

2003 Annual Report

Lower Missouri River Pallid Sturgeon Monitoring and Population Assessment Project Segments 13 and 14

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by

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Introduction

Pallid sturgeon (*Scaphirhynchus albus*) abundance has declined throughout the Missouri River since dam construction and inception of the Bank Stabilization and Navigation Project in 1912 (Carlson et al. 1985). Loss of habitat, reduced turbidity, increased velocity, loss of natural flows, reduction in forage, increased hybridization and inadequate reproduction and recruitment are factors contributing to the decline of the pallid and other native species (Pflieger and Grace 1987). Since 1996, surveys conducted throughout the Missouri and Mississippi Rivers show an increase in hybridization and continued decline of pallid sturgeon (Grady et al. 2001).

In an independent scientific evaluation of the condition and management of the Missouri River, the National Research Council (2002) concluded that altered flow and habitat conditions associated with current management practices on the Missouri River have resulted in an unhealthy river ecosystem. Similar conclusions presented in the U. S. Fish and Wildlife Service Biological Opinion recommended, in part, that the Army Corps of Engineers (COE) initiate modified flow regimes by 2003 to avoid jeopardizing three listed species (endangered pallid sturgeon and least tern; threatened piping plover) and begin restoring the river's ecological health. The COE is responsible for monitoring and evaluating biotic responses of the pallid sturgeon to operational and habitat changes on the Missouri River (USFWS 2000). Habitat restoration, higher spring and lower summer flows combined with adaptive management are recommended measures to restore pallid sturgeon populations on the Lower Missouri River. Adaptive management is an approach to natural resources management that promotes carefully designed management actions, monitoring and assessment of impacts and application of results and findings to subsequent policy and management strategies. Monitoring sturgeon populations will provide vital information needed to guide restoration of form and function (habitat and hydrology) in the Lower Missouri River.

In response to the 2000 Missouri River Biological Opinion, the COE is developing monitoring and restoration projects to avoid jeopardizing pallid sturgeon populations. As part of their Implementation Plan, the COE is working with the U. S. Fish and Wildlife Service (USFWS) and State Resource Agencies to develop and conduct a pallid sturgeon monitoring and assessment program. The objectives of this program are to document relative abundance, reproduction, recruitment, and distribution of pallid sturgeon in the Missouri River; and biotic responses of pallid sturgeon and associated fish species to habitat and hydrologic changes. This report represents Columbia Missouri Fisheries Resources Office's (CMFRO) third year effort toward those objectives.

Hatchery production of pallid sturgeon has become a high priority as pallid populations continue to decline. In 2003, 14,555 pallids were stocked in the Lower Missouri River, including 4,600 within CMFRO's sampling reach (personal communication, Steve Krentz, Bismarck Fish and Wildlife Management Assistance Office, February 2003). CMFRO attempted to capture some of these fish to evaluate movement, growth, habitat and species associations.

Methods

Sampling was performed in accordance with guidelines created in 2002 by a panel of representatives from various state and federal agencies involved with pallid recovery on the Missouri River (Drobish, 2003). The sampling guidelines were meant to be adaptive and have been modified throughout the year to ensure sampling efficiency and scientific accuracy.

CMFRO was contracted to sample two of fourteen segments on the River. Segment 14 starts at the mouth of the Missouri (RM 0) and ends at the mouth of the Osage River (RM 130.2). Segment 13 is from the mouth of the Osage to Glasgow, MO (RM 228.2). Segments were divided into bends (defined as the start of the thalweg crossing from one bank to the opposite side) and 10 bends were randomly selected from each segment. Ten bends were sampled from March through June and designated as the sturgeon season. Then another 10 bends were selected to be sampled as the community season. All 10 bends were sampled in segment 14, however only 7 bends were sampled in segment 13 community season due to lack of resources. Sampling gears consisted of hoop nets (HN) (1.5 inch bar mesh, 7 hoop, 4ft diameter, two throats), otter trawls (OT 16) (16 ft, 1.5 inch stretch, # 9 polyethelene) and trammel nets (TN) (125 ft, 1 inch mesh X 6 ft. deep). During the community season, mini-fyke (MF) (4 ft. X 2 ft. cab, ¼ inch ace mesh) nets and seines (BS) (30ft, ¼ inch mesh) were added. Habitat units were defined as follows:

MACRO

ISB (inside bend)

OSB (outside bend),

CONF (confluence- area downstream of a tributary)

SCCS or SCCL (side channel connected small or large)

TRMS or TRML (small or large tributary mouth)

MESO

CHNB (channel border- where depth is > 4 ft. to toe of thalweg)

POOL (scour hole)

ITIP (island tip- associated with SCCS or SCCL where the two water currents meet behind an island)

BARS (sand bar or shallow water habitat where depth is < 4 ft. meters)

TLWG (thalweg- main channel between channel borders conveying majority of water)

Each MESO habitat could occur within each MACRO habitat and was targeted with each gear type for at least two samples. A sample was defined as a: 300m drift (TN), 300m tow (OT), 1 overnight set (HN,MF) or 30ft half arc pull (BS). A minimum of 8 samples were taken for each gear type per bend.

Gillnetting differed from the standard replicate sampling design. Five ten-mile reaches were randomly selected from only segment 13. Gillnets were set overnight when water temperature was below 55 F°. POOL habitats were targeted with standard effort, but CHNB habitats were sampled with extra effort. Two hundred foot experimental gillnets were used with repeating 25

ft panels (1.5, 2.0, 3.0 and 4.0 inch mesh) X 8ft deep. Alternatively, some 100-foot nets were used on channel borders. Effort was calculated by 100ft net-night.

Data Collection and Analysis

GPS locations, temperature, turbidity and depth (beginning, mid-point, end) were taken for each sample. Additionally, substrate and velocity samples were collected randomly twice for each gear type in each meso-habitat within each macro-habitat. Substrate samples were reported as an estimate of the percentage of silt/sand/gravel within each dredge sample. Water column velocity was measured at (bottom), 80% (8/10) and 20% (2/10) of the depth. All habitat data was collected when pallid sturgeon were encountered.

Length measurements (mm) were collected on all fish and a sub-sample of target fish were weighed (g). PIT (passive integrated transponder) tags were implanted under the dorsal fin in pallid sturgeon, lake sturgeon and some hybrid (pallid X shovelnose) sturgeon. Hybrids were determined by a calculation performed through a series of morphometric measurements and meristic counts (Sheehan et al. 1999). Sturgeon were called hybrid only when they were verified to be within the range of (- 0.50 to + 0.50) on the Sheehan's Character Index.

All pallid sturgeon were measured with Sheehan's index for verification. Additionally, fin clips were collected from pallid sturgeon to be analyzed for genetic purity and pictures were taken for documentation. Pallid sturgeon captured in the spring, were implanted with sonic transmitters by USGS biologists for telemetry work.

Data was collected under protocol guidelines as "standard" meaning it was part of the agreed upon method collecting data. Data collected outside of these protocol limits was deemed "wild". In addition, random and non-random samples and bend replicates were separated on the data sheets. For the purposes of this report, tabular and graphical comparisons did not separate wild or non-random data. Two bends were allowed to be selected as wild, but in 2003 all were selected randomly. However, some additional sampling was done and coded non-random. Future changes in the data sheet have coded these "additional". A small amount of wild sampling was performed with most being done in the winter with gillnets on channel borders and this was later changed to a standard gear.

Results

Pallid Sturgeon

Segment 13

Four pallid sturgeon including; 1 recapture and 1 presumed recapture were captured in 141 trammel drifts (34,214m) and 192 trawl tows (45,930m) (Table 1). The two recaptured stocked fish were captured below the Lamine River confluence about 7 miles above the Booneville stocking site (Figure A1). The recaptured PIT tagged fish had grown 64 mm and 21g in about 6 weeks following stocking. Only one pallid was captured in 310 (100ft gillnet) nights of effort (Figure A2). This fish was implanted with a sonic transmitter by the USGS and tracked throughout the year. This fish remained within 2 miles of the original capture site throughout the remainder of the year (personal communication, Aaron Deloney, USGS, November 2003). The 3 pallid sturgeon captured in trawls and trammels occurred between average depths of 2.7m to 3.4m where velocities were about 0.33 m/s (Figure A3).

Eight of seventeen pallid hybrids were captured in gillnets with mid depths (usually deepest portion of pool) ranging from 3m to 9m. The remaining 9 hybrids came from trammel and hoop nets in average depths ranging from 2.1m to 3.9m. Bottom water velocities ranged from 0.24 to 0.98 m/s in active gears. Confluence and island tip habitat (which are relatively scarce habitats) accounted for 3 of the 9 hybrids captured. Catch rates were higher for lake sturgeon and hybrids in segment 13 (Appendix A).

Segment 14

Three pallid sturgeon including one coded wire tagged fish were captured in 154 trammel net drifts (36,140m) and 162 trawls (36,540m) (Table 1). The coded wire recapture was from a Missouri Department of Conservation (MDC) stocking in the fall of 1997 (Figure A4). The fish was about 220mm when stocked (Personal communication, Vince Tranvnichek, MDC, March, 2004). This fish was at large for 7 years and grew 628mm. Two pallids were captured in unique habitat exhibiting large rolling sand drop-offs, whereby the sand on the edge of the sand bar shoaled up near the water surface and dropped back off to ≥ 3 meters deep (Figures A5 and A6). Pallid, high numbers of shovelnose and lake sturgeon were associated with this habitat. Average capture depth for the 3 pallid sturgeon ranged from 2.7m to 3.1m and the average bottom water velocity ranged from 0.33 to 0.44 m/s (Table 1). All three fish came from inside bend channel border habitats.

One hybrid pallid sturgeon was captured in an otter trawl and two were captured in trammel drifts. Bottom velocity for two of the fish was 0.79m/s. The average depth at capture ranged from 2.7 to 3.6m for the three fish. One fish was captured in island tip habitat and the other two were captured in ISB and OSB channel border habitats.

Table 1. Pallid and hybrid sturgeon point-of-capture information in the Lower Missouri River for 2003. Bold numbers indicate initial tagging information.

Spp.	Segment	Date	Gear	Length (mm)	Weight (g)	(C°)	River Mile	Habitat Type		Depth (m)				Bottom Velocity (m/s)	Substrate Silt/sand/gravel	Recap
								Macro	Meso	Start	Mid	End	Avg.			
Pallid	13	3/26	GN	890	2380	13	183.0	OSB	POOL	10.7	8.2	9.5	0.12			
Pallid	13	5/2	TN	807	1990	20	141.5	ISB	CHNB	3.5	2.9	2	2.8	0.32	0 / 50 / 50	
Pallid	13	7/16	TN	431	279	28	201.7	CONF	CHNB	3	3	4.2	3.4			PIT scar
Pallid	13	10/22	OT	320	90	17	202.1	CONF	CHNB	3	2.7	2.3	2.7	0.36	0 / 100 / 0	PIT
	13	9/4		264	69		195.1									
Pallid	14	8/4	OT	683	832	29	44.4	ISB	CHNB	3.8	3.3	1.7	2.9	0.44	0 / 60 / 40	
Pallid	14	6/17	TN	628	857	22	126.6	ISB	CHNB	3.2	2.6	2.4	2.7	0.72	0 / 95 / 5	CWT
Pallid	14	8/5	TN	748	1321	28	39.7	ISB	CHNB	2.8	3	3.5	3.1	0.31	0 / 100 / 0	
Hybrid	13	4/9	GN	614		10	195.6	ISB	POOL	1.8	4.8	4.4	3.7	0.17		
Hybrid	13	4/9	GN	668		10	195.6	ISB	POOL	1.8	4.8	4.4	3.7	0.17		
Hybrid	13	3/20	GN	588	774	12	152.8	ISB	POOL		6.7	2.1		0.01		
Hybrid	13	3/20	GN	615	885	12	155.1	ISB	POOL							
Hybrid	13	2/11	GN	634	1016	2	154.1	ISB	POOL		7.9	4.6				
Hybrid	13	3/10	GN	588	733	3	208.5	OSB	POOL		9	7.6			100 / 0 / 0	
Hybrid	13	3/26	GN	643	948	13	176.5	ISB	POOL		8.5	4.9		0.24		
Hybrid	13	3/26	GN	794		13	180	OSB	POOL		3	2.4		0.98		
Hybrid	13	6/30	OT	675	1195	26	202.3	CONF	CHNB	2.4	2.3	2	2.2		40 / 60 / 0	
Hybrid	13	7/22	OT	629	815	29	141.5	ISB	CHNB	2.7	2.1	2.1	2.3	0.33	0 / 97 / 3	
Hybrid	13	7/9	OT	630		30	159	ISB	CHNB	3.6	3.8	3.4	3.6			
Hybrid	13	5/27	TN	613		20	141.5	ISB	CHNB	3.5	2.9	2	3.5	0.32	50 / 50 / 0	
Hybrid	13	7/16	TN	663	1104	29	203.2	ISB	CHNB	2.5	2	1.8	2.1	0.75	0 / 100 / 0	
Hybrid	13	7/16	TN	535	491	29	202.5	ISB	CHNB	2.5	3.6	3.1	3.1	0.52	0 / 100 / 0	
Hybrid	13	7/18	TN	717	1357	28	200.4	ISB	CHNB	2.8	2.2	1.7	2.2			
Hybrid	13	7/15	TN	663		29	216.8	SCCS	ITIP	3.7	3.9	4.2	3.9		0 / 100 / 0	
Hybrid	13	7/15	TN	609		29	216.8	SCCS	ITIP	3.7	3.9	4.2	3.9		0 / 100 / 0	
Hybrid	14	6/24	OT	690	1015	26	68.7	ISB	CHNB	2.2	2.8	3	2.7	0.79	0 / 100 / 0	
Hybrid	14	6/24	TN	555		36	66.8	OSB	CHNB	4.5	3.4	2.8	3.6	0.79		
Hybrid	14	6/24	TN	690	1150	26	48.9	SCCS	ITIP	0.7	3.3	4.8	2.9			

Pallid Sturgeon Summary

The ratio of pallid sturgeon (wild and hatchery) to all river sturgeon was 1:303 in segment 13 and 1:278 in segment 14 when gillnets were excluded. With gillnets included, the ratio was 1:1188 in segment 13 (segment 14 was not sampled with gillnets) (Table 2).

Table 2. Number of sturgeon species captured and their relative proportions in the Lower Missouri River during 2003.

Sturgeon Species	Sampling Segments		
	13 with gillnets	13 w/o gillnets	14 without gillnets
Pallid Sturgeon	4	3	3
Hybrid (Shovelnose X Pallid)	17	9	3
Lake sturgeon	57	12	1
Shovelnose sturgeon	4679	885	831
Pallid / hybrid	1:4	1:3	1:1
Pallid / all sturgeon spp.	1:1188	1:303	1:278
Wild / hatchery pallids	2:2	1:2	2:1

The difference in ratios between segments suggests pallid sturgeon used different wintering habitat than shovelnose, thereby skewing true ratios of the sturgeon throughout the River. Carlson et al (1985) used setlines, drifted and set trammel nets to get their reported pallid to shovelnose ratio of 1:904 within segments 13 and 14 in the late 1970's. They recognized that most pallids came from set lines and that 36% of the pallids captured throughout the Middle Mississippi and Lower Missouri Rivers had a low degree of association with shovelnose. Also, pallid sturgeon have been found to inhabit greater velocities than shovelnose (Ruelle and Keenlyne, 1994). The low water conditions in 2003 (46% lower than mean average flows) would support speculation that pallids inhabited channel border areas rather than taking refuge in dike holes and explain why only one pallid was captured in winter gillnetting efforts (this was the most effort ever expended for 1 pallid since sampling began in 1999). Considering only wild pallid sturgeon and assuming similar sampling techniques from 2003 to the 1970's, ratios have now declined to 1:2,339 pallid/shovelnose in segment 13. Efforts in 2004 were spread evenly across habitat types and pallids were found in CHNB, ITIP and POOL habitats.

YOY (young-of-year) sturgeon

YOY sturgeon were captured from June 19 to July 23 within temperature ranges of 22-30 °C. Appendix B shows maps of sturgeon captures. Sturgeon captured smaller than 120mm were classified as YOY based on a length frequency graph compiled for 2003 data (Figure 1). Juvenile shovelnose were designated as fish >120mm and ≤ 480mm. Future aging determinations should help to verify these age designations. Likewise, a definition for juvenile pallid sturgeon is still debatable and should be discussed.

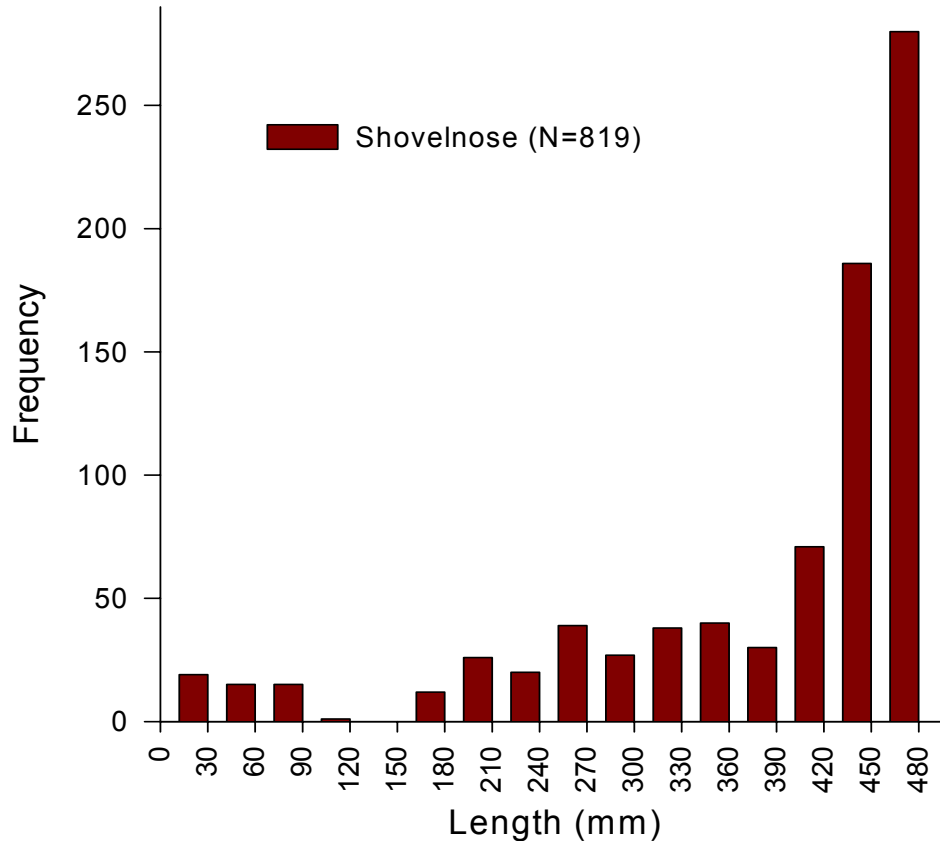


Figure 1. Length frequencies for juvenile shovelnose or unidentified sturgeon captured in segments 13 and 14 in 2003.

The amount of sampling within this seasonal period and temperature range could account for the variation that will be seen between sampling segments or between sturgeon and community seasons regarding a successful spawning event. Although past data suggests that YOY fish can be collected into October, it is important to coordinate future sampling to provide the best data possible during the post spawn period. Standard sampling effort is likely insufficient during this time period to get the data needed to appropriately identify spawning success.

YOY sturgeon were more abundant relative to effort expended in the following habitats (Figures 8 and 9):

Segment 13: ISB-CHNB, OSB-CHNB, SCCS and SCCL-ITIP

Segment 14: ISB-CHNB, SCCL-ITIP, TLWG and CHNB

ISB-CHNB is the most abundant shallow water habitat and YOY sturgeon were consistently captured there. YOY were captured in all but 4 designated habitat types among both segments, with relatively small amounts of effort being designated to each (Figures 2 and 3). This may suggest that YOY sturgeon may be well dispersed at this time and would be vulnerable to capture in any habitat if enough effort were expended. Alternately, there may be some preference towards the rarer side-channel or channel border habitats. More effort, in addition to standard sampling, will be needed during this critical temperature and time frame to determine the importance of these habitats to young sturgeon.

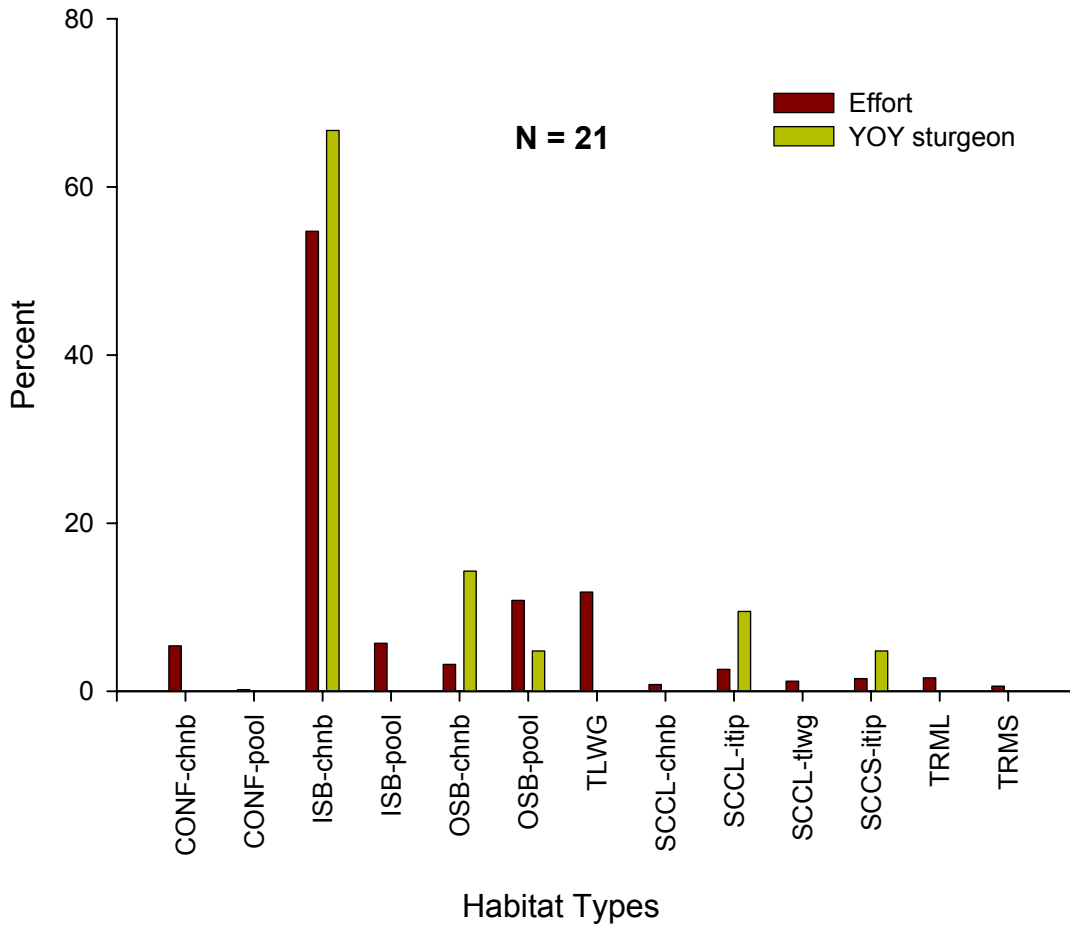


Figure 2. YOY sturgeon catch compared to sampling effort in temperatures between 22 and 30°C across all habitat types in Segment 13.

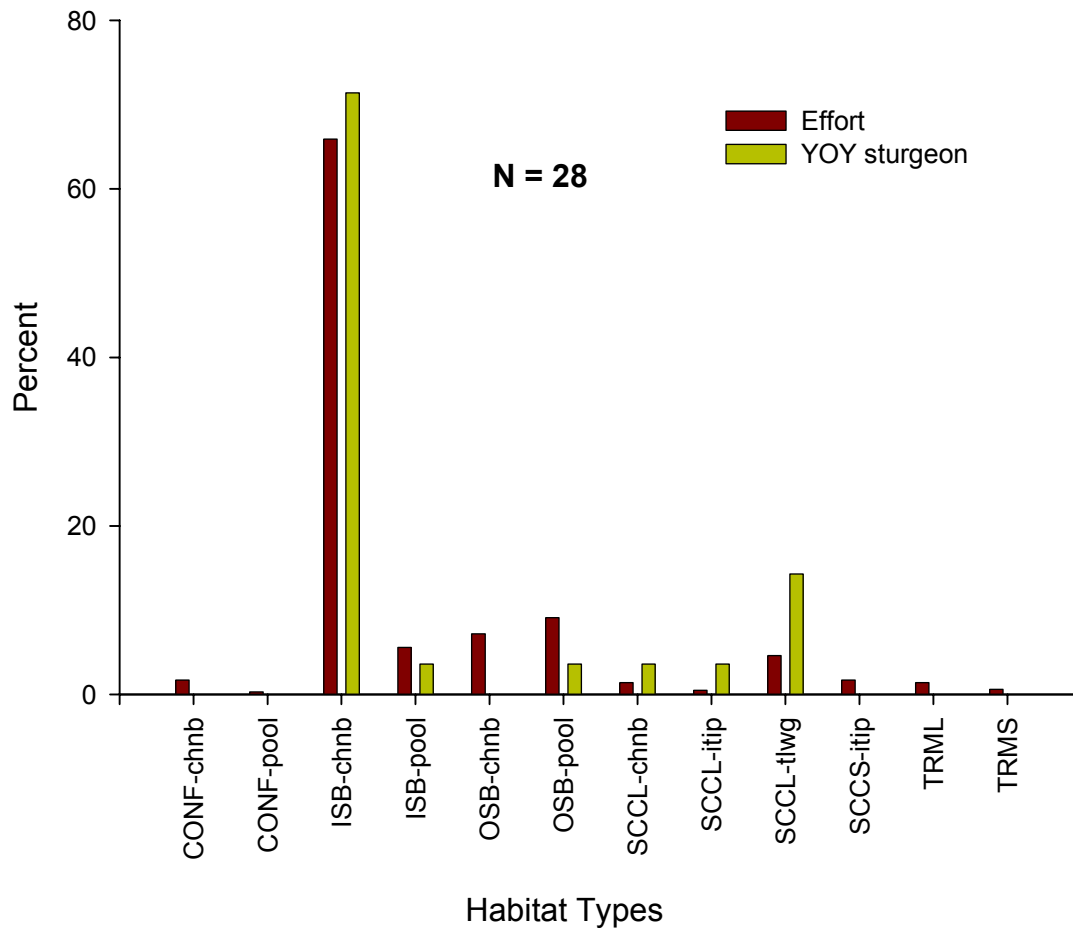


Figure 3. YOY sturgeon catch compared to sampling effort in temperatures from 22-30°C across all habitat types in Segment 14.

Target Species

Segment 13

Gillnets / Sturgeon Season

Appendix C shows tables for all gears. Shovelnose were the most abundant fish in gillnets samples (N=3801) representing 68% of the total fish captured (N=5549) in 310 (100 ft.) net-nights of effort. Catch rate was much higher for shovelnose within ISB-POOL habitat (14.76) vs. OSB-POOL habitat (9.65), but CPUE was slightly lower in ISB-CHNB habitat (4.68) compared to OSB-CHNB habitat (6.57). Excluding shovelnose sturgeon, all other target species combined (N= 129) only represented 7% of the remaining fish total. Sauger were the second most abundant target species and occurred more frequently within ISB-CHNB habitat (CPUE=0.37). Forty-five lake sturgeon were collected with most occurring in ISB-POOL habitat (CPUE= 0.19). Twenty-six tagged fish were recovered including: 21 coded wire tags, 3 T-bar (or floy), and 2 PIT tags (all lake sturgeon were PIT tagged after capture).

Otter Trawl / Sturgeon Season

In 26,545 meters of trawling, 467 target fish were collected representing all targeted species except *Hybognathus* spp. Shovelnose sturgeon were the most abundant target species sampled (47%) and represented 15% of all fish sampled. Catch rate was highest for shovelnose in CONF-CHNB (CPUE=1.76) and in SCCL-ITIP (CPUE=1.59) habitats. Sauger were more prevalent in SCCL-TLWG habitat (CPUE=3.63) and rarely occurred in any other habitat. Speckled chubs represented 36% of the target species sampled but occurred in relatively equal proportions across the habitats sampled. All other target species were captured in relatively low numbers. One hybrid sturgeon and nine YOY sturgeon were also collected.

Otter Trawl / Community Season

In 19,385 meters of trawling, 401 target fish were collected representing 7 target species. Shovelnose sturgeon were the most abundant target species sampled (53%) and represented 15% of all the fish sampled. Catch rate was highest for shovelnose in SCCL-ITIP (CPUE=1.77) and ISB-CHNB (CPUE= 1.42). Sicklefins were also abundant (20% of target spp.), followed by speckled chubs (11%) and unidentified chubs (11%). Sicklefins were most prevalent within OSB-POOL habitat (CPUE=1.42). Two lake sturgeon, two hybrid and one pallid sturgeon were also captured. The pallid was captured at the Lamine River confluence.

Trammel Net / Sturgeon Season

In 19,733 meters of drift, 118 target fish were collected representing 3 species. Shovelnose sturgeon represented 69% of all fish sampled and 97% of target species sampled. CPUE for shovelnose was highest within SCCL-ITIP habitat (CPUE=1.46). One hybrid and one pallid sturgeon were captured on ISB-CHNB habitat.

Trammel Net / Community Season

In 14,481 meters of drift, 304 target fish representing 5 species were collected. Shovelnose sturgeon represented 74% of all fish sampled and 92% of the target species. Catch rate was highest for shovelnose sturgeon within SCCS-ITIP (CPUE=3.72) habitat, followed by CONF-CHNB (CPUE=2.11) and ISB-CHNB (CPUE=1.89). Nine lake sturgeon, 1 pallid and 5 hybrid pallid sturgeon were also captured. Fourteen percent of sampling was done within CONF-CHNB habitat and produced 7 of 9 lake sturgeon (Osage River mouth) and one pallid sturgeon (Lamine River confluence). Varying temperatures near the Osage may make this area especially appealing to cool-water fishes. Collection of sauger was also greatest in this area.

Hoop Net / Sturgeon Season

In 87 net-nights, 80 target fish were collected representing 4 species. Shovelnose sturgeon were the most abundant fish species (27%) and blue suckers were the third most abundant species (13%) of all the fish collected. Catch rate was highest for shovelnose sturgeon at ISB-POOL habitat and highest for blue suckers within OSB-CHNB habitat. Blue suckers were only collected in ISB-POOL and OSB-POOL habitats (N=3). It was obvious that there was a seasonal migration which made these fish susceptible to this gear. Blue suckers were gravid and the males were inundated with breeding tubercles. Likewise, shovelnose sturgeon were likely, susceptible because of seasonal spawning movement. The timing of hoop net effort and placement of nets may be critical to catching pallid sturgeon or larger numbers of target species. Variation in CPUE by season and habitat between segments throughout the river could be minimized by identifying migration dates and habitats in which fish are most vulnerable.

Hoop Net / Community Season

In 62 net-nights, 7 target fish including; 2 shovelnose, 4 blue suckers and 1 big mouth buffalo were collected out of 161 total fish. Similar numbers of species were captured between seasons (17 in sturgeon vs.16 in community) and catch rates were also comparable (2.23 st. and 2.60 comm). However, it appears that the target species are not as vulnerable to this gear during the community season as in the sturgeon season.

Bag Seine / Community Season

In 3,420 m² of seining, 53 target fish were collected representing 6 species, which accounted for only 2% of the total number of fish sampled. Hybognathus spp. (N=30) and sand shiners (N=15) were the most numerous of the 6 target species sampled. Hybognathus spp. occurred in greater proportion within ISB-BARS habitat (CPUE=1.32), while sand shiners were found more often on SCCS-BARS (CPUE=1.17). All target species were collected most often on ISB-BARS and SCCS-BARS.

Mini-Fyke Net / Community Season

In 45 net nights, 86 target fish representing 5 species were collected. These accounted for only 2% of all fish sampled. Sicklefins were most abundant (N=33) and occurred more often on ISB-BARS (CPUE=1.71). Unidentified chubs were also abundant within this habitat. Sand shiners, sauger, speckled chubs and Hybognathus spp. were also found, but in relatively small numbers. All of the target species collected were found on ISB-BARS and SCCS-BARS.

Segment 14

Otter Trawl / Sturgeon Season

Appendix D shows tables for all gears. In 19,741 meters of trawling, 192 target fish were collected representing 7 target species. Shovelnose sturgeon predominated trawls, accounting for 65% of the target species sampled. Target species made up 22% of the total sample of fish. Catch rate was highest for shovelnose on OSB-CHNB (CPUE=1.59) and SCCS-ITIP (CPUE=1.54) habitats. Speckled chubs were also caught more frequently at SCCS-ITIP habitat (CPUE=0.63). Other target species occurred in relatively low numbers. One hybrid was captured on ISB-CHNB habitat and no YOY were captured.

Otter Trawl / Community Season

In 16,800 meters of trawling, 353 target fish were collected representing 8 target species. Sicklefins were the most abundant target species (47%) followed by shovelnose sturgeon (32%). Sicklefins occurred in every habitat but were most abundant in the outside bend. The largest sample of sturgeon chubs was taken in this period with a high CPUE in OSB-CHNB habitat (CPUE = 1.02). Half of the sicklefin chubs were under 30mm in length suggesting that slack-water pools were being used as rearing habitat for newly hatched fish. Catch rate was highest for shovelnose sturgeon in SCCS-ITIP habitat (CPUE=1.80). Target species made up 18% of the total sample.

Trammel Net / Sturgeon Season

In 18,114 meters of drift, 335 shovelnose sturgeon were collected accounting for 71% of the total sample of all fish and 90% of the target fish. Although most of the sturgeon were captured from ISB-CHNB habitat (including one pallid sturgeon), this habitat represented 91% of all the habitat sampled. Less sampled areas had higher CPUE's for shovelnose including; OSB-CHNB (3.87), SCCL-ITIP (2.93) and CONF-CHNB (2.16). Thirty-two blue suckers were collected with 28 coming from ISB-CHNB habitats (CPUE=0.17), but like shovelnose, the CPUE in SCCL-ITIP was higher (0.73). Two hybrid sturgeon were collected; 1 in OSB-CHNB habitat and 1 in a SCCS-ITIP habitat. One pallid sturgeon was collected on ISB-CHNB habitat.

Trammel Net / Community Season

In 18,028 meters of drift, 246 shovelnose sturgeon were captured. Shovelnose accounted for 70% of the total sample and 92% of the target fish sample. CPUE for shovelnose was three times higher in SCCL-ITIP habitat (3.16) than in ISB-CHNB (1.31) or OSB-CHNB(1.61). Ninety-three percent of sampling was done on ISB-CHNB where one lake sturgeon and one pallid sturgeon were also collected. Seventeen blue suckers were collected on ISB-CHNB habitat, but CPUE was relatively low (0.10).

Hoop Net / Sturgeon Season

Fourteen target fish representing 3 species accounted for 8% of the total sample of fish. Ten shovelnose sturgeon were collected without any outstanding habitat associations. Three blue suckers were all captured on OSB-CHNB habitat along with one big-mouth buffalo.

Hoop Net / Community Season

Blue suckers were the only target fish collected in 72 net-nights and made up 6% of the total fish sample. Nine of ten blue suckers came from OSB-CHNB habitat (CPUE= 0.33).

Bag Seine / Community Season

Forty-two target fish representing 6 species were collected in 4,513 m² of seining. Target species made up only 2% of the total sample. Sand shiners were the most abundant target species (N=19) followed by sicklefin chubs (N=10).

Mini-Fyke Net / Community Season

Eighty-six target fish, representing 3 species were caught in 57 net-nights of effort. Target fish accounted for only 4% of the 2446 fish collected. Proportionate to sampling effort, more speckled chubs (CPUE=1.20) and sand shiners (CPUE=2.60) were captured in CONF-BARS habitat.

Target Species Summary

The gillnet protocol for 2004 has changed to spread sampling over alternate habitats on the bend level and this change has resulted in more pallids being captured in 2004. Sauger and bigmouth buffalo were more vulnerable to gillnets than other gears. The degree to which these fish are deemed important, may dictate the incorporation of different techniques in warmer weather to increase capture. Appendix E shows summary graphs for this section.

Blue suckers and shovelnose sturgeon appear to be vulnerable to hoop nets during the spring when spawning migration occurs. The passive nature of this gear requires fish movement and therefore is most effective during this time period. Throughout the rest of the year, hoop nets were marginally effective in capturing target species. Given the cost and amount of effort required to deploy hoop nets, serious consideration should be given to alternative methods of capture or a more concentrated effort when fish are most vulnerable.

Large lake and pallid sturgeon do not appear to be vulnerable to the current trammel nets, while smaller sturgeon up to 750mm generally become easily entangled just by making contact with the multifilament mesh. Other large native fishes like buffalo, drum and large catfish were also not captured in trammel nets despite their relative abundance in the system. In one instance, an attempt was made to recapture a large pallid (900mm) in a known location. Sonar positioning showed the pallid avoiding over 8 trammel net drifts. The fish was finally captured with a drifted experimental gillnet. It is impossible to know if larger fish are absent from the habitat being sampled or are avoiding trammel gear.

Catch rate was higher for many target species within ISB-CHNB habitat, probably because it was the only shallow water habitat available and was sampled most frequently. Little effort was expended on other habitat types because of lack of availability. Despite this, habitat types such as; OSB-CHNB, CONF, SCCS and SCCL (ITIP and CHNB) emerged as areas important to target species. In contrast to ISB-CHNB, the small numbers of fish collected and effort expended will likely present high variability in statistical testing. Not encountering these important habitats, because of high summer flows or random bend selection could delay the ability to statistically declare these habitats as important. A more targeted approach to sampling these less available habitats (in addition to random bend selection) would increase the ability to detect important habitats.

Shovelnose sturgeon were the most abundant species sampled in trammel nets, gillnets and otter trawl gears. The amount of effort expended with these gears appears to be sufficient to obtain statistically comparable data between habitat types over time. Comparatively, other species such as; bigmouth buffalo, sand shiners, *Hybognthus* spp., sauger and sturgeon chubs appear in such low numbers that it is doubtful that meaningful comparisons necessary to predict effects of changing hydrology could be made (Table 3). While some target species can be detected with sturgeon gears, others will not be available except through increased effort using non-sturgeon gears (mini-fykes and seines). The degree to which these species are deemed vital to the project may necessitate more overall effort or a more concentrated effort at the exclusion of using sturgeon gears.

Table 3. Sum of target species within MACRO habitat types in the Lower Missouri River in 2003.

SPECIES	Segment 13							Segment 14							Grand Total
	CONF	ISB	OSB	SCCL	SCCS	TRML	TOTAL	CONF	ISB	OSB	SCCL	SCCS	TRML	Total	
Bigmouth buffalo		1	4	1	2	1	9			2				2	11
Blue sucker		21	30	2			53	53	13	5	1			72	125
Hybognathus Spp.		28	1	4	5		38	8				2		10	48
Lake sturgeon	7	39	11				57	1						1	58
Pallid sturgeon	2	1	1				4	3						3	7
Sicklefin chub	7	107	33	2	1		150	1	81	118	4	5		209	359
Sauger	4	53	13	16	3	1	90	4	3	1			2	10	100
Sturgeon chub		8	1				9	13	17			2		32	41
Speckled chub	20	155	42	7	1		225	7	65	18	4	6		100	325
Hybrid pallid/shovel.	1	12	2		2		17	1	1			1		3	20
Shovelnose sturgeon	86	3499	1004	31	61		4681	18	690	66	48	9		831	5512
Sand shiner	4	9			10		23	16	12	15		10	2	55	78
Total	131	3925	1141	63	85	2	5356	42	918	236	62	34	4	1328	6684
Total (no/sh)	45	426	137	32	24	2	675	24	228	170	14	25	4	497	1172

(no/sh) = no shovelnose included in sum

Shovelnose Sturgeon Habitat Characteristics

Trawl and Trammel Nets

Relationships between average depth of sample and CPUE of target species within depth intervals were summarized for otter trawls and trammel nets (Tables 4 and 5). Only ISB-CHNB habitat was used for the comparison because most of the effort for both gears was in that habitat. Only shovelnose sturgeon had a comparable sample size. In the community season, there appears to be a trend for increased catch as depth increases up to 4.0m, with the largest numbers observed between 3 and 4 meters. Sturgeon appeared to prefer shallower water in the sturgeon season in trammel nets, but otter trawls had more variability (Figure 4). Sand bars typically drop off into the main channel at 3.0 meters. The high CPUE at this point may represent an important depth that can be hard to sample but important to sturgeon. Tables 4 and 5 show that most of the sampling in the community season occurred shallower than 3 meters (72%,OT and 83%,TN). Pallid sturgeon have been found to inhabit (if not prefer) swifter and deeper water than shovelnose sturgeon (Carlson et al. 1985). If this year's efforts are representative of the challenges all stations face in adequately sampling deeper water on sand bars, it is reasonable to assume that all channel border habitat is not being sampled effectively or comparably. Efforts to partition sampling across depth ranges within ISB-CHNB habitat could be important to precisely defining use of the habitat in future years.

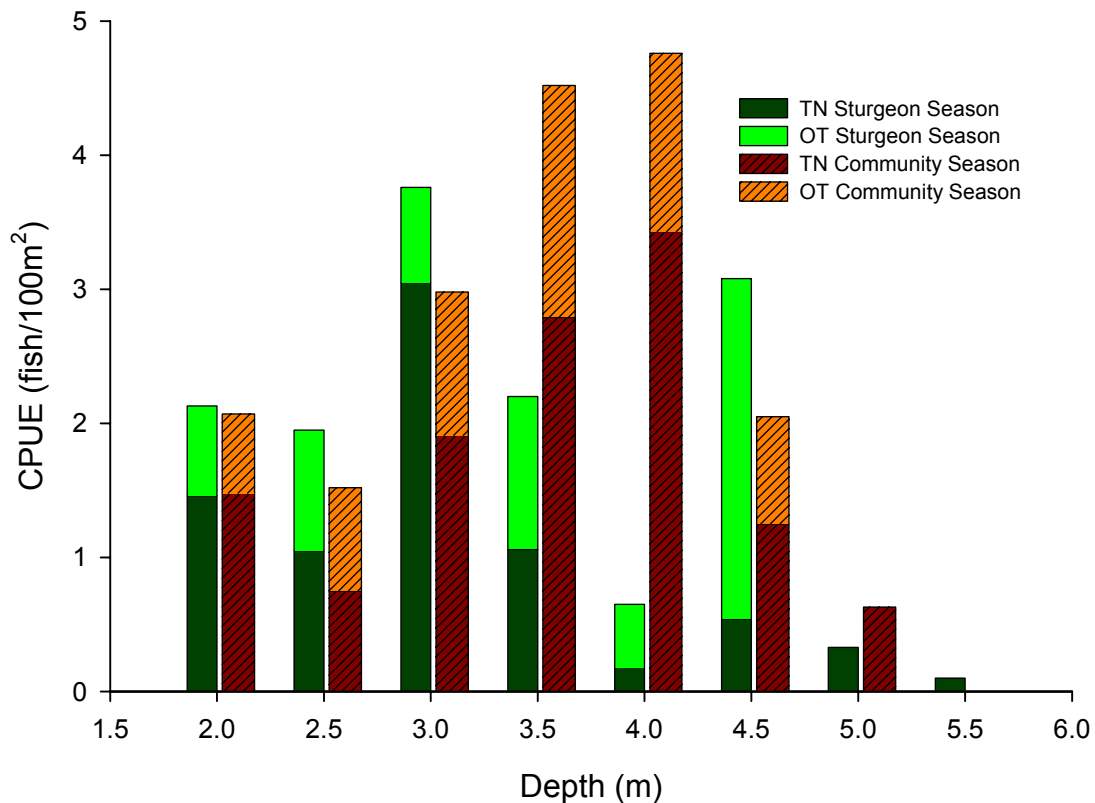


Figure 4. Comparison of CPUE of shovelnose sturgeon in combined segments between seasons within average depths they occurred. Sturgeon were captured using trammel nets (N= 405/st., N=415/comm.) and trawls (N=197/st., N=259/comm.) on Inside Bend Channel Border habitat in 2003.

Table 4. CPUE (N) (fish/ 100m) of target species at graduating average depths intervals for trawls within ISB-CHNB habitat.

Depth (m)	<2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	>7.0
St. effort	61.1	64.5	60.2	22.9	15.0	5.9	5.7		1		2.9	0.8
Sicklefin chub	0.16 (10)	0.05 (3)	0.23 (14)	0.22 (5)	0.33 (5)		0.53 (3)				1.03 (3)	1.25 (1)
Speckled chub	0.67 (41)	0.65 (42)	0.42 (25)	0.22 (5)	0.47 (7)	0.68 (4)						
Blue sucker		0.02 (1)	0.17 (1)	0.04 (1)	0.07 (1)	0.17 (1)						
Shovelnose sturgeon	0.67 (41)	0.90 (58)	0.71 (43)	1.14 (26)	0.47 (7)	2.54 (15)						
YOY Sturgeon	0.20 (12)	0.16 (10)	0.02 (1)	0.13 (3)	0.07 (1)							
Comm. effort	39.0	70.3	67.1	37.5	21.0	8.8						
Sicklefin Chub	0.33 (13)	0.46 (32)	0.51 (34)	0.37 (14)		0.34 (3)						
Speckled Chub	0.18 (7)	0.10 (7)	0.18 (12)	0.34 (13)	0.33 (7)							
Blue Sucker		0.04 (3)	0.04 (3)				0.11 (1)					
Shovelnose Sturgeon	0.59 (23)	0.77 (54)	1.07 (72)	1.73 (65)	1.33 (28)	0.80 (7)						
YOY Sturgeon		0.04 (3)	0.04 (3)		0.05 (1)							

Table 5. CPUE (fish/100m) of target species at graduating average depth intervals for trammel net drifts within ISB-CHNB habitat.

Depth (m)		<2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	>7.0
<u>St. effort</u>		63.6	67.6	51.7	47.8	43.4	18.4	15.0	9.5		2.2		2.7
Blue sucker	<u>CPUE</u>	0.28	0.06	0.10	0.02								
	<u>N</u>	(18)	(4)	(5)	(1)								
Shovelnose sturgeon	<u>CPUE</u>	1.46	1.05	3.05	1.06	0.18	0.54	0.33	0.10				
	<u>N</u>	(93)	(71)	(158)	(51)	(8)	(10)	5 (5)	(1)				
<u>Comm. effort</u>		47.4	105.5	73.8	22.2	16.6	4.0	1.6					
Blue sucker	<u>CPUE</u>	0.04		0.07	0.05	0.06							
	<u>N</u>	(2)		(5)	(1)	(1)							
Shovelnose sturgeon	<u>CPUE</u>	1.48	0.75	1.91	2.79	3.43	1.25	0.63					
	<u>N</u>	(70)	(79)	(141)	(62)	(57)	(5)	(1)					
Lake sturgeon	<u>CPUE</u>		0.01	0.01	0.05								
	<u>N</u>		(1)	(1)	(1)								
Sauger	<u>CPUE</u>		0.01	0.03	0.05								
	<u>N</u>		(1)	(2)	(1)								

Gillnets

Catch rates at depth and temperature were determined for target species. There appears to be a slight increase in shovelnose CPUE as depth increased (Figure 5, Table 6). There was no obvious trend change in CPUE over a temperature gradient (Table 7).

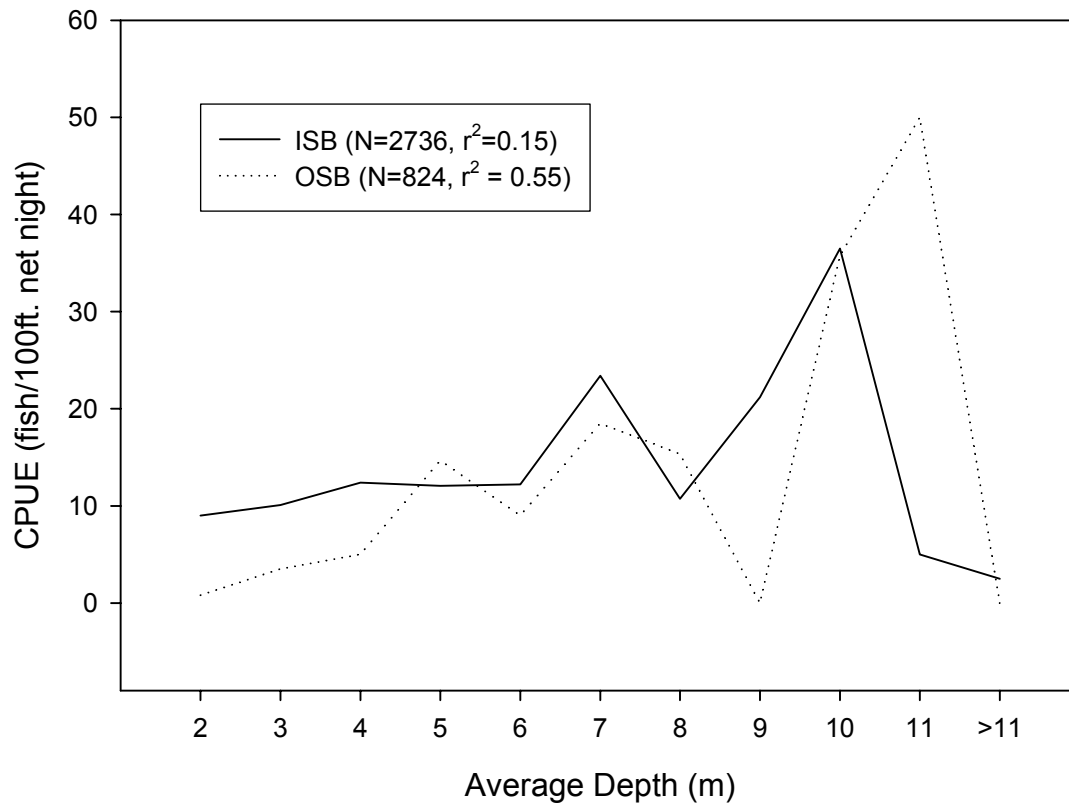


Figure 5. CPUE of shovelnose captured in gillnets within ISB and OSB POOL habitat in 2003.

Table 6. Shows CPUE (fish/100ft net night) of target species caught in POOL habitat with gillnets at increasing depths.

Depth (m)	≤2		3		4		5		6		7		8		9		10		11		>11
	Macro Effort	ISB	OSB	ISB	OSB	ISB	OSB	ISB	OSB	ISB	OSB	ISB	OSB	ISB	OSB	ISB	OSB	ISB	OSB	ISB	OSB
Shovel. St. <u>N</u>	36	4	223	21	398	130	338	176	416	171	796	37	86		212	92	219	143	10	50	2
Shovel. St. <u>CPUE</u>	9	0.8	10.1	3.5	12.4	5	12.07	14.67	12.23	9	23.4	18.5	10.75		21.2	15.33	36.5	35.75	5	50	2.5
Sauger <u>N</u>			3	1	11	2	3	1	8	3	7		5	2							
Sauger <u>CPUE</u>			0.14	0.17	0.34	0.08	0.11	0.08	0.24	0.16	0.21		0.63	1.0							
Lake St. <u>N</u>			6		1	1	3	1	7	1	9				5	4	2	1			
Lake St. <u>CPUE</u>			0.27		0.03	0.04	0.11	0.08	0.21	0.05	0.26				0.5	0.67	0.33	0.25			
Shovel. St. Hyb. <u>N</u>				1	2		1				1					1					
Shovel. St. Hyb. <u>CPUE</u>				0.17	0.06		0.04				0.03					0.17					
Pallid St. <u>N</u>																	1				
Pallid St. <u>CPUE</u>																	0.25				

Table 7. Shows CPUE (fish/100ft net night) of target species caught in POOL habitat with gillnets over increasing temperatures

Temp C°	≤1		2		3		4		9		10		11		12		13	
	Macro Effort	ISB	OSB	ISB	OSB	ISB	OSB	ISB	OSB	ISB	OSB	ISB	OSB	ISB	OSB	ISB	OSB	ISB
Shovel. St. <u>N</u>	61	592	21	784	251	203	32	26	30	163	47	164	24	290	38	441	387	
Shovel. St. <u>CPUE</u>	10.2	22.8	5.3	12.6	7.8	11.3	7.4	6.5	7.5	11.6	4.7	27.3	4.8	12.1	7.6	15.8	17.6	
Sauger <u>N</u>	6	7	1	12	12	3								11		1		
Sauger <u>CPUE</u>	1.0	0.27	0.25	0.19	0.37	0.17								0.46		0.04		
Lake St. <u>N</u>	7	7		7	2	2		1		1		1		3		7	6	
Lake St. <u>CPUE</u>	1.2	0.27		0.11	0.06	0.11		0.25		0.07		0.17		0.13		0.25	0.27	
Shovel. St. Hyb. <u>N</u>		1	1	1						2				2		1	1	
Shovel. St. Hyb. <u>CPUE</u>		0.04	0.25	0.02				0.25		0.07							0.05	
Pallid St. <u>N</u>																	1	
Pallid St. <u>CPUE</u>																	0.05	

Gear Comparisons

Mean lengths of shovelnose sturgeon were compared between gears and within gillnet mesh sizes using an ANOVA. All gears and mesh sizes caught statistically different ($P < 0.001$) sizes of sturgeon, with the exception of 2 and 4 inch mesh (Table 8). The difference between mesh sizes was relatively small however, and probably not biologically important. Notably, all gears caught large and small sturgeon, but otter trawls and trammel nets caught the widest range of sizes. Gillnets showed bias against smaller sturgeon ($< 350\text{mm}$) (Figure 6). This suggests that stocked pallid sturgeon would not be recruiting to the gear in 2003 and would not be expected to begin to recruit until age three.

Table 8. Average length (mm) of shovelnose sturgeon captured in trammel nets, trawls and four experimental gillnet mesh sizes. Using an ANOVA, all gears and mesh sizes were determined to be statistically different (< 0.001), except for mesh sizes 2 and 4).

<u>Mesh/gear</u>	<u>N</u>	<u>Mean</u>	<u>SE</u>	<u>min</u>	<u>max</u>
1.5	1662	560	1.72	286	740
2	1527	587	1.39	204	735
3	351	600	2.98	315	740
4	214	580	4.68	272	707
trammel	842	539	3.66	90	751
trawl	561	505	6.16	20	710

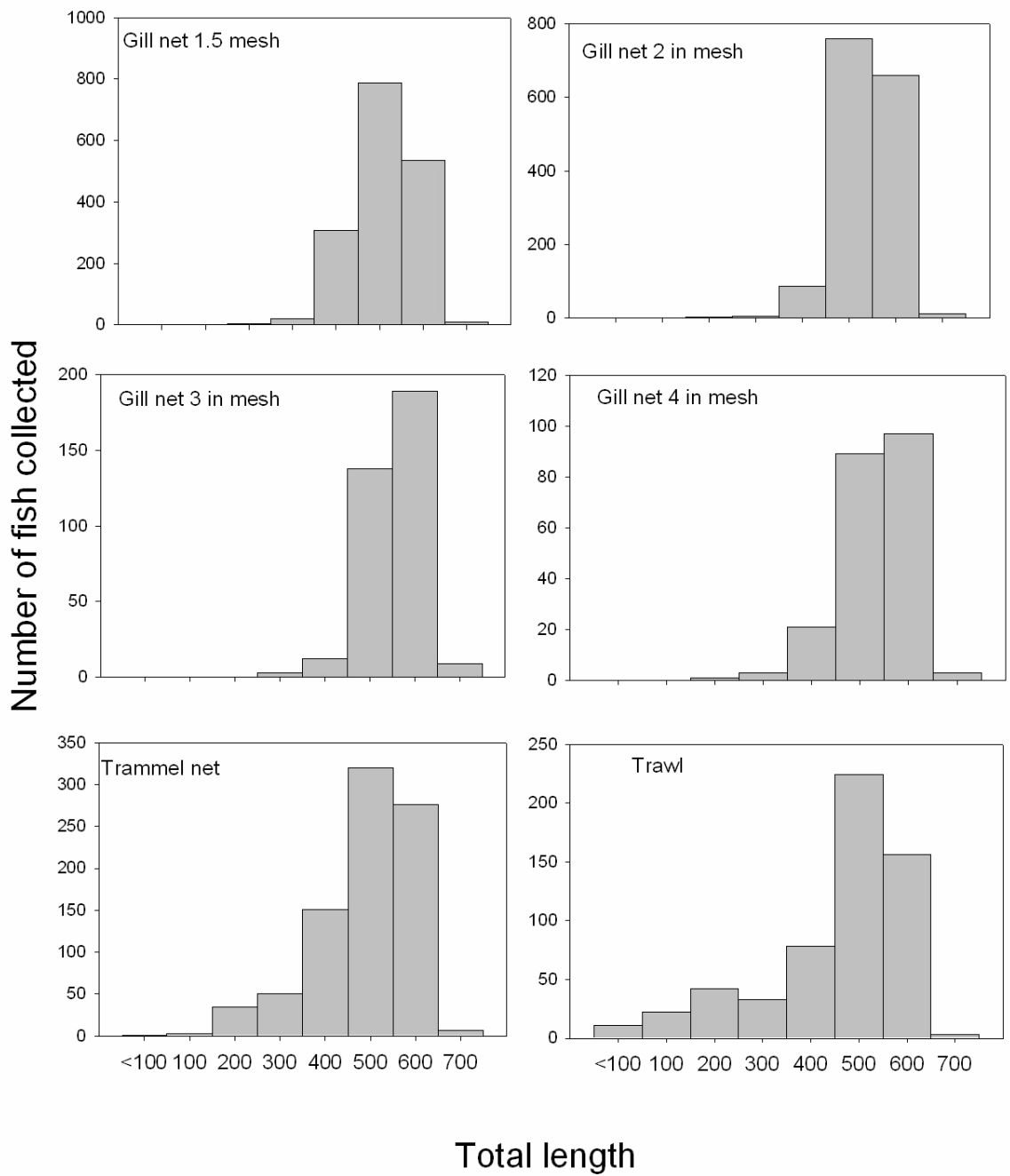


Figure 6. Proportion of shovelnose sturgeon captured within different gears and gillnet mesh sizes in the Lower Missouri River in 2003 (N = 5,517).

Summary and Discussion

Pallid sturgeon did not appear to be susceptible to gillnets in POOL habitat during drought conditions. Gillnetting in previous years at more normal flows has produced more pallids relative to the effort expended. Shallow water habitat is likely important to pallid sturgeon throughout the winter months as well as the rest of the year.

More effort should be expended in alternate habitats as they occur. Island-tip, OSB-CHNB, CONF and side-channel habitat appear to be important to target fishes, YOY sturgeon and likely pallid sturgeon. These habitats are not available in every bend, so target species affinity to these habitats may not be fully realized.

It is known that pallid sturgeon are collected in hoop nets and strategically set gillnets deployed by commercial fishermen during seasonal spawning runs. Shovelnose sturgeon and blue suckers were most vulnerable to capture in hoop nets during this spring period. Developing strategies for gillnet placement on dikes to intercept moving fish along with stratified use of hoop nets seasonally, rather than throughout the year may increase our ability to sample important species.

Adaptive sampling methods have already yielded higher numbers of pallid sturgeon, YOY and target fish in 2004. Increased effort across different habitat types will be important in coming years to prove the necessity for changing flows and increasing shallow water habitat on the Missouri River.

Acknowledgments

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Literature Cited

- Drobish, M. 2003. Long-term pallid sturgeon and associated fish community assessment for the Missouri River and standardized guidelines for sampling and data collection. (DRAFT).
- Carlson, D.M., W.L. Plieger, L. Trial and P.S. Haverland. 1985. Distribution, biology and hybridization of *Scaphirhynchus albus* and *S. platyrhynchus* in the Missouri and Mississippi Rivers. *Environmental Biology of Fishes* 14(1):51-59.
- Grady, J.M., J. Milligan, C. Gemming, D. Herzog, G. Mestl, and R.J. Sheehan. 2001. Pallid and shovelnose sturgeons in the Lower Missouri and Middle Mississippi Rivers. Final Report for MICRA.
- Ruelle, R. and K.D. Keenlyne. 1994. The Suitability of Shovelnose Sturgeon as a Surrogate for Pallid Sturgeon. *Proceedings of South Dakota Academy of Sciences* Vol 73: 67-81.
- National Research Council. 2002. *The Missouri River Ecosystem: Exploring the Prospects for Recovery*. National Academy Press, Washington, D. C.
- Pflieger, W.L. and T.B. Grace. 1987. Changes in the Fish Fauna of the Lower Missouri River, 1940-1983, pp. 166-177. *In: Community and Evolutionary Ecology of North American Stream Fishes*. W.J. Matthews and D.C. Heins (eds.). Univ. of Okla. Press, Norman.
- Sheehan, R.J., R.C. Heidinger, P.S. Wills, M.A. Schmidt, G.A. Conover, and K.L. Hurley. 1999. Guide to the Pallid Sturgeon Shovelnose Sturgeon Character Index (CI) and Morphometric Character Index (mCE). *SIUC Fisheries Bulletin* No. 14, Southern Illinois University, Carbondale, Illinois. 16pp.
- U.S. Fish and Wildlife Service. 2000. *Biological Opinion on the Operation of the Missouri River Main Stem Reservoir System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System*. Fort Snelling, MN.

Appendix A

GIS maps of pallid sturgeon capture locations and associated sturgeon species samples. Map includes method of capture within seasons. Juvenile and YOY codes show the presence of younger shovelnose sturgeon, while white symbols show samples where no target species were captured (including those other than sturgeon).

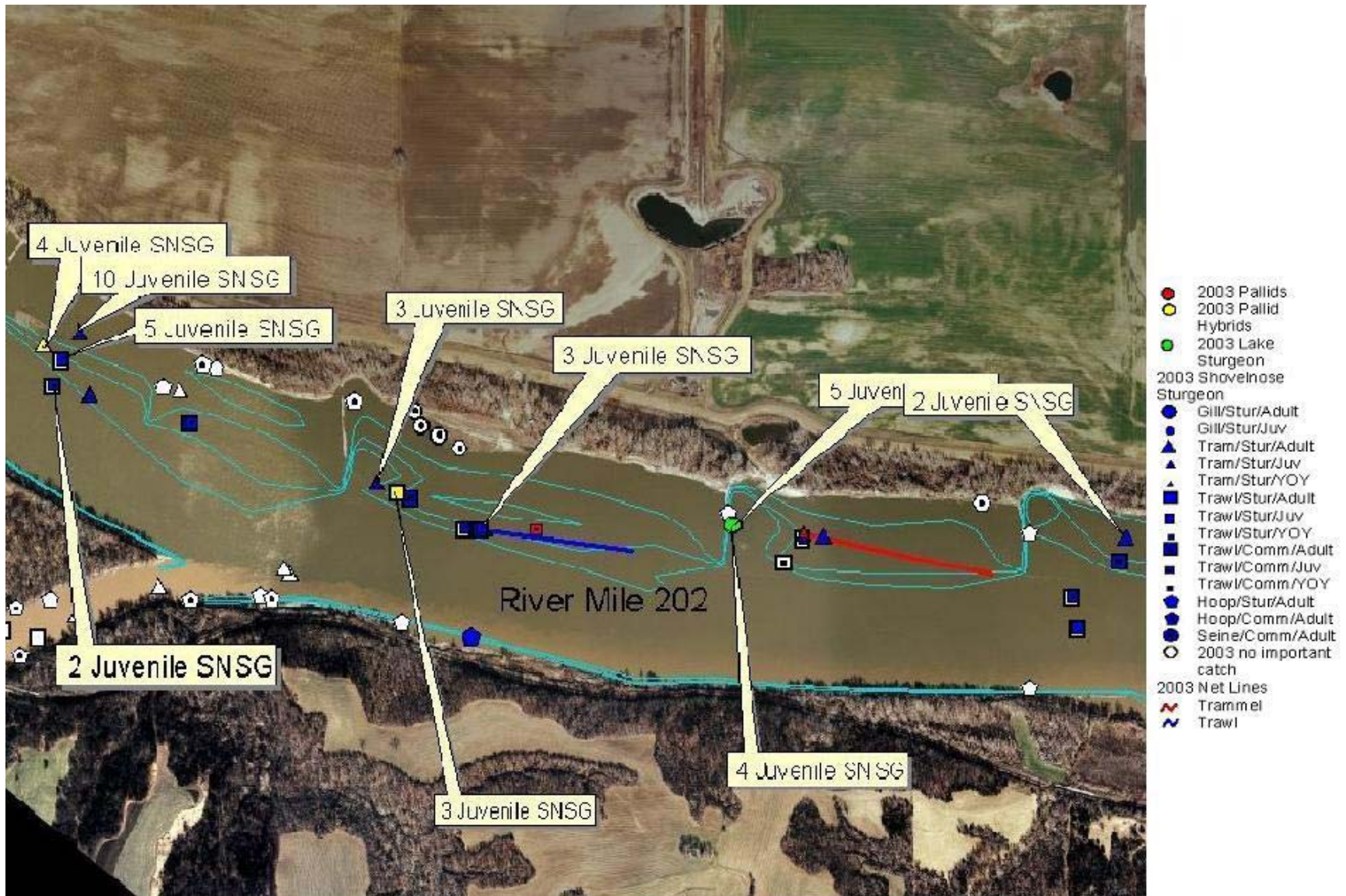


Figure A1. Shows location of two stocked pallid sturgeon captured on 7/16/03 (blue/trammel net/ RM 201.7) and 10/22/03 (red/trawl/ 202.1). Associated bend samples show presence of sturgeon and absence of target species.

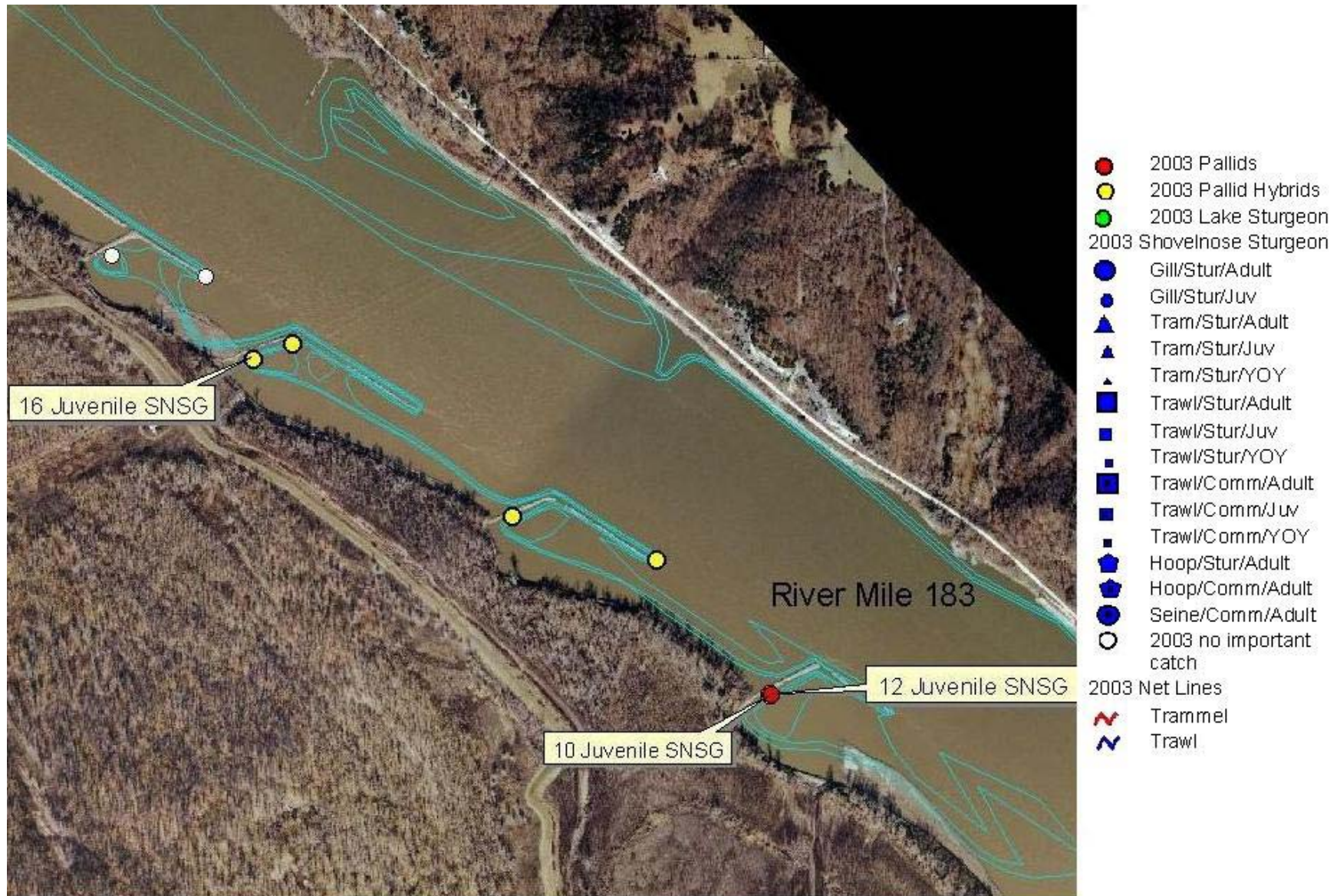


Figure A2. Shows location of an adult pallid sturgeon captured in an overnight gill net on 3/26/03 at RM 183.0. This fish was subsequently tagged with a sonic transmitter by USGS. Associated bend samples show presence of sturgeon and absence of target species.

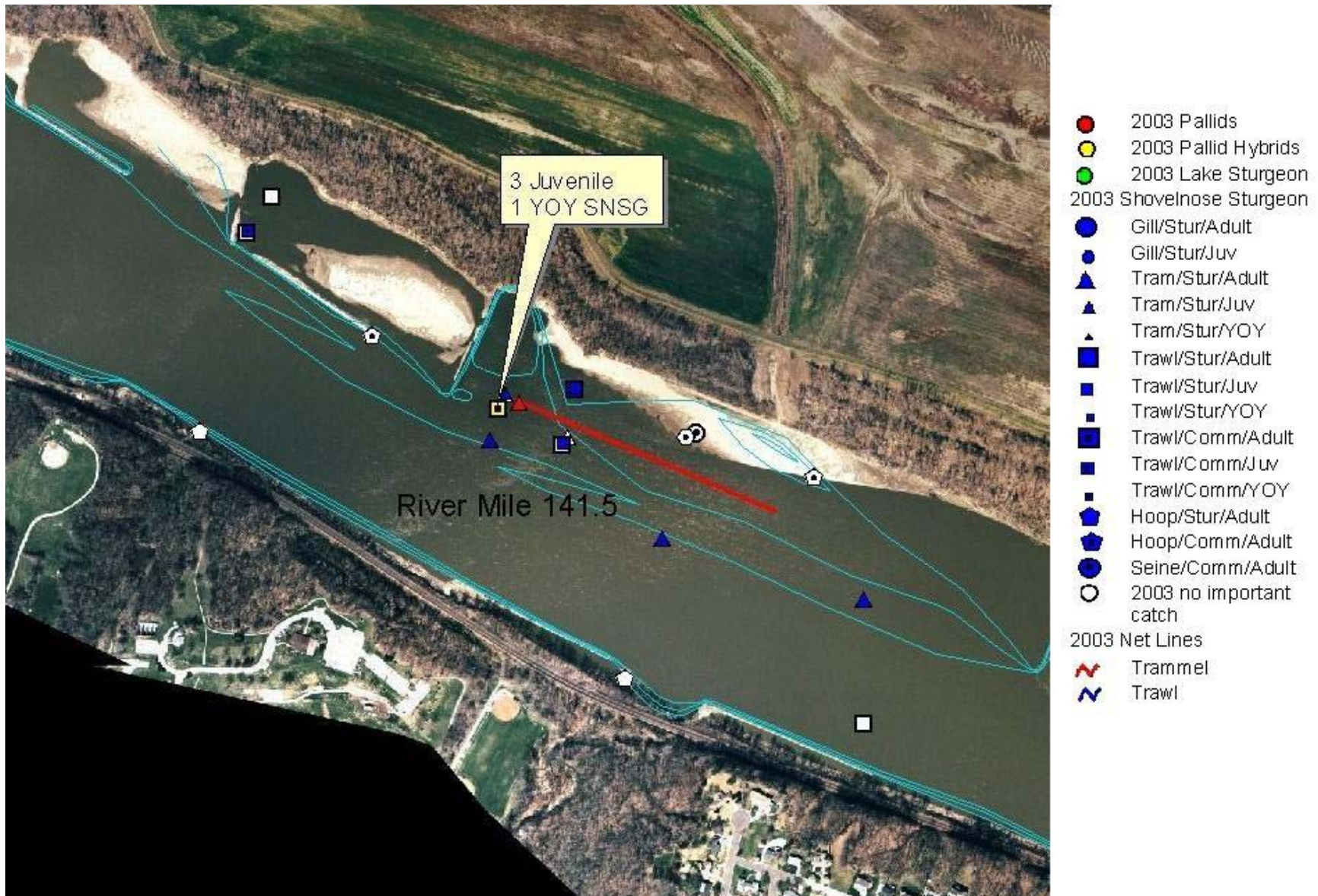


Figure A3. Shows location of adult pallid sturgeon captured on 5/2/03 in a drifted trammel net at RM 141.5. Associated bend samples show presence of sturgeon and absence of target species.

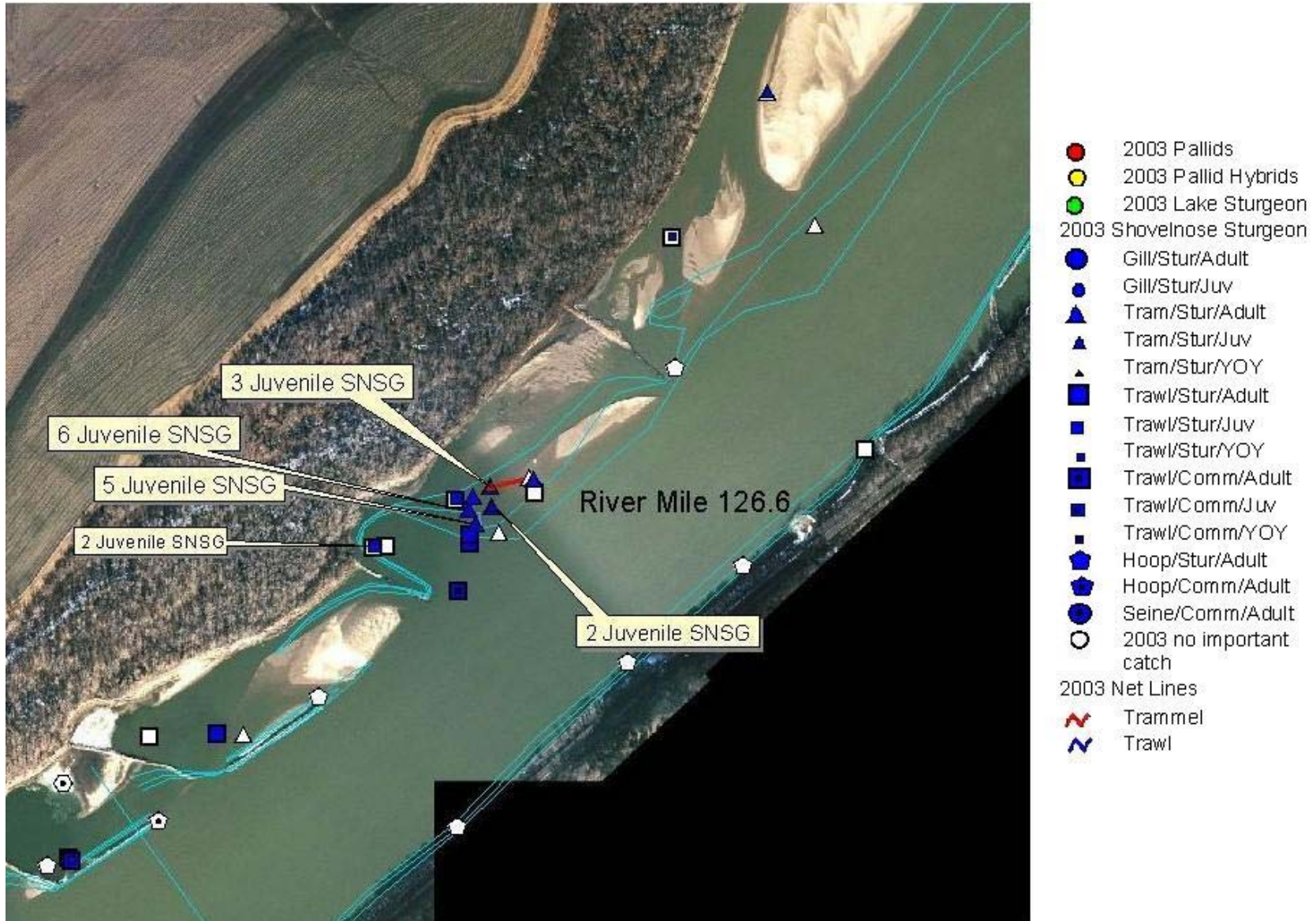


Figure A4. Shows location of an adult pallid sturgeon captured on 6/17/2003 at RM 126.6 in a drifted trammel net. Upper wing dike and notch of upper L-dike was overflowing at the time. Associated bend samples show presence of sturgeon and absence of target species.



Figure A5. Shows location of an adult pallid captured on 8/4/2003 at RM 44.4 in an otter trawl tow. Photograph does not depict drop-offs that occurred where depths changed from 0.5m to 3m on the edge of the channel border. Numerous shovelnose were captured at this site in successive trammel net drifts. Associated bend samples show presence of sturgeon and absence of target species.

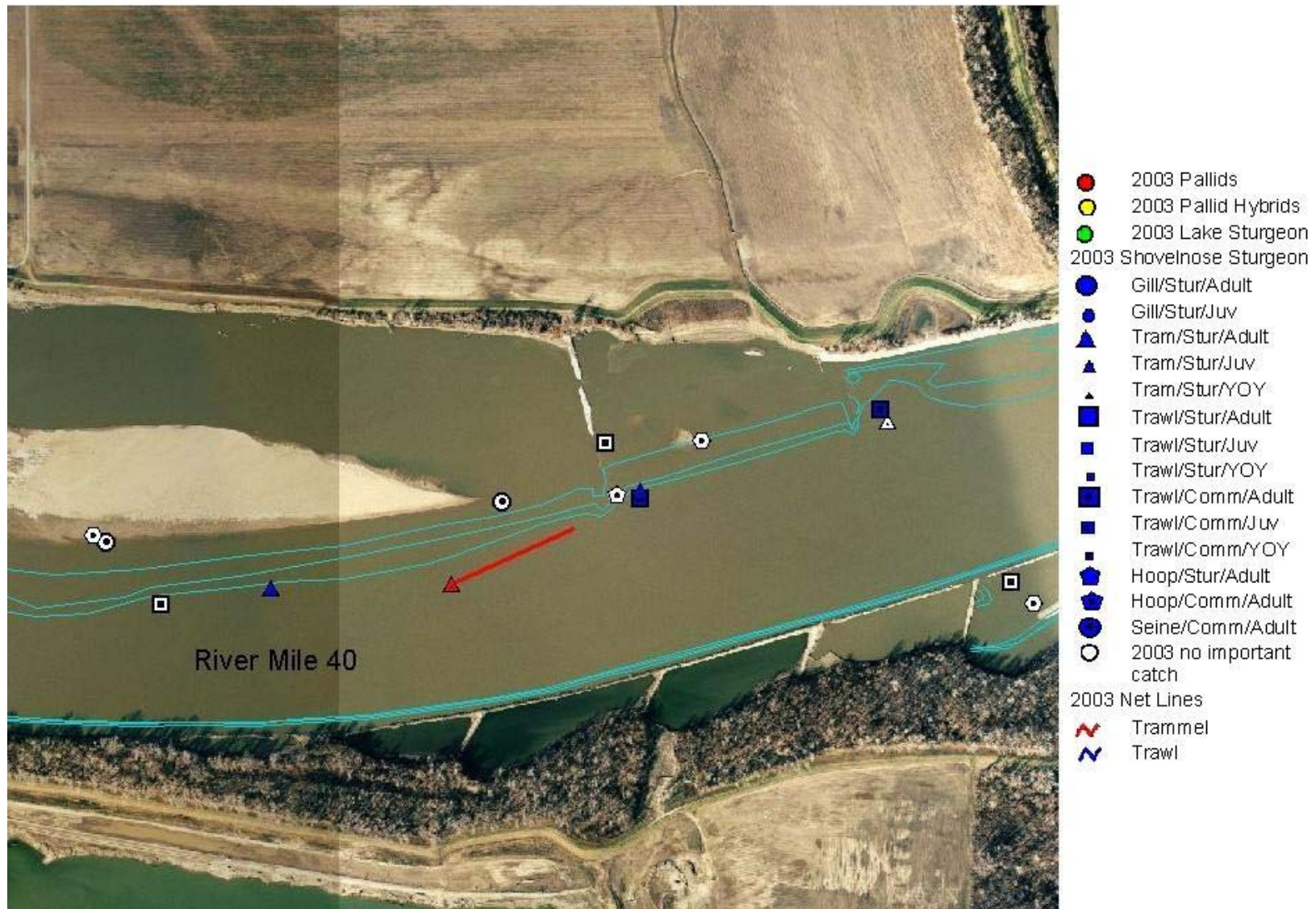
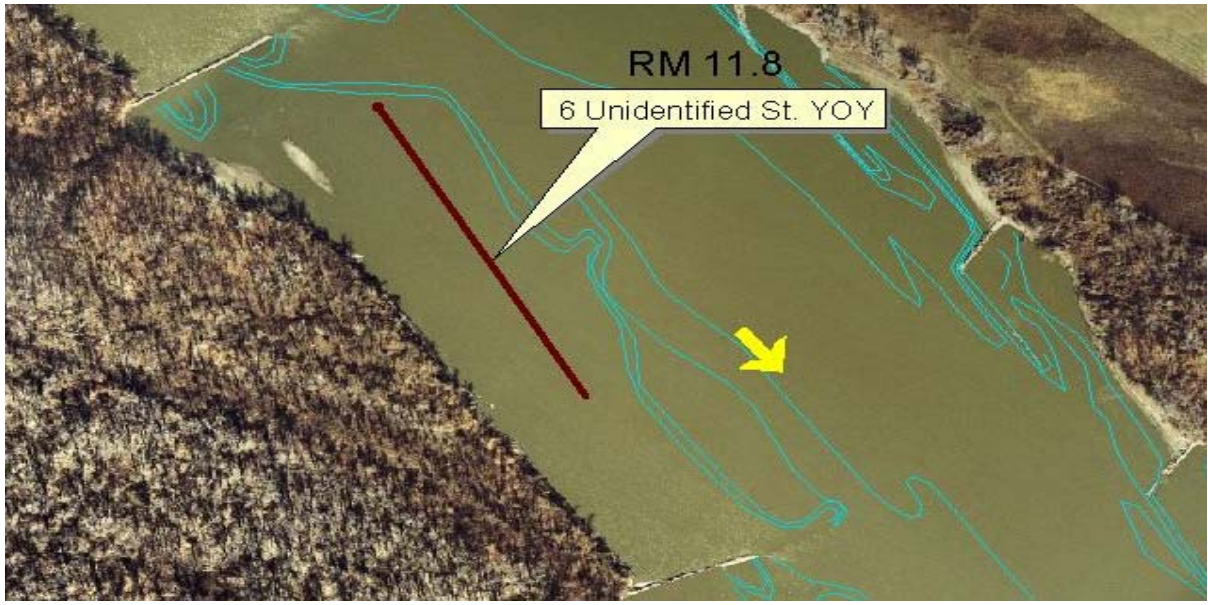


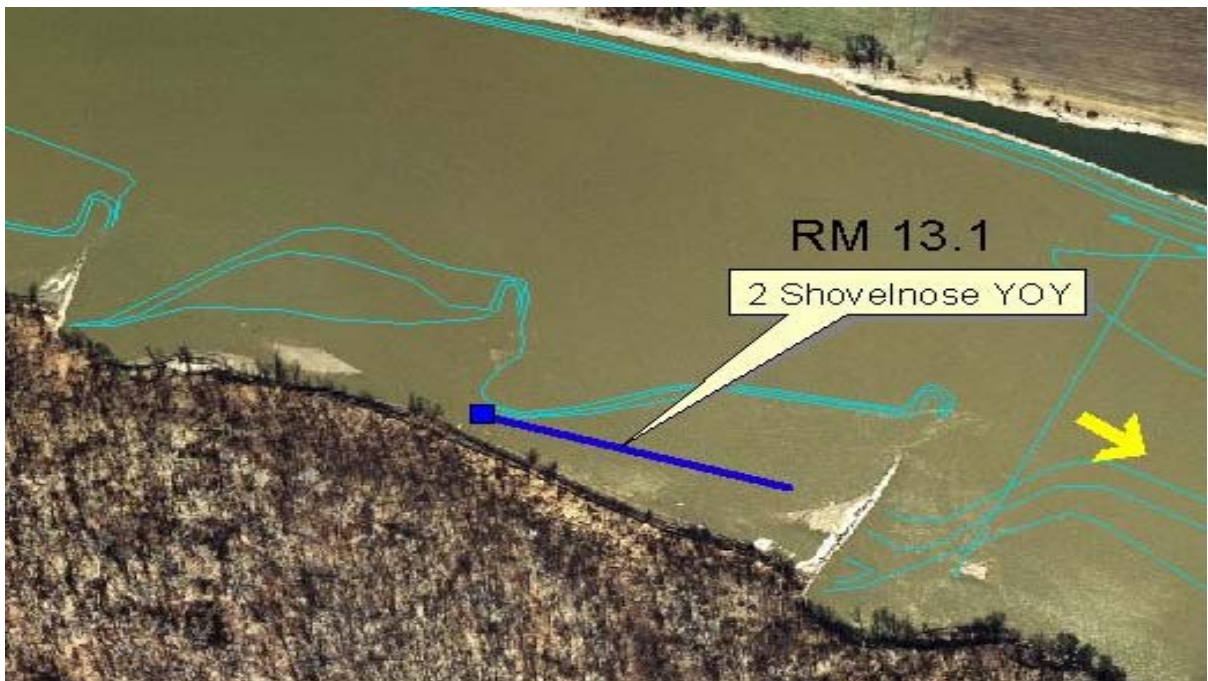
Figure A6. Shows location of an adult pallid sturgeon captured on 8/5/04 at RM 40.2 in a trammel net drift. Photograph does not depict sharp drop-offs that occurred where the depth changed from 0.5m to 3.5m towards the end of the sand bar. Associated bend samples show presence of sturgeon and absence of target species.

Appendix B

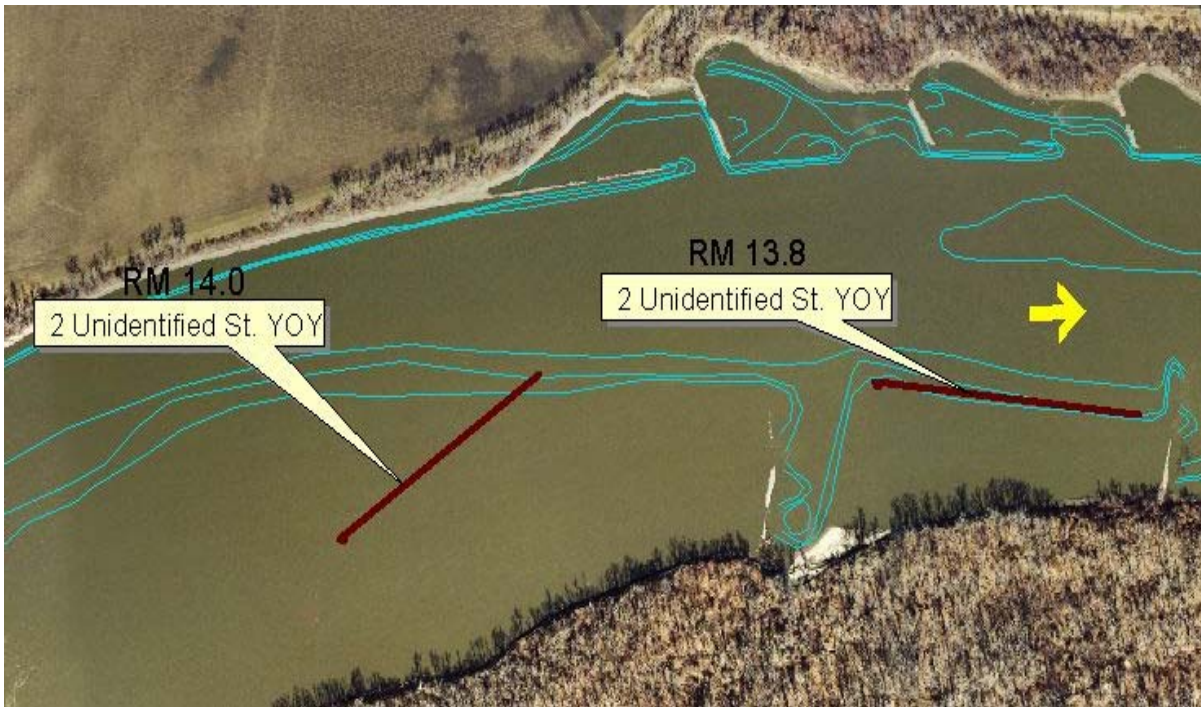
GIS locations of YOY (Young of Year) sturgeon captures
using a 16ft. otter - trawl in 2003.



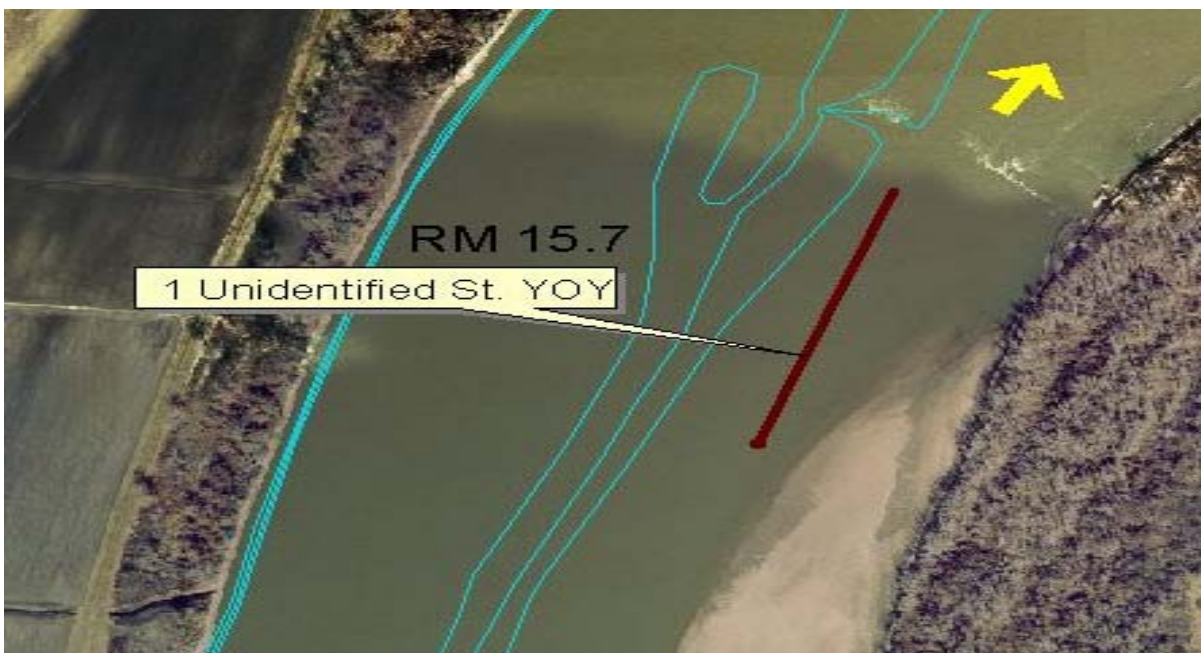
B1. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



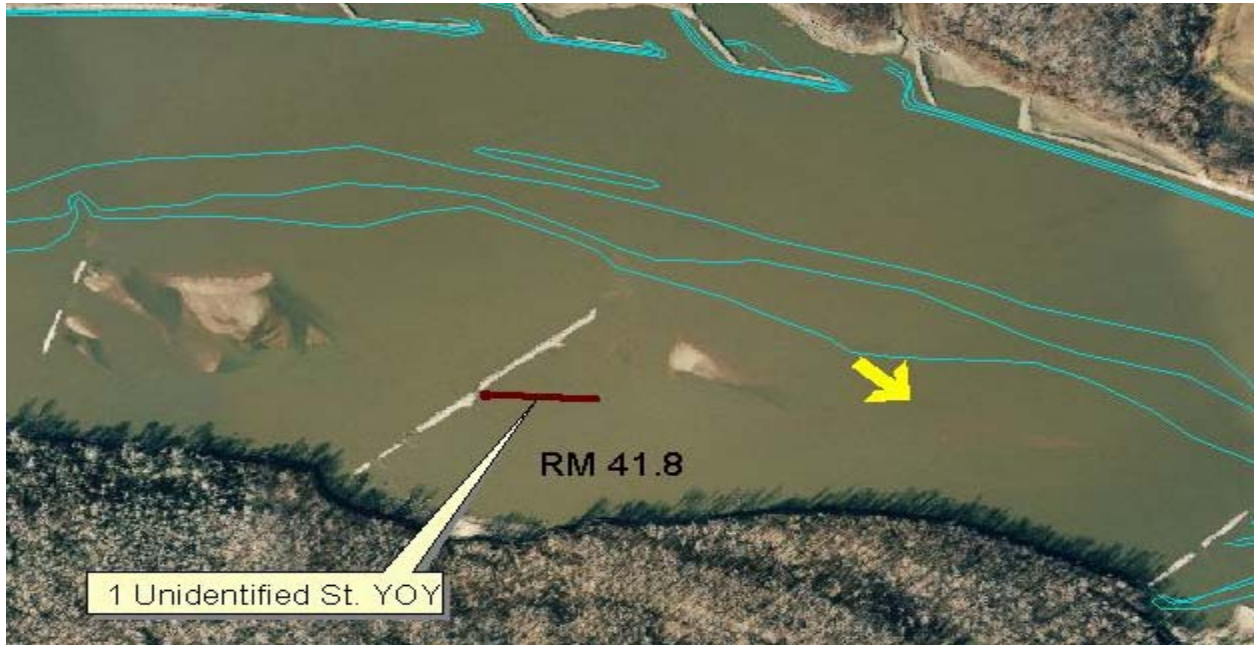
B2. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



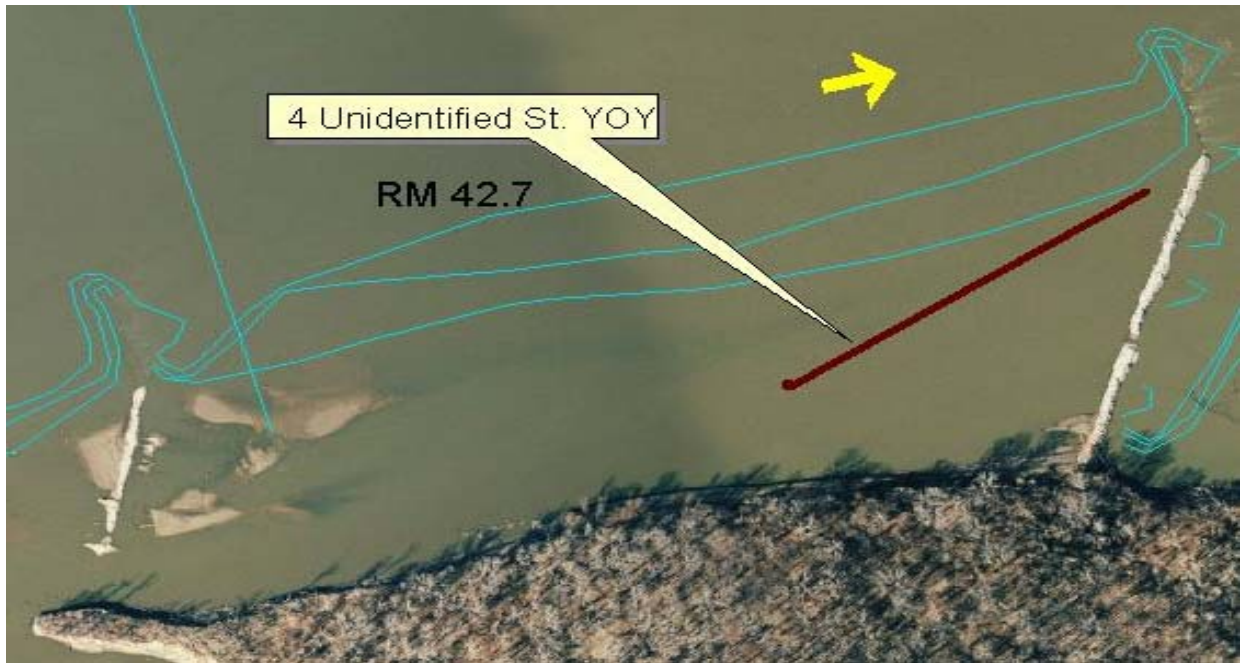
B3. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



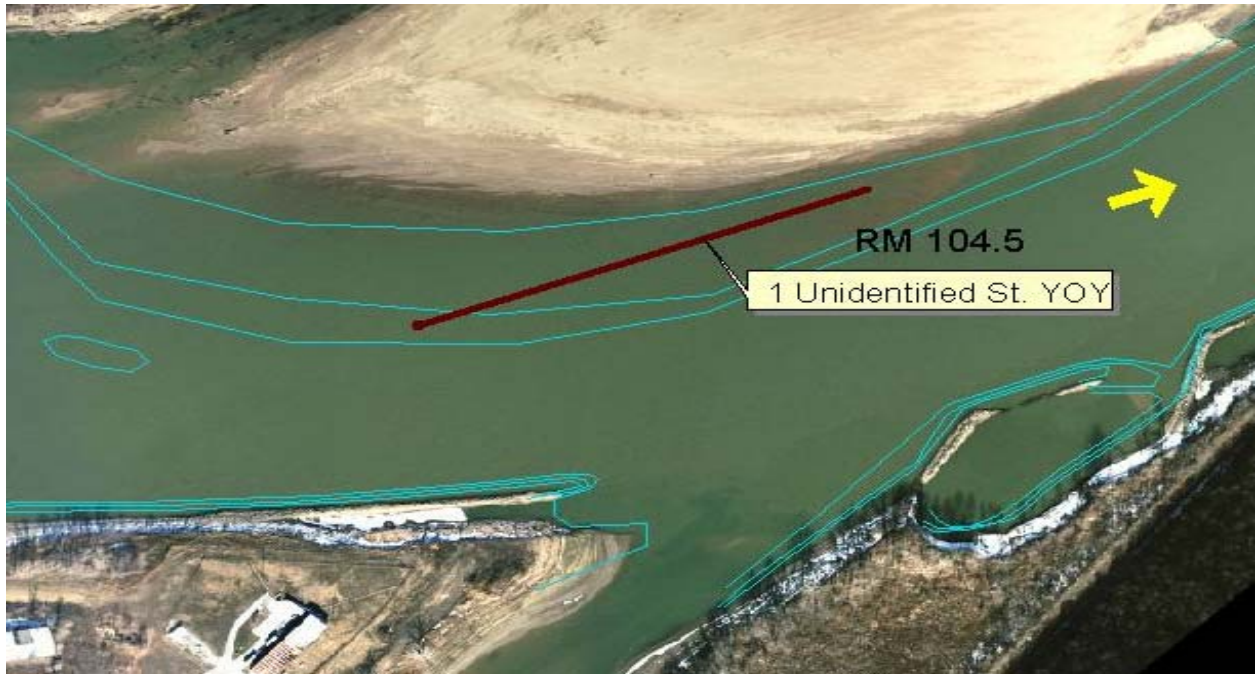
B4. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



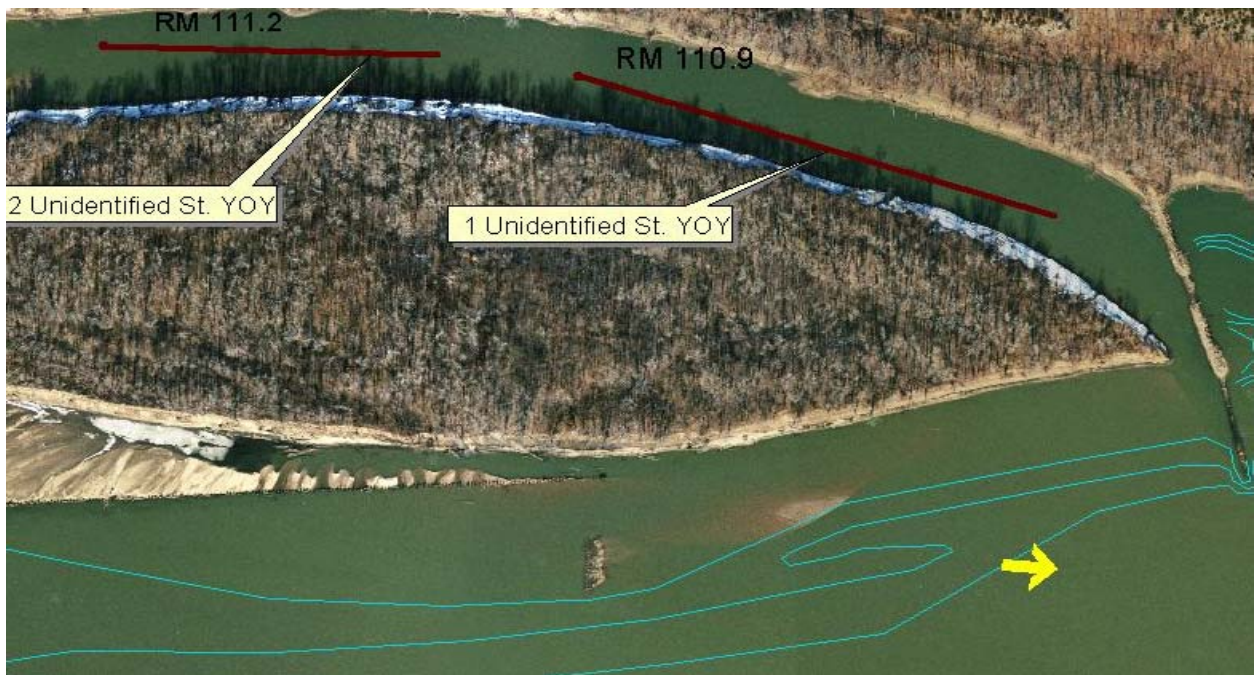
B5. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B6. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B7. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B8. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B9. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



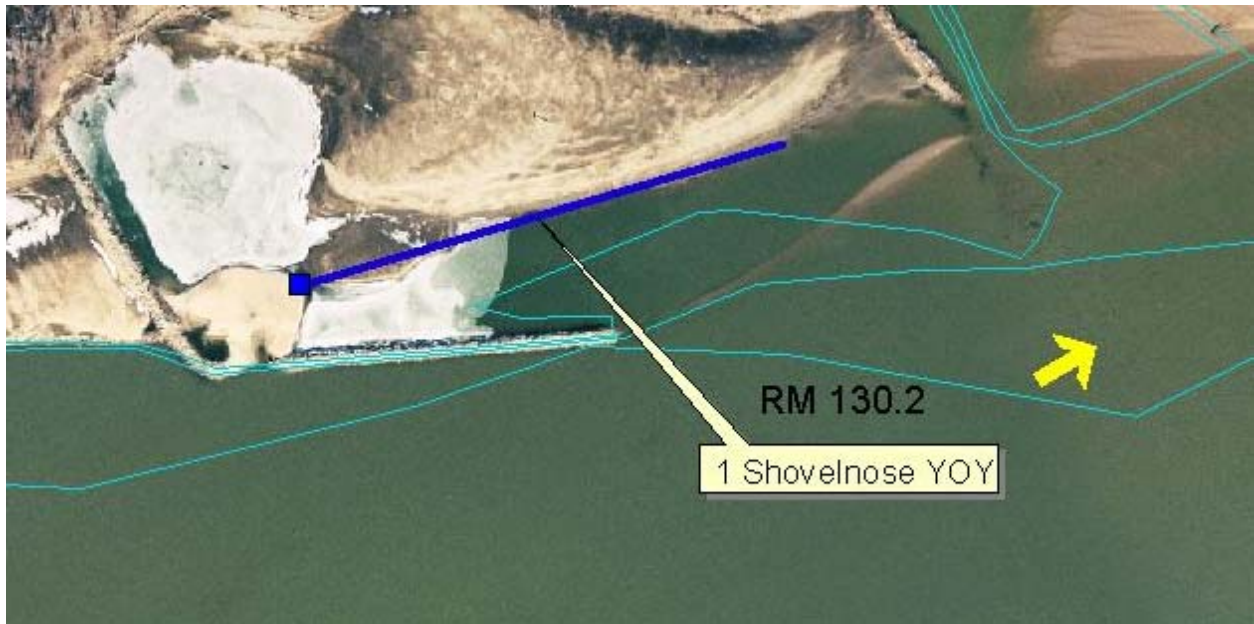
B10. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



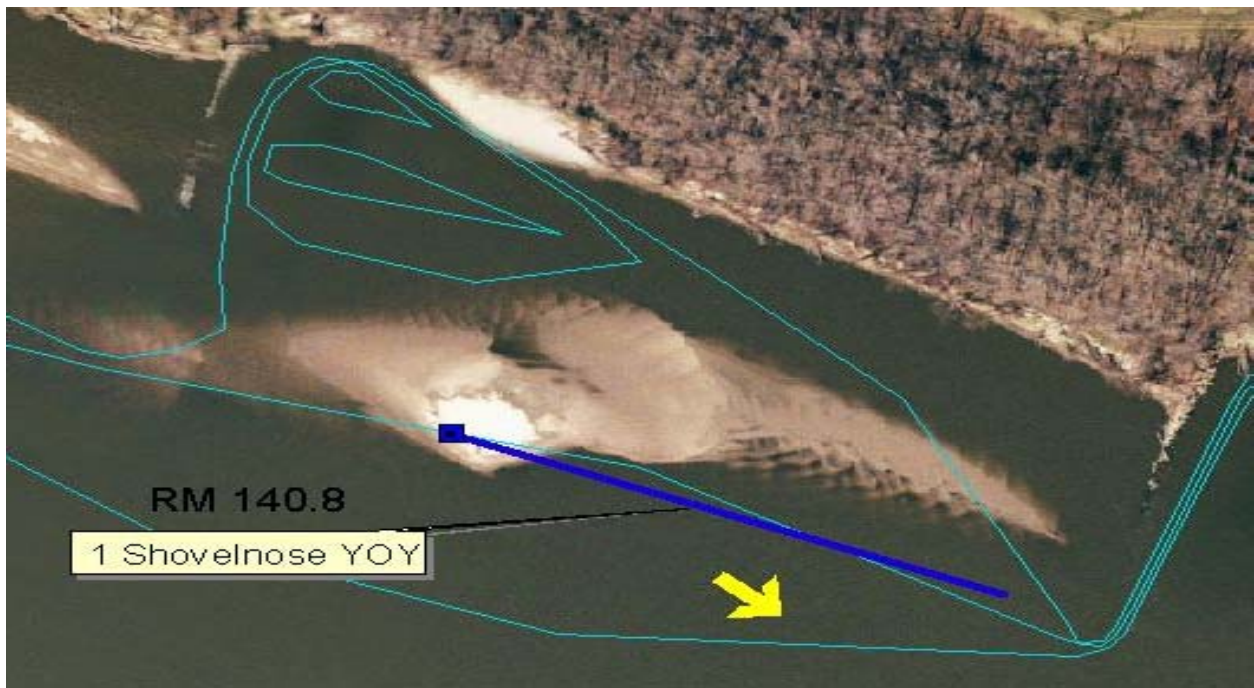
B11. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B12. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



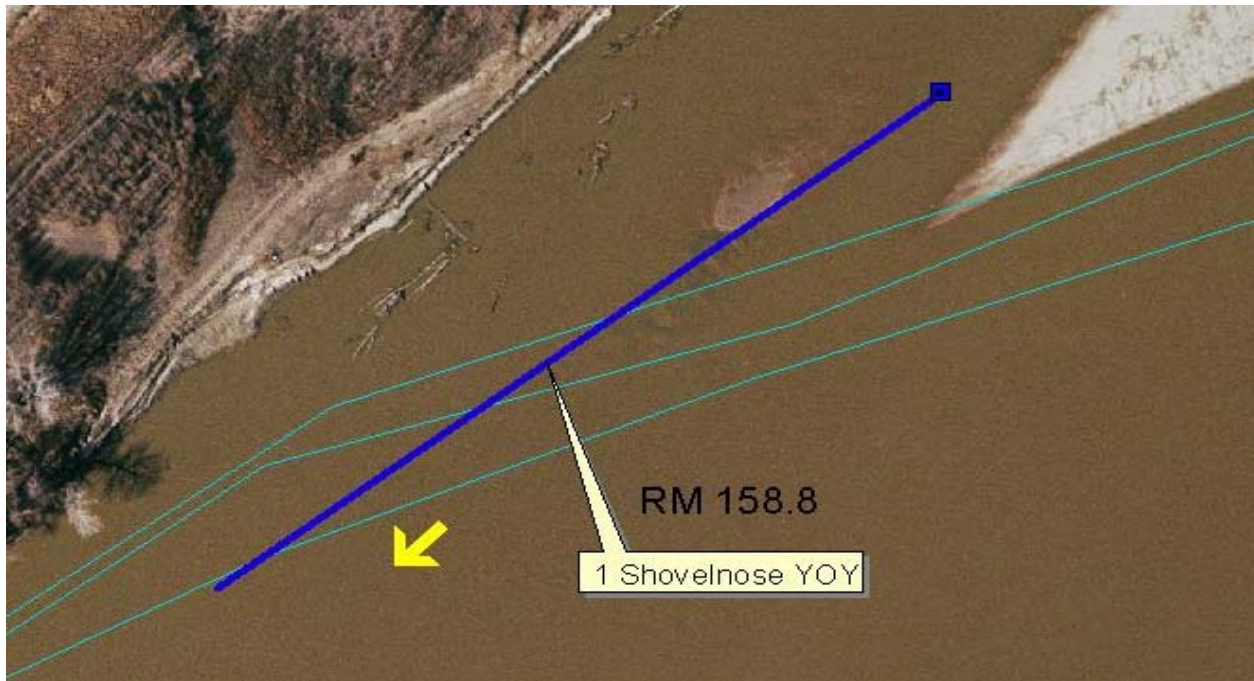
B13. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B14. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B15. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B16. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B17. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B18. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



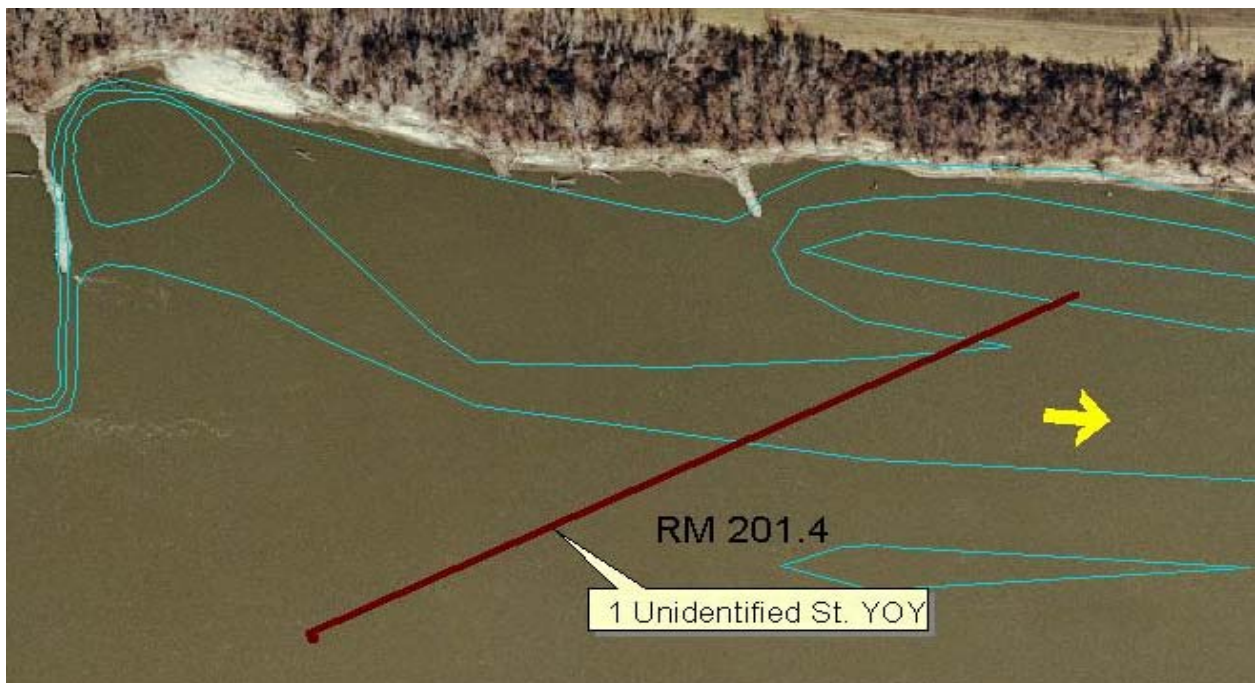
B19. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



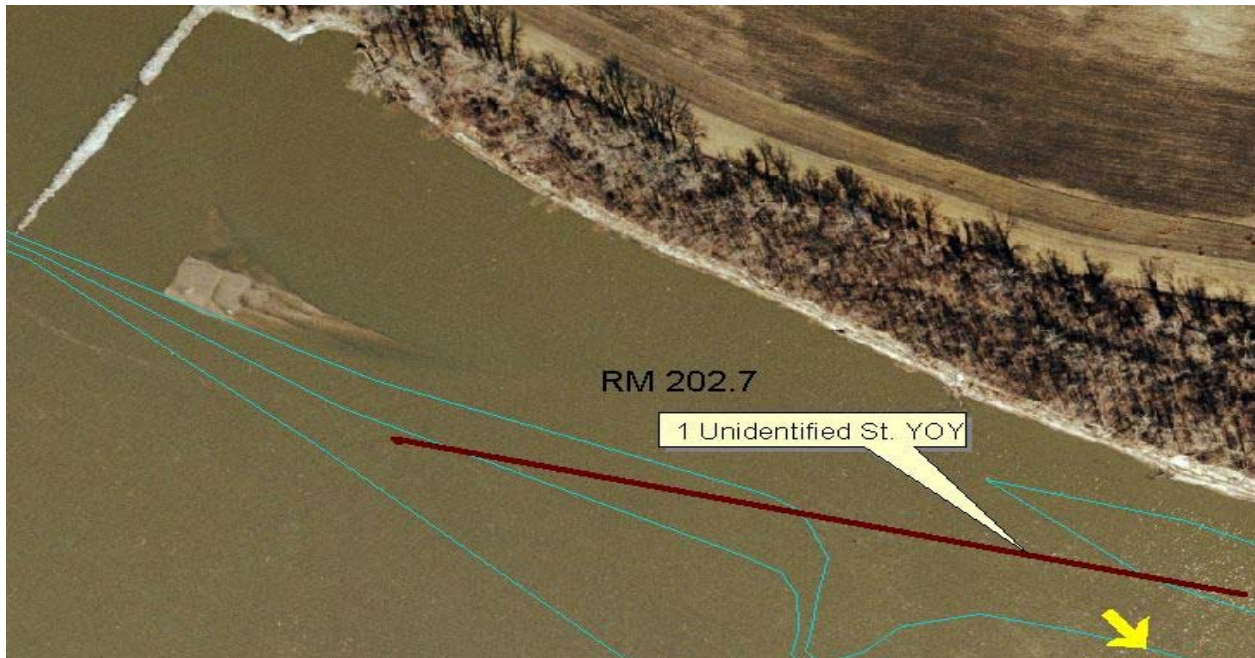
B20. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



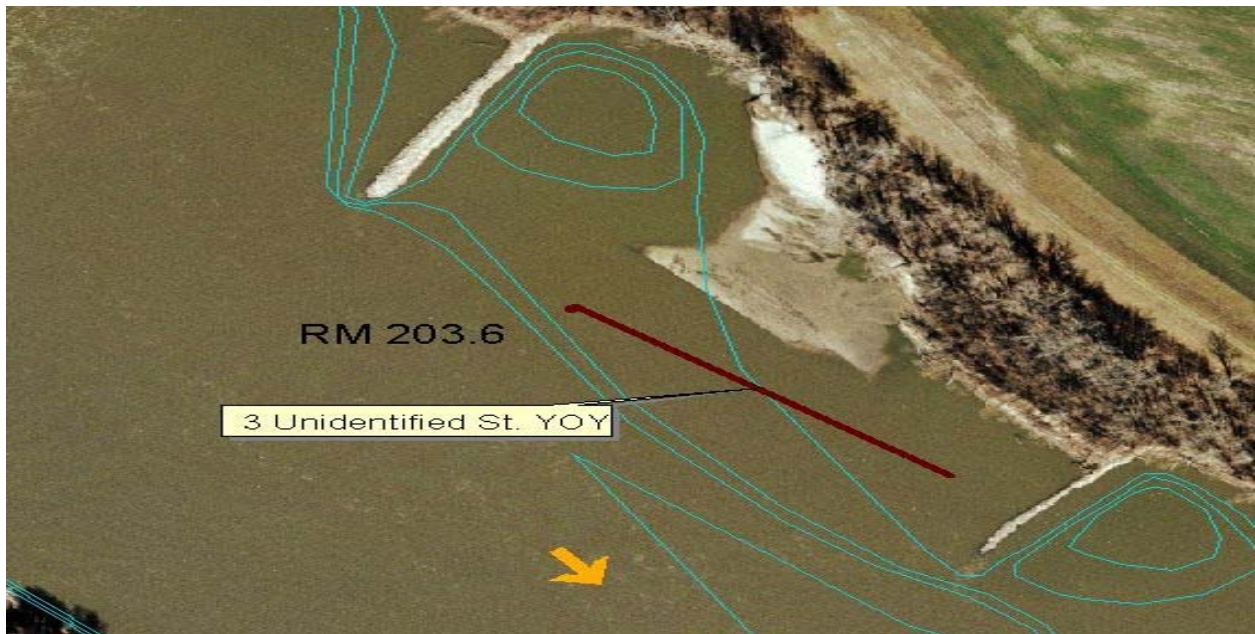
B21. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



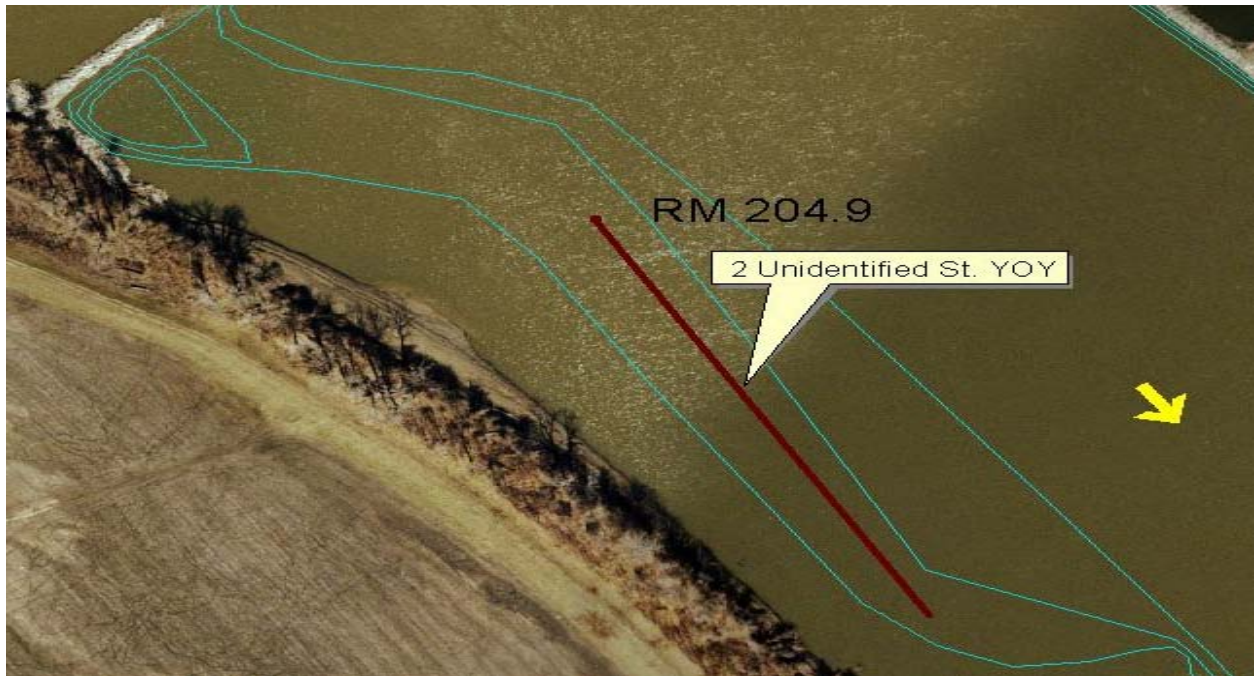
B22. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B23. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B24. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B25. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.



B26. YOY sturgeon captured with an Otter Trawl in the Missouri River for 2003.

Appendix C

Species Code List & Segment 13 tables for Sturgeon and Community Sampling

Table C1. Code and species list for target, invasive and native Missouri River fish.

Code	Common Name	Code	Common Name
Target Species			
BMBF	Big Mouth Buffalo	SKCB	Speckled Chub
BUSK	Blue Sucker	SNPD	Shovelnose/Pallid Hybrid
HBNS	Hybognathus spp.	SNSG	Shovelnose Sturgeon
LKSG	Lake Sturgeon	SNSN	Sand Shiner
PDSG	Pallid Sturgeon	U-HY	Unidentified Chub
SFCB	Sicklefin Chub	U-SG	Unidentified Sturgeon
SGER	Sauger		
Invasive Species			
BHCP	Bighead Carp		
CARP	Common Carp		
GSCP	Grass Carp		
SVCP	Silver Carp		
Native Species			
BHMW	Bullhead Minnow	NHSC	Northern Hog Sucker
BKSS	Brook Silverside	NTSF	Northern Studfish
BLCF	Blue Catfish	OSSF	Orange Spotted Sunfish
BLCP	Black Crappie	PDFH	Paddlefish
BLGL	Bluegill	QLBK	Quillback
BNMW	Bluntnose Minnow	RDSN	Red Shiner
CLSR	Central Stoneroller	RVCS	RiverCarp sucker
CNCF	Channel Catfish	SBSN	Silverband Shiner
CNLP	Chestnut Lamprey	SBWB	Striped/ White Bass Hybrid
CNSN	Channel Shiner	SGCB	Sturgeon Chub
ERSN	Emerald Shiner	SHRH	Shorthead Redhorse
FHCF	Flathead Catfish	SMBF	Smallmouth Buffalo
FHMW	Fathead Minnow	SMBS	Smallmouth Bass
FWDM	Freshwater Drum	SNGR	Shortnose Gar
GDEY	Goldeye	SVCB	Silver Chub
GDRH	Golden Redhorse	UCF	Unidentified Catfish
	Green Sunfish/ Orangespotted	U-CN	Unidentified Sunfish
GSOS		U-CY	Unidentified Minnow
GZSD	Gizzard Shad	U-DR	Unidentified Lamprey
HFCS	HighFin Carpsucker	UNID	Unidentified fish
LNGR	Longnose Gar	WLYE	Walleye
LMBS	Largemouth Bass	WTBS	White Bass
MMSN	Mimic Shiner	WTCP	White Crappie
MNEY	Mooneye	WTSK	White Sucker
MQFH	Mosquitofish		

Table C2. Gillnets; sturgeon season summary for segment 13. Lists CPUE and fish sampled by habitat type in 5 ten mile reaches on the Lower Missouri River in 2003.

MACRO MESO EFFORT	ISB						OSB						SCCS		TRMS		Grand Total	
	CHNB		POOL		Total		CHNB		POOL		Total		ITIP		1		310	
	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE
BMBF**			1	0.01	1		1	0.07	3	0.03	4	0.04			5	0.02		
BUSK**	5	0.26	5	0.03	10	0.05			1	0.01	1	0.01			11	0.04		
LKSG**			36	0.19	36	0.17	1	0.07	8	0.09	9	0.09			45	0.15		
PDSG**									1	0.01	1	0.01			1	0.00		
SGER**	7	0.37	45	0.24	52	0.25	3	0.21	9	0.10	12	0.12			59	0.19		
SNPD**			6	0.03	6	0.03			2	0.02	2	0.02			8	0.03		
SNSG**	89	4.68	2774	14.76	2863	13.83	92	6.57	830	9.65	922	9.22	16	8	3801	12.26		
BHCP*			4	0.02	4	0.02			2	0.02	2	0.02			6	0.02		
GSCP*			8	0.04	8	0.04	8	0.57	3	0.03	5	0.05	2	1	15	0.05		
SVCP*			9	0.05	9	0.04			1	0.01	1	0.01			10	0.03		
BKCP			1	0.01	1										1	0.00		
BLCF			159	0.85	159	0.77	14	1.00	58	0.67	72	0.72			231	0.75		
CARP	1	0.05	29	0.15	30	0.14	6	0.43	37	0.43	43	0.43	1	0.5	1	1	75	0.24
CNCF	3	0.16	41	0.22	44	0.21			29	0.34	42	0.42	1	0.5	3	3	90	0.29
CNLP			1	0.01	1										1	0.00		
FHCF	1	0.05	4	0.02	5	0.02			4	0.05	4	0.04			9	0.03		
FWDM			54	0.29	54	0.26	12	0.86	10	0.12	22	0.22			1	1	77	0.25
GDEY	11	0.58	369	1.96	380	1.54	30	2.14	125	1.45	155	1.55			535	1.73		
GDRH			10	0.05	10	0.05	4	0.29	58	0.67	62	0.62			72	0.23		
GZSD			36	0.19	36	0.17			33	0.38	41	0.41			1	1	78	0.25
HFCS			2	0.01	2	0.01			1	0.01	1	0.01			3	0.01		
LMBS											1	0.01			1	0.00		
LNGR			32	0.17	32	0.15			17	0.20	17	0.17			49	0.16		
MNEY			1	0.01	1				1	0.01	1	0.01			2	0.01		
NHSK									1	0.01	1	0.01			1	0.00		
PDFH	1	0.05	11	0.06	12	0.06			6	0.07	6	0.06			18	0.06		
QLBK			2	0.01	2	0.01			1	0.01	1	0.01			3	0.01		
RVCS			58	0.31	58	0.28	9	0.64	58	0.67	67	0.67			125	0.40		
SBWB			1	0.01	1				2	0.02	2	0.02			3	0.01		
SHRH	8	0.42	13	0.07	21	0.10	2	0.14	15	0.17	17	0.17			2	2	40	0.13
SMBF			23	0.12	23	0.11	1	0.07	26	0.30	27	0.27			50	0.16		
SMBS									1	0.01	1	0.01			1	0.00		
SNGR			45	0.24	45	0.22	1	0.07	39	0.45	40	0.40			1	1	86	0.28
WLYE	1	0.05	2	0.01	3	0.01									3	0.01		
WTBS			4	0.02	4	0.02	1	0.07	4	0.05	5	0.05			9	0.03		
WTCP	2	0.11			2	0.01			1	0.01	1	0.01			3	0.01		
WTSK	1	0.05	4	0.02	5	0.02	1	0.07	15	0.17	16	0.16			1	1	22	0.07
Total	130	6.84	3790	20.18	3920	18.59	186	13.27	1402	16.24	1604	16.04	20	10	10	10	5549	17.91

** (blue) – target species

* (red) - invasive species

Table C3. Otter trawl: sturgeon season summary for segment 13. Lists CPUE (fish/100m) fish sampled by habitat type in the Lower Missouri River in 2003.

MACRO MESO EFFORT	CONF			ISB				OSB				SCCL			TRML			TRMS	GRAND TOTAL																	
	CHNB	POOL	TOTAL	CHNB	POOL	TLWG	TOTAL	CHNB	POOL	TLWG	TOTAL	ITIP	TLWG	TOTAL	CHNB	TLWG	TOTAL	2.29	265.45																	
Species	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE																
BMBF**														1	0.23	1	0.09			1	0.01															
BUSK**				1	0.01	1	0.05	2	0.01					1	0.16	1	0.09			3	0.01															
SFCB**				23	0.18	1	0.05	24	0.16	7	0.18	5	0.15	12	0.16	1	0.23	1	0.09	37	0.14															
SGCB**				2	0.02	1	0.05	3	0.02			1	0.03	1	0.01					4	0.02															
SGER**				2	0.02			2	0.01					16	3.63	16	1.49			18	0.07															
SKCB**	14	0.70	14	0.67	108	0.85	8	0.43	116	0.78	1	0.63	25	0.65	6	0.17	32	0.43	6	0.95	168	0.63														
SNPD**	1	0.05	1	0.05																1	0.01															
SNSG**	35	1.76	35	1.68	133	1.05	13	0.71	146	0.99			26	0.68	1	0.03	27	0.36	10	1.59	218	0.82														
SNSN**						1	0.05	1	0.01												1	0.01														
U-HY**				7	0.06			7	0.05												7	0.03														
USG**				6	0.05			6	0.04	3	1.90										3	0.04														
BHCP*				1	0.01			1	0.01												1	0.00														
CARP*	2	0.10	2	0.10	4	0.03	2	0.11	6	0.04			4	0.10	3	0.09	7	0.09	4	0.91	4	0.37														
SVCP*				2	0.02			2	0.01										1	0.32	1	0.11														
																					12	5.24														
BHMW				9	0.07	1	0.05	10	0.07			2	0.05									13	0.05													
BLCF	13	0.65	13	0.62	97	0.77	41	2.23	138	0.93	3	1.90	128	3.34	4	0.12	135	1.82			1	0.33														
BLGL																						1	0.11													
BNMW				2	0.02			2	0.01													4	0.37													
CNCF	32	1.61	2	2.22	34	1.63			156	1.05	3	1.90	156	4.07			159	2.14	7	1.11	4	0.91														
ERSN	3	0.15	3	0.14	20	0.16	1	0.05	21	0.14			7	0.18			7	0.09	1	0.23	1	0.09														
FHCF				1	0.01			1	0.01			2	0.05				2	0.03	1	0.16	1	0.09														
FWDM	1	0.05	1	0.05	12	0.09	8	0.43	20	0.13			42	1.10			42	0.56			5	1.13														
GDEY				1	0.01			1	0.01												2	0.45														
GSOS																					3	0.96														
GZSD	1	0.05	1	0.05																	1	0.09														
PDFH	1	0.05	1	0.05	10	0.08	7	0.38	17	0.11			6	0.16	2	0.06	8	0.11				3	0.33													
RDSN				24	0.19	1	0.05	25	0.17			18	0.47				18	0.24				4	1.75													
RVCS				14	0.11	1	0.05	15	0.10			7	0.18				7	0.09				8	3.49													
SMBF						2	0.11	2	0.01			2	0.05				2	0.03				5	0.02													
SNGR				2	0.02			2	0.01											1	0.23	1	0.09													
SVCB				10	0.08			10	0.07						1	0.03	1	0.01			1	0.44														
U-DR				1	0.01			1	0.01													8	3.49													
UNID																						2	0.19													
Total	103	5.17	2	2.22	105	5.05	631	4.98	106	5.75	737	4.97	10	6.33	432	11.27	23	0.67	465	6.26	25	3.97	43	9.75	68	6.35	4	1.32	5	1.61	9	0.98	28	12.23	1412	5.32

** (blue) – target species,
* (red) - invasive species

Table C4. Trammel net: sturgeon season summary for segment 13. Lists CPUE (fish/100m) and fish sampled by habitat type in the Lower Missouri River in 2003.

MACRO	CONF	ISB	OSB			SCCL	SCCS	TRML	Grand Total	
MESO Effort	CHNB 15.65	CHNB 162.45	CHNB 6.5	POOL 0.95	TOTAL 7.45	CHNB 4.9	ITIP 4.1	2.78	197.33	
Species	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N	CPUE
BUSK**		1 0.01							1	0.01
PDSG**		1 0.01							1	0.01
SNPD**		1 0.01							1	0.01
SNSG**	1 0.06	107 0.66		1 1.05	1 0.13		6 1.46		115	0.58
SVCP*		1 0.01							1	0.01
BKCP								1 0.36	1	0.01
BLCF	1 0.06	12 0.07		2 2.11	2 0.27				15	0.08
CNCF		3 0.02				1 0.20			4	0.02
FWDM								1 0.36	1	0.01
GDEY		1 0.01				2 0.41			3	0.02
GZSD		1 0.01				2 0.41			3	0.02
LNGR	9 0.58							1 0.36	10	0.05
RVCS		3 0.02							3	0.02
SMBF		8 0.05							8	0.04
Total	11 0.70	139 0.86		3 3.16	3 0.40	5 1.02	6 1.46	3 1.08	167	0.85

** (blue) – target species

* (red) - invasive species

Table C5. Hoop net: sturgeon season summary for segment 13. Lists CPUE (fish/net night) and fish sampled by habitat type in the Lower Missouri River in 2003.

MACRO MESO Effort	CONF			ISB			OSB			SCCS			TRML	TRMS	Grand Total											
	CHNB 2	POOL 1	TOTAL 3	CHNB 1	POOL 14	TOTAL 15	CHNB 45	POOL 12	TOTAL 57	CHNB 2	TLWG 2	TOTAL 4	CHNB 3	5		87										
<u>Species</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>										
BUSK**									22	0.49	3	0.25	25	0.44		25	0.29									
LKSG**									1	0.02			1	0.02		1	0.01									
SGER**	1	0.50								1	0.08		1	0.02		2	0.02									
SNSG**	1	0.50														52	0.60									
BHCP*														2	0.40	2	0.02									
CARP*									1	0.02			1	0.02		2	0.02									
BLCF	1	0.50							11	0.24	1	0.08	12	0.21		14	0.16									
CNCF	1	0.50							11	0.24	1	0.08	12	0.21	1	0.50	1	0.25								
FHCF					2	0.14	2	0.13	5	0.11			5	0.09	3	1.00	3	0.60								
FWDM	4	2.00	1	1	5	1.67	8	0.57	8	0.53			14	0.31												
GDEY									4	0.09			4	0.07												
GZSD									7	0.16			7	0.12												
PDFH									2	0.04			2	0.04												
RVCS					1	0.07	1	0.07	3	0.07	1	0.08	4	0.07	1	0.33										
SMBF	3	1.50			3	1.00			3	0.07	2	0.17	5	0.09												
WTBS									2	0.04			2	0.04												
WTCP															7	1.40	7	0.08								
Total	11	5.50	1	1	12	4.00	30	2.14	30	2.00	109	2.42	24	2.00	133	2.33	2	1.00	2	0.50	4	1.33	13	2.60	194	2.23

** (blue) – target species

* (red) - invasive species

Table C6. Otter trawl: community season summary for segment 13. Lists CPUE (fish/100m) and fish sampled by habitat type in the Lower Missouri River in 2003.

MACRO MESO Effort	CONF CHNB 15.11	CHNB 115.87	ISB POOL 5.54		TOTAL 121.41	CHNB 12.29	OSB POOL 8.66		TLWG 12.29	TOTAL 33.24	CHNB 2.97	SCCL ITIP 9.61		TOTAL 12.58	SCCS ITIP 5.57	TRML TOTAL 5.94	Grand Total 193.85
Species	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE
BUSK**		3 0.03			3 0.02								1 0.10	1 0.08			4 0.02
LKSG**		1 0.01			1 0.01		1 0.12			1 0.03							2 0.01
PDSG**	1 0.07																1 0.01
SFCB**	7 0.46	52 0.45	2 0.36		54 0.44	3 0.24	14 1.62	1 0.08		18 0.54	1 0.34			1 0.08			80 0.41
SGCB**		5 0.04			5 0.04												5 0.03
SGER**																1 0.17	1 0.01
SKCB**	1 0.07	33 0.28			33 0.27	6 0.49	4 0.46			10 0.30	1 0.34			1 0.08			45 0.23
SNPD**		2 0.02			2 0.02												2 0.02
SNSG**	7 0.46	164 1.42	5 0.90		169 1.39	16 1.30	2 0.23			18 0.54	1 0.34	17 1.77	18 1.43	1 0.18			213 1.10
U-HY**		14 0.12	2 0.36		16 0.13	7 0.57	6 0.69			13 0.39	4 1.35			4 0.32		13 2.19	46 0.24
USG**		2 0.02			2 0.02												2 0.01
CARP*						1 0.08	1 0.12	1 0.8		3 0.09						2 0.34	5 0.03
BKCP																2 0.34	2 0.01
BLCF	7 0.46	221 1.91	28 5.05		249 2.05	70 5.70	42 4.85	1 0.08		113 3.40	7 2.36	6 0.62	13 1.03	5 0.90			387 2.00
BLGL																11 1.85	11 0.06
BNMW																3 0.51	3 0.02
CNCF	2 0.13	65 0.56	2 0.36		67 0.55	50 4.07	11 1.27			61 1.83	5 1.68			5 0.40		2 0.34	137 0.71
ERSN							4 0.46			4 0.12							4 0.02
FHCF		2 0.02			2 0.02	1 0.08	1 0.12			2 0.06		1 0.10	1 0.08				5 0.03
FHMW																1 0.17	1 0.01
FWDM		110 0.95	6 1.08		116 0.96	7 0.57	34 3.93			41 1.23	122 41.06			122 9.70		3 0.51	282 1.45
GDEY		47 0.41			47 0.39						5 1.68			5 0.40			52 0.27
LNGR		1 0.01			1 0.01												1 0.01
PDFH											1 0.34			1 0.08			1 0.01
RDSN		1 0.01			1 0.01												1 0.01
RVCS		1 0.01	3 0.54		4 0.03		1 0.12	1 0.08		2 0.06						3 0.51	9 0.05
SMBF			1 0.18		1 0.01	2 0.16				2 0.06							3 0.02
STCT		37 0.32			37 0.30												37 0.19
SVCB	3 0.20	2 0.02			2 0.02						18 6.06			18 1.43		2 0.34	25 0.13
UCF		13 0.11	2 0.36		15 0.12			1 0.08		1 0.03					3 0.54		19 0.10
UNID						11 0.90				11 0.33							11 0.06
Total	28 1.85	776 6.70	51 9.21		827 6.81	174 14.16	121 13.97	5 0.41		300 9.02	165 55.56	25 2.60	190 15.10	9 1.62	43 7.24		1397 7.21

** (blue)- target species

* (red) - invasive species

Table C7. Trammel net: community season summary for segment 13. CPUE (fish/100m) and fish sampled by habitat type in the Lower Missouri River for 2003.

MACRO	CONF	ISB	OSB	SCCL			SCCS	Grand Total
MESO	CHNB	CHNB	CHNB	CHNB	ITIP	TOTAL	ITIP	
Effort	19.88	102.98	4.4	3.23	4.1	7.33	10.22	144.81
Species	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE	N CPUE
BUSK**		5 0.05						5 0.03
LKSG**	7 0.35	2 0.02						9 0.06
PDSG**	1 0.05							1 0.01
SGER**	3 0.15	2 0.02						5 0.03
SNPD**		3 0.03					2 0.20	5 0.03
SNSG**	42 2.11	195 1.89	1 0.23	1 0.31	2 0.49	3 0.41	38 3.72	279 1.93
CARP*	1 0.05							1 0.01
SVCP*		1 0.01						1 0.01
BLCF	3 0.15	23 0.22						26 0.18
CNCF		10 0.10					1 0.10	11 0.08
FHCF	1 0.05							1 0.01
FWDM	5 0.25						1 0.10	6 0.04
GDEY	2 0.10	5 0.05						7 0.05
GZSD	3 0.15	3 0.03						6 0.04
LNGR		1 0.01						1 0.01
QLBK	6 0.30	1 0.01						7 0.05
RVCS				2 0.62		2 0.27		2 0.01
SMBF		4 0.04						4 0.03
TOTAL	74 3.72	255 2.48	1 0.23	3 0.93	2 0.49	5 0.68	42 2.60	377 2.60

** (blue) - target species

* (red) - invasive species

Table C8. Hoop net: community season summary for Segment 13. CPUE (fish/net-night) and fish sampled by habitat type on the Lower Missouri River in 2003.

MACRO MESO Effort	CONF			ISB			OSB			SCCL			SCCS	TRML	Grand Total															
	CHNB 2	POOL 1	TOTAL 3	CHNB 12	POOL 13	TOTAL 25	CHNB 17	POOL 10	TOTAL 27	CHNB 1	POOL 1	TOTAL 2	ITIP 1	CHNB 4		62														
Species	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE														
BMBF**															1	0.25														
BUSK**							4	0.24			4	0.15																		
SNSG**							2	0.12			2	0.07																		
BHCP*				5	0.42	1	0.08	6	0.24				1		20	5														
CARP*				3	0.25	1	0.08	4	0.16	2	0.12	3	0.30	5	0.19															
GSCP*												1	1.00	1	0.50															
BKCP														1	0.25	1														
BLCF				4	0.33			4	0.16	4	0.24			4	0.15															
CNCF	2	1.00		2	0.17			2	0.08	13	0.76	1	0.10	14	0.52															
FHCF	2	1.00		5	0.42	10	0.77	15	0.60			1	1.00	1	0.50															
FWDM	2	1.00		3	0.25	2	0.15	5	0.20	13	0.76	2	0.20	15	0.56															
LNGR				1	0.08			1	0.04	5	0.29	8	0.80	13	0.48															
PDFH	1	0.50		2	0.17			2	0.08			1	0.10	1	0.04															
RVCS										3	0.18	1	0.10	4	0.15															
SMBF	1	0.50		6	0.50	1	0.08	7	0.28	7	0.41	1	0.10	8	0.30															
SNGR												1	1.00	1	0.50															
TOTAL	8	4.00		8	2.67			31	2.58	15	1.15	46	1.84	53	3.12	18	1.80	71	2.63		5	5.00	5	2.5	4	4.00	27	6.75	161	2.60

** (blue) – target species

* (red) - invasive species

Table C9. Bag seine: community season summary for segment 13. Lists CPUE (fish/m²) and fish sampled by habitat type in the Lower Missouri River in 2003.

MACRO	CONF		ISB		OSB		SCCS		SCN		TRML		Grand Total	
MESO	BARS		BARS		BARS		BARS		BARS		BARS		34.2	
Effort	2.28		19.76		3.04		6.84		1.52		0.76			
Species	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE
BMBF**							2	0.29			2	2.63	4	0.12
HBNS**			26	1.32	1	0.33	3	0.44					30	0.88
SGER**							2	0.29					2	0.06
SKCB**			1	0.05									1	0.03
SNSG**			1	0.05									1	0.03
SNSN**			7	0.35			8	1.17					15	0.44
BHCP*			10	0.51									10	0.29
CARP*					1	0.33							1	0.03
BHMW			7	0.35			2	0.29			3	3.95	12	0.35
BNMW			3	0.15			2	0.29					5	0.15
CNCF			18	0.91									18	0.53
ERSN	37	16.23	279	14.12	5	1.64	131	19.15	2	1.32	1	1.32	455	13.30
FWDM			23	1.16									23	0.67
GDEY							1	0.15	2	1.32			3	0.09
GZSD	1	0.44	750	37.96	7	2.30	45	6.58			1	1.32	804	23.51
LMBS					2	0.66	4	0.58			2	2.63	8	0.23
LNGR							1	0.15					1	0.03
MQTF			1	0.05			1	0.15			4	5.26	6	0.18
OSSF							3	0.44					3	0.09
RDSN	19	8.33	243	12.30	39	12.83	127	18.57	11	7.24	1	1.32	440	12.87
RVCS	6	2.63	489	24.75	43	14.14	117	17.11					655	19.15
SVCB			25	1.27	2	0.66	1	0.15					28	0.82
U-CY					1	0.33							1	0.03
U-NO			1	0.05									1	0.03
WTBS			1	0.05									1	0.03
TOTAL	63	27.63	1885	95.39	101	33.22	450	65.79	15	9.87	14	9.87	2528	73.92

** (blue) – target species

* (red) - invasive species

Table C10. Mini-fyke net: community season summary for segment 13. Lists CPUE (fish/net-night) and fish sampled by habitat type in the Lower Missouri River in 2003.

MACRO MESO Effort	CONF BARS 6		ISB BARS 17		OSB BARS 9		SCCL BARS 3		SCCS BARS 9		TRML BARS 1	GRAND TOTAL 45		
<u>Species</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>
HBNS**			2	0.12			4	1.33	2	0.22			8	0.18
SFCB**			29	1.71	3	0.33			1	0.11			33	0.73
SGER**			2	0.12					1	0.11			3	0.07
SKCB**	5	0.83	5	0.29					1	0.11			11	0.24
SNSN**	4	0.67	1	0.06					2	0.22			7	0.16
U-HY**	1	0.17	23	1.35									24	0.53
BHCP*			44	2.59	52	5.78	78	26.00	3	0.33			177	3.93
CARP*			3	0.18	1	0.11			1	0.11			5	0.11
GSCP*							5	1.67					5	0.11
SVCP*			1	0.06			9	3.00					10	0.22
BHMW	1	0.17	6	0.35	13	1.44			2	0.33	1	1.00	23	0.51
BKSS					1	0.11							1	0.02
BLGL	10	1.67	1	0.06	1	0.11							12	0.27
BNMW			6	0.35	2	0.22	1	0.33					9	0.20
BNSN			2	0.12									2	0.04
BTTM					1	0.11							1	0.02
CNCF	1	0.17	78	4.59	5	0.56	1	0.33	4	0.44			89	1.96
ERSN	409	68.17	545	32.06	72	8.00	29	9.67	65	7.33	1	1.00	1121	24.91
FHCF			1	0.06	3	0.33							4	0.09
FHMW			1	0.06			1	0.33					2	0.04
FWDM			278	16.35	6	0.67	35	11.67	2	0.22			321	7.13
GDEY	1	0.17	4	0.24									5	0.11
GDBG	1	0.17											1	0.02
GZSD	67	11.17	402	23.65	59	6.56	27	9.00	322	36.11	3	3.00	880	19.56
LNGR	4	0.67					2	0.67	2	0.22			8	0.18
MQTF	10	1.67					2	0.67					12	0.27
OSSF	1	0.17			1	0.11							2	0.04
RDSN	278	46.33	489	28.76	102	11.33	17	5.67	128	14.56	3	3.00	1017	22.60
RVCS	1	0.17	293	17.24	23	2.56	10	3.33	21	2.33			348	7.73
RVSN			15	0.88									15	0.33
SMBF									1	0.11			1	0.02
SNGR			4	0.24			3	1.00	5	0.56			12	0.27
SVCB			20	1.18	1	0.11	34	11.33	1	0.11			56	1.24
U-CY	3	0.50	6	0.35									9	0.20
UNID			1	0.06									1	0.02
WTBS			2	0.12									2	0.04
WTCP	2	0.33			1	0.11	2	0.67	3	0.33			8	0.18
YLBH	1	0.17											1	0.08
Total	800	133.33	2264	133.18	347	38.56	260.00	86.67	567	63.00	8	8.00	4246	94.36

** (blue) – target species

* (red) - invasive species

Appendix D

Segment 14 summary tables by gear type and sampling season.

Table D1. Otter trawl: sturgeon season summary for segment 14. Lists CPUE (fish/100m) and fish sampled by habitat type in the Lower Missouri River in 2003.

MACRO MESO EFFORT	CONF			ISB			OSB			SCCL				SCCS	TRML	TRMS	GRAND TOTAL																				
	CHNB	POOL	TOTAL	CHNB	POOL	TOTAL	CHNB	POOL	TOTAL	CHNB	ITIP	TLWG	TOTAL	ITIP																							
	5.2	0.9	6.1	115.06	15.36	130.42	14.44	14.74	29.18	4.44	1.60	14.24	20.28	5.20	4.40	1.83	197.41																				
Species	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE																			
BUSK**					4	0.03			4	0.03			1	0.07	1	0.05	1	0.19	6	0.03																	
HBNS**							1	0.07	1	0.01									1	0.01																	
SFCB**					17	0.15	1	0.07	18	0.14	2	0.14	1	0.07	3	0.10			21	0.11																	
SGER**																		2	0.45	2	0.01																
SKCB**	1	0.19			30	0.26	2	0.13	32	0.25			1	0.63	1	0.07	1	0.05	35	0.18																	
SNPD**					1				1	0.01									1	0.01																	
SNSG**	1	0.19			64	0.56	5	0.33	69	0.53	23	1.59	10	0.68	33	1.13	1	0.23	1	0.63	11	0.77	13	0.64	8	1.54	124	0.63									
SNSN**																			2	0.45	2	0.01															
CARP*					1	0.01			1	0.01				2	0.14	2	0.10			3	0.02																
BHMW																			2	0.45	2	0.01															
BLCF		1	1.11	1	0.16	30	0.26	16	1.04	46	0.35	17	1.18	33	2.24	50	1.71	1	0.23	1	0.63	2	0.14	4	0.20			2	0.45	102	0.52						
CNCF					110	0.96	43	2.80	153	1.17	21	1.45	27	1.83	48	1.64	56	12.61	1	0.63	23	1.62	80	3.94	1	0.19	1	0.23	8	4.37	290	1.47					
ERSN					5	0.04	1	0.07	6	0.05										4	0.91										10	0.05					
FHCF					1	0.01			1	0.01																					1	0.01					
FWDM		2	2.22	2	0.33	10	0.09	11	0.72	21	0.16	8	0.55	33	2.24	41	1.41	2	0.45	1	0.63			3	0.15					36	19.67	103	0.52				
GDEY																				4	0.90			4	0.20							4	0.02				
GZSD							2	0.13	2	0.16												1	0.63									3	0.02				
MMSN					1	0.01			1	0.01																						10	2.27	11	0.06		
PDFH					30	0.26	2	0.13	32	0.25	7	0.48	2	0.14	9	0.31						44	3.09	44	2.17	4	0.77						89	0.45			
RDSN					1	0.01			1	0.01																							1	0.01			
RVCS							1	0.07	1	0.01			5	0.34	5	0.17																1	0.23	1	0.55	8	0.04
SMBF							2	0.13	2	0.02			1	0.07	1	0.03																		3	0.02		
SNGR					1	0.01	1	0.07	2	0.02																							1	0.55	3	0.02	
SVCB					1	0.01			1	0.01																							1	0.23	2	0.02	
U-HY					3	0.03			3	0.02																								1	0.23	5	0.03
U-PC																																		1	0.01		
USG					16	0.14	1	0.07	17	0.13																								1	0.23	23	0.12
WLYE																																		1	0.05	1	0.01
Total	2	0.38	3	3.33	5	0.82	326	2.86	89	5.79	415	3.18	78	5.40	112	7.60	190	6.51	66	14.86	7	4.38	90	6.32	163	8.04	14	2.69	24	5.45	46	25.14	857	4.34			

** (blue) – target species

* (red) - invasive species

Table D2. Trammel net: sturgeon season summary for segment 14. Lists CPUE (fish/100m) and fish sampled by habitat type in the Lower Missouri River in 2003

MACRO	CONF		ISB		OSB		SCCL			SCCS		Grand Total		
MESO Effort	CHNB		CHNB		CHNB		ITIP	TLWG	TOTAL	ITIP	181.14			
	7.4		164.36		1.81		4.1	0.97	5.07	2.5				
Species	<u>N CPUE</u>		<u>N CPUE</u>		<u>N CPUE</u>		<u>N CPUE</u>	<u>N CPUE</u>	<u>N CPUE</u>	<u>N CPUE</u>	<u>N</u>	<u>CPUE</u>		
BUSK**			28	0.17			3	0.73	1	1	4	0.79	32	0.18
PDSC**			1	0.01									1	0.01
SGER**							1	0.24			1	0.20	1	0.01
SNPD**					1	0.55					1	0.40	2	0.01
SNSG**	16	2.16	298	1.81	7	3.87	12	2.93	1	1	13	2.56	335	1.85
BHCP*			3	0.02									3	0.02
BLCF	2	0.27	46	0.28			1	0.24	1	1	2	0.39	4	1.6
CNCF			8	0.05			2	0.49	1	1	3	0.59	11	0.06
FHCF			1	0.01									1	0.01
GDEY			6	0.04									6	0.03
GZSD			1	0.01			1	0.24	1	1	2	0.39	3	0.02
LNGR			2	0.01			4	0.98			4	0.79	1	0.40
MNEY			1	0.01									1	0.01
QLBK			2	0.01									2	0.01
RVCS			7	0.04			1	0.24			1	0.20	8	0.04
SHRH			1	0.01									1	0.01
SMBF			3	0.02									3	0.02
SNGR			1	0.01									1	0.01
Total	18	2.43	409	2.49	8	4.42	25	6.10	5	5.15	30	5.92	7	2.8

** (blue) – target species

* (red) - invasive species

Table D3. Hoop net: sturgeon season summary for segment 14. Lists CPUE (fish/net night) and fish sampled by habitat type in the Lower Missouri River in 2003.

MACRO	CONF			ISB	OSB			SCCL			SCCS	TRML	Grand Total																		
	CHNB	POOL	TOTAL		CHNB	POOL	TOTAL	CHNB	TLWG	TOTAL				CHNB																	
MESO Effort	3	3	6	16	25	15	40	8	3	11	2	2	77																		
Species	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE															
BMBF**							1	0.04							1	0.03															
BUSK**							3	0.12							3	0.08															
SNSG**			1	0.33	1	0.17	4	0.25	2	0.08	2	0.13	4	0.10			1	0.33	1	0.09			10	0.13							
GSCP*									1	0.04																		1	0.01		
SVCP*									1	0.04																		1	0.01		
BLCF	1	0.33			1	0.17			6	0.24	10	0.67	16	0.40	4	0.50														21	0.27
BLGL															1	0.13													1	0.01	
CNCF			1	0.33	1	0.17	1	0.06	8	0.32	2	0.13	10	0.25	4	0.50													16	0.21	
FHCF							2	0.13	18	0.72			18	0.45	7	0.88	1	0.33	8	0.73	10	5.00							38	0.49	
FWDM							8	0.50	12	0.48	5	0.33	17	0.43	5	0.63					5	0.45	1	0.50	2	1.00			33	0.43	
GDEY							1	0.06	1	0.04			1	0.03															2	0.03	
GZSD									1	0.04			1	0.03															1	0.01	
LNGR			1	0.33	1	0.17			1	0.04			1	0.03															2	0.03	
PDFH	1	0.33			1	0.17	1	0.06	2	0.08			2	0.05															4	0.05	
RVCS	1	0.33			1	0.17			7	0.28			7	0.18															12	0.16	
SHRH									1	0.04			1	0.03															1	0.01	
SMBF							1	0.06	17	0.68	2	0.13	19	0.48	1	0.13													21	0.27	
Total	3	1.00	3	1.00	6	1.00	18	1.13	82	3.28	21	1.40	103	2.58	22	2.75	2	0.67	24	2.18	11	5.50	6	3.00			168	2.18			

** (blue) – target species
* (red) - invasive species

Table D4. Otter trawl: community season summary for segment 14. Lists CPUE (fish/100m) and fish sampled in the Lower Missouri River in 2003.

MACRO MESO Effort	ISB						OSB						SCCS	Grand Total
	CHNB		POOL		TOTAL		CHNB		POOL		TOTAL		ITIP	
	130.77		4.60		135.37		9.85		18.34		28.19		4.44	168.00
Species	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE
BMBF**									1	0.05	1	0.04	1	0.01
BUSK**	3	0.02			3	0.02							3	0.02
PDSC**	1	0.01			1	0.01							1	0.01
SFCB**	48	0.37	5	1.09	53	0.39	14	1.42	99	5.41	113	4.01	166	0.99
SGCB**	13	0.10			13	0.10	10	1.02	7	0.38	17	0.60	2	0.45
SGER**	1	0.01			1	0.01			2	0.11	2	0.07	3	0.02
SKCB**	13	0.10			13	0.10	10	1.02	7	0.38	17	0.60	2	0.45
SNSG**	95	0.73	3	0.65	98	0.72	7	0.71	2	0.11	9	0.32	8	1.80
CARP*	1	0.01	1	0.22	2	0.01	2	0.20	1	0.05	3	0.11		5
SVCP*			2	0.43	2	0.01								2
BHMW	4	0.03			4	0.03	1	0.10	10	0.55	11	0.39		15
BLCF	266	2.03	38	8.26	304	2.25	82	8.32	183	10.00	265	9.41		569
CNCF	122	0.93	9	1.96	131	0.97	68	6.90	51	2.79	119	4.23	1	0.23
CNLP	2	0.02			2	0.01								2
ERSN	14	0.11			14	0.10							1	0.23
FHCF			1	0.22	1	0.01			2	0.11	2	0.07		3
FWDM	2	0.02	33	7.17	35	0.26	5	0.51	213	11.64	218	7.74		253
GDEY	193	1.48	9	1.96	202	1.49	16	1.62	15	0.82	31	1.10		233
GZSD	2	0.02			2	0.01			2	0.11	2	0.07		4
LNGR			1	0.22	1	0.01								1
MMSN	36	0.28			36	0.27	3	0.30			3	0.11		39
RVCS	1	0.01	4	0.87	5	0.04			9	0.49	9	0.32		14
SHRH	1	0.01			1	0.01								1
SNGR	2	0.02			2	0.01			2	0.11	2	0.07		4
SVCB	18	0.14			18	0.13								18
UCF									50	2.73	50	1.78		50
U-HY	1	0.01	14	3.04	15	0.11			5	0.27	5	0.18		20
WTBS	1	0.01			1	0.01								1
Total	831	6.35	120	26.09	951	7.02	208	21.12	655	35.79	863	30.66	12	2.70

** (blue) – target species

* (red) - invasive species

Table D5. Trammel net: community season summary for segment 14. Lists CPUE (fish/net-night) and fish sampled in the Lower Missouri River in 2003.

MACRO MESO Effort	ISB CHNB 168.12		OSB CHNB 8.05		SCCL ITIP 4.11		Grand Total 180.28	
Species	N	CPUE	N	CPUE	N	CPUE	N	CPUE
BUSK**	17	0.10	1	0.12			18	0.10
LKSG**	1	0.01					1	0.01
PDSG**	1	0.01					1	0.01
SGER**	3	0.02					3	0.02
SNSG**	220	1.31	13	1.61	13	3.16	246	1.36
BHCP*	4	0.02					4	0.02
CARP*	1						1	0.01
BLCF	67	0.40	1	0.12			68	0.38
CNCF	4	0.02					4	0.02
GDEY	6	0.04	4	0.50			10	0.06
GZSD	1	0.01					1	0.01
LNGR	5	0.03			1	0.24	6	0.03
QLBK	6	0.04					6	0.03
RVCS	3	0.02					3	0.02
SHRH	1	0.01			1	0.24	2	0.01
SMBF	4	0.02					4	0.02
SNGR	3	0.02					3	0.02
TOTAL	347	2.06	19	2.36	15	3.65	381	2.11

** (blue) – target species

* (red) - invasive species

Table D6. Hoop net: community season summary for segment 14. Lists CPUE (fish/net night) and fish sampled in the Lower Missouri River in 2003.

MACRO MESO Effort	CONF		ISB				OSB				SCCL		SCCS		Grand Total					
	POOL 1		CHNB 5		POOL 17		TOTAL 22		CHNB 27		POOL 16		TOTAL 43		CHNB 2		CHNB 4		72	
<u>Species</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>	<u>N</u>	<u>CPUE</u>
BUSK**			1	0.20			1	0.05	9	0.33			9	0.21			10	0.14		
BHCP*			4	0.80	3	0.18	7	0.32	31	1.07	2	0.13	33	0.77	12	6.00	2	0.50	54	0.75
CARP*									1	0.04	1	0.06	2	0.05			2	0.03		
BLCF					2	0.12	2	0.09	6	0.22	1	0.06	7	0.16			2	0.50	11	0.15
CNCF									7	0.26	1	0.06	8	0.18	2	1.00			10	0.14
FHCF					6	0.35	6	0.27	8	0.30	5	0.31	13	0.30					19	0.26
FWDM					2	0.12	2	0.09	4	0.15	6	0.38	10	0.23	1	0.50	1	0.25	14	0.19
LNGR			1	0.20			1	0.05	2	0.07			2	0.05			2	0.50	5	0.07
PDFH									1	0.04			1	0.02					1	0.01
RVCS			1	0.20	2	0.12	3	0.14	1	0.04	4	0.25	5	0.12	1	0.50			9	0.13
SHRH									1	0.04			1	0.02					1	0.01
SMBF			5	1.00	1	0.06	6	0.27	22	0.81	2	0.13	24	0.56			1	0.25	31	0.43
TOTAL			12	2.40	16	0.94	28	1.27	93	3.44	22	1.38	115	2.67	16	8.00	8	2.00	167	2.32

** (blue) – target species
* (red) - invasive species

Table D7. Bag seine: community season for segment 14. Lists CPUE (fish/100m²) and fish sampled in the Lower Missouri River in 2003.

MACRO	CONF		ISB		OSB		SCCL		SCCS		SCN		Grand Total	
MESO Effort	2.28		24.07		3.04		1.52		12.72		1.52		45.13	
Species	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE
HBNS**			7	0.29					2	0.16			9	0.20
SFCB**			5	0.21			4	2.67	1	0.08			10	0.22
SGER**					1	0.33							1	0.02
SKCB**			2	0.08									2	0.04
SNSG**			1	0.04									1	0.02
SNSN**	3	1.30	6	0.25					10	0.79			19	0.42
BHCP*			1	0.04	1	0.33			1	0.08			3	0.07
CARP*					1	0.33							1	0.02
GSCP*					1	0.33							1	0.02
BHMW	1	0.43	5	0.21					2	0.16			8	0.18
BKSS			2	0.08									2	0.04
BLGL									1	0.08	1	0.67	2	0.04
CLSR									1	0.08			1	0.02
CNCF			110	4.56	2	0.67			1	0.08			113	2.51
ERSN	67	29.13	307	12.74	18	6.00	3	2.00	158	12.44	31	20.67	584	12.95
FWDM			1	0.04	2	0.67			1	0.08			4	0.09
GDEY	2	0.87	7	0.29	1	0.33							10	0.22
GZSD			120	4.98	29	9.67	5	3.33	39	3.07			193	4.28
MMSN			4	0.17					3	0.24			7	0.16
MQTF			2	0.08							2	1.33	4	0.09
NTSF			1	0.04									1	0.02
OSSF			1	0.04							1	0.67	2	0.04
RDSN	1	0.43	44	1.83	6	2.00			54	4.25	3	2.00	108	2.39
RVCS	6	2.61	541	22.45	21	7.00	105	70.00	313	24.65	69	46.00	1055	23.39
SBSN			1	0.04									1	0.02
SNGR			1	0.04									1	0.02
SVCB	3	1.30	10	0.42	7	2.30			1	0.09			21	0.48
WTBS			7	0.29	5	1.67							12	0.27
Total	83	36.09	1186	49.21	95	31.67	117	78.00	588	46.30	107	71.33	2176	48.25

** (blue) – target species

* (red) - invasive species

Table D8. Mini-fyke net: community season summary for segment 14. Lists CPUE (fish/net- night and fish sampled in the Lower Missouri River in 2003.

MACRO	CONF		ISB		OSB		SCCL		SCCS		TRMS		Grand Total	
MESO Effort	BARS		BARS		BARS		BARS		BARS		BARS		57	
	5		24		12		2		13		1			
Species	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE	N	CPUE
SFCB**	1	0.20	5	0.21	2	0.17			4	0.31			12	0.21
SKCB**	6	1.20	18	0.75	1	0.08			6	0.46			31	0.54
SNSN**	13	2.60	6	0.25	15	1.25							34	0.60
U-HY**			8	0.33					1	0.08			9	0.16
BHCP*					2	0.17							2	0.04
GSCP*							2	1.00					2	0.04
BHMW	5	1.00	27	1.13	9	0.75	2	1.00	30	2.31			73	1.28
BKSS	1	0.20			1	0.08			1	0.08			3	0.05
BLCF			3	0.13									3	0.05
BLGL	52	10.40	25	1.04	14	1.17			9	0.69	113	113.00	213	3.74
BNMW			11	0.46	4	0.33	2	1.00	1	0.08	1	1.00	19	0.33
CNCF	3	0.60	28	1.17	10	0.83	3	1.50	10	0.77			54	0.95
CNLP			1	0.04									1	0.02
CNSN					11	0.92							11	0.19
ERSN	147	29.40	627	26.13	85	7.08	16	8.00	106	8.15	1	1.00	982	17.23
FHCF			1	0.04									1	0.02
FHMW			1	0.04									1	0.02
FWDM	1	0.20	1	0.04	2	0.17							4	0.07
GDEY					2	0.17			1	0.08			3	0.05
GZSD	2	0.40	51	2.13	18	1.50			11	0.85			82	1.44
LNGR			1	0.04									1	0.02
MMSN			1	0.04					2	0.15			3	0.05
NTSF			3	0.13									3	0.05
OSSF			2	0.08	3	0.25							5	0.09
RDSN	156	31.20	255	10.63	17	1.42	3	1.50	137	10.54			568	9.96
RVCS	4	0.80	250	10.42	5	0.42			36	2.77	7	7.00	302	5.30
SNGR			6	0.25	2	0.17			1	0.08			9	0.16
SVCB	1	0.20	1	0.04	2	0.17							4	0.07
UCF			1	0.04									1	0.02
U-CN					2	0.17							2	0.04
U-CY					2	0.17							2	0.04
WTBS			3	0.13					1	0.08			4	0.07
WTCP					2	0.17							2	0.04
Total	392	78.40	1336	55.67	211	17.58	28	14.00	357	27.46	122	122.00	2446	42.91

** (blue) – target species

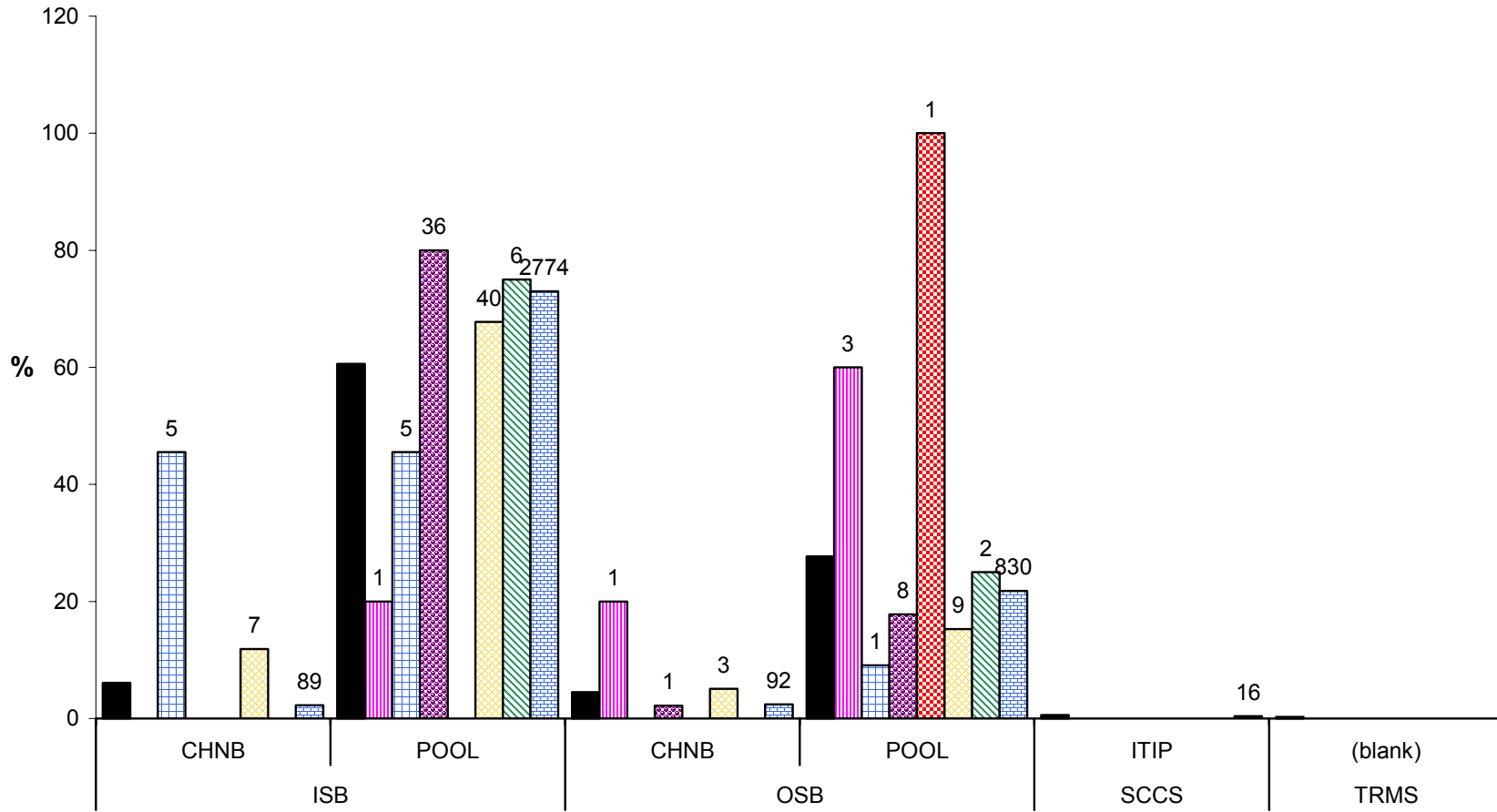
* (red) - invasive species

Appendix E

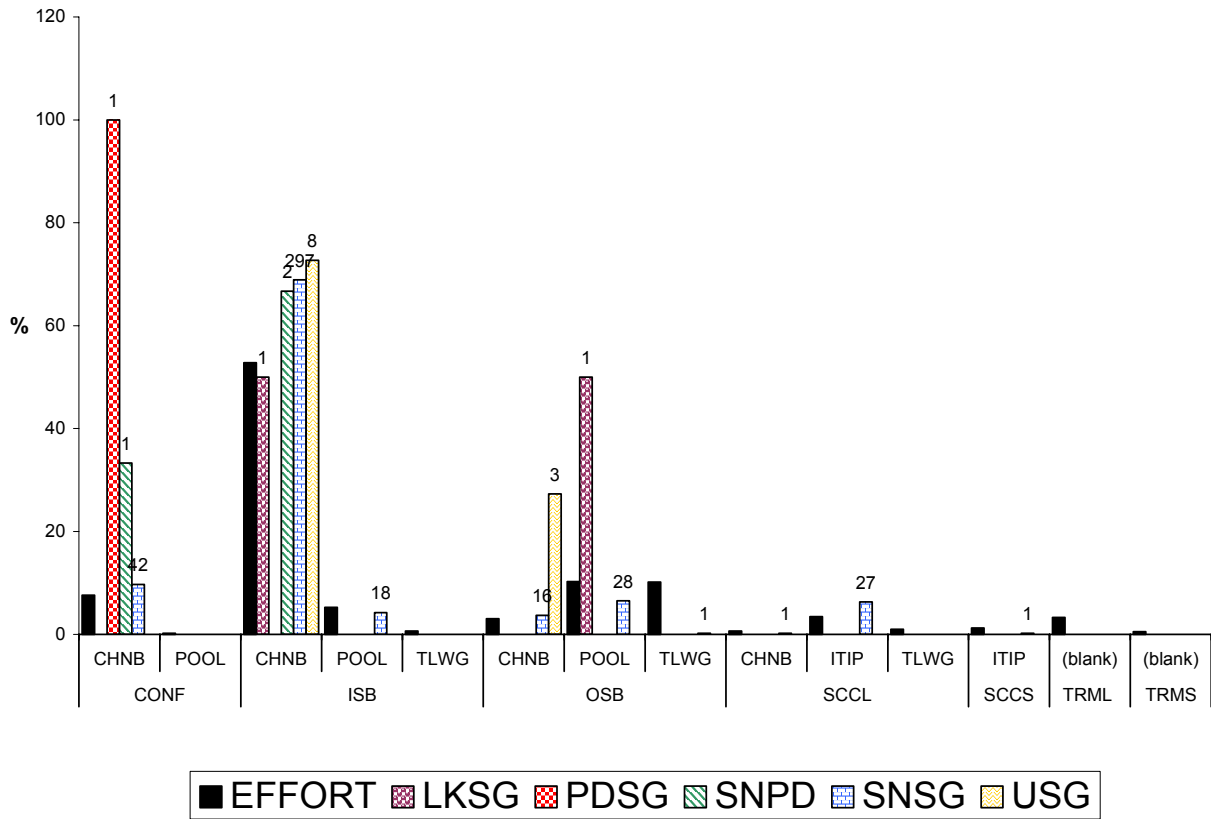
Percent composition by species and effort among MACRO and MESO habitat types for Segment 13 and 14 with combined seasons.

Target species catch was proportioned relative to effort to determine importance of habitat. N values above bars give relevance to high percentage values. Important habitats will have a lower effort relative to higher percentage of catch in a species with a high N value.

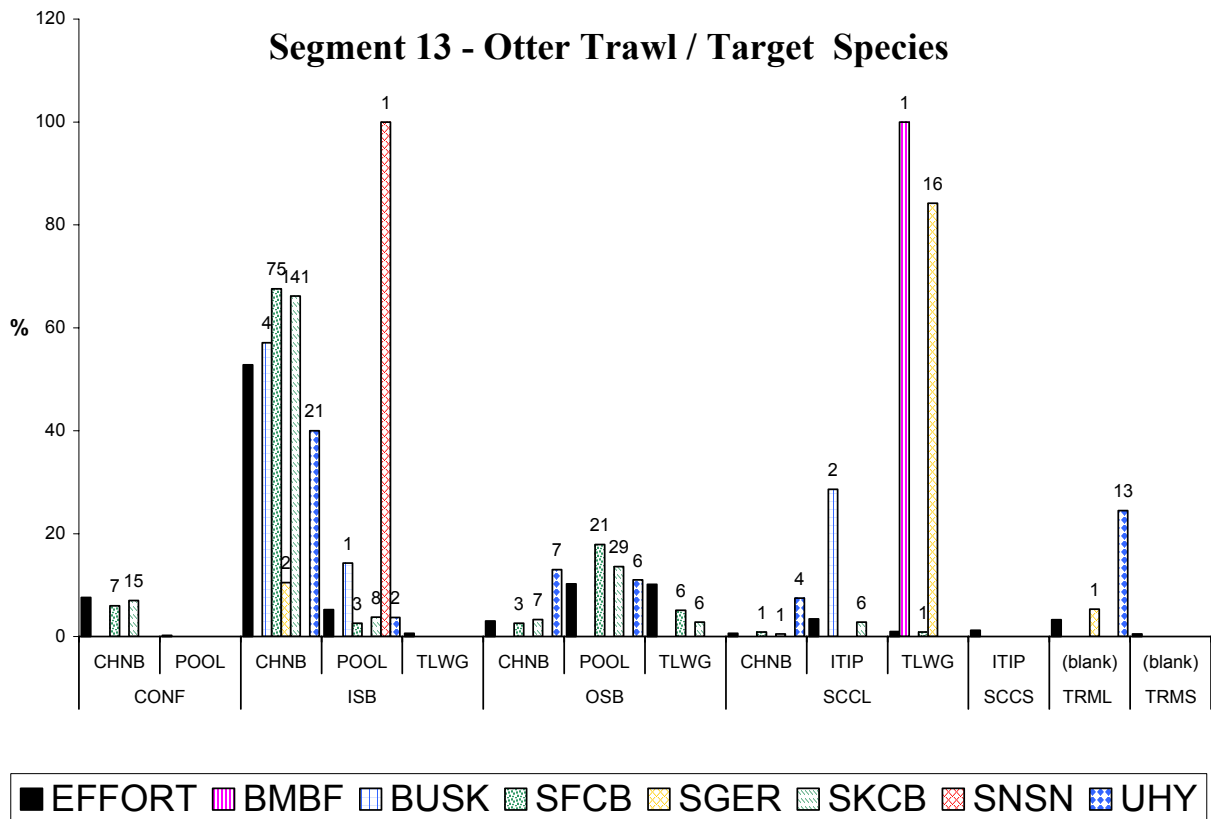
Segment 13 - Gillnets



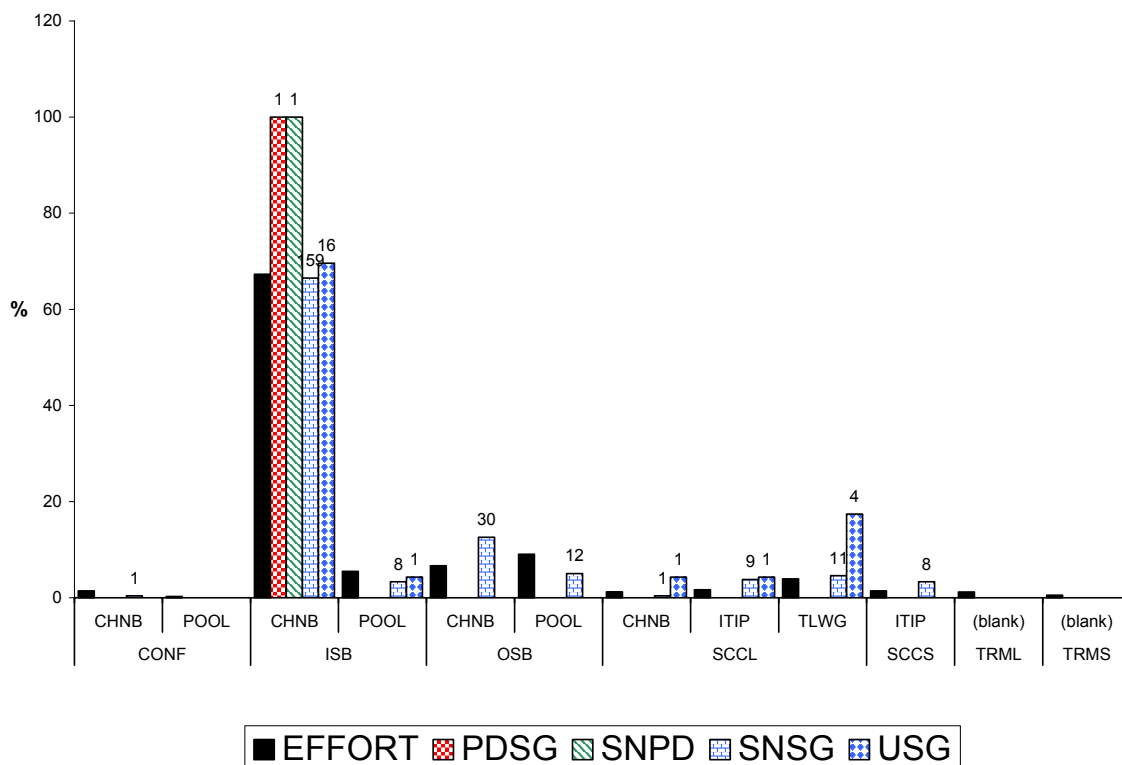
Segment 13 - Otter Trawl / Sturgeon Species



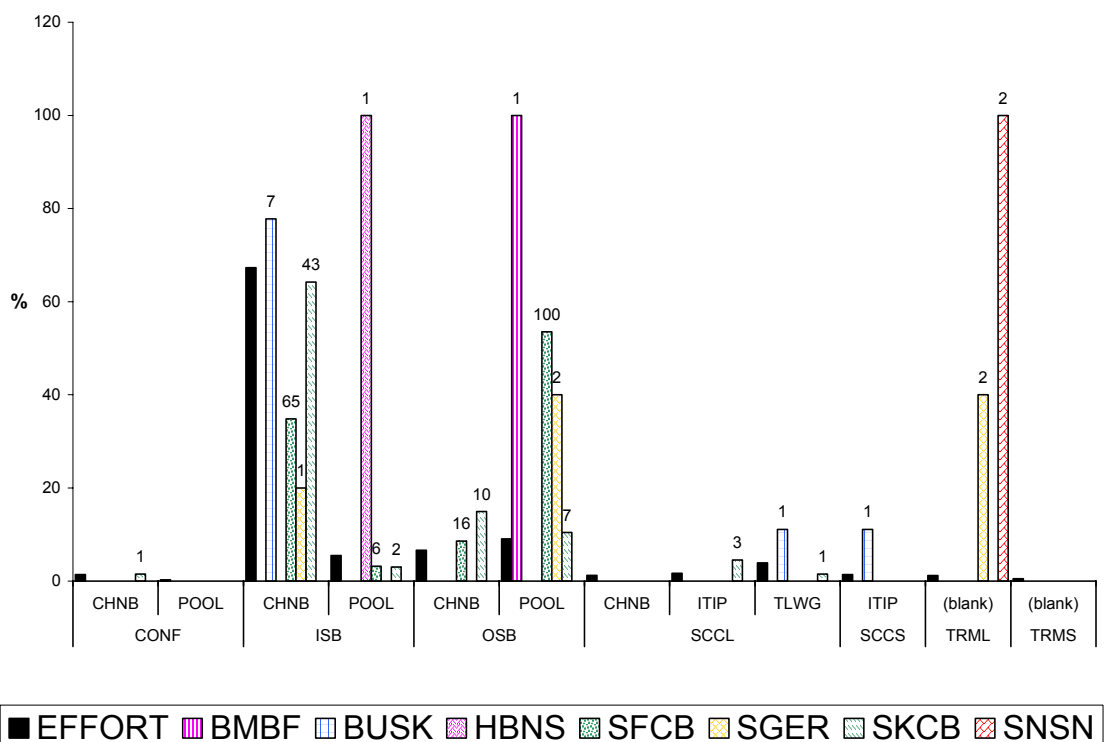
Segment 13 - Otter Trawl / Target Species



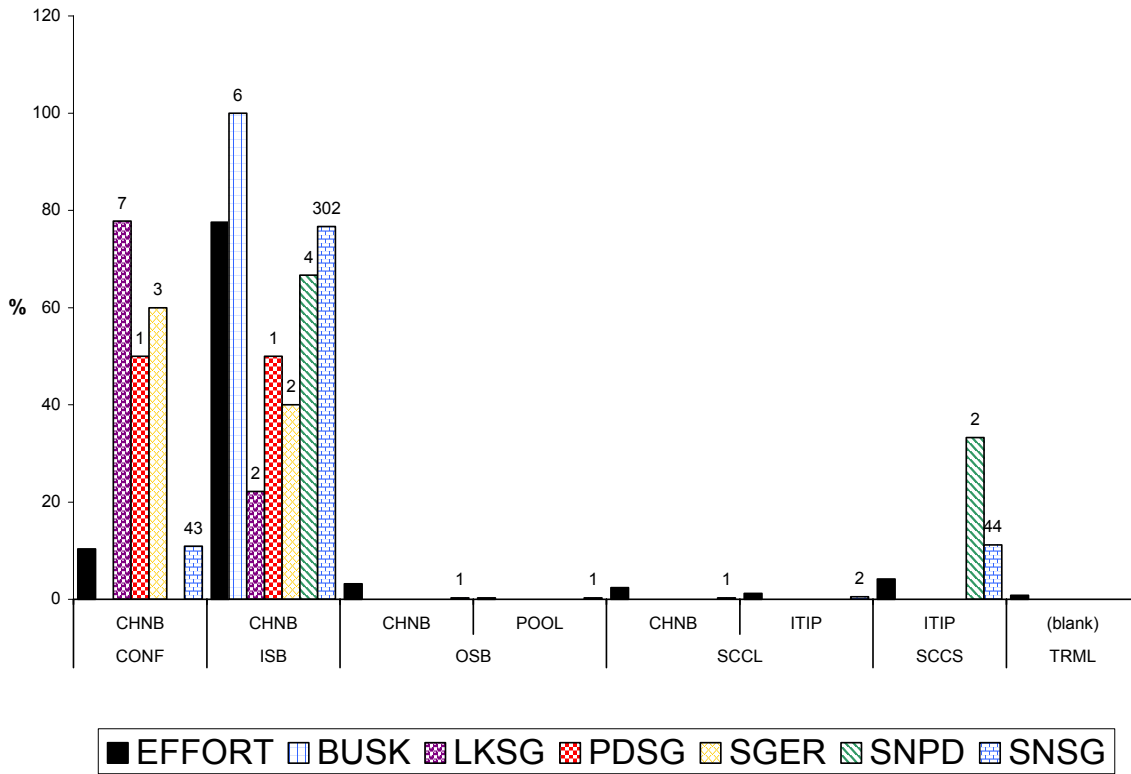
Segment 14 - Otter Trawl / Sturgeon Species



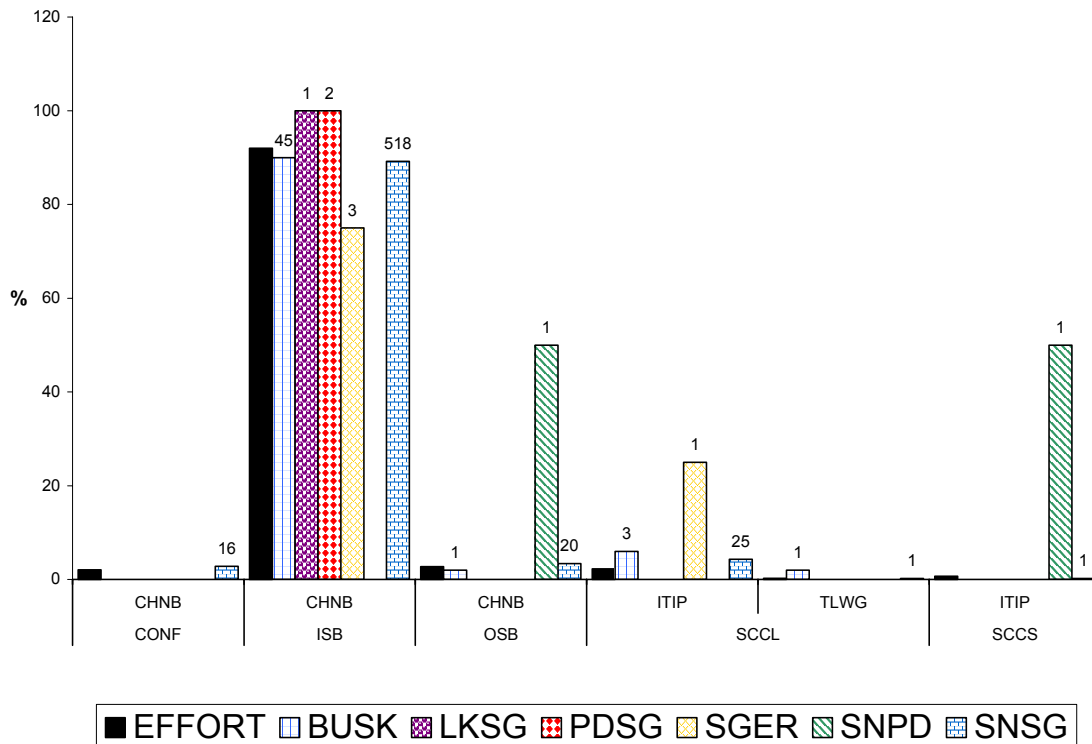
Segment 14 - Otter Trawl / Target Species



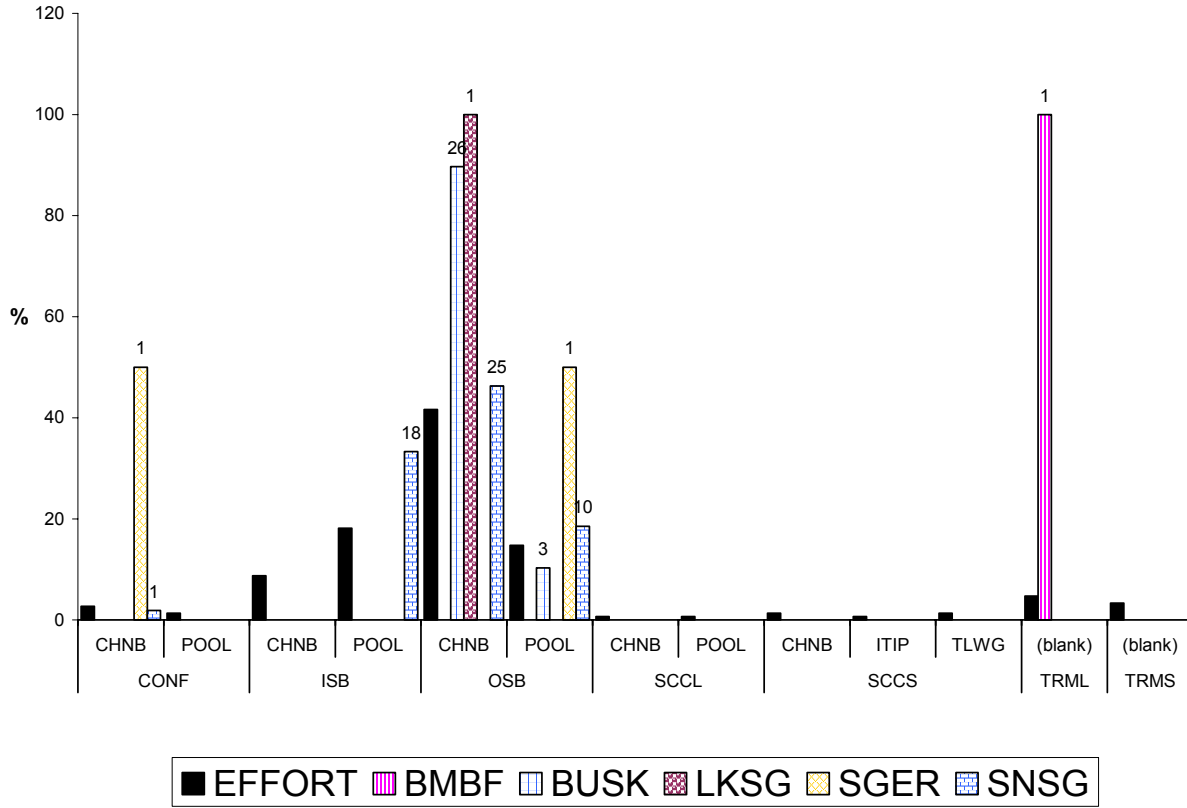
Segment 13 – Trammel Nets



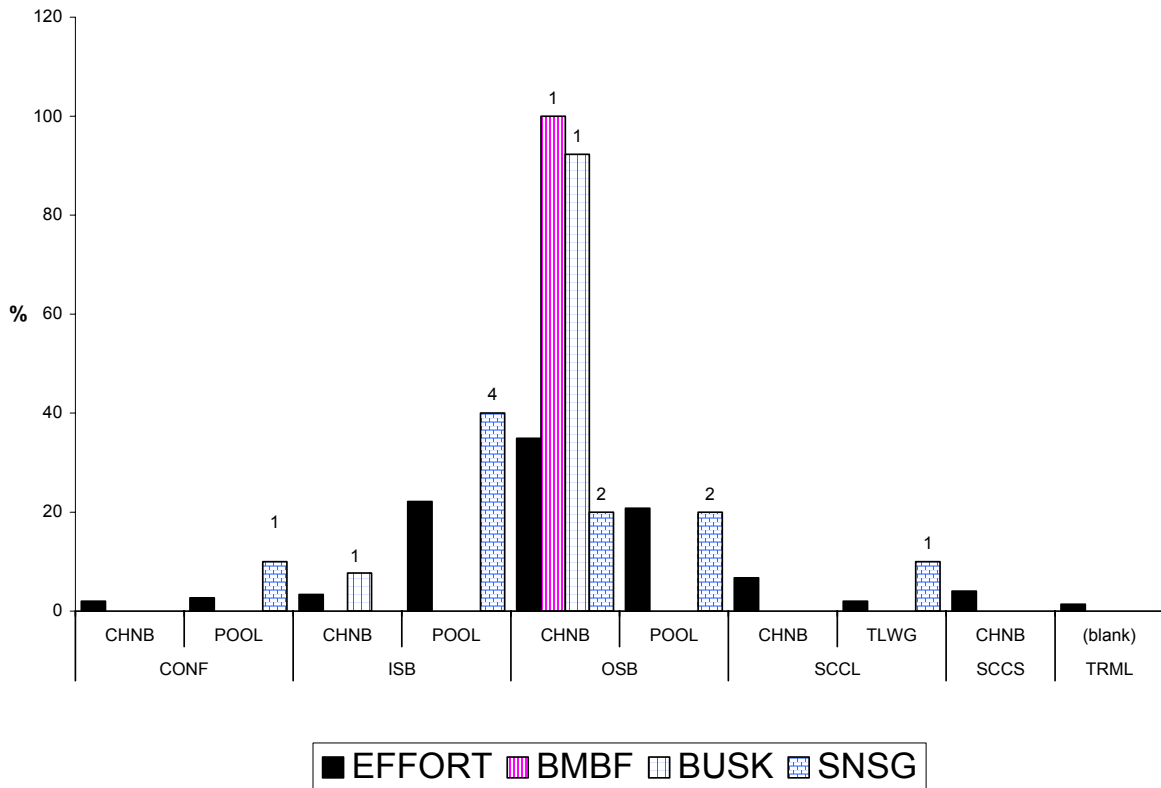
Segment 14 – Trammel Nets



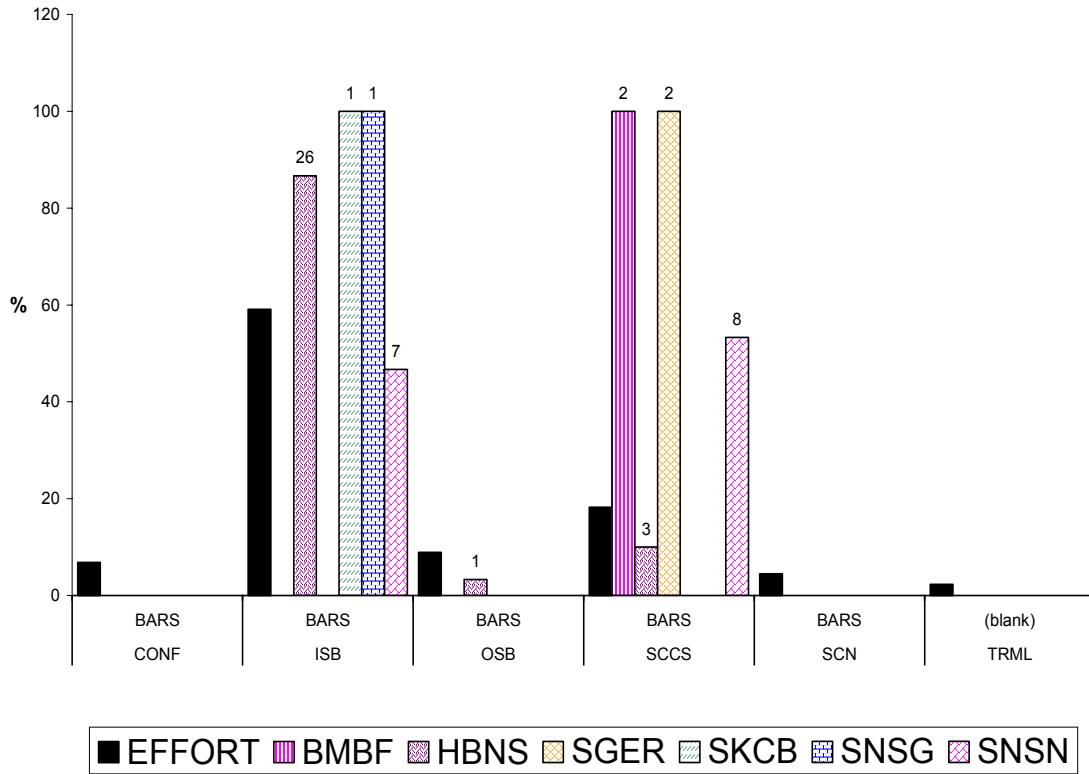
Segment 13 - Hoop Nets



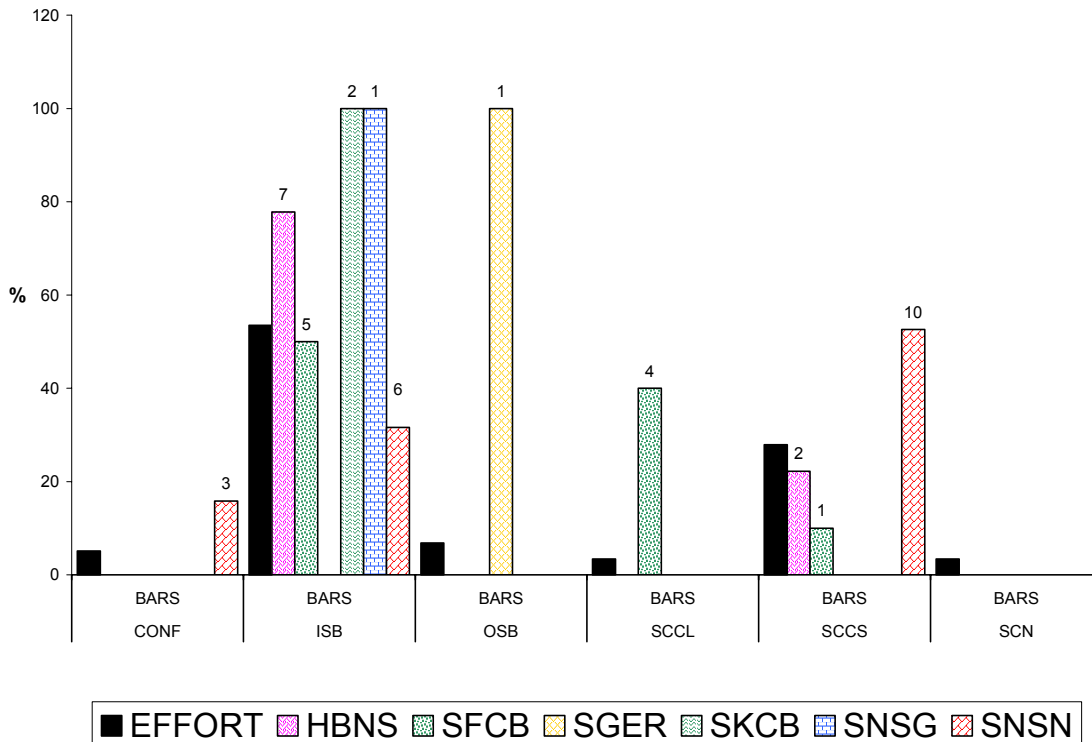
Segment 14 - Hoop Nets



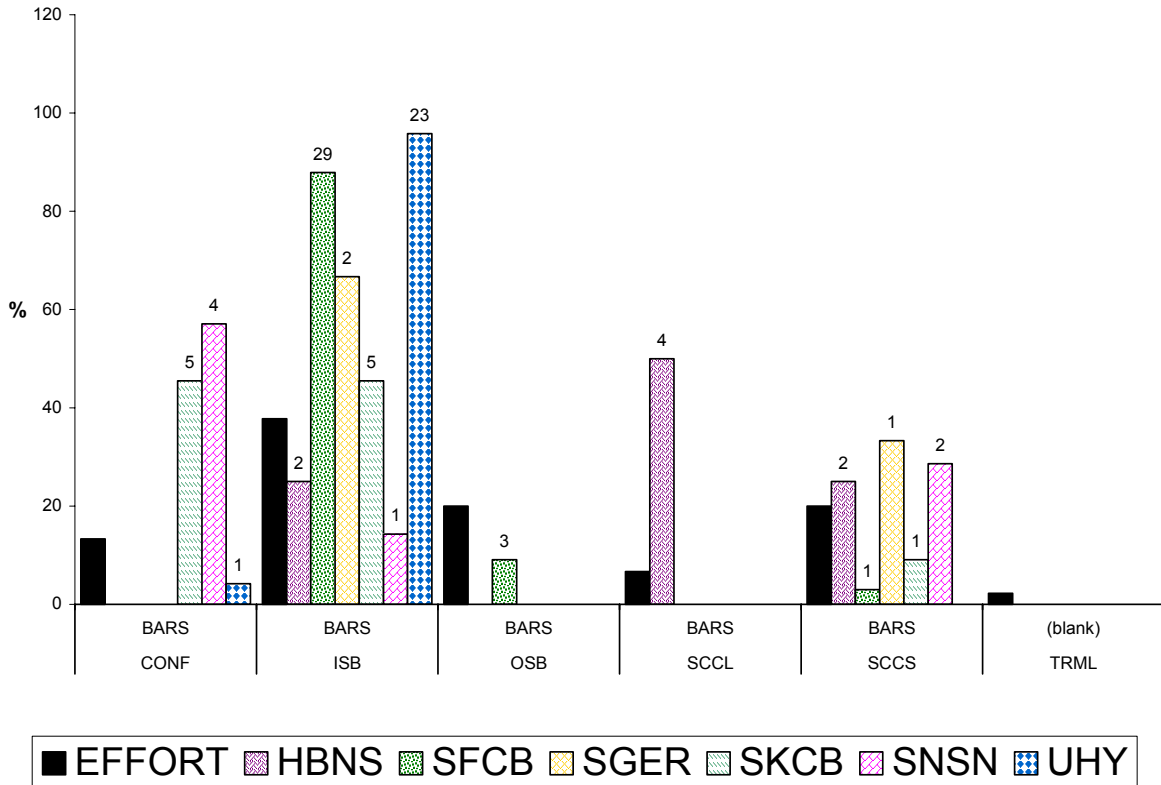
Segment 13 – Bag Seine



Segment 13 – Bag Seine



Segment 13 – Mini-Fyke Nets



Segment 14 – Mini-Fyke Nets

