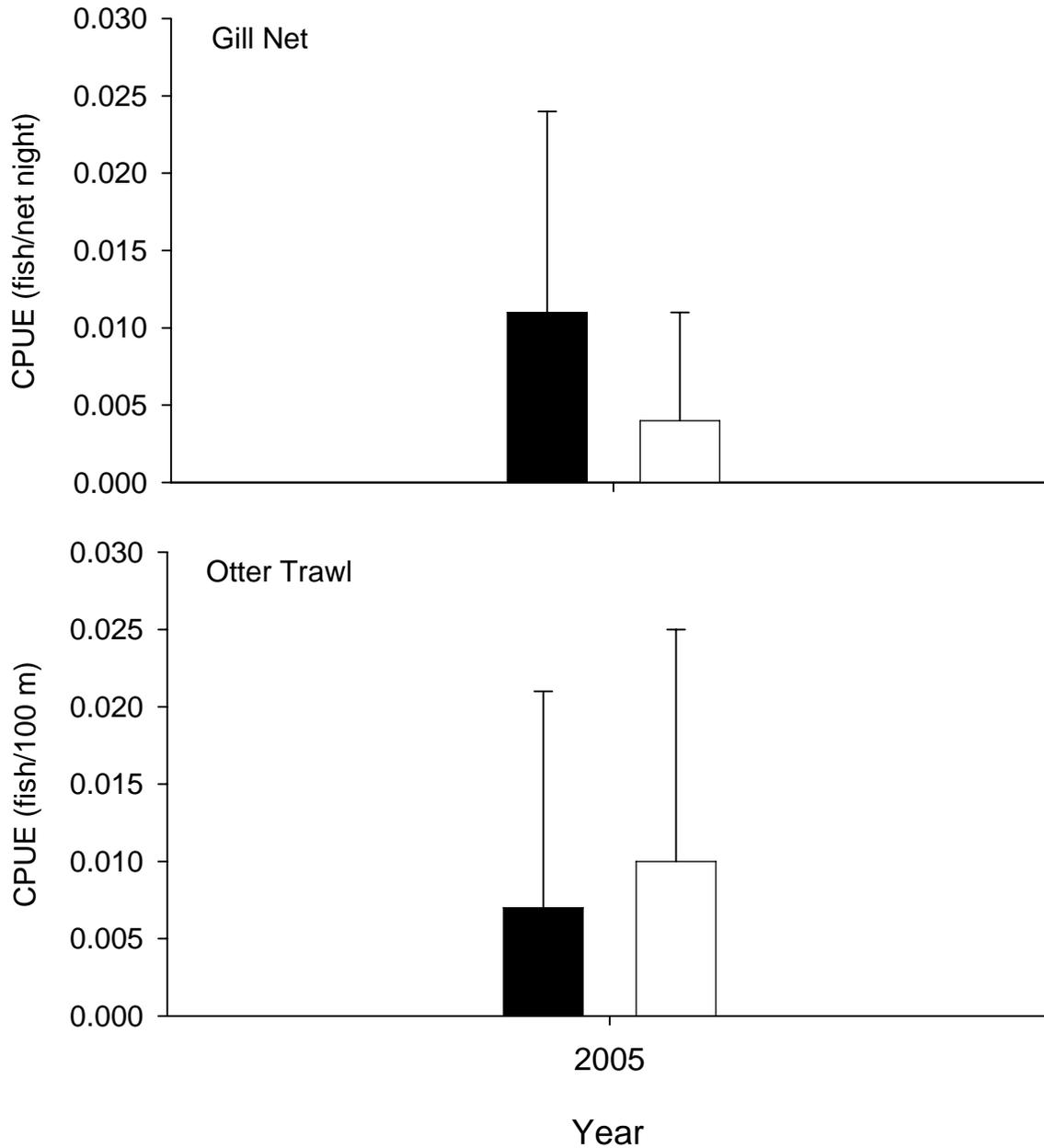


Figure 2. Mean annual catch-per-unit-effort (± 2 SE) of wild (black bars) and stocked (white bars) pallid sturgeon in segment 8 of the Missouri River for gill nets and otter trawls during sturgeon season 2005. All pallids that were captured with no evidence of previously being tagged were deemed wild pending genetic verification.

Segment 8 - Pallid Sturgeon / Sturgeon Season

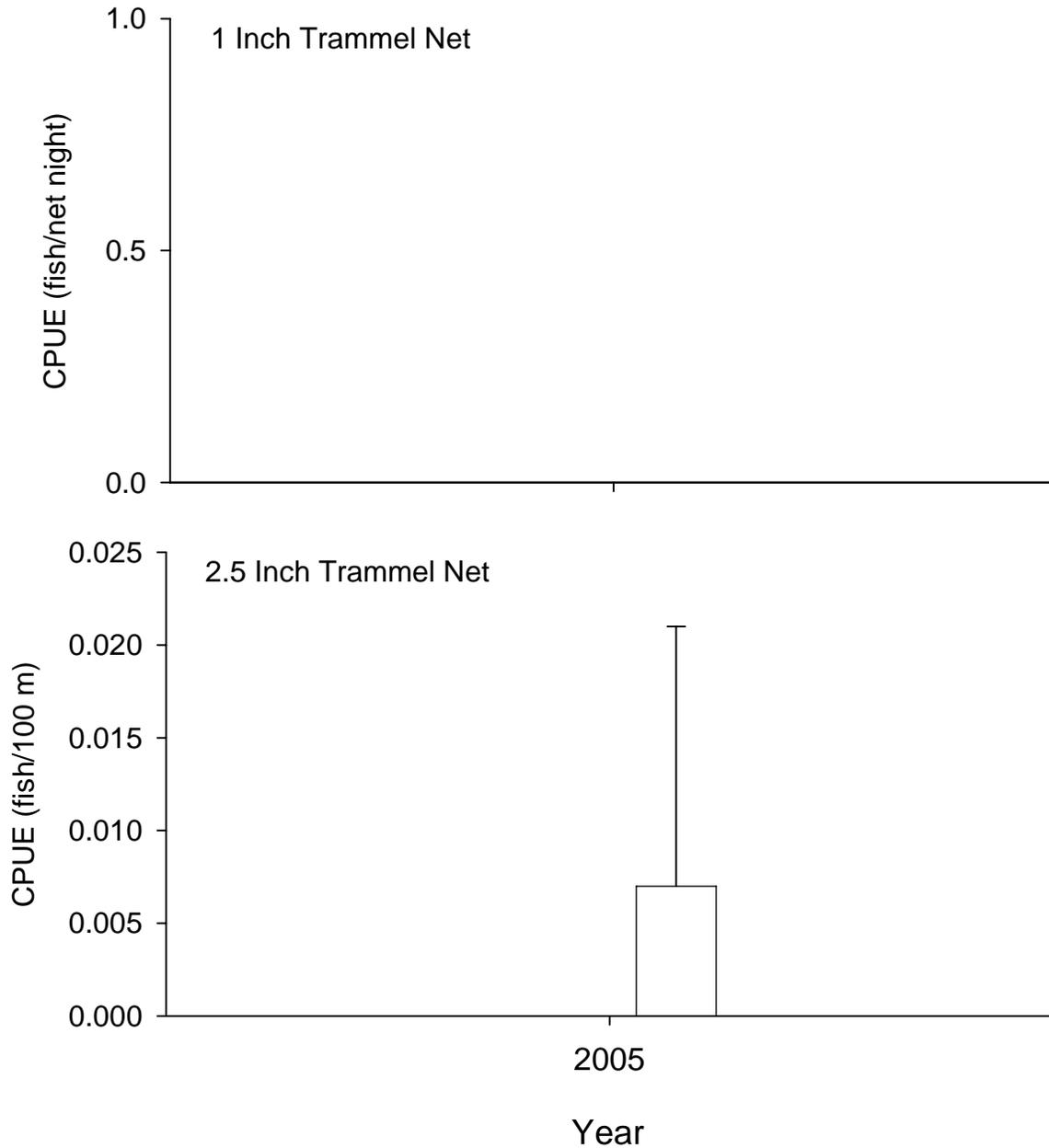


Figure 3. Mean annual catch-per-unit-effort (± 2 SE) of wild (black bars) and stocked (white bars) pallid sturgeon in segment 8 of the Missouri River for 1 and 2.5 inch trammel nets during sturgeon season 2005. All pallids that were captured with no evidence of previously being tagged were deemed wild pending genetic verification.

Segment 8 - Pallid Sturgeon / Fish Community Season

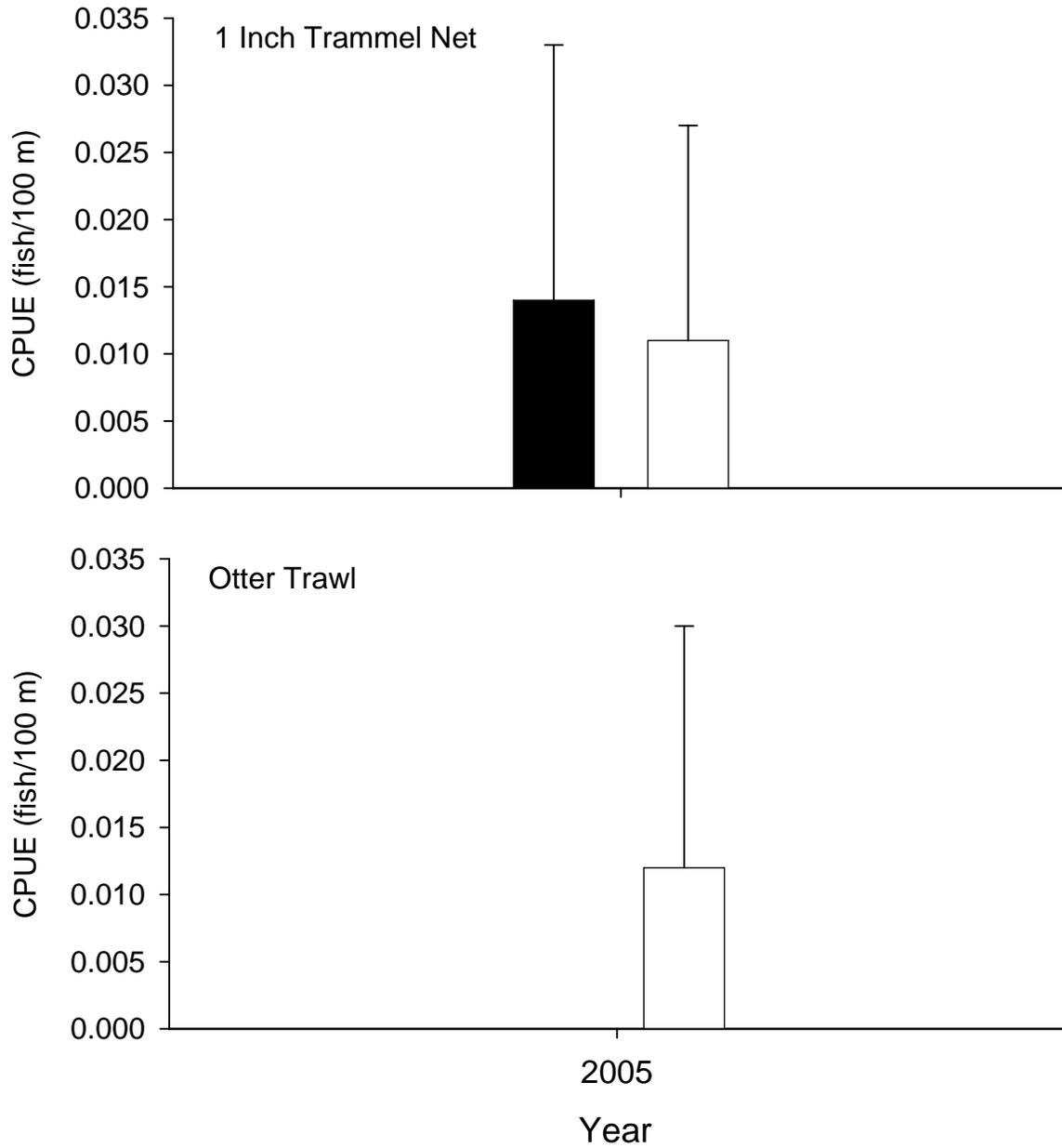


Figure 5. Mean annual catch-per-unit-effort (± 2 SE) of wild (black bars) and stocked (white bars) pallid sturgeon in segment 8 of the Missouri River for 1 inch trammel nets and otter during fish community season 2005. All pallids that were captured with no evidence of p were deemed wild pending genetic 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 8 of the Missouri River during 2005. 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	SCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0	N-E	24		N-E	N-E	76			N-E	N-E				
2.5 Inch Trammel Net	0		24				76								
Gill Net	0		21				79								
Otter Trawl	1		23				100								
						77									
Beam Trawl	Not a standard gear in segment 8														
Fish Community Season (Summer)															
1 Inch Trammel Net	0	N-E	24		N-E	N-E	76			N-E	N-E				
Bag Seine	0		22				75	4							
Mini-Fyke Net	0		25				71	4							
Otter Trawl	0		24				74							2	
Beam Trawl	Not a standard gear in segment 8														

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 8 of the Missouri River during 2005. 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					
		BARS	CHNB	DTWT	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)							
1 Inch Trammel Net	0		100	N-E	N-E		
2.5 Inch Trammel Net	0		100				
Gill Net	0		47			53	
Otter Trawl	1		100				
			100				
Beam Trawl	Not a standard gear in segment 8						
Fish Community Season (Summer)							
1 Inch Trammel Net	0		100	N-E	N-E		
Bag Seine	0	100					
Mini-Fyke Net	0	100					
Otter Trawl	0		100				
			100				
Beam Trawl	Not a standard gear in segment 8						

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 8 of the Missouri River during 2005. 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	SCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0	N-E	24		N-E	N-E	76			N-E	N-E				
2.5 Inch Trammel Net	0		24				76								
Gill Net	0		21				79								
Otter Trawl	2		23				100								
Otter Trawl							77								
Beam Trawl	Not a standard gear in segment 8														
Fish Community Season (Summer)															
1 Inch Trammel Net	1	N-E	24		N-E	N-E	100			N-E	N-E				
Bag Seine	0		22				75	4							
Mini-Fyke Net	0		25				71	4							
Otter Trawl	1		24				100								
Otter Trawl							74								
Beam Trawl	Not a standard gear in segment 8														

Table 12. Total number of sub-stock size size (200-329 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 8 of the Missouri River during 2005. 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					
		BARS	CHNB	DTWT	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)							
1 Inch Trammel Net	0		100	N-E	N-E		
2.5 Trammel Net	0		100				
Gill Net	0		47			53	
Otter Trawl	2		100				
			100				
Beam Trawl	Not a standard gear in segment 8						
Fish Community Season (Summer)							
1 Inch Trammel Net	1		100	N-E	N-E		
			100				
Bag Seine	0	100					
Mini-Fyke Net	0		100				
Otter Trawl	1		100				
			100				
Beam Trawl	Not a standard gear in segment 8						

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 8 of the Missouri River during 2005. 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	SCN	TRIB	TRML	TRMS	WILD				
Sturgeon Season (Fall through Spring)																			
1 Inch Trammel Net	0	N-E	24		N-E	N-E	76			N-E	N-E								
2.5 Trammel Net	1						100												
Gill Net	2		24				76												
			21				100												
Otter Trawl	1		100																
		23				77													
Beam Trawl	Not a standard gear in segment 8																		
Fish Community Season (Summer)																			
1 Inch Trammel Net	3	N-E	24		N-E	N-E	100			N-E	N-E								
							76												
Bag Seine	0		22				75	4											
Mini-Fyke Net	0		25				71	4											
Otter Trawl	1						100												
		24		74								2							
Beam Trawl	Not a standard gear in segment 8																		

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 8 of the Missouri River during 2005. 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					
		BARS	CHNB	DTWT	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)							
1 Inch Trammel Net	0		100	N-E	N-E		
2.5 Trammel Net	1		100				
			100				
Gill Net	2		50			50	
			47			53	
Otter Trawl	1		100				
			100				
Beam Trawl	Not a standard gear in segment 8						
Fish Community Season (Summer)							
1 Inch Trammel Net	3		100	N-E	N-E		
			100				
Bag Seine	0	100					
Mini-Fyke Net	0						
		100					
Otter Trawl	1		100				
			100				
Beam Trawl	Not a standard gear in segment 8						

Table 15. Total number of quality and above size (>630 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in segment 8 of the Missouri River during 2005. 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	SCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0	N-E	24		N-E	N-E	76			N-E	N-E				
2.5 Trammel Net	0		24				76								
Gill Net	2		21				100								
Otter Trawl	0		23				77								
Beam Trawl	Not a standard gear in segment 8														
Fish Community Season (Summer)															
1 Inch Trammel Net	0	N-E	24		N-E	N-E	76			N-E	N-E				
Bag Seine	0		22				75	4							
Mini-Fyke Net	0		25				71	4							
Otter Trawl	0		24				74					2			
Beam Trawl	Not a standard gear in segment 8														

Table 16. Total number of quality and above size (>630 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 8 of the Missouri River during 2005. 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					
		BARS	CHNB	DTWT	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)							
1 Inch Trammel Net	0		100	N-E	N-E		
2.5 Trammel Net	0		100				
Gill Net	2		47			100	
						53	
Otter Trawl	0		100				
Beam Trawl	Not a standard gear in segment 8						
Fish Community Season (Summer)							
1 Inch Trammel Net	0		100	N-E	N-E		
Bag Seine	0	100					
Mini-Fyke Net	0	100					
Otter Trawl	0		100				
Beam Trawl	Not a standard gear in segment 8						

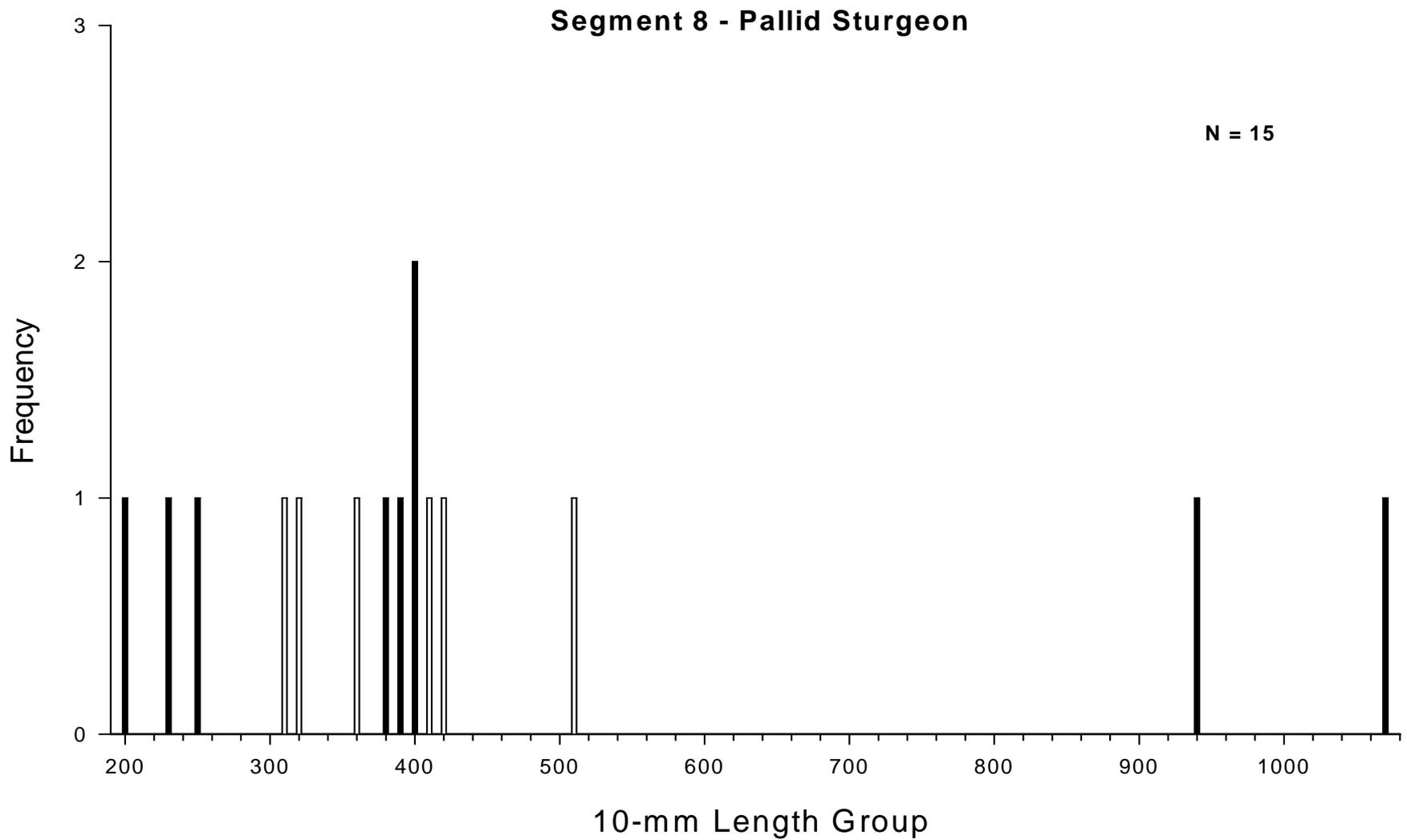


Figure 8. Length frequency of pallid sturgeon during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 8 of the Missouri River during 2005.

Segment 8 - Cumulative Pallid Sturgeon Capture History

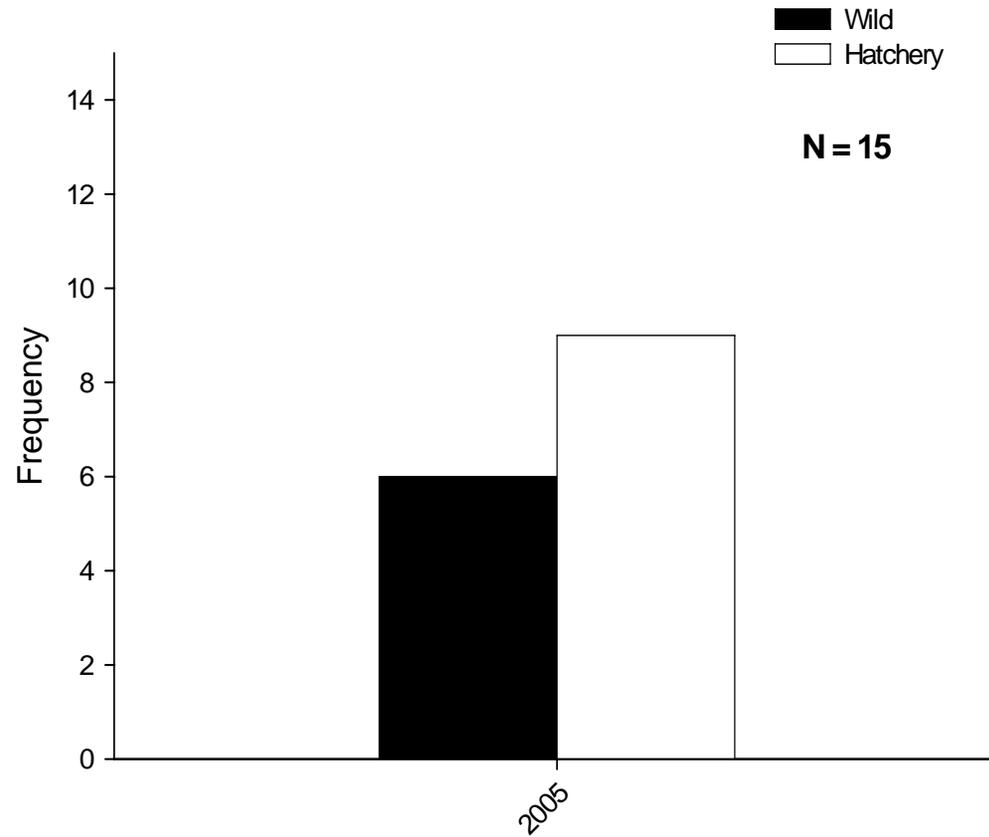


Figure 9. Cumulative capture history of wild (black bars) and hatchery reared (white bars) pallid sturgeon collected in segment 8 of the Missouri River in 2005.

Segment 8 - Cumulative Pallid Sturgeon Length Frequency History

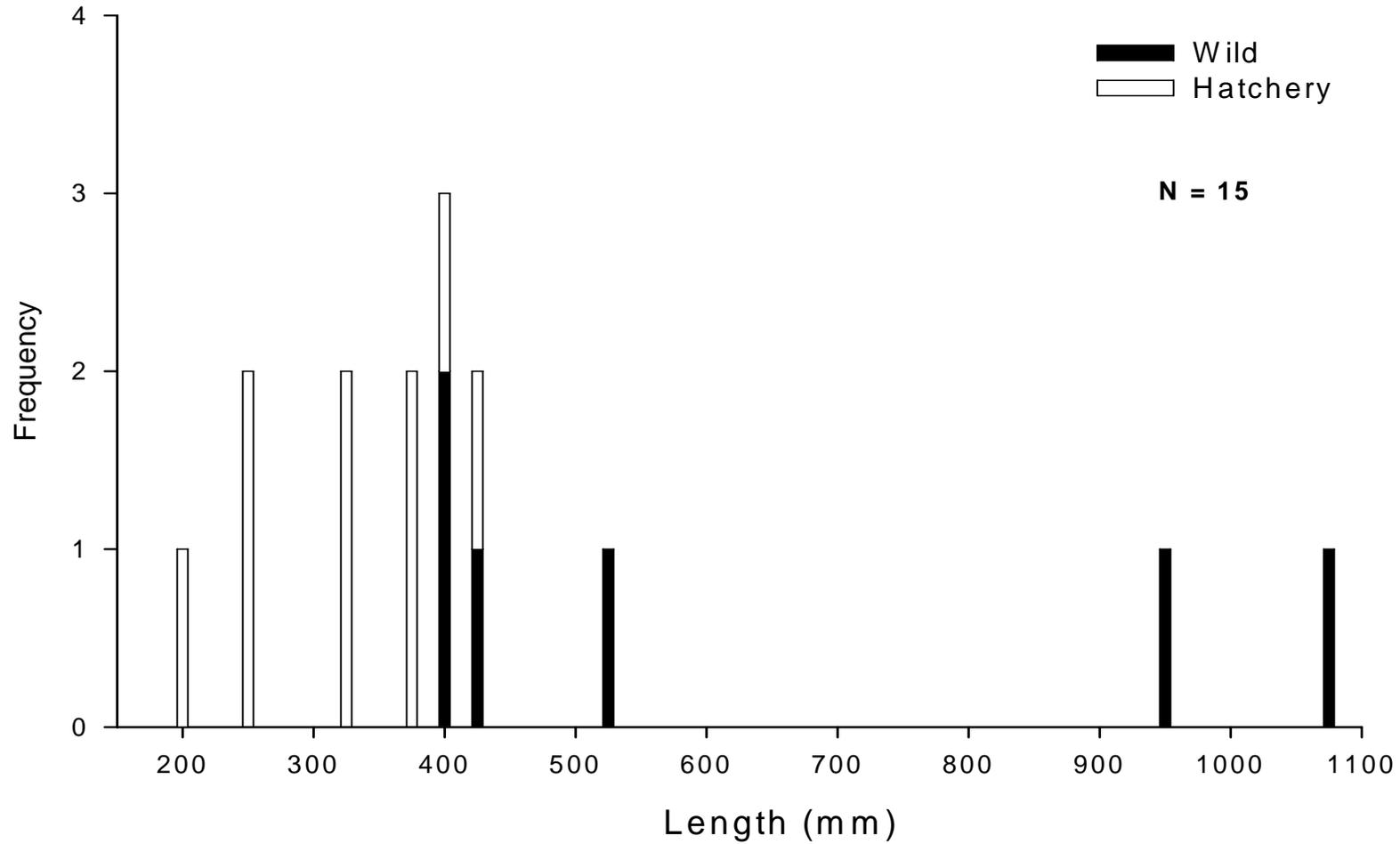


Figure 10. Cumulative pallid sturgeon length frequency histogram for segment 8 comparing hatchery reared (white bars) and wild (black bars) pallid sturgeon captures in 2005.

Targeted Native River Species

Shovelnose Sturgeon

A total of 1,201 shovelnose sturgeon were captured in gill nets (N = 582), 1" trammel nets (N = 428), 2.5" trammel nets (N = 10), and otter trawls (N = 181) in segment 8 during 2005. Overall catch-per-unit-effort was greatest in gill nets (2.18 fish per net night) followed by 1" trammel nets (CPUE = 1.32 fish per 100 m drifted) (Appendix F).

Gill nets were the most effective gear during the sturgeon season (CPUE = 2.18 fish per net night) (Figures 11 and 12) while 1.0" trammel nets had the greatest CPUE for the fish community season (2.27 fish per 100 m drifted) (Figure 14). During the sturgeon season no standard gears were very effective at sampling sub-stock and stock size shovelnose sturgeon. Gill nets had the highest CPUE (2.16 fish per net night) for quality and above size shovelnose sturgeon during the sturgeon season followed by otter trawls (CPUE = 0.37 fish per 100 m drifted).

Higher CPUE's for both sub-stock size ranges of shovelnose sturgeon were seen during the fish community season than during the compared to sturgeon season. Otter trawls were most effective in capturing sub-stock (0-149 mm) (CPUE = 0.023 fish per 100 m trawled) followed by 1" trammel nets (CPUE = 0.006 fish 100 m drifted) (Figure 14). Also during the fish community season, sub-stock (150-249 mm) shovelnose sturgeon were captured most frequently in otter trawls (CPUE = 0.026 fish 100 m trawled) followed by 1" trammel nets (CPUE = 0.012 fish per 100 m drifted). One inch trammel nets captured stock size shovelnose sturgeon most effectively during the fish community season (CPUE = 0.035 fish per 100 m drifted). Quality and above size shovelnose were also sampled most effectively by 1" trammel nets (CPUE = 2.22 fish per 100 m drifted) during the fish community season. No shovelnose sturgeon were captured with bag seines or mini-fyke nets in segment 8 during 2005.

Segment 8 - Shovelnose Sturgeon / Sturgeon Season

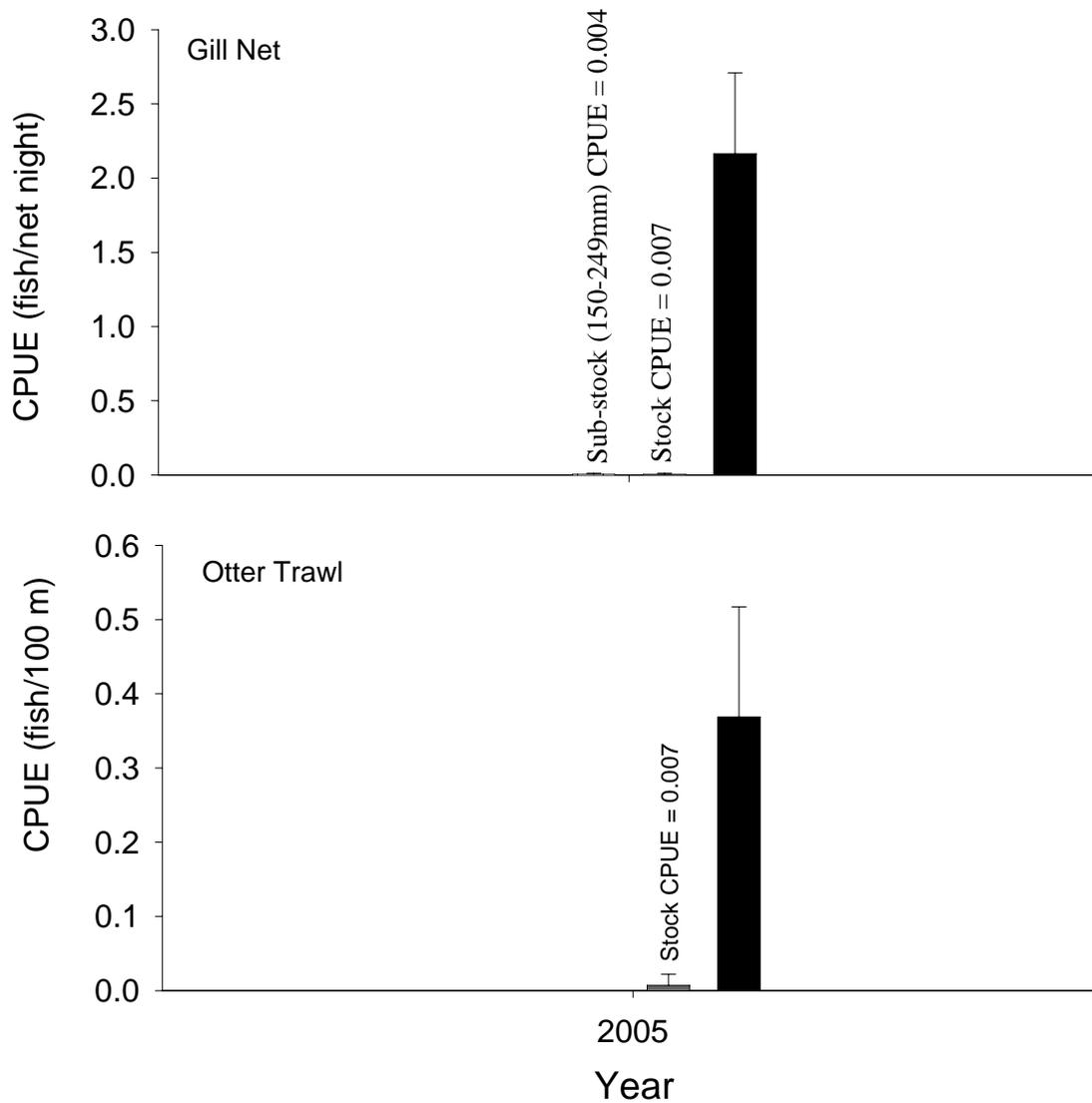


Figure 11. Mean annual catch-per-unit-effort (\pm 2SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size (> 380 mm; black bars) shovelnose sturgeon in segment 8 of the Missouri River for gill nets and otter trawls during sturgeon season 2005.

Segment 8 - Shovelnose Sturgeon / Sturgeon Season

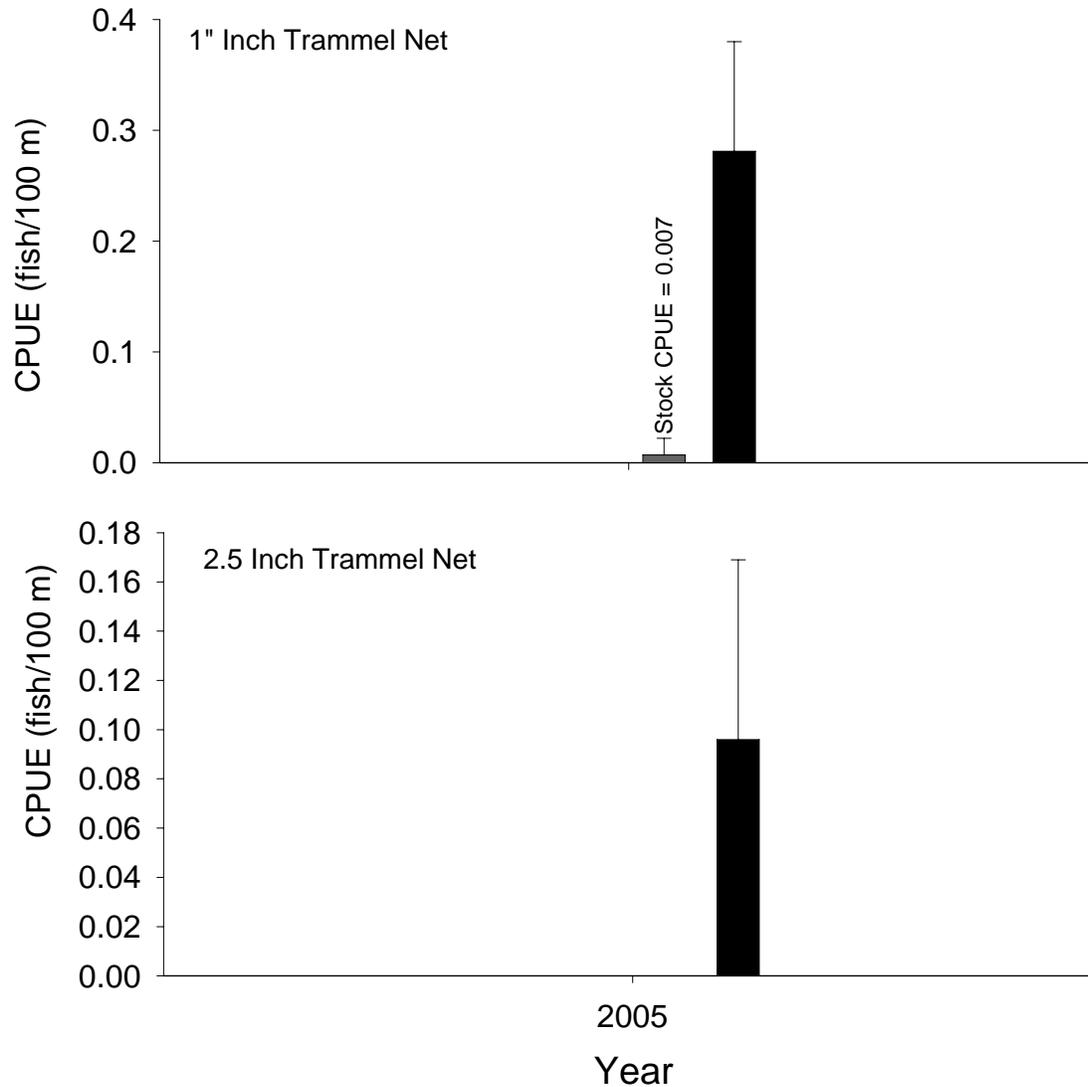


Figure 12. Mean annual catch-per-unit-effort (\pm 2SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size (> 380 mm; black bars) shovelnose sturgeon in segment 8 of the Missouri River for 1 and 2.5 inch trammel nets during sturgeon season 2005.

Segment 8 - Shovelnose Sturgeon / Fish Community Season

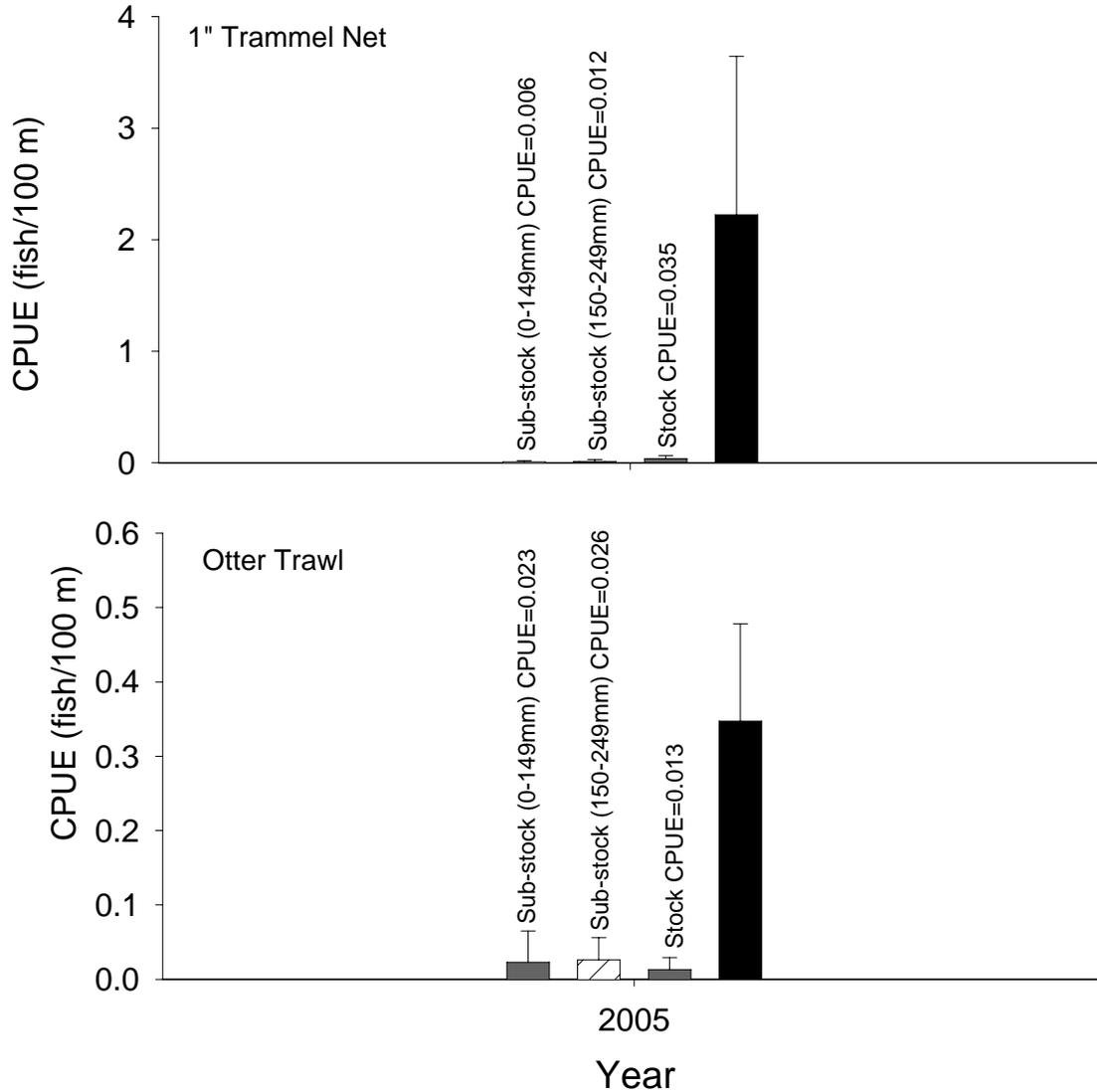


Figure 14. Mean annual catch-per-unit-effort (+/- 2SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size (> 380 mm; black bars) shovelnose sturgeon in segment 8 of the Missouri River for 1" trammel nets and otter trawls during fish community season 2005.

Habitat Use

Overall, very few ($n = 29$) sub-stock (0 – 149 mm and 150 – 249 mm) and stock size (250-279 mm) shovelnose sturgeon were captured compared to fish quality and above size ($n = 1172$). Most of the stock size and smaller fish were caught during fish community season ($n = 25$). During the fish community season, stock size and smaller fish were found almost entirely in channel borders within the inside bend with only two being captured within the crossover macrohabitat (Tables 17-22). More quality and above size shovelnose sturgeon were caught during sturgeon season ($n = 764$) than during the fish community season ($n = 408$). During both the sturgeon and fish community seasons, these fish were captured in fairly similar proportion to sampling effort in crossover and inside bend macrohabitats (Table 23). Four times as many fish were caught in large tributary mouth macrohabitats in proportion to the sampling effort in that habitat. However, sampling effort in the large tributary mouths was only a small proportion of all sampling efforts. Quality and above size shovelnose sturgeon were caught more frequently (79%) in pools than in channel borders (21%) during the sturgeon season (Table 24). Gill nets were the only gear used to sample pool mesohabitats and were used only during the sturgeon season. All quality and above size fish were caught in channel border habitats during the fish community season.

A total of 1,201 shovelnose sturgeon were measured in 2005 (Figure 17). The average fork length was 548 mm during sturgeon season compared to 524 mm during fish community season. The length range for shovelnose sturgeon was 244 to 712 mm for sturgeon season compared to 54 to 709 mm during fish community season. As previously mentioned, more large shovelnose sturgeon were captured during both seasons compared to smaller fish. The proportion of quality and preferred length category fish proposed by Quist et al. (1998) was very high in the population during both the sturgeon and fish community seasons (Table 25). PSD values of 82 and 75 for sturgeon and fish community seasons respectively reflect the preponderance of larger fish sampled.

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 8 of the Missouri River during 2005. 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	SCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0	N-E	24		N-E	N-E	76			N-E	N-E				
2.5 Inch Trammel Net	0		24				76								
Gill Net	0		21				79								
Otter Trawl	0		23				77								
Beam Trawl	Not a standard gear in segment 8														
Fish Community Season (Summer)															
1 Inch Trammel Net	1	N-E	24		N-E	N-E	100			N-E	N-E				
Bag Seine	0		22				75	4							
Mini-Fyke Net	0		25				71	4							
Otter Trawl	8		24				100							2	
Beam Trawl	Not a standard gear in segment 8														

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 8 of the Missouri River during 2005. 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					
		BARS	CHNB	DTWT	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)							
1 Inch Trammel Net	0		100	N-E	N-E		
2.5 Inch Trammel Net	0		100				
Gill Net	0		47			53	
Otter Trawl	0		100				
Beam Trawl	Not a standard gear in segment 8						
Fish Community Season (Summer)							
1 Inch Trammel Net	1		100	N-E	N-E		
			100				
Bag Seine	0	100					
Mini-Fyke Net	0	100					
Otter Trawl	8		100				
			100				
Beam Trawl	Not a standard gear in segment 8						

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 8 of the Missouri River during 2005. 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	SCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0	N-E	24		N-E	N-E	76			N-E	N-E				
2.5 Inch Trammel Net	0		24				76								
Gill Net	1		21				100								
Otter Trawl	0		23				77								
Beam Trawl	Not a standard gear in segment 8														
Fish Community Season (Summer)															
1 Inch Trammel Net	2	N-E	24		N-E	N-E	100			N-E	N-E				
Bag Seine	0		22				75	4							
Mini-Fyke Net	0		25				71	4							
Otter Trawl	5		24				100							2	
Beam Trawl	Not a standard gear in segment 8														

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 8 of the Missouri River during 2005. 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					
		BARS	CHNB	DTWT	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)							
1 Inch Trammel Net	0		100	N-E	N-E		
2.5 Inch Trammel Net	0		100				
Gill Net	1		47			100	
						53	
Otter Trawl	0		100				
Beam Trawl	Not a standard gear in segment 8						
Fish Community Season (Summer)							
1 Inch Trammel Net	2		100	N-E	N-E		
			100				
Bag Seine	0	100					
Mini-Fyke Net	0		100				
Otter Trawl	5		100				
			100				
Beam Trawl	Not a standard gear in segment 8						

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 8 of the Missouri River during 2005. 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	SCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	1	N-E			N-E	N-E	100			N-E	N-E				
			24				76								
2.5 Inch Trammel Net	0														
			24				76								
Gill Net	1														
Otter Trawl	1														
Beam Trawl	Not a standard gear in segment 8														
Fish Community Season (Summer)															
1 Inch Trammel Net	6	N-E	33		N-E	N-E	67			N-E	N-E				
			24				76								
Bag Seine	0														
			22				75	4							
Mini-Fyke Net	0														
Otter Trawl	3														
Beam Trawl	Not a standard gear in segment 8														

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 8 of the Missouri River during 2005. 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						
		BARS	CHNB	DTWT	ITIP	POOL	TLWG	
Sturgeon Season (Fall through Spring)								
1 Inch Trammel Net	1		100	N-E	N-E			
			100					
2.5 Inch Trammel Net	0							
			100					
Gill Net	1						100	
			47				53	
Otter Trawl	1		100					
			100					
Beam Trawl	Not a standard gear in segment 8							
Fish Community Season (Summer)								
1 Inch Trammel Net	6		100	N-E	N-E			
			100					
Bag Seine	0							
		100						
Mini-Fyke Net	0							
		100						
Otter Trawl	3		100					
			100					
Beam Trawl	Not a standard gear in segment 8							

Table 23. Total number of quality and above size (>380 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in segment 8 of the Missouri River during 2005. 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	SCN	TRIB	TRML	TRMS	WILD					
Sturgeon Season (Fall through Spring)																				
1 Inch Trammel Net	84	N-E	11		N-E	N-E	89			N-E	N-E									
			24				76													
2.5 Inch Trammel Net	10								100											
			24						76											
Gill Net	580								87											
			13						79											
		21				69														
Otter Trawl	90					77														
		31																		
		23																		
Beam Trawl	Not a standard gear in segment 8																			
Fish Community Season (Summer)																				
1 Inch Trammel Net	334	N-E	22		N-E	N-E	78			N-E	N-E									
			24				76													
Bag Seine	0																			
			22						75			4								
Mini-Fyke Net	0																			
			25						71			4								
Otter Trawl	74					76							8							
		16				74							2							
		24																		
Beam Trawl	Not a standard gear in segment 8																			

Table 24. Total number of quality and above size (>380 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 8 of the Missouri River during 2005. 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					
		BARS	CHNB	DTWT	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)							
1 Inch Trammel Net	84		100	N-E	N-E		
			100				
2.5 Inch Trammel Net	10		100				
			100				
Gill Net	580		21			79	
			47			53	
Otter Trawl	90		100				
			100				
Beam Trawl	Not a standard gear in segment 8						
Fish Community Season (Summer)							
1 Inch Trammel Net	334		100	N-E	N-E		
			100				
Bag Seine	0						
		100					
Mini-Fyke Net	0						
		100					
Otter Trawl	74		100				
			100				
Beam Trawl	Not a standard gear in segment 8						

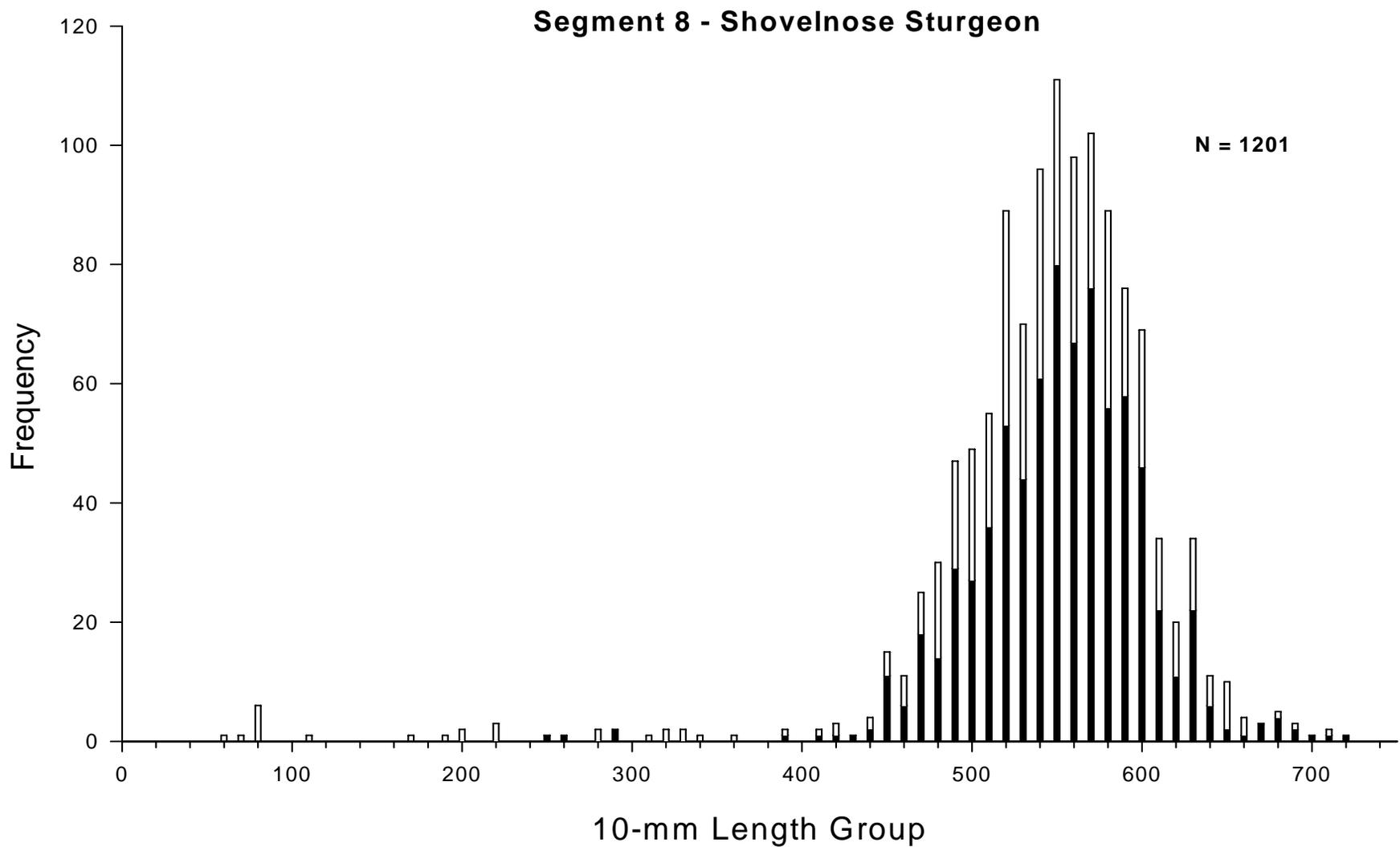


Figure 17. Length frequency of shovelnose sturgeon from fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 8 of the Missouri River during 2005.

Table 25. Relative stock density (RSD)^a by a length category for shovelnose sturgeon in segment 8 of the Missouri River captured during 2005. Length categories^b determined using methods proposed by Quist (1998).

Length category	N	RSD
Sturgeon Season		
Sub-stock (0-149 mm)	0	
Sub-stock (150-249 mm)	1	
Stock	767	
Quality	764	100
Preferred	626	82
Memorable	17	2
Trophy	0	0
Fish Community Season		
Sub-stock (0-149 mm)	9	
Sub-stock (150-249 mm)	7	
Stock	417	
Quality	408	98
Preferred	312	75
Memorable	14	3
Trophy	0	0

^a RSD = number of fish of a specified length ÷ number minimum stock length fish x 100.

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

Sturgeon Chub

A total of 13 sturgeon chubs were captured during the 2005 sampling season. All fish were captured with otter trawls. Three sturgeon chubs were captured during the sturgeon season while 10 fish were captured during fish community season. No other gear used in either season was effective in capturing sturgeon chubs. Catch per unit effort for otter trawls during the sturgeon season was 0.01 fish per 100 m trawled and 0.03 fish per 100 m trawled during fish community season (Appendix H). The average fork length of the sturgeon chubs sampled was 74.9 mm with a length range of 57 to 102 mm. Due to the low number of fish sampled habitat associations were difficult to distinguish and therefore not made.

Sicklefin Chub

A total of 33 sicklefin chubs were captured during the 2005 sampling season. All fish were captured with otter trawls. The majority of fish were captured during field community season ($n = 24$). No other gear used in either season was effective in capturing sicklefin chubs. Catch per unit effort for otter trawls during the sturgeon season was 0.036 fish per 100 m trawled and 0.09 fish per 100 m trawled during fish community season (Appendix H). The average fork length of the sicklefin chubs sampled was 100.8 mm with a length range of 79 to 125 mm. Due to the low number of fish sampled habitat associations were difficult to distinguish and therefore not made.

Speckled Chub

A total of 59 speckled chubs were captured in otter trawls ($n = 57$) and mini-fyke nets ($n = 2$) during the 2005 sampling season. Catch per unit effort for otter trawling during the sturgeon season was 0.18 fish per 100 m trawled (Figure 26). During the fish community season otter trawls again had the greatest catch per unit effort (0.10 fish per 100 m trawled) followed by mini-fyke nets (0.015 fish per net night) (Figures 27 and 28). Bag seines failed to capture any speckled chubs.

The majority of speckled chubs collected during the sturgeon season while otter trawling were sampled on the inside bend (74%) while the rest were caught in channel cross-overs (26%) (Table 30). These catches were proportionate to sampling effort in each habitat. During the fish community season, more speckled chubs were collected from inside bends than the proportion of sampling effort for both otter trawls and mini-fyke nets. Channel border mesohabitat accounted for all otter trawl catches of speckled chubs during the sturgeon and fish community seasons (Table 31). All speckled chubs collected with mini-fyke nets were from bar habitats.

A total of 59 speckled chubs were measured during 2005, with 38 being sampled in the sturgeon season (Figure 29). The average fork length was 48.2 mm during the sturgeon season and 51.6 during the fish community season. The length range for sturgeon chubs sampled during the sturgeon season was 36 to 74 mm compared to 30 to 78 mm during the fish community season.

Segment 8 - Speckled Chub / Sturgeon Season

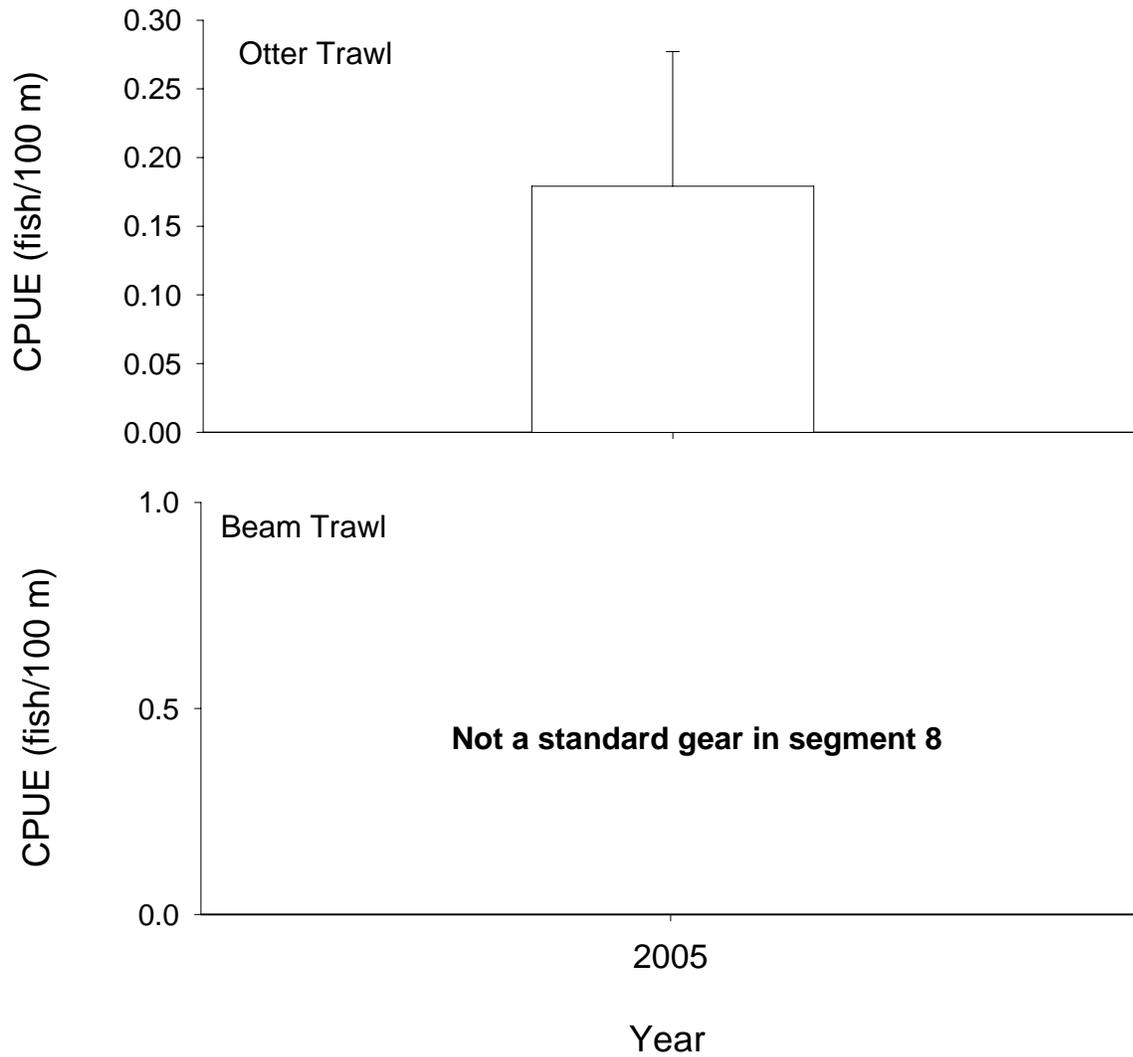


Figure 26. Mean annual catch-per-unit-effort ($\pm 2SE$) of speckled chub in segment 8 of the Missouri River for otter and beam trawls during sturgeon season 2005.

Segment 8 - Speckled Chub / Fish Community Season

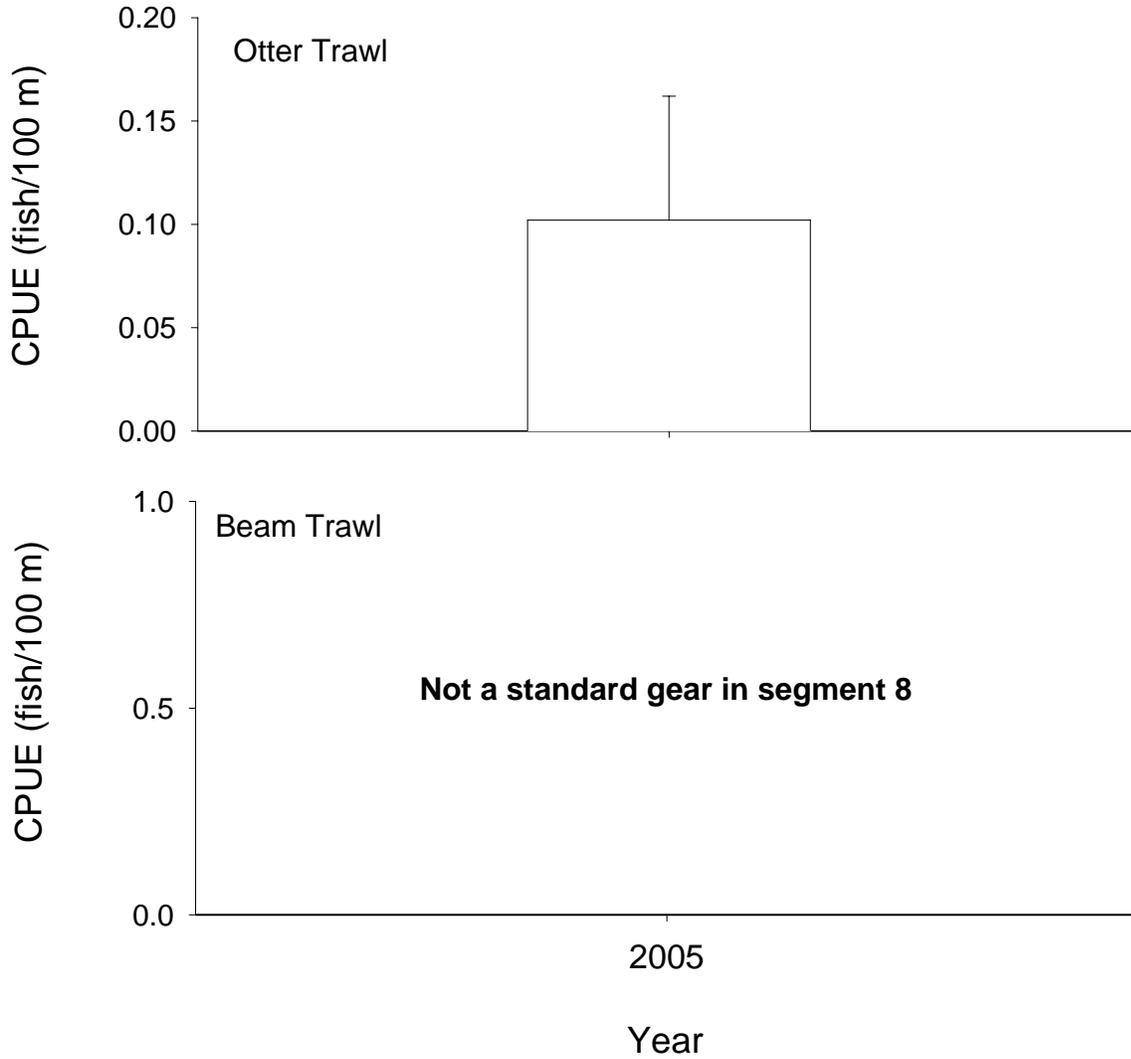


Figure 27. Mean annual catch-per-unit-effort ($\pm 2SE$) of speckled chub in segment 8 of the Missouri River for otter and beam trawls during fish community season 2005.

Segment 8 - Speckled Chub / Fish Community Season

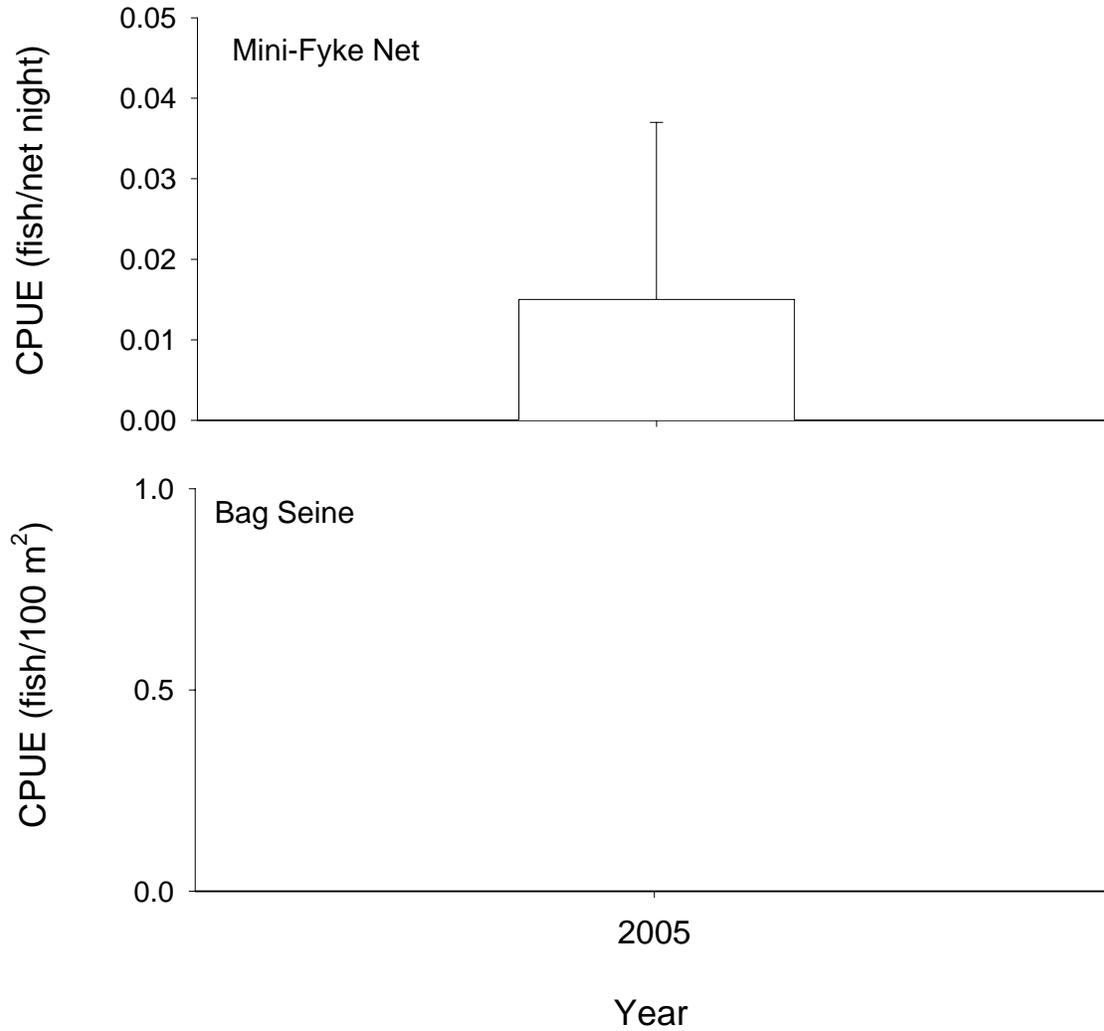


Figure 28. Mean annual catch-per-unit-effort (\pm 2SE) of speckled chub in segment 8 of the Missouri River for mini-fyke nets and bag seines during fish community season 2005.

Table 30. Total number of speckled chubs captured for each gear during each season and the proportion caught within each macrohabitat type in segment 8 of the Missouri River during 2005. 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	SCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0	N-E	24		N-E	N-E	76			N-E	N-E				
2.5 Trammel Net	0		24				76								
Gill Net	0		21				79								
Otter Trawl	38		26				74								
			23			77									
Beam Trawl	Not a standard gear in segment 8														
Fish Community Season (Summer)															
1 Inch Trammel Net	0	N-E	24		N-E	N-E	76			N-E	N-E				
Bag Seine	0		22				75	4							
Mini-Fyke Net	2		25				71	4							
Otter Trawl	19		11				89								
			24			74						2			
Beam Trawl	Not a standard gear in segment 8														

Table 31. Total number of speckled chubs captured for each gear during each season and the proportion caught within each mesohabitat type in segment 8 of the Missouri River during 2005. 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					
		BARS	CHNB	DTWT	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)							
1 Inch Trammel Net	0		100	N-E	N-E		
2.5 Inch Trammel Net	0		100				
Gill Net	0		47			53	
Otter Trawl	38		100				
			100				
Beam Trawl	Not a standard gear in segment 8						
Fish Community Season (Summer)							
1 Inch Trammel Net	0		100	N-E	N-E		
Bag Seine	0	100					
Mini-Fyke Net	2	100					
		100					
Otter Trawl	19		100				
			100				
Beam Trawl	Not a standard gear in segment 8						

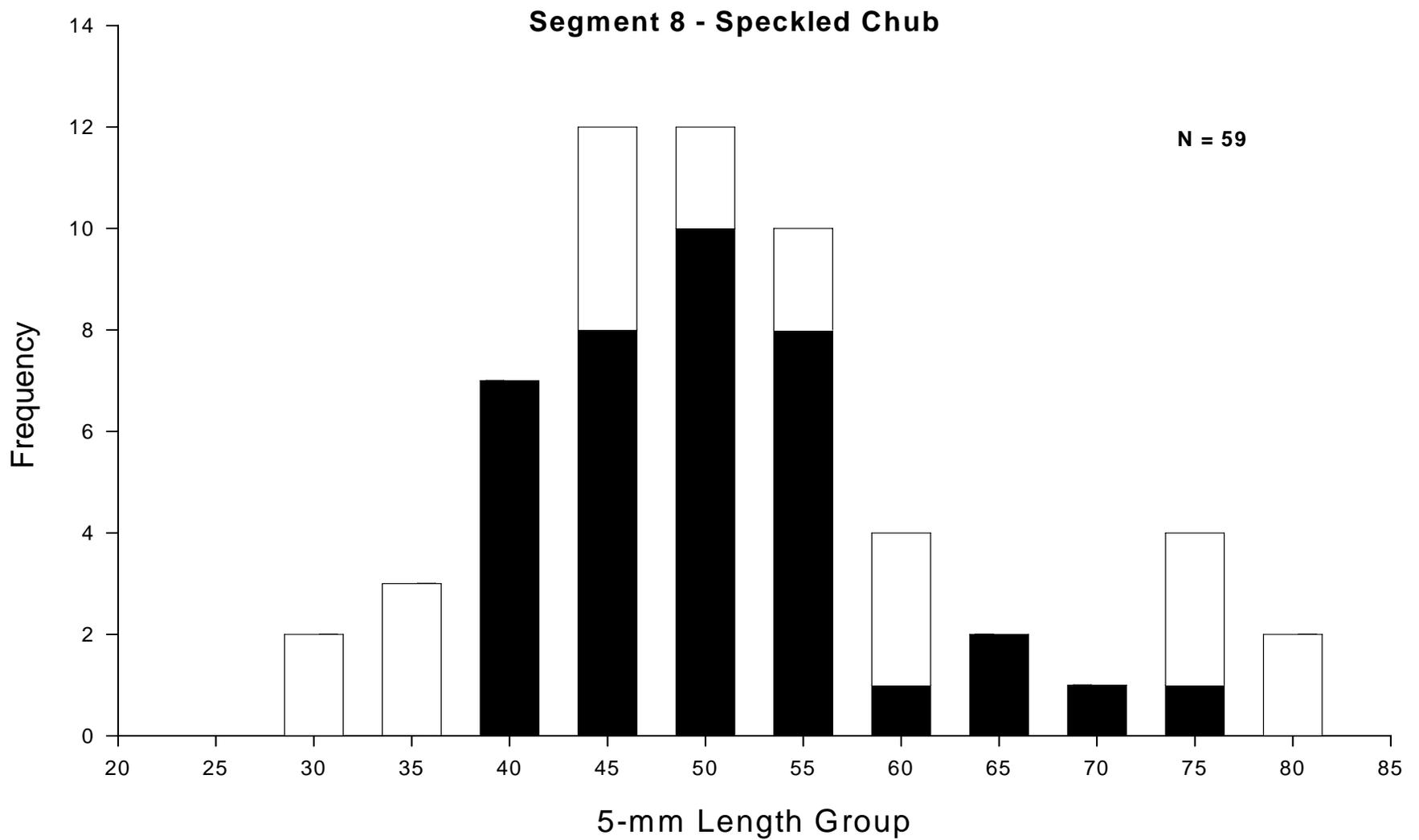


Figure 29. Length frequency of speckled chubs during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 8 of the Missouri River during 2005.

Sand Shiner

A total of 252 sand shiners were captured in otter trawls (n = 3), mini-fyke nets (n = 88), and bag seines (n= 161) during the 2005 sampling season. Catch per unit effort for otter trawling during the sturgeon season was 0.01 fish per 100 m trawled (Figure 30). During the fish community season mini-fyke nets had the greatest catch per unit effort (0.68 fish per net night) followed by bag seines (CPUE= 0.54 fish per 100 m²) (Figure 32). Otter trawls failed to capture sand shiners during the fish community season.

The majority of sand shiners collected during the fish community season in bag seines and mini-fyke nets were within inside bend macrohabitats (Table 32). Catches were proportionate to sampling effort in each macrohabitat. All fish were found in bar mesohabitats during the fish community season while channel borders were the only habitat sand shiners were sampled in during sturgeon season (Table 33).

A total of 252 sand shiners were measured during 2005 (Figure 33). Almost all fish (n = 249) were sampled during fish community season. The average fork length was 43.9 mm with a length range of 22 to 64 mm.

Segment 8 - Sand Shiner / Sturgeon Season

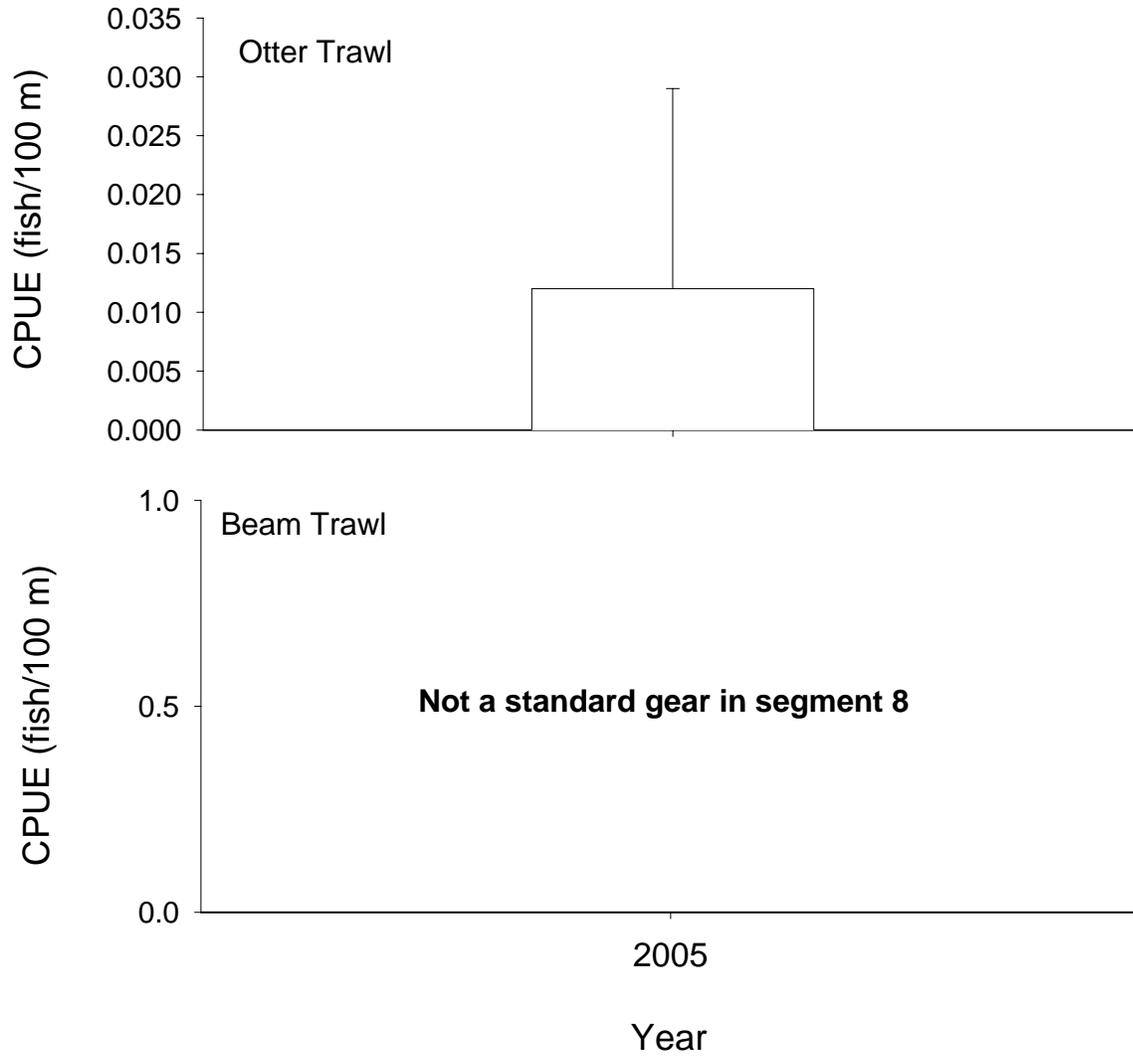


Figure 30. Mean annual catch-per-unit-effort ($\pm 2SE$) of sand shiner in segment 8 of the Missouri River for otter and beam trawls during sturgeon season 2005.

Segment 8 - Sand Shiner / Fish Community Season

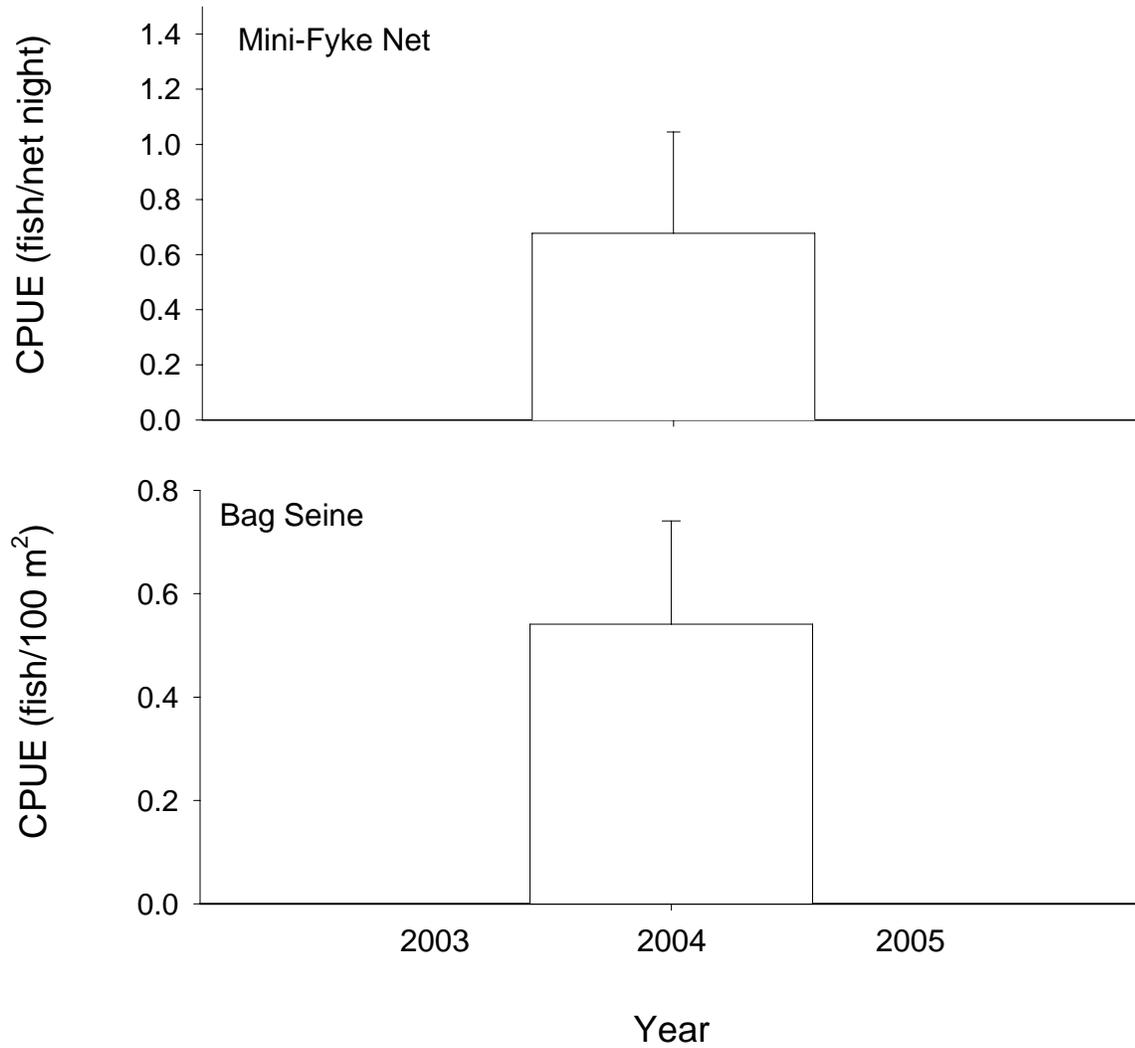


Figure 32. Mean annual catch-per-unit-effort ($\pm 2SE$) of sand shiner in segment 8 of the Missouri River for mini-fyke nets and bag seines during fish community season 2005.

Table 32. Total number of sand shiners captured for each gear during each season and the proportion caught within each macrohabitat type in segment 8 of the Missouri River during 2005. 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	SCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	0	N-E	24		N-E	N-E	76			N-E	N-E				
2.5 Inch Trammel Net	0		24				76								
Gill Net	0		21				79								
Otter Trawl	3		23				100								
Otter Trawl							77								
Beam Trawl	Not a standard gear in segment 8														
Fish Community Season (Summer)															
1 Inch Trammel Net	0	N-E	24		N-E	N-E	76			N-E	N-E				
Bag Seine	161		23				75	2							
Mini-Fyke Net	88		22				75	4							
Mini-Fyke Net			36				64								
Otter Trawl	0						71	4							
Otter Trawl			24				74					2			
Beam Trawl	Not a standard gear in segment 8														

Table 33. Total number of sand shiners captured for each gear during each season and the proportion caught within each mesohabitat type in segment 8 of the Missouri River during 2005. 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					
		BARS	CHNB	DTWT	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)							
1 Inch Trammel Net	0		100	N-E	N-E		
2.5 Inch Trammel Net	0		100				
Gill Net	0		47			53	
Otter Trawl	3		100				
			100				
Beam Trawl	Not a standard gear in segment 8						
Fish Community Season (Summer)							
1 Inch Trammel Net	0		100	N-E	N-E		
Bag Seine	161	100					
		100					
Mini-Fyke Net	88	100					
		100					
Otter Trawl	0		100				
Beam Trawl	Not a standard gear in segment 8						

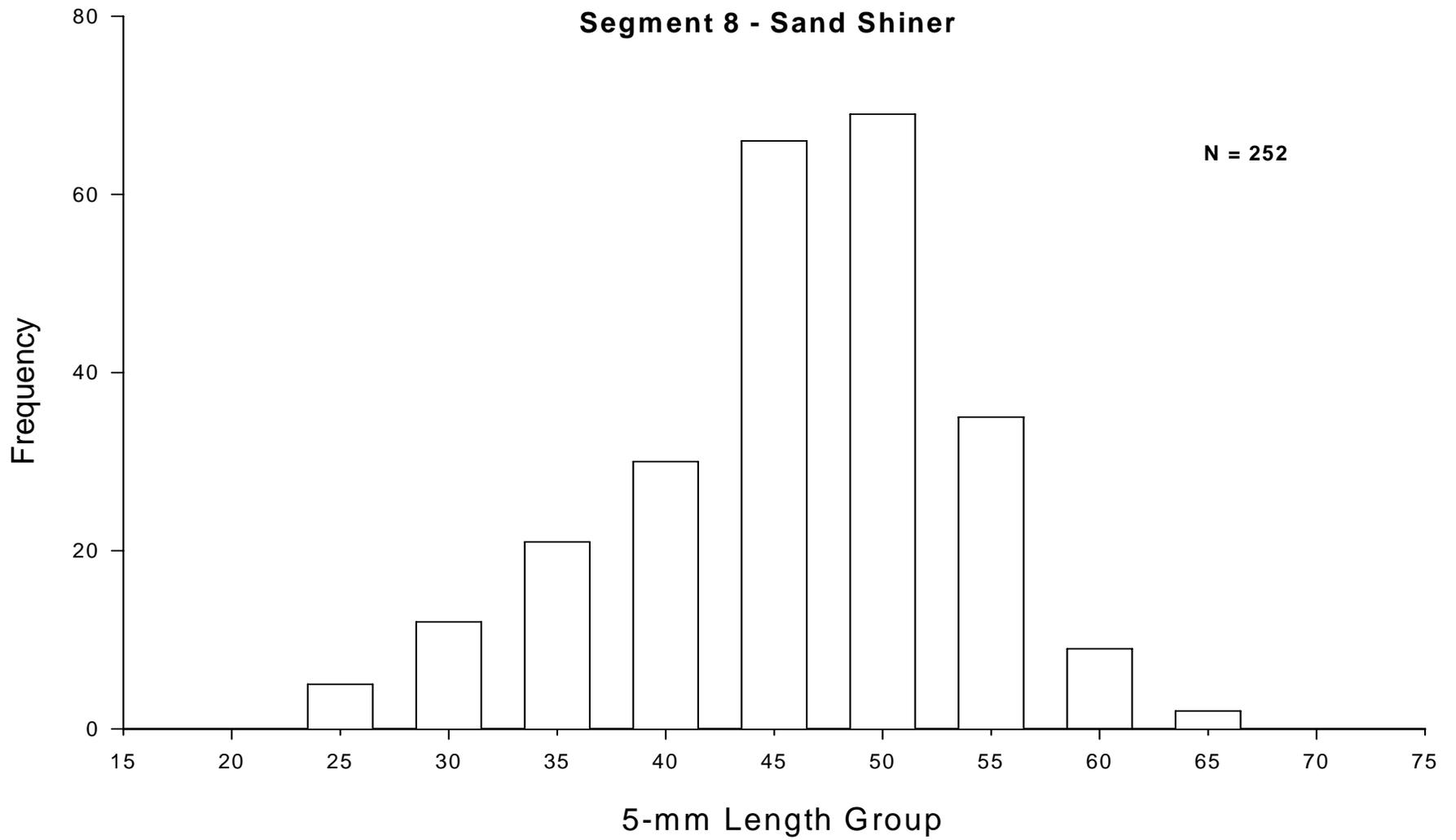


Figure 33. Length frequency of sand shiners in segment 8 of the Missouri River during summer (fish community season) 2005.

***Hybognathus* spp.**

A total of 19 *Hybognathus* spp. were captured in bag seines (n = 13) and mini-fyke nets (n = 6) during the 2005 sampling season. All fish were captured during the fish community season. No other gear used in either season was effective in capturing *Hybognathus* spp. Catch per unit effort for bag seines was 0.03 fish per 100 m² compared to 0.05 fish per net night for mini-fyke nets (Appendix H). The average fork length of the *Hybognathus* spp. sampled was 42.1 mm with a length range of 29 to 66 mm. Due to the low number of fish sampled habitat associations were difficult to distinguish and therefore not made.

Blue Sucker

A total of 675 blue suckers were captured in gill nets (n = 331), 1.0" trammel nets (n = 229), 2.5" trammel nets (n = 46) and otter trawls (n = 69) during the 2005 sampling season. During the sturgeon season catch per unit effort was greatest for gill nets (1.24 fish per net night) followed by 2.5" trammel nets (0.56 fish per 100 m drifted) (Figures 38 and 39). One inch trammel nets provided the best catch per unit effort for blue suckers during fish community season (CPUE = 1.26 fish per 100 m drifted) (Figure 41). Mini-fyke nets and bag seines failed to collect blue suckers during fish community season.

Blue suckers were most frequently sampled during the sturgeon and fish community season from inside bend macrohabitats with all gears (Table 36). In most cases percentages of fish caught were proportionate to percentages of sampling effort within each macrohabitat. The majority of blue suckers were sampled in pool mesohabitats during gill netting (90%) even though almost half of the sampling effort was in channel border mesohabitats (Table 37). During the sturgeon and fish community season for all other gears, channel border mesohabitats provided all of the blue suckers collected.

A total of 674 blue suckers were measured during 2005, with 447 being sampled during the sturgeon season (Figure 44). The average fork length was 654.1 mm during the sturgeon season compared to 648.9 mm for the fish community season. The length range for blue suckers sampled during the sturgeon season was 364 to 820 mm compared to 212 to 859 mm for the fish community season.

Segment 8 - Blue Sucker / Sturgeon Season

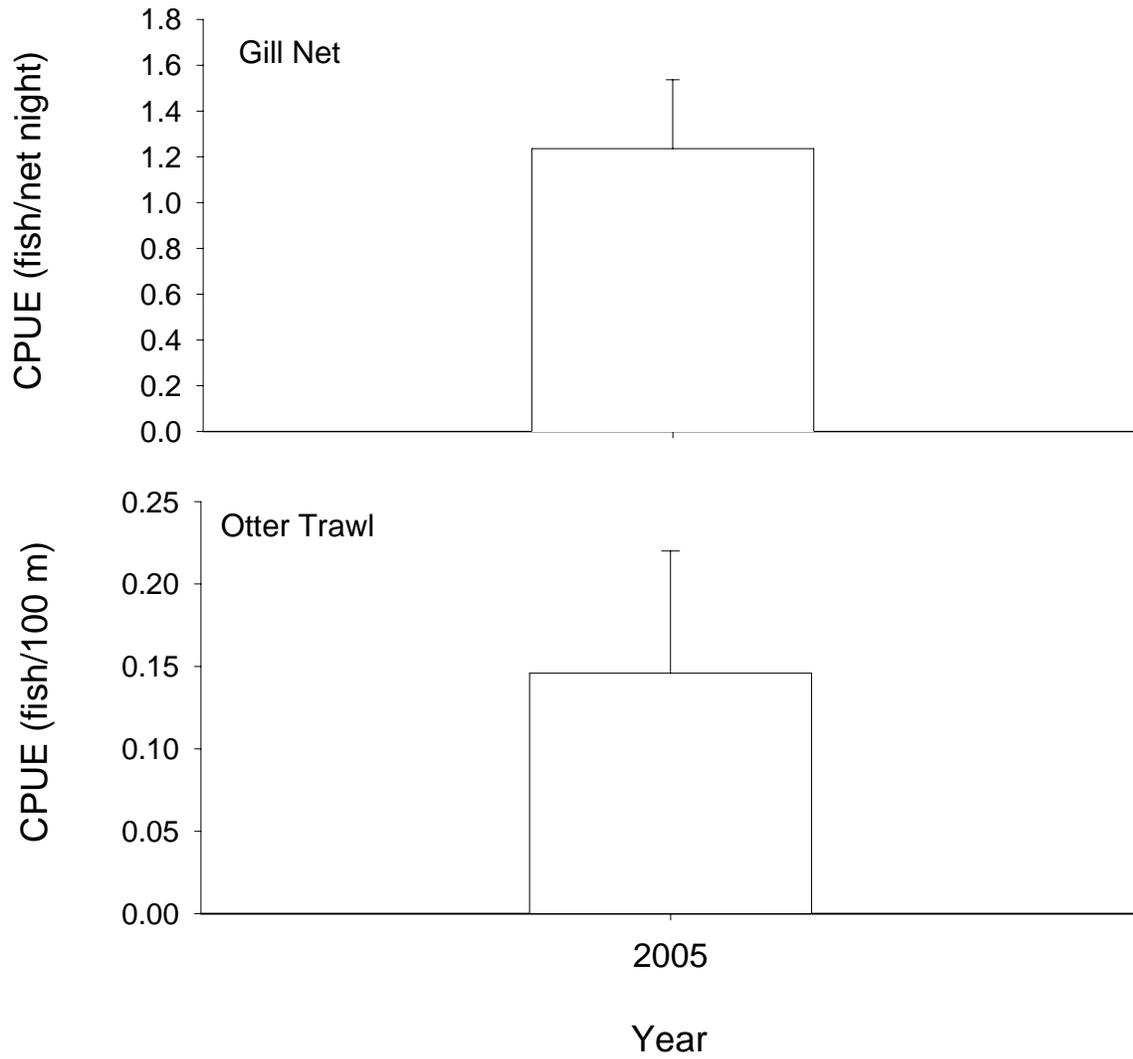


Figure 38. Mean annual catch-per-unit-effort (± 2 SE) of blue sucker in segment 8 of the Missouri River for gill nets and otter trawls during sturgeon season 2005.

Segment 8 - Blue Sucker / Sturgeon Season

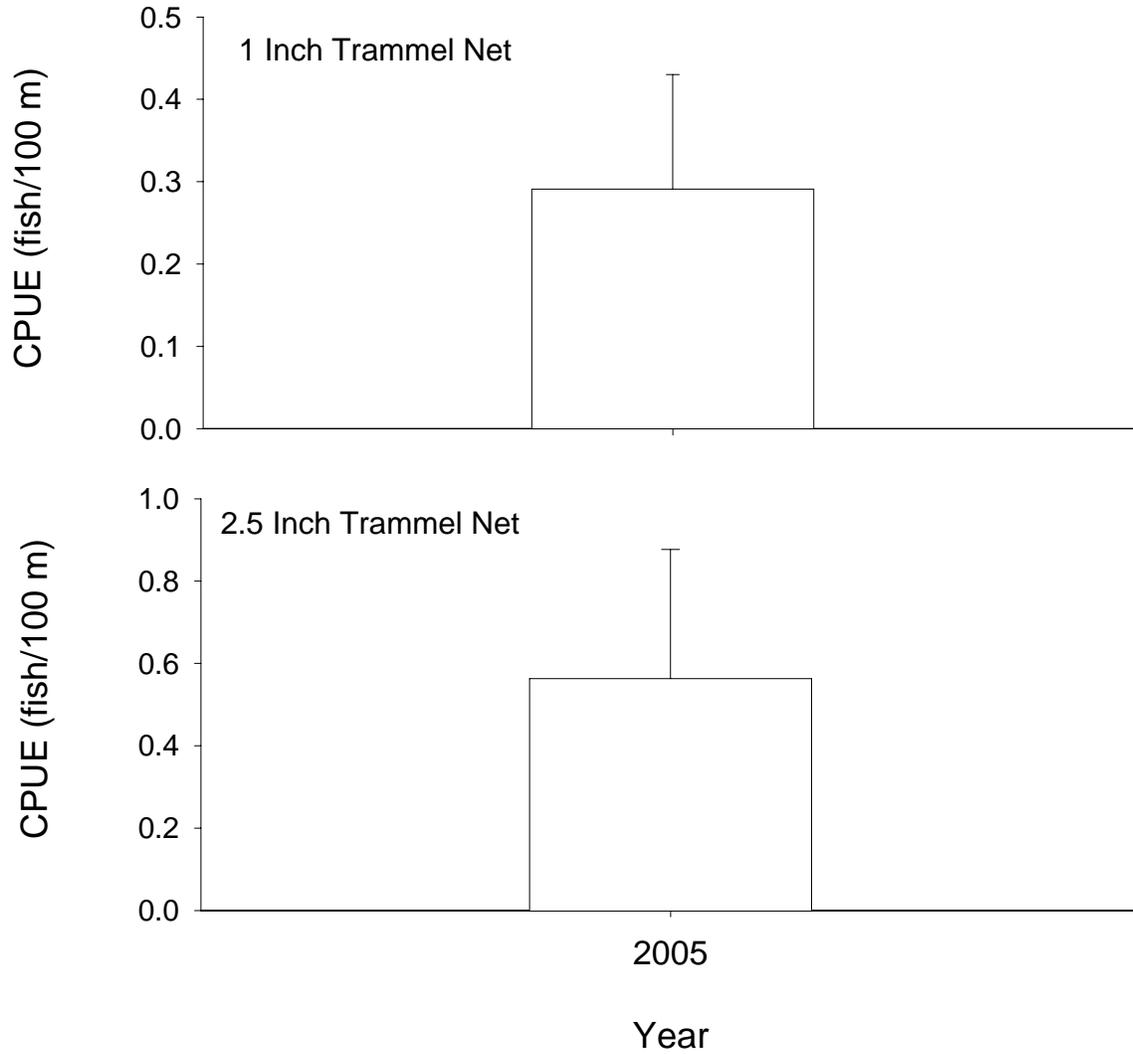


Figure 39. Mean annual catch-per-unit-effort (± 2 SE) of blue sucker in segment 8 of the Missouri River for 1 and 2.5 inch trammel nets during sturgeon season 2005.

Segment 8 - Blue Sucker / Fish Community Season

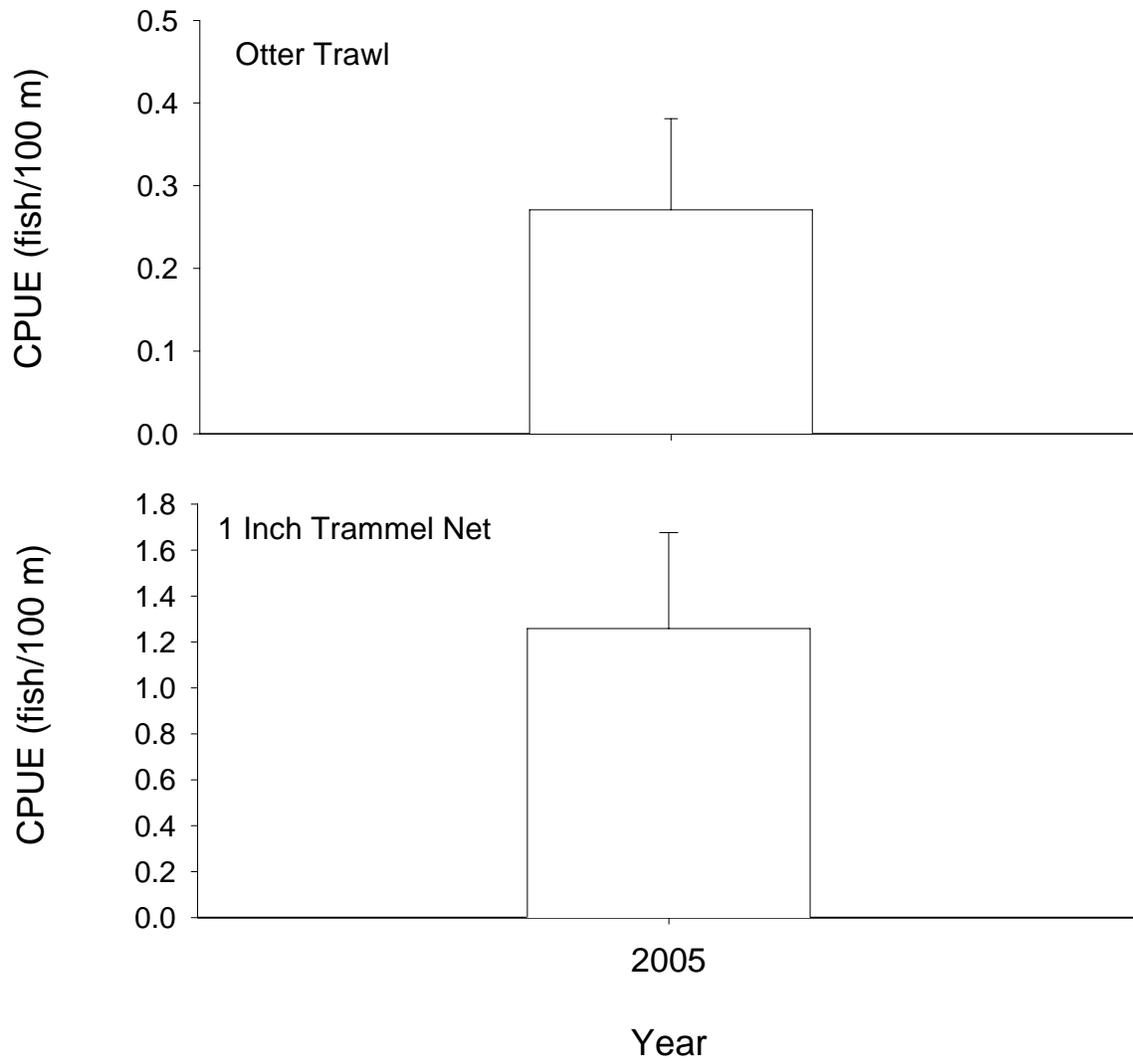


Figure 41. Mean annual catch-per-unit-effort (\pm 2SE) of blue sucker in segment 8 of the Missouri River for otter trawls and 1 inch trammel nets during fish community season 2005.

Table 36. Total number of blue suckers captured for each gear during each season and the proportion caught within each macrohabitat type in segment 8 of the Missouri River during 2005. 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	SCN	TRIB	TRML	TRMS	WILD					
Sturgeon Season (Fall through Spring)																				
1 Inch Trammel Net	43	N-E	7		N-E	N-E	93			N-E	N-E									
			24						76											
2.5 Inch Trammel Net	46		11						89											
			24						76											
Gill Net	331		22						78											
			21						79											
Otter Trawl	27		33						67											
			23						77											
Beam Trawl	Not a standard gear in segment 8																			
Fish Community Season (Summer)																				
1 Inch Trammel Net	186	N-E	16		N-E	N-E	84			N-E	N-E									
			24						76											
Bag Seine	0		22						75			4								
Mini-Fyke Net	0		25						71			4								
Otter Trawl	42		14						86											
			24						74								2			
Beam Trawl	Not a standard gear in segment 8																			

Table 37. Total number of blue suckers captured for each gear during each season and the proportion caught within each mesohabitat type in segment 8 of the Missouri River during 2005. 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					
		BARS	CHNB	DTWT	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)							
1 Inch Trammel Net	43		100	N-E	N-E		
			100				
2.5 Inch Trammel Net	46		100				
			100				
Gill Net	331		10			90	
			47			53	
Otter Trawl	27		100				
			100				
Beam Trawl	Not a standard gear in segment 8						
Fish Community Season (Summer)							
1 Inch Trammel Net	186		100	N-E	N-E		
			100				
Bag Seine	0	100					
Mini-Fyke Net	0						
		100					
Otter Trawl	42		100				
			100				
Beam Trawl	Not a standard gear in segment 8						

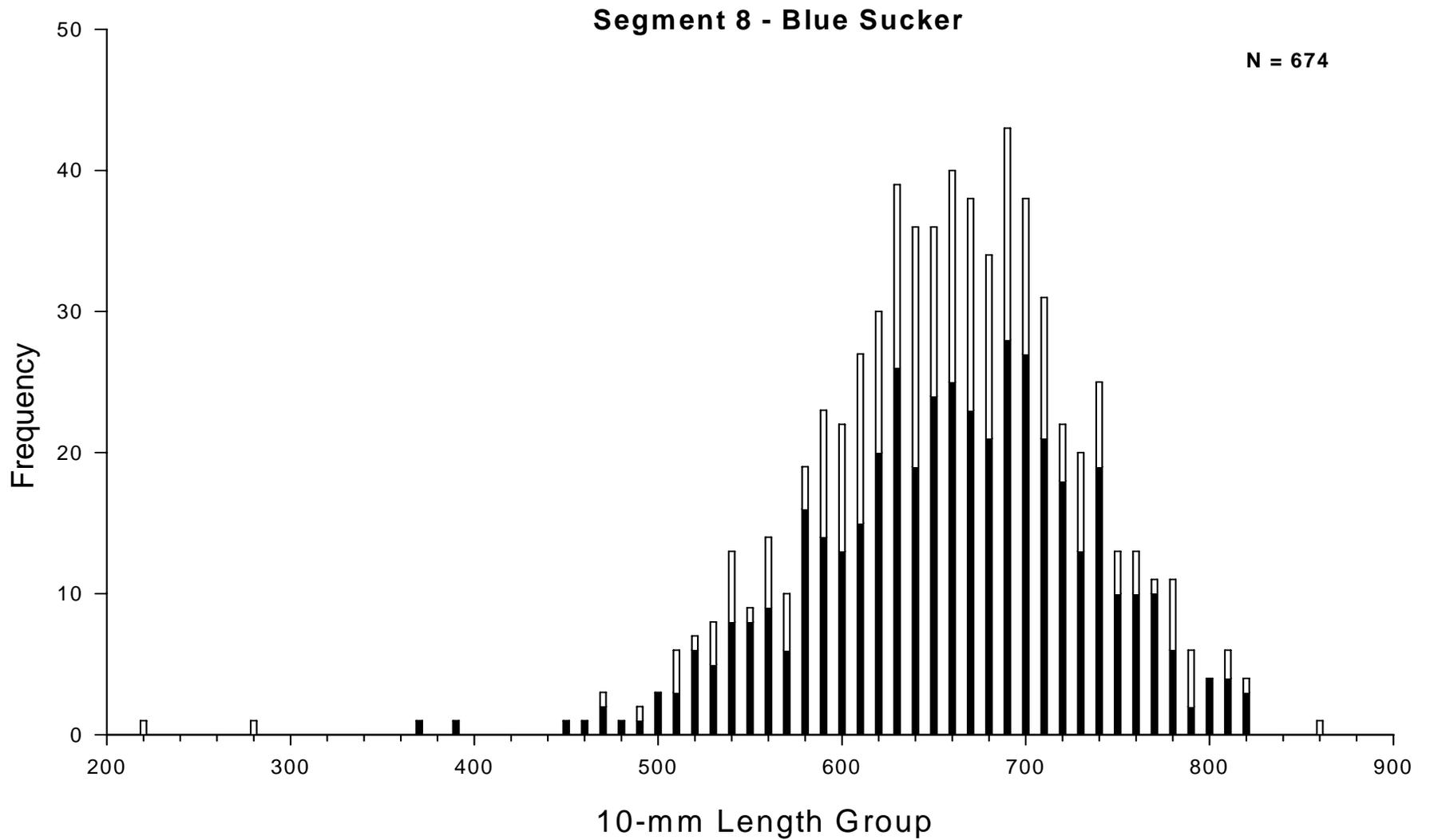


Figure 44. Length frequency of blue suckers during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 8 of the Missouri River during 2005.

Sauger

A total of 43 sauger were captured in gill nets (n = 20), 1" trammel nets (n = 8), otter trawls (n = 8), bag seines (n = 4) and mini-fyke nets (n = 3) during the 2005 sampling season. 25 fish were sampled during the sturgeon season while 18 came from fish community season. Gill nets had the greatest catch per unit effort during sturgeon season (0.08 fish per net night) and 1" trammel nets had the greatest CPUE during fish community season (0.04 fish per 100 m drifted) (Appendix H). The average fork length was 401.6 mm during the sturgeon season compared to 250.1 mm for the fish community season. The length range for saugers sampled during the sturgeon season was 144 to 505 mm compared to 81 to 608 mm for the fish community season. Due to the low number of fish sampled habitat associations were difficult to distinguish and therefore not made.

Missouri River Fish Community

Sturgeon season – Gill Netting

During 2005 a total of 1,188 fish representing 19 species were captured in 268 net nights with a total CPUE of 4.4 fish per net night (Appendix F1). Shovelnose sturgeon were the most frequently captured species (n = 583) with a CPUE of 2.18 fish per net night, followed by blue suckers (n = 331, CPUE = 1.24 fish per net night) and goldeye (n = 186, CPUE = 0.69 fish per net night). All other species were sampled at a frequency 0.08 fish per net night or less

Sturgeon season – 1.0” Trammel Netting

During 2005 a total of 333 fish and 14 species were captured in 15,471 meters of drifting trammel nets with a total CPUE of 2.15 fish per 100 m drifted (Appendices F2 and H). Blue suckers were the most frequently captured species with a CPUE of 0.29 fish per 100 m drifted, followed by shovelnose sturgeon (0.29 fish per 100 m drifted) and channel catfish (0.22 fish per 100 m drifted). All other species were captured at CPUEs of less than 0.06 fish per /100 m drifted.

Sturgeon season – Otter Trawling

In 2005, a total of 513 fish representing 23 species were captured in 22,812 meters of trawling with a CPUE of 2.25 fish per 100 m trawled (Appendix F4). Channel catfish were the most frequently captured species with a CPUE of 0.58 fish per 100 m trawled, followed by silver chub (0.57 fish per 100 m trawled), shovelnose sturgeon (0.38 fish per 100 m trawled), and freshwater drum (0.31 fish per 100 m trawled). All other species were captured at a frequency of 0.18 or less.

Sturgeon season – 2.5” Trammel Netting

In 2005, a total of 85 fish representing 13 species were captured in 8,492 meters of drifting trammel nets with a CPUE of 1.00 fish per 100 m drifted (Appendix F3). Blue suckers were the most frequently captured species with a CPUE of 0.56 fish 100 m drifted, followed by shovelnose sturgeon (CPUE = 0.10 fish per 100 m drifted) and smallmouth

buffalo (CPUE = 0.07 fish per 100 m drifted). All other species were captured at a frequencies less than 0.05 fish/100 m.

Fish community season – 1.0” Trammel Netting

During 2005 a total of 706 fish representing 19 species were captured in 16,057 of drifting trammel nets with a CPUE of 4.4 fish per 100 m drifted. Shovelnose sturgeon were the most frequently captured species with a CPUE of 2.27 fish per 100 m drifted, followed by blue suckers (1.26 fish per 100 m drifted) and goldeye (0.45 fish per 100 m drifted). All other species were sampled at a frequency of less than 0.3 fish per 100 m drifted.

Fish community season – Otter Trawling

During 2005 a total of 1,350 fish representing 21 species were captured in 19,610 meters of trawling. Channel catfish were the most frequently captured species with a CPUE of 2.57 fish per 100 m trawled, followed by freshwater drum (1.6 fish 100 m trawled) and silver chub (1.57 fish 100 m trawled).

Fish community season – Bag seining

A total of 4,520 fish representing 30 species were captured in 136 seine hauls, with a CPUE of 17.7 fish per 100 m² (Appendix F7). Gizzard shad were the most frequently captured species with a CPUE of 4.81 fish per 100 m², followed by emerald shiner (3.16 fish per 100 m²) and white bass (CPUE = 2.69 fish per 100 m²).

Fish community season – Mini-Fyke Netting

In 2005, a total of 2,604 fish representing 34 species were captured in 130 net nights with a CPUE of 20.03 fish per net night (Appendix F6). White bass were the most frequently captured species with a CPUE of 3.75 fish per net night, followed by red shiners (3.69 fish per net night) and emerald shiners (2.17 fish per net night).

Discussion

Pallid Sturgeon

Fifteen pallid sturgeon were collected during the 2005 sampling season in segment 8 of the Missouri River. Hatchery reared fish made up the majority of the pallid sturgeon sampled ($n = 9$). Although gill nets have been the most effective gear for capturing pallid sturgeon in past years for other segments (Steffensen and Mestl 2005, Shuman et al. 2005) otter trawls caught the most fish ($n = 6$) in segment 8 during the 2005 sampling season. Pallid sturgeon were captured in inside bend and crossover macrohabitats with the majority being collected on inside bends. Most fish were collected in channel border mesohabitat. It is difficult to determine pallid sturgeon habitat associations at this level because a majority of the sampling was conducted in these habitats (inside bends and channel borders) and because very few fish were caught. When pool mesohabitats could be sampled (ie. gill netting season) a noticeable difference in catches could be seen compared to channel borders. Pallid sturgeon were sampled in locations with a mean water depth of 3.23 m and an average bottom velocity of 0.50 mps. While gill netting, pallid sturgeon were collected in deeper water (5.1 m) and slower water velocities (0.45 mps) compared to trammel netting and otter trawling (2.6 m and 0.52 mps). Different factors could be causing fish to use different types of habitat during different times of the year. Continued sampling and greater sample sizes is desired for the future to aid in drawing conclusions on pallid sturgeon habitat use.

Almost 9,000 hatchery reared pallid sturgeon were stocked in RPMA #4 during 2005. All of these fish were from the 2004 year class. Four fish were recaptured during our 2005 efforts. Other recaptured hatchery reared fish represented the 2001 and 2002 year classes. Stocking sites for the nine recaptured hatchery reared pallid sturgeon were Mulberry Bend, NE, Bellevue, NE, and Sioux City, IA. All but one recaptured hatchery reared fish was found downstream of its stocking location.

Shovelnose Sturgeon

Gill nets (CPUE = 2.18 fish per net night) and 1" trammel nets (CPUE = 1.32 fish per 100 m drifted) were the most effective sampling gears for shovelnose sturgeon, collecting 84% of all shovelnose sturgeon during 2005. Similar to pallid sturgeon, while gill netting,

shovelnose sturgeon were found in greater quantities in pools compared to channel borders. Very few stock and sub-stock size shovelnose sturgeon were captured in segment 8 during 2005. However, recruitment of shovelnose sturgeon is evident in segment 8. The low numbers of small shovelnose sturgeon in the samples may be credited to gear types and efforts not targeting different fish sizes equally. Drifting trammel nets proved to be difficult in this segment of the Missouri river. A seventy-five meter drift between wing dikes is not always possible due to wing dike spacing and placement on the bends. We observed that drifting trammel nets outside of wing dike tips produced low catch rates and higher number of damaged or lost netting.

Macrophybopsis species

Otter trawling was the most effective sampling method for all *Macrophybopsis* species. Otter trawling collected all sturgeon chubs (n = 13), all sicklefin chubs (n = 33) and 57 of 59 speckled chubs throughout both seasons. Seining failed to collect any *Macrophybopsis* species and mini-fyke netting only collected two speckled chubs. Since otter trawl runs are made only in channel border mesohabitats and collected over 98% of *Macrophybopsis* species no habitat associations were made.

Hybognathus species

Very few *Hybognathus* species were collected during 2005 (n = 19). Seining and mini-fyke nets were the only gears in which they were collected. Very little can be said about *Hybognathus* species in segment 8 during 2005 because the sample size was so low. At the moment the population seems to be very low compared to catches in similar segments in past years.

Sand Shiners

Seining and mini-fyke nets were most effective method to collect sand shiners in segment 8 during the 2005 sampling season. Only three fish were collected during the sturgeon season (otter trawl) while the rest (n = 249) were sampled during fish community season. Seines and mini-fyke nets are only deployed on bar habitats and therefore all fish were found in this habitat during the fish community season.

Blue Sucker

Gill nets were the most effective sampling method, collecting nearly 50% of all blue suckers during 2005. The vast majority of fish caught in gill nets were found in pools (90%). Many large blue sucker were captured throughout both sampling seasons compared to smaller fish, further suggesting that gear types and efforts are not targeting all sizes of fish equally.

Sauger

Only 43 sauger were sampled from segment 8 during 2005. Gill nets were most effective catching 20 fish during sturgeon season. 1” trammel nets and otter trawls doubled the effort of gill nets but only contributed 8 fish each.

Otter Trawling

In April of 2005, Nebraska Game and Parks Commission along with other agencies participating in the Pallid Sturgeon Population Assessment Program arranged an on river consultation meeting with Greg Faulkner (Master Trawl Designer and Builder) of Innovative Net Systems. Mr. Faulkner has finally standardized the 16 ft. otter trawl. 2005 was the first year when the sapphire 16 ft. otter trawl was completely used. In other segments in past years an increase in catch rates has been observed in target species when the newest sapphire otter trawls were being used.

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APPENDICES

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

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

Appendix A. (continued).

Scientific name	Common name	Letter Code
ORDER CLUPEIFORMES		
Clupeidae – herrings		
<i>Alosa alabame</i>	Alabama shad	ALSD
<i>Alosa chrysochloris</i>	Skipjack herring	SJHR
<i>Alosa pseudoharengus</i>	Alewife	ALWF
<i>Dorosoma cepedianum</i>	Gizzard shad	GZSD
<i>Dorosoma petenense</i>	Threadfin shad	TFSD
<i>D. cepedianum X D. petenense</i>	Gizzard-threadfin shad hybrid	GSTS
ORDER CYPRINIFORMES		
Cyprinidae – carps and minnows		
<i>Campostoma anomalum</i>	Central stoneroller	CLSR
<i>Campostoma oligolepis</i>	Largescale stoneroller	LSSR
<i>Carassus auratus</i>	Goldfish	GDFH
<i>Carassus auratus X Cyprinus carpio</i>	Goldfish-Common carp hybrid	GFCC
<i>Couesius plumbens</i>	Lake chub	LKCB
<i>Ctenopharyngodon idella</i>	Grass carp	GSCP
<i>Cyprinella lutrensis</i>	Red shiner	RDSN
<i>Cyprinella spiloptera</i>	Spotfin shiner	SFSN
<i>Cyprinus carpio</i>	Common carp	CARP
<i>Erimystax x-punctatus</i>	Gravel chub	GVCB
<i>Hybognathus argyritis</i>	Western silvery minnow	WSMN*
<i>Hybognathus hankinsoni</i>	Brassy minnow	BSMN
<i>Hybognathus nuchalis</i>	Mississippi silvery minnow	SVMW
<i>Hybognathus placitus</i>	Plains minnow	PNMW*
<i>Hybognathus spp.</i>	Unidentified Hybognathus	HBNS*
<i>Hypophthalmichthys molitrix</i>	Silver carp	SVCP
<i>Hypophthalmichthys nobilis</i>	Bighead carp	BHCP
<i>Luxilus chrysocephalus</i>	Striped shiner	SPSN
<i>Luxilus cornutus</i>	Common shiner	CMSN
<i>Luxilus zonatus</i>	Bleeding shiner	BDSN
<i>Lythrurus unbratilis</i>	Western redfin shiner	WRFS
<i>Macrhybopsis aestivalis</i>	Speckled chub	SKCB*
<i>Macrhybopsis gelida</i>	Sturgeon chub	SGCB*
<i>Macrhybopsis meeki</i>	Sicklefin chub	SFCB*
<i>Macrhybopsis storeriana</i>	Silver chub	SVCB
<i>M. aestivalis X M. gelida</i>	Speckled-Sturgeon chub hybrid	SPST
<i>M. gelida X M. meeki</i>	Sturgeon-Sicklefin chub hybrid	SCSC
<i>Macrhybopsis spp.</i>	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 buchanani</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
Cyprinidae – carps and minnows		
<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
<i>Notropis stramineus</i>	Sand shiner	SNSN*
<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
Catostomidae - suckers		
<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
<i>Cycleptus elongates</i>	Blue sucker	BUSK*
<i>Hypentelium nigricans</i>	Northern hog sucker	NHSK
<i>Ictiobus bubalus</i>	Smallmouth buffalo	SMBF
<i>Ictiobus cyprinellus</i>	Bigmouth buffalo	BMBF
<i>Ictiobus niger</i>	Black buffalo	BKBF
<i>Ictiobus</i> spp.	Unidentified buffalo	UBF
<i>Minytrema melanops</i>	Spotted sucker	SPSK
<i>Moxostoma anisurum</i>	Silver redhorse	SVRH
<i>Moxostoma carinatum</i>	River redhorse	RVRH
<i>Moxostoma duquesnei</i>	Black redhorse	BKRH
<i>Moxostoma erythrurum</i>	Golden redhorse	GDRH
<i>Moxostoma macrolepidotum</i>	Shorthead redhorse	SHRH
<i>Moxostoma</i> spp.	Unidentified redhorse	URH

Appendix A. (continued).

Scientific name	Common name	Letter Code
Catostomidae - suckers	Unidentified Catostomidae	UCT
ORDER SILURIFORMES		
Ictaluridae – bullhead catfishes		
<i>Ameiurus melas</i>	Black bullhead	BKBH
<i>Ameiurus natalis</i>	Yellow bullhead	YLBH
<i>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		
Esocidae - pikes		
<i>Esox americanus vermiculatus</i>	Grass pickerel	GSPK
<i>Esox lucius</i>	Northern pike	NTPK
<i>Esox masquinongy</i>	Muskellunge	MSKG
<i>E. lucius</i> X <i>E. masquinongy</i>	Tiger Muskellunge	TGMG
Umbridae - mudminnows		
<i>Umbra limi</i>	Central mudminnow	MDMN
Osmeridae - smelts		
<i>Osmerus mordax</i>	Rainbow smelt	RBST
Salmonidae - trouts		
<i>Coregonus 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
ORDER PERCOPSIFORMES		
Percopsidae – trout-perches		
<i>Percopsis omiscomaycus</i>	Trout-perch	TTPH
ORDER GADIFORMES		
Gadidae - cods		
<i>Lota lota</i>	Burbot	BRBT
ORDER ATHERINIFORMES		
Cyprinodontidae - killifishes		
<i>Fundulus catenatus</i>	Northern studfish	NTSF
<i>Fundulus 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
Poeciliidae - livebearers		
<i>Gambusia affinis</i>	Western mosquitofish	MQTF
Atherinidae - silversides		
<i>Labidesthes sicculus</i>	Brook silverside	BKSS
ORDER GASTEROSTEIFORMES		
Gasterosteidae - sticklebacks		
<i>Culea inconstans</i>	Brook stickleback	BKSB
ORDER SCORPAENIFORMES		
Cottidae - sculpins		
<i>Cottus bairdi</i>	Mottled sculpin	MDSP
<i>Cottus carolinae</i>	Banded sculpin	BDSP
ORDER PERCIFORMES		
Percichthyidae – temperate basses		
<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
Centrarchidae - sunfishes		
<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
Centrarchidae - sunfishes		
<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
Percidae - perches		
<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
<i>Sander canadense</i>	Sauger	SGER**
<i>Sander vitreus</i>	Walleye	WLEY
<i>S. canadense</i> X <i>S. vitreus</i>	Sauger-walleye hybrid/Saugeye	SGWE
<i>Sander</i> spp.	Unidentified <i>Sander</i> (formerly <i>Stizostedion</i>) spp.	UST
	Unidentified Percidae	UPC
Sciaenidae - drums		
<i>Aplodinotus grunniens</i>	Freshwater drum	FWDM
NON-TAXONOMIC CATEGORIES		
	Age-0/Young-of-year fish	YOYF
	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 ³ /s, and the sample area extends 300 m into the tributary	TRML
Tributary small mouth	Macro	Mouth of entering tributary whose mean annual discharge is < 20 m ³ /s, mouth width is > 6 m wide and the sample area extends 300 m into the tributary	TRMS
Wild	Macro	All habitats not covered in the previous habitat descriptions	WILD
Bars	Meso	Sandbar or shallow bank-line areas with depth < 1.2 m	BARS
Pools	Meso	Areas immediately downstream from sandbars, dikes, snags, or other obstructions with a formed scour hole > 1.2 m	POOL
Channel border	Meso	Area in the channelized river between the toe and the thalweg, area in the unchannelized river between the toe and the maximum depth	CHNB
Thalweg	Meso	Main channel between the channel borders conveying the majority of the flow	TLWG
Island tip	Meso	Area immediately downstream of a bar or island where two channels converge with water depths > 1.2 m	ITIP

Appendix C. List of standard and wild gears (type), their corresponding codes in the database, seasons deployed (Fall-Spring, Summer, or all), years used, and catch-per-unit-effort units for collection of Missouri River fishes in segment 8 for the long-term pallid sturgeon and associated fish community sampling program. Long-term monitoring began in 2005 for segment 8.

Gear	Code	Type	Season	Years	CPUE units
Trammel net – 1 inch inner mesh	TN	Standard	All	2005 - Present	fish/100 m drift
Trammel net – 2.5 inch inner mesh	TN25	Standard	Sturgeon	2005 - Present	fish/100 m drift
Gillnet – 4 meshes, small mesh set upstream	GN14	Standard	Sturgeon	2005 - Present	fish/net night
Gillnet – 4 meshes, large mesh set upstream	GN41	Standard	Sturgeon	2005 - Present	fish/net night
Gillnet – 8 meshes, small mesh set upstream	GN18	Standard	Sturgeon	2005 - Present	fish/net night
Gillnet – 8 meshes, large mesh set upstream	GN81	Standard	Sturgeon	2005 - Present	fish/net night
Otter trawl – 16 ft head rope	OT16	Standard	All	2005 - Present	fish/100 m trawled
Bag Seine – quarter arc method pulled upstream	BSQU	Standard	Fish Comm.	2005 - Present	fish/100 m ²
Bag Seine – quarter arc method pulled downstream	BSQD	Standard	Fish Comm.	2005 - Present	fish/100 m ²
Bag Seine – half arc method pulled upstream	BSHU	Standard	Fish Comm.	2005 - Present	fish/100 m ²
Bag Seine – half arc method pulled downstream	BSHD	Standard	Fish Comm.	2005 - Present	fish/100 m ²
Bag seine – rectangular method pulled upstream	BSRU	Standard	Fish Comm.	2005 - Present	fish/100 m ²
Bag seine – rectangular method pulled upstream	BSRD	Standard	Fish Comm.	2005 - Present	fish/100 m ²
Mini-fyke net	MF	Standard	Fish Comm.	2005 - Present	fish/net night

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

State(s)	RPMA	Site Name	Code	River	RM
MT	2	Above Intake	AIN	Yellowstone	70 +
MT	2	Intake	INT	Yellowstone	70.0
MT	2	Sidney	SID	Yellowstone	31.0
MT	2	Big Sky Bend	BSB	Yellowstone	17.0
ND	2	Fairview	FRV	Yellowstone	9.0
MT	2	Milk River	MLK	Milk	11.5
MT	2	Mouth of Milk	MOM	Missouri	1761.5
MT	2	Wolf Point	WFP	Missouri	1701.5
MT	2	Poplar	POP	Missouri	1649.5
MT	2	Brockton	BRK	Missouri	1678.0
MT	2	Culbertson	CBS	Missouri	1621.0
MT	2	Nohly Bridge	NOB	Missouri	1590.0
ND	2	Confluence	CON	Missouri	1581.5
SD/NE	3	Sunshine Bottom	SUN	Missouri	866.2
SD/NE	3	Verdel Boat Ramp	VER	Missouri	855.0
SD/NE	3	Standing Bear Bridge	STB	Missouri	845.0
SD/NE	4	St. Helena	STH	Missouri	799.0
SD/NE	4	Mullberry Bend	MUL	Missouri	775.0
NE/IA	4	Ponca State Park	PSP	Missouri	753.0
NE/IA	4	Sioux City	SIO	Missouri	732.6
NE/IA	4	Decatur	DCT	Missouri	691.0
NE/IA	4	Boyer Chute	BYC	Missouri	637.4
NE/IA	4	Bellevue	BEL	Missouri	601.4
NE/IA	4	Rulo	RLO	Missouri	497.9
NE/MO/KS	4	Kansas River	KSR	Missouri	367.5
NE	4	Platte River	PLR	Platte	5.0
KA/MO	4	Leavenworth	LVW	Missouri	397.0
MO	4	Kansas City	KAC	Missouri	342.0
MO	4	Miami	MIA	Missouri	262.8
MO	4	Grand River	GDR	Missouri	250.0
MO	4	Boonville	BOO	Missouri	195.1
MO	4	Overton	OVT	Missouri	185.1
MO	4	Hartsburg	HAR	Missouri	160.0
MO	4	Jefferson City	JEF	Missouri	143.9
MO	4	Mokane	MOK	Missouri	124.7
MO	4	Hermann	HER	Missouri	97.6
MO	4	Washington	WAS	Missouri	68.5
MO	4	St. Charles	STC	Missouri	28.5

Appendix E. Juvenile and adult pallid sturgeon stocking summary for segment 8 of the Missouri River (RPMA 4).

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Average Length (mm)	Primary Mark	Secondary Mark
2002	Ponca State Park	35	1997	4/23/2002	582	PIT tag	Elastomer
2002	Ponca State Park	180	1999	4/23/2002	437	PIT tag	None
2002	Bellevue	2326	2001	6/26/2002	207	PIT tag	Some Elastomer
2002	Bellevue	187	1999	11/01/2002	421	PIT tag	None
2003	Bellevue	3155	2002	Fall 2003	276	PIT tag	Some Elastomer
2003	Bellevue	1781	2003	12/02/2003	N/A	Elastomer	None
2004	Bellevue	1234	2003	July 2004	222	PIT tag	Elastomer
2004	Boyer Chute	51	2003	8/2/2004	262	PIT tag	Elastomer
2004	Bellevue	6634	2004	9/10/2004	81	Elastomer	None
2005	Sioux City	2533	2004	4/22/2005	206	Elastomer	PIT/Coded Wire tags

Appendix F

Total catch, overall mean catch per unit effort (± 2 SE), and mean CPUE (fish/100 m) by Mesohabitat within a Macrohabitat for all species caught with each gear type during sturgeon season and fish community season for segment 8 of the Missouri River during 2005. 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: overall season and segment summary. Lists CPUE (fish/net night) and 2 standard errors in brackets.

Species	Total Catch	Overall CPUE	CHXO		ISB	
			CHNB	POOL	CHNB	POOL
BMBF	1	0.004 (0.007)				0.009 (0.018)
BUSK*	331	1.235 (0.301)	0.115 (0.122)	2.367 (0.963)	0.290 (0.122)	2.036 (0.546)
CARP	3	0.011 (0.013)		0.033 (0.067)		0.018 (0.025)
CNCF	20	0.075 (0.033)	0.038 (0.077)	0.033 (0.067)	0.030 (0.034)	0.134 (0.065)
FWDM	1	0.004 (0.007)				0.009 (0.018)
GDEY	186	0.694 (0.294)	0.115 (0.166)	1.300 (1.457)	0.05 (0.052)	1.241 (0.538)
GSCP	1	0.004 (0.007)			0.010 (0.020)	
GZSD	2	0.007 (0.011)				0.018 (0.025)
PDFH	3	0.011 (0.013)		0.067 (0.091)		0.009 (0.018)
PDSG*	4	0.015 (0.015)			0.010 (0.020)	0.027 (0.030)
QLBK	5	0.019 (0.016)		0.033 (0.067)	0.010 (0.020)	0.027 (0.030)
RVCS	6	0.022 (0.023)		0.067 (0.091)		0.036 (0.050)
SGER*	20	0.075 (0.033)	0.038 (0.077)	0.100 (0.145)	0.030 (0.034)	0.116 (0.057)
SHRH	9	0.034 (0.022)		0.033 (0.067)	0.010 (0.020)	0.062 (0.045)
SMBF	4	0.015 (0.015)				0.036 (0.035)
SNGR	3	0.011 (0.022)				0.027 (0.054)
SNSG*	583	2.175 (0.548)	1.154 (1.112)	1.600 (0.571)	0.920 (0.520)	3.688 (1.069)
WLYE	5	0.019 (0.016)		0.033 (0.067)		0.036 (0.035)
WTSK	1	0.004 (0.007)			0.010 (0.020)	

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

Species	Total Catch	Overall CPUE	CHXO	ISB	TRMS
			CHNB	CHNB	CHNB
BHCP	1	0.003 (0.005)		0.003 (0.007)	
BMBF	1	0.004 (0.008)		0.005 (0.010)	
BUSK*	229	0.792 (0.233)	0.491 (0.31)	0.894 (0.292)	
CARP	6	0.019 (0.016)		0.026 (0.021)	
CNCF	85	0.263 (0.125)	0.343 (0.434)	0.238 (0.088)	
FHCF	3	0.010 (0.016)		0.013 (0.021)	
FWDM	1	0.003 (0.006)		0.004 (0.008)	
GDEY	207	0.766 (0.401)	0.504 (0.224)	0.854 (0.529)	
GSCP	8	0.022 (0.016)		0.029 (0.022)	
GZSD	2	0.007 (0.010)	0.015 (0.031)	0.005 (0.009)	
LNGR	9	0.033 (0.036)	0.066 (0.132)	0.022 (0.022)	
PDSG*	4	0.013 (0.013)		0.017 (0.017)	
QLBK	6	0.018 (0.020)	0.067 (0.081)	0.002 (0.004)	
RVCS	9	0.033 (0.050)		0.011 (0.016)	
SGER*	8	0.027 (0.019)	0.042 (0.049)	0.022 (0.020)	
SHRH	5	0.018 (0.019)		0.024 (0.025)	
SMBF	17	0.054 (0.029)	0.031 (0.044)	0.062 (0.035)	
SNGR	6	0.021 (0.017)	0.015 (0.029)	0.018 (0.018)	1.333

Appendix F2 (continued).

Species	Total Catch	Overall CPUE	CHXO	ISB	TRMS
			CHNB	CHNB	CHNB
SNSG*	428	1.317 (0.749)	1.072 (1.508)	1.403 (0.868)	
WLYE	4	0.014 (0.014)		0.019 (0.018)	

Appendix F3. 2.5 Inch Trammel Net: overall season and segment summary. Lists CPUE (fish/100 m) and 2 standard errors in brackets.

Species	Total Catch	Overall CPUE	CHXO	ISB
			CHNB	CHNB
BHCP	3	0.041 (0.082)		0.055 (0.110)
BMBF	4	0.049 (0.048)	0.157 (0.173)	0.014 (0.027)
BUSK*	46	0.563 (0.314)	0.271 (0.273)	0.659 (0.407)
CARP	3	0.040 (0.046)	0.052 (0.104)	0.037 (0.051)
FHCF	1	0.014 (0.027)		0.018 (0.036)
GDEY	2	0.025 (0.035)		0.033 (0.047)
GSCP	4	0.044 (0.052)		0.058 (0.069)
PDFH	2	0.023 (0.032)		0.030 (0.043)
PDSG*	1	0.007 (0.010)		0.010 (0.019)
RVCS	2	0.024 (0.034)		0.032 (0.046)
SMBF	6	0.069 (0.062)		0.091 (0.082)
SNSG*	10	0.096 (0.073)		0.127 (0.096)
SVCP	1	0.012 (0.024)		0.016 (0.032)

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

Species	Total Catch	Overall CPUE	CHXO	ISB	TRML
			CHNB	CHNB	CHNB
BHCP	1	0.003 (0.005)		0.004 (0.007)	
BLCF	9	0.025 (0.027)		0.033 (0.037)	
BLGL	1	0.004 (0.007)	0.014 (0.028)		
BUSK*	69	0.207 (0.066)	0.197 (0.147)	0.213 (0.074)	
CARP	4	0.011 (0.011)		0.011 (0.013)	0.238 (0.476)
CNCF	601	1.542 (0.465)	0.753 (0.553)	1.721 (0.556)	7.440 (14.881)
ERSN	49	0.169 (0.275)	0.014 (0.028)	0.226 (0.375)	
FHCF	6	0.018 (0.015)		0.025 (0.021)	
FWDM	318	0.932 (1.127)	0.324 (0.532)	0.398 (0.368)	46.952 (90.935)
GDEY	6	0.018 (0.020)	0.051 (0.068)	0.007 (0.013)	
PDSG*	6	0.015 (0.014)	0.014 (0.028)	0.015 (0.016)	
RDSN	19	0.056 (0.061)	0.018 (0.036)	0.070 (0.082)	
RVCS	17	0.055 (0.079)	0.007 (0.013)	0.019 (0.019)	3.274 (6.548)
SFCB*	33	0.063 (0.030)	0.077 (0.082)	0.059 (0.030)	
SFSN	2	0.004 (0.006)		0.006 (0.008)	
SGCB*	13	0.018 (0.014)	0.040 (0.048)	0.011 (0.010)	
SGER*	8	0.024 (0.017)	0.029 (0.034)	0.022 (0.020)	
SGWE	1	0.004 (0.008)	0.015 (0.031)		

Appendix F4 (continued).

Species	Total Catch	Overall CPUE	CHXO	ISB	TRML
			CHNB	CHNB	CHNB
SHRH	5	0.014 (0.013)		0.020 (0.018)	
SKCB*	57	0.142 (0.058)	0.117 (0.080)	0.153 (0.075)	
SMBF	3	0.011 (0.016)	0.028 (0.055)	0.005 (0.010)	
SNSG*	181	0.392 (0.103)	0.399 (0.187)	0.378 (0.120)	1.087 (2.174)
SNSN*	3	0.006 (0.009)		0.008 (0.012)	
STCT	1	0.004 (0.007)		0.005 (0.010)	
SVCB	417	1.053 (0.305)	0.856 (0.366)	1.138 (0.395)	
WLYE	4	0.009 (0.009)	0.020 (0.029)	0.005 (0.007)	
WTBS	134	0.406 (0.29)	0.920 (0.981)	0.233 (0.197)	

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

Species	Total Catch	Overall CPUE	CHXO	ISB	OSB
			BARS	BARS	BARS
BKCP	5	0.038 (0.04)	0.030 (0.061)	0.043 (0.053)	
BLGL	30	0.231 (0.177)	0.091 (0.102)	0.196 (0.155)	1.800 (3.600)
BMBF	1	0.008 (0.015)			0.200 (0.400)
CARP	71	.546 (0.552)	0.182 (.268)	0.609 (0.764)	1.800 (2.227)
CNCF	144	1.108 (0.497)	0.727 (0.455)	1.272 (0.679)	0.600 (1.200)
ERSN	163	1.254 (0.710)	2.424 (2.578)	0.880 (0.375)	0.400 (0.800)
FHCF	2	0.015 (0.022)	0.061 (0.084)		
FHMW	23	0.177 (0.128)	0.303 (0.403)	0.130 (0.108)	0.200 (0.400)
FWDM	266	2.046 (0.617)	1.424 (0.718)	2.098 (0.795)	5.200 (3.763)
GNSF	6	0.046 (0.043)	0.030 (0.061)	0.054 (0.057)	
GZSD	132	1.015 (0.772)	0.788 (0.882)	1.098 (1.044)	1.000 (1.265)
LMBS	3	0.023 (0.026)		0.033 (0.037)	
LNGR	3	0.023 (0.026)	0.030 (0.061)	0.022 (0.031)	
OSSF	21	0.162 (0.104)	0.061 (0.084)	0.207 (0.143)	
PNMW*	6	0.046 (0.057)	0.061 (0.121)	0.043 (0.069)	
QLBK	8	0.062 (0.081)		0.087 (0.114)	
RDSN	480	3.692 (1.361)	4.364 (2.705)	3.533 (1.658)	2.200 (2.993)
RVCS	11	0.085 (0.062)	0.030 (0.061)	0.109 (0.084)	

Appendix F6 (continued).

Species	Total Catch	Overall CPUE	CHXO	ISB	OSB
			BARS	BARS	BARS
RVSN	233	1.792 (1.498)	1.545 (1.209)	1.924 (2.073)	1.000 (1.549)
SFSN	282	2.169 (1.030)	3.061 (2.517)	1.924 (1.142)	0.800 (1.166)
SGER*	3	0.023 (0.026)	0.061 (0.084)	0.011 (0.022)	
SHRH	21	0.162 (0.176)	0.152 (0.303)	0.152 (0.221)	0.400 (0.800)
SKCB*	2	0.015 (0.022)		0.022 (0.031)	
SMBF	4	0.031 (0.03)	0.061 (0.084)	0.022 (0.031)	
SMBS	2	0.015 (0.022)		0.022 (0.031)	
SNGR	34	0.262 (0.099)	0.333 (0.207)	0.239 (0.117)	0.200 (0.400)
SNSN*	88	0.677 (0.368)	0.970 (0.885)	0.609 (0.412)	
STCN	2	0.015 (0.022)	0.061 (0.084)		
SVCB	37	0.285 (0.237)	0.242 (0.231)	0.293 (0.324)	0.400 (0.800)
UCN	1	0.008 (0.015)			0.200 (0.400)
UCY	23	0.177 (0.282)		0.250 (0.398)	
WLYE	4	0.031 (0.030)	0.030 (0.061)	0.033 (0.037)	
WTBS	487	3.746 (1.089)	4.182 (1.986)	3.250 (1.241)	10.000 (9.839)
WTCP	6	0.046 (0.037)	0.030 (0.061)	0.043 (0.043)	0.200 (0.400)

Appendix F7. Bag Seine: overall season and segment summary. Lists CPUE (fish/100 m²) and 2 standard errors in brackets.

Species	Total Catch	Overall CPUE	CHXO	ISB	OSB
			BARS	BARS	BARS
BKCP	1	0.003 (0.007)	0.014 (0.027)		
BMBF	73	0.159 (0.266)	0.055 (0.081)	0.205 (0.373)	
BMSN	4	0.016 (0.023)	0.041 (0.081)	0.008 (0.016)	
CARP	92	0.340 (0.372)	0.037 (0.058)	0.466 (0.522)	
CKCB	2	0.010 (0.015)		0.006 (0.012)	0.131 (0.262)
CNCF	73	0.344 (0.479)	1.138 (1.946)	0.076 (0.062)	0.262 (0.524)
ERSN	745	3.156 (0.705)	3.377 (1.659)	3.063 (0.807)	3.403 (2.134)
FHCB	2	0.006 (0.009)		0.009 (0.012)	
FHMW	11	0.038 (0.035)	0.127 (0.136)	0.010 (0.014)	
FWDM	125	0.499 (0.376)	0.767 (0.962)	0.362 (0.407)	1.189 (1.253)
GNSF	1	0.008 (0.015)	0.031 (0.062)		
GZSD	1362	4.806 (2.005)	5.769 (4.302)	3.335 (1.543)	22.458 (26.664)
LMBS	2	0.006 (0.009)	0.014 (0.027)	0.004 (0.008)	
LNGR	1	0.004 (0.008)			0.092 (0.183)
OSSF	1	0.003 (0.005)		0.004 (0.008)	
PNMW*	13	0.026 (0.043)		0.037 (0.06)	
QLBK	18	0.077 (0.049)	0.178 (0.163)	0.047 (0.039)	
RDSN	488	1.846 (0.598)	1.521 (1.309)	1.92 (0.695)	2.428 (2.814)

Appendix F7 (continued).

Species	Total Catch	Overall CPUE	CHXO	ISB	OSB
			BARS	BARS	BARS
RVCS	33	0.144 (0.073)	0.256 (0.179)	0.115 (0.082)	
RVSN	165	0.727 (0.287)	0.582 (0.612)	0.786 (0.344)	0.599 (0.766)
SFSN	214	0.704 (0.278)	0.637 (0.402)	0.772 (0.366)	
SGER*	4	0.014 (0.014)		0.019 (0.019)	
SHRH	30	0.081 (0.063)	0.132 (0.140)	0.069 (0.074)	
SJHR	1	0.003 (0.006)	0.012 (0.025)		
SMBF	43	0.144 (0.087)	0.178 (0.199)	0.133 (0.102)	0.131 (0.262)
SNGR	2	0.008 (0.017)		0.012 (0.023)	
SNSN*	161	0.541 (0.200)	0.626 (0.556)	0.522 (0.204)	0.393 (0.786)
SVCB	47	0.175 (0.108)	0.256 (0.318)	0.150 (0.106)	0.131 (0.262)
UCY	7	0.024 (0.028)	0.041 (0.081)	0.020 (0.029)	
WTBS	799	2.687 (0.961)	3.670 (2.162)	2.415 (1.126)	1.656 (1.258)

Appendix G. Hatchery names, locations, and abbreviations.

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

Appendix H. Alphabetic list of Missouri River fishes with total catch-per-unit-effort by gear type for sturgeon season (fall through spring) and fish community season (summer) during 2005 for segment 8 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	2.5 Inch Trammel Net	Gill Net	Otter Trawl	1 Inch Trammel Net	Bag Seine	Mini-Fyke Net	Otter Trawl
BDKF								
BESN								
BHCP		0.041		0.005	0.005			
BHMW								
BKBF								
BKBH								
BKCP						0.003	0.038	
BKSS								
BLCF								0.051
BLGL							0.231	0.007
BMBF	0.008	0.049	0.004			0.159	0.008	
BMSN						0.016		
BNMW								
BRBT								
BSMW								
BTTM								
BUSK*	0.291	0.563	1.235	0.146	1.258			0.271
CARP	0.020	0.040	0.011		0.018	0.340	0.546	0.022
CKCB						0.010		
CLSR								
CMSN								
CNCF	0.224		0.075	0.579	0.299	0.344	1.108	2.570
CNLP								
CNSN								
ERSN				0.018		3.156	1.254	0.330
FHCB						0.006		
FHCF		0.014		0.007	0.019		0.015	0.030
FHMW						0.038	0.177	
FWDM			0.004	0.308	0.006	0.499	2.046	1.597

Appendix H. (continued).

Species Code	Sturgeon Season (Fall through Spring)				Fish Community Season (Summer)			
	1 Inch Trammel Net	2.5 Inch Trammel Net	Gill Net	Otter Trawl	1 Inch Trammel Net	Bag Seine	Mini-Fyke Net	Otter Trawl
GDEY	1.108	0.025	0.694	0.025	0.447			0.010
GDRH								
GDSN								
GNSF						0.008	0.046	
GDBG								
GSCP	0.023	0.044	0.004		0.021			
GSPK								
GZSD	0.008		0.007		0.007	4.806	1.015	
HBNS*								
HFCS								
JYDR								
LAB								
LESF								
LGPH								
LKSG								
LMBS						0.006	0.023	
LNDC								
LNGR	0.008				0.055	0.004	0.023	
MMSN								
MNEY								
MQTF								
NFSH								
NTPK								
OSSF						0.003	0.162	
PDFH		0.023	0.011					
PDSG*		0.007	0.015	0.017	0.025			0.012
PNMW*						0.026	0.046	
QLBK	0.011		0.019		0.025	0.077	0.062	
RBST								
RDSN				0.052		1.846	3.692	0.059

Appendix H. (continued).

Species Code	Sturgeon Season (Fall through Spring)				Fish Community Season (Summer)			
	1 Inch Trammel Net	2.5 Inch Trammel Net	Gill Net	Otter Trawl	1 Inch Trammel Net	Bag Seine	Mini-Fyke Net	Otter Trawl
RFSN								
RKBS								
RVCS	0.011	0.024	0.022	0.017	0.053	0.144	0.085	0.095
RVRH								
RVSN						0.727	1.792	
SBWB								
SDBS								
SFCB*				0.036				0.092
SFSN				0.008		0.704	2.169	
SGCB*				0.009				0.027
SGER*	0.013		0.075	0.013	0.040	0.014	0.023	0.036
SGWE								0.008
SHRH	0.008		0.034	0.020	0.027	0.081	0.162	0.008
SJHR						0.003		
SKCB*				0.179			0.015	0.102
SMBF	0.055	0.069	0.015	0.014	0.053	0.144	0.031	0.008
SMBS							0.015	
SMMW								
SNGR			0.011		0.040	0.008	0.262	
SNPD								
SNSG*	0.289	0.096	2.175	0.376	2.274			0.408
SNSN*				0.012		0.541	0.677	
SPSK								
STBS								
STCT				0.007			0.015	
STSN								
SVCB				0.571		0.175	0.285	1.567
SVCP		0.012						
TPMT								
UBF								

Appendix H. (continued).

Species Code	Sturgeon Season (Fall through Spring)				Fish Community Season (Summer)			
	1 Inch Trammel Net	2.5 Inch Trammel Net	Gill Net	Otter Trawl	1 Inch Trammel Net	Bag Seine	Mini-Fyke Net	Otter Trawl
UCN							0.008	
UCS								
UCT								
UCY						0.024	0.177	
UHY								
ULP								
UNID								
UNO								
URH								
USG								
WLYE			0.019	0.017	0.027		0.031	
WSMW								
WTBS						2.687	3.746	0.839
WTCP							0.046	
WTSK			0.004					
YLBH								
YOYF								
YWPH								