A Summary of the National Paddlefish Stock Assessment Project 1995-2004

Presented to the Mississippi Interstate Cooperative Resource Association

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EXECUTIVE SUMMARY

Paddlefish, *Polyodon spathula*, have been an important fisheries resource in North America since the late 1800's. Despite the fact that the paddlefish is an important sport or commercial fish in several Midwestern and Southeastern states, little is currently known about paddlefish stocks, habitats, movements, distributions, and current exploitation rates. MICRA began a large-scale, multi-agency, coded-wire tag (CWT) paddlefish tag-and-release study in 1995 under a $200,000 Federal Aid Administrative Funding cooperative agreement. This study initiated a multi-state, multi-year coded wire tagging effort to assess paddlefish stocks throughout the Mississippi River Basin. Long-term goals of the study are to assess paddlefish habitat use, distribution, movements, extent of harvest and exploitation by stock. This multi-agency study is precedent setting; nothing of this magnitude has ever been attempted on an inland, freshwater fishery.

Twenty-two of MICRA's 28 member states have participated in this study by tagging wild-caught adult and hatchery-raised juvenile paddlefish. State and federal agencies completed 1,551 paddlefish sampling trips between 1995 and 2004, exerting nearly 30,000 hours of effort. MICRA participants collected over 22,000 paddlefish from 1995 through 2004. Eighty-seven percent of these fish were marked with coded wire tags and returned to the water. State and federal hatcheries stocked almost 1.8 million paddlefish from 1988 through 2005 with coded wire tags. Average tag retention rate for hatchery stocked fish was 90.4%.

Rough population estimates in sites within each of the major river basins were determined using the Jolly-Seber model. Future Program MARK analyses will use encounter histories for individual fish to provide more precise estimates of paddlefish populations. Basin management plans written in partnership by Paddlefish/Sturgeon Committee members are in various stages of progress. Specific recommendations regarding the future of the stock assessment project will be derived in part from these collective efforts following the March 2006 Paddlefish/Sturgeon committee meeting.

Recommendations

Develop funding and support mechanisms to support continued coded wire tagging mark and recapture activities.

Analyze mark-recapture data with MARK software

Increase sampling efforts in those areas most likely to produce sufficient recaptures for analysis

Increase or begin sampling efforts in areas where state and federal hatcheries are stocking fish

Improve quality of data from harvested fish where possible

Determine tag retention rate for jawtags

Disclaimers

This report references all data received and entered into the MICRA Paddlefish Stock Assessment Database as of December 2004. In some cases this includes the state's data from 2004; in most cases the datasets end in 2003. Data from Louisiana's fish sampling efforts in 2002-2004 is present in some of the summary tables as it has been communicated to us. Their data is not available in the database; therefore, it is not covered in the statistical analyses. Data for the Gavins Point tailwater paddlefish population, jointly managed by the states of Nebraska and South Dakota, has been combined at their request.

This summary document provides information on the current status of the MICRA paddlefish stock assessment project. Recommendations provided by the database managers in this document are based on a review of data provided to MICRA. Basin management plans written in partnership by Paddlefish/Sturgeon Committee members are in various stages of progress. Specific recommendations regarding the future of the stock assessment project will be derived in part from these collective efforts following the March 2006 Paddlefish/Sturgeon committee meeting.

Cover Photo: Cliff Wilson, U.S. Fish and Wildlife Service fishery biologist holds paddlefish collected by gillnetting in Lower Missouri River. Photo credit: Andy Plauck, U.S. Fish & Wildlife Service

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INTRODUCTION

Paddlefish, *Polyodon spathula,* have been an important fisheries resource in North America since the late 1800's. North American paddlefish were historically abundant throughout Mississippi basin and Gulf coast rivers and existed in some of the Great Lakes during the early 1900s (Carlson and Bonislawsky 1981; Figure 1). Many populations declined by the 1980s due to dam construction, pollution and overexploitation. Paddlefish exist in 22 of the original 26 states where they were known to occur. Surveys completed by biologists in the original 26 states during 1996 showed that populations were believed to be increasing in four states, stable in 10 states, decreasing in five states, extirpated in four states, and in three states the population status was unknown or biologists were not in agreement (Graham 1997).

Figure 1. Historic range and distribution of paddlefish

Paddlefish were listed under the Convention on International Trade in Endangered Species and Wild Fauna and Flora treaty (CITES) as an Appendix II species in 1992. Appendix II regulates trade in species not threatened with extinction but which may become threatened if trade goes unregulated. The listing of paddlefish and all sturgeon species makes caviar importation into the United States more difficult and costly. International trade in Appendix II species is allowed only with a CITES permit from the management agency of the exporting nation. Recently paddlefish were subjected to a CITES Significant Trade Review. Following the review, paddlefish were classified as a category 2 species; species for which not enough information had been provided by range states to conclude if CITES is implemented in a way that ensures that international trade is not detrimental to the species. Paddlefish are listed by the IUCN (World Conservation Union) as a VU A3de species. This is a vulnerable species with a projected "population size reduction of $\geq$ 30%, suspected to be met within three generations, caused by: 1) actual or potential levels of exploitation and 2) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites (IUCN 2004). Current demand for paddlefish roe as caviar is expected to increase over the coming years as world sturgeon stocks decline due to over exploitation. The Fish and Wildlife Service suspended imports of beluga sturgeon caviar originating in the littoral states of the Caspian Sea and Black Sea on September 30 and October 28, 2005, respectively (70 FR 57316, 70 FR 62135). Paddlefish and sturgeon exploitation is expected to increase to meet the domestic demand (Graham and Rasmussen 1999). Both legal and illegal exploitation of paddlefish is a renewed threat as the demand for paddlefish eggs is expected to increase due to declines in world sturgeon stocks.

Paddlefish have a combination of morphology, habits, and life history characteristics which make them extremely sensitive to overexploitation (Boreman 1997). Annual exploitation rates of less than 20% may be compatible with sustainable paddlefish fisheries. Combs (1982) documented annual exploitation rates of 15.2% (1979) and 18.8% (1980) from tag returns in the Neosho River, Oklahoma sport fishery. These harvest levels did not appear to be a detriment to the population. Annual exploitation in sport fisheries of the Yellowstone, Mississippi, Missouri, and Osage rivers often ranged from 8-14% in the 1960s and 1970s and had generally not been associated with overharvest. Pasch and Alexander (1986) described a historical pattern of overexploitation and recovery of paddlefish populations in the Tennessee River Valley. They suggested that sustainable fisheries are possible at exploitation rates of less than 15-20%, but expressed concern that increasing pressure from caviar interests would lead to overharvest. The effects of increased caviar pressure were documented by Hoffnagle and Timmons (1989) in the lower Tennessee River paddlefish population. High egg prices ($110/kg) in 1985 resulted from a United States ban on Iranian caviar in the late 1970s. The lower Tennessee River paddlefish population was young with few spawning adults and 69% total annual mortality. Reduced caviar pressure by the 1991-1992 season resulted in a 22% annual mortality rate and a 14% exploitation rate (Timmons and Hughbanks 2000). The Kentucky Lake population was further examined by Scholten and Bettoli (2005) in 2004. The lake provides on average 80% of Tennessee paddlefish harvest and a large portion of U.S. commercially harvested paddlefish. Total annual mortality in their study was 68 percent. As natural mortality of paddlefish is usually less than 10% (Timmons and Hughbanks 2000), this indicates recent exploitation rates were high. Scholten and Bettoli (2005) recommended an increase in minimum length limit to allow female paddlefish to reach reproductive sizes and to reduce recruitment overfishing.

Despite the fact that the paddlefish is an important sport or commercial fish in several Midwestern and Southeastern states, little is currently known about paddlefish stocks, habitats, movements, distributions, and current exploitation rates. There has been concern that paddlefish harvested in one state may, in fact, have been produced in another state or river where the species is listed as protected. In an effort to address this concern the 28 member states of the Mississippi Interstate Cooperative Resource Association (MICRA) established a Paddlefish/Sturgeon Committee in the fall of 1992. One of the main objectives of the MICRA Paddlefish/Sturgeon Committee is to encourage development and implementation of regulations and policies to optimize paddlefish resources in the Mississippi River Basin.

MICRA began a large-scale, multi-agency, coded-wire tag (CWT) paddlefish tag-and-release study in 1995 under a $200,000 Federal Aid Administrative Funding cooperative agreement. This study initiated a multi-state, multi-year coded wire tagging effort to assess paddlefish stocks throughout the Mississippi River Basin. The tagging protocols and original dBase database structure were developed by Tennessee Wildlife Resources Agency in cooperation with Northwest Marine Technology, Inc. and Tennessee Technological University, respectively. The tag processing and database management were transferred to the Fish and Wildlife Service's Carterville, Illinois and Columbia, Missouri Fishery Resources Offices in 1997. Modifications were made to project datasheets to both reduce the number of pages required by field biologists and to clarify code usage per request of project participants (Grady and Conover 1998). The database was transferred to Microsoft ACCESS in 2004 to increase direct usability by project participants. Structured query language (SQL) programming to link the histories of recaptured paddlefish was completed by the Delta Systems Group, Inc. in 2005. The tag processing portion of the project was moved from Carterville, Illinois to Columbia, Missouri in 2005. Reducing project responsibilities to a single facility will speed tag reading and data processing to benefit project participants.

Long-term goals of the study are to assess paddlefish habitat use, distribution, movements, extent of harvest and exploitation by stock. This multi-agency study is precedent setting; nothing of this magnitude has ever been attempted on an inland, freshwater fishery. The purpose of this study was to further understanding of the habitat requirements and population status of paddlefish across the Mississippi River Basin. Twenty-two of MICRA's 28 member states have participated in this study by tagging wild-caught adult and hatchery-raised juvenile paddlefish according to procedures outlined in Oven (1995), Oven and Fiss (1996) and Grady and Conover (1998). Northwest Marine Technology contracted Lars Mobrand of Mobrand Biometrics, Inc. in 1998 to assess the paddlefish project. Lars uses the Ecosystem Diagnosis and Treatment Method (EDT) to model salmon populations through their ecosystem. The method uses a species or population and information about its life history to diagnose an ecosystem's condition for sustainability (Lestelle et al. 1996; Mobrand et al. 1997). Lars identified the following data needs and objectives for our project:

- A lack of knowledge of young fish needed for cohort analysis
- Need for significant multiple recaptures to make population estimates
- Need to determine specific habitats within spawning areas
- Need to identify and map discrete population boundaries and core populations of fish
- Determine reproductive success
- Determine "limiting factors" and habitat requirements for paddlefish throughout their life history
- Develop routed spatial network (to capture geography in database).

Lars identified the need to continue the paddlefish stock assessment project for an additional five years to increase paddlefish recaptures and develop additional data. Project participants worked on maps to identify distinct populations and divided the basin into five sub-basins: Gulf Rivers, Missouri Basin, Upper Mississippi Basin, Lower Mississippi Basin and Ohio Basin. Additionally, workgroups from each of these Basins identified specific management units within these Basins. In some project areas, sampling efforts were continued or expanded to meet the project needs identified by Mobrand Biometrics. Many of the information needs such as information about young fish, determining spawning sites and reproductive success were outside the scope of the MICRA project and still need to be addressed in order to consider using that population tool.

The objectives of this document are to provide a summary of wild fish sampling and tagging efforts, hatchery stocking activities, and tag recovery data for 1995 through 2004.

SAMPLING

Effort

State and federal agencies in 19 states completed 1,551 paddlefish sampling trips between 1995 and 2004, exerting nearly 30,000 hours of effort (Table 1). The Mississippi Basin experienced the most sampling effort at 656 trips. This number is due in part to the large size of the basin. While the Gulf Rivers had the smallest number of individual trips (234); the number of trips by state was highest for this sub-basin. While the number of sampling trips in Nebraska and South Dakota appear small; few trips were needed to capture the target goal of 300 fish per year as fish were concentrated below Gavins Point Dam.

Table 1. Number of sampling trips completed by MICRA participants to assess paddlefish stocks from 1995 to 2004. GP indicates the jointly managed Gavins Point Dam fishery. (Italics indicate information received from biologists but not in MICRA database).

State	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Gulf Basin										
LA	2	20	20	2	7	6	7	18	4	*5*
OK	-	-	-	12	-	5	2	14	9	2
TX	-	19	61	19	-	-	-	-	-	-
Mississippi Basin										
AR	6	4	-	-	-	-	-	-	-	-
IA	1	15	28	28	18	9	21	33	22	22
IL	37	7	25	13	18	15	18	14	11	16
LA	-	1	-	-	-	-	2	1	1	*1*
MN	31	25	-	8	-	6	-	49	1	-
MO	-	2	4	2	-	-	-	-	-	-
MS	-	3	2	1	4	1	-	-	-	-
OK	3	1	11	4	3	4	5	2	5	-
TN	3	1	1	-	-	-	1	-	-	-
WI	18	5	16	16	10	4	1	7	9	-
Missouri Basin										
IA	1	-	3	3	3	3	1	2	2	-
KS	-	1	-	1	-	1	-	-	-	-
MO	16	-	1	2	-	10	5	15	10	-
GP	17	15	18	14	16	8	4	9	7	-
NE	-	3	1	2	-	1	-	3	1	-
SD	-	8	1	3	1	5	2	2	1	-
Ohio Basin										
IL	6	15	17	22	28	21	18	19	14	19
IN	9	24	13	16	9	3	4	1	2	9
KY	9	23	19	22	26	13	6	8	1	5
OH	2	6	2	2	2	-	-	2	1	1
PA	-	2	-	-	-	-	-	-	-	-
TN	18	16	3	1	-	-	-	-	1	-
WV	-	-	3	3	2	-	-	-	-	-

Biologists primarily sampled for paddlefish in those areas where they can most efficiently collect paddlefish in an effort to increase recaptures of tagged fish. Project participants had committed themselves to collecting and tagging 300 wild fish per state per year. Sampling effort was highest during late winter and early spring months (February through May) with paddlefish catch during a given month being proportionately similar to the amount of effort expended (Figure 2).

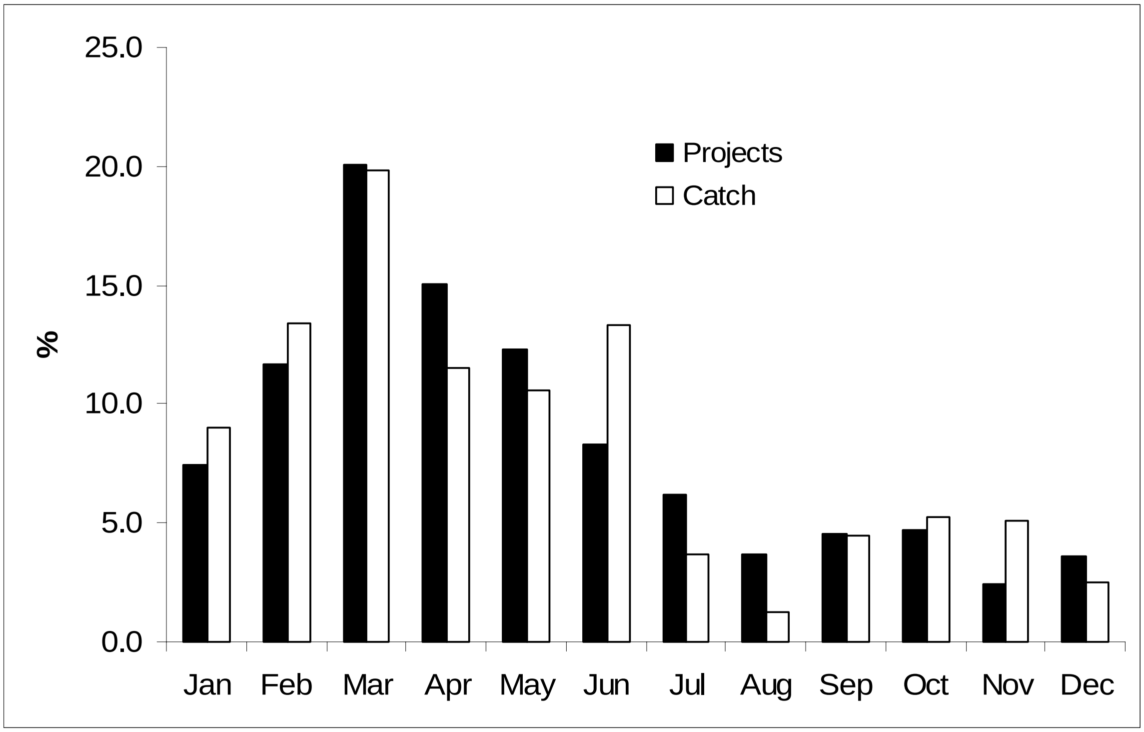

Figure 2. Percent of total sampling effort and catch by month for MICRA paddlefish stock assessment project, 1995 – 2004.

Sampling effort by participating agencies was greatest in main channel and tailwater habitats for the Mississippi, Missouri, and Ohio River basins (Figure 3). The bulk of effort within the Mississippi basin were spread across main channel (37.7%), tailwater (33.9%), and backwater (21.8%) habitats. Nearly 58% of effort in the Missouri basin took place in tailwater habitats while 24.4% occurred in main channels. Effort in the Ohio basin was similar to the Missouri with 28.7% of effort in main channel habitats and 37.2% in tailwater areas. The majority of effort in the Gulf basin took place in main channel (58.9%) and backwater habitats (16.4%).

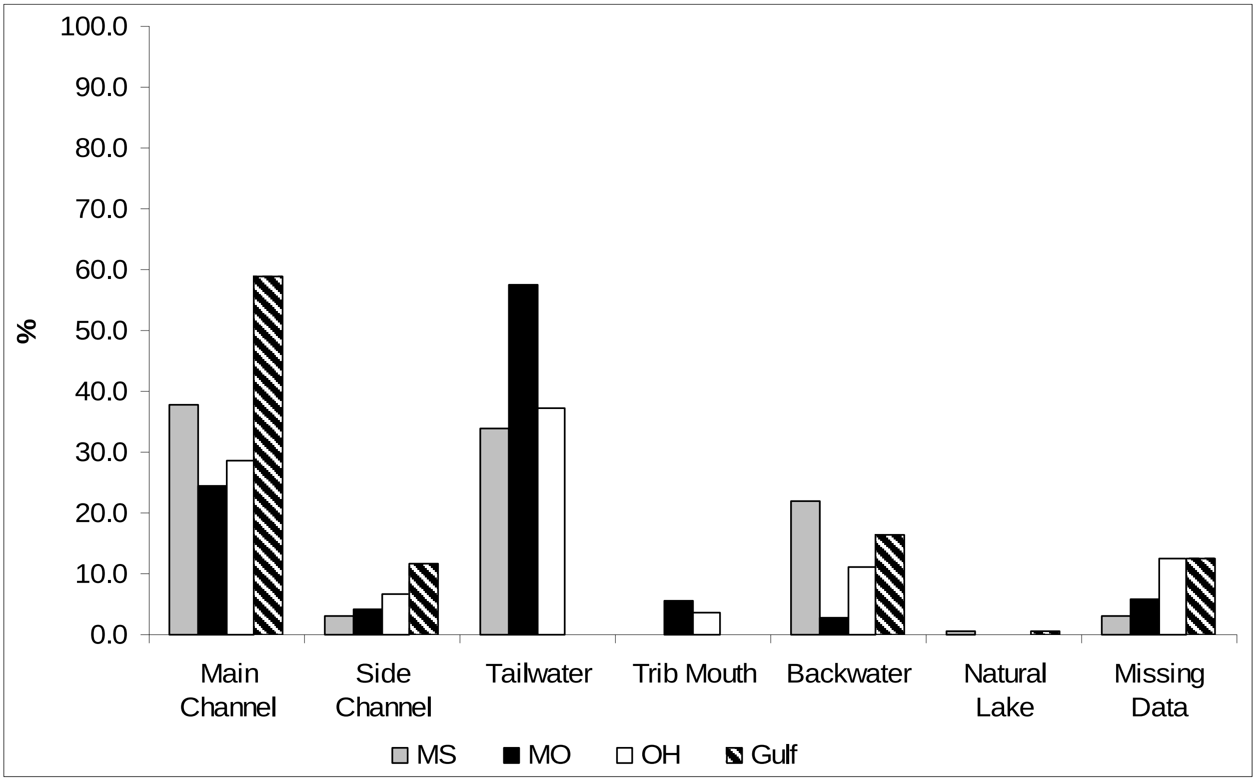

Figure 3. Percent of total sampling effort by habitat type and basin for MICRA paddlefish stock assessment project, 1995-2004.

Similar to previous reports, the vast majority of sampling effort was made with nets (Figure 4). More than 85% of the total sampling efforts in all four basins (Mississippi – 85.7%; Missouri – 92.6%; Ohio – 94.6%; Gulf – 98.6%) were nets. Snagging was used for 13.4% and 4.3% of the total sampling effort in the Mississippi and Missouri basins, respectively. Electrofishing accounted for 4.7% of the total sampling effort in the Ohio basin.

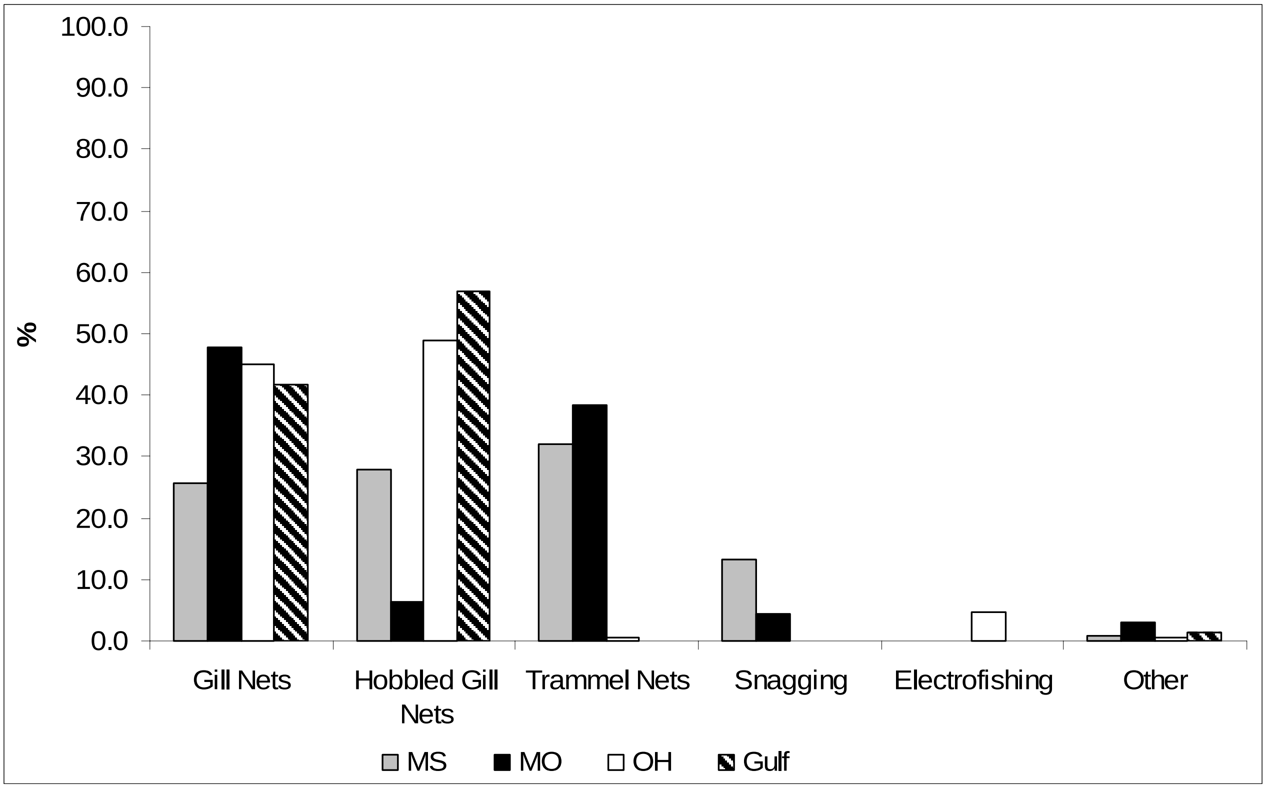

Figure 4. Percent of total sampling efforts by gear and basin for MICRA paddlefish stock assessment project, 1995-2004.

Catch

MICRA participants collected over 22,000 paddlefish from 1995 through 2004 (Table 2). Eighty-seven percent of these fish were marked with coded wire tags and returned to the water (Table 3). There are several reasons for the differences in numbers between total catch and fish marked and released. Oklahoma has opted to only place coded wire tags in hatchery stocked fish and jawtag their adult fish. Some agencies sample areas repeatedly within a season and recapture fish marked with fin clips unique to that area. These fish are not remarked with coded wire tags. In some cases, the difference between total catch and fish released with coded wire tags is due to broodstock removal from the system, equipment failure or fish mortality.

Table 2. Number of paddlefish collected by state and federal agencies for the MICRA paddlefish stock assessment project, 1995-2004. GP indicates the jointly managed Gavins Point Dam fishery. (Italics indicate information received from biologists but not in MICRA database).

State	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	TOTAL
Gulf Basin											
LA	29	182	220	53	143	89	65	*130*	*60*	*51*	1061*
OK	-	-	-	25	-	62	25	139	134	38	423
TX	-	29	6	1	-	-	-	-	-	-	36
Mississippi Basin											
AR	16	29	-	-	-	-	-	-	-	-	45
IA	2	207	120	368	179	36	216	482	347	363	2320
IL	119	320	239	209	475	355	124	142	247	231	2461
LA	-	3	-	-	-	-	*15*	*1*	*14*	*0*	16*
MN	6	9	-	-	-	5	-	16	3	-	39
MO	-	5	26	14	-	-	-	-	-	-	45
MS	-	23	20	18	48	24	-	-	-	-	133
OK	128	18	144	15	45	36	73	65	65	-	589
TN	203	7	-	-	-	-	8	-	-	-	218
WI	17	76	163	145	74	1	1	1	18	-	496
Missouri Basin											
IA	11	-	50	51	12	141	0	14	16	-	295
KS	-	4	-	84	-	45	-	-	-	-	133
MO	158	-	-	1	-	11	7	17	19	-	213
GP	729	719	920	626	741	246	330	523	490	-	5324
NE	-	28	19	51	-	19	-	76	24	-	217
SD	-	75	-	19	4	44	44	18	15	-	219
Ohio Basin											
IL	13	87	177	298	281	256	510	432	400	277	2731
IN	245	428	315	386	326	105	119	31	33	112	2100
KY	221	155	183	304	259	753	321	287	1	147	2631
OH	6	90	103	36	134	-	-	132	7	12	520
TN	105	70	26	16	-	-	-	-	1	-	218
WV	-	-	6	29	26	-	-	-	-	-	61
TOTAL	2008	2564	2737	2770	2747	2228	1843	2375	1819	1180	22544

* LA collected 280 paddlefish in Gulf Rivers and 13 fish in the Mississippi Basin 1990-1994.

Table 3. Number of paddlefish collected by state and federal agencies, marked with coded wire tags, and released as part of the MICRA paddlefish stock assessment project, 1995-2004. GP indicates the jointly managed Gavins Point Dam fishery. (Italics indicate information received from biologists but not in MICRA database). Note Oklahoma tagged wild adult fish with jawtags and not coded wire tags.

State	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	TOTAL
Gulf Basin											
LA	29	174	192	53	39	42	31	*54*	*39*	*38*	531
OK	-	-	-	1	-	-	-	-	-	-	1
TX	-	27	1	-	-	-	-	-	-	-	28
Mississippi Basin											
AR	7	24	-	-	-	-	-	-			31
IA	2	188	108	306	154	35	188	434	320	343	2078
IL	119	320	229	200	471	353	124	142	246	221	2425
LA	-	3	-	-	-	-	*15*	*1*	*10*	*0*	3
MN	5	9	-	-	-	5	-	13	3	-	35
MO	-	5	25	14	-	-	-	-	-	-	44
MS	-	17	20	18	41	24	-	-	-	-	120
OK	-	-	72	-	-	-	-	-	1	-	73
TN	203	7	-	-	-	-	8	-	-	-	218
WI	17	69	137	90	65	1	1	1	13	-	394
Missouri Basin											
IA	11	-	50	51	12	140	0	14	16	-	294
KS	-	4	-	8	-	45	-	-	-	-	57
MO	158	-	-	1	-	9	6	6	18	-	198
GP	682	686	895	611	711	242	324	457	486	-	5094
NE	-	23	19	51	-	19	-	73	24	-	209
SD	-	75	0	19	4	44	44	18	14	-	218
Ohio Basin											
IL	13	85	168	277	271	254	502	179	389	253	2391
IN	245	428	310	359	318	94	104	27	30	40	1955
KY	221	155	182	280	242	719	317	242	-	137	2495
OH	6	89	102	35	129	-	-	117	7	-	485
TN	102	53	21	11	-	-	-	-	-	-	187
WV	-	-	6	28	20	-	-	-	-	-	54
TOTAL	1778	2441	2537	2413	2477	2026	1649	1723	1567	994	19605

Paddlefish catches by habitat were proportionately similar to efforts expended. Catches in the Mississippi basin totaled over 6,300 fish, and were spread across main channel (41.6%), tailwater (45.8%), and backwater (8.1%) habitats (Figure 5). Of 6,394 paddlefish captured in the Missouri basin, 87.7% were captured in tailwater habitats while 7.1% were caught in main channels (Figure 5). Projects in the Ohio captured 8,227 paddlefish with 46.7% caught in tailwater habitats and 18.2% in main channel areas (Figure 5). The majority of paddlefish captured in the Gulf basin were caught in main channel (49.4%) and backwater habitats (26.3%; Figure 5). Hoxmeier and DeVries (1997) examined paddlefish habitat use in the Lower Alabama

River. Paddlefish primarily inhabited backwater areas in summer and fall and shifted to channel areas during winter and spring.

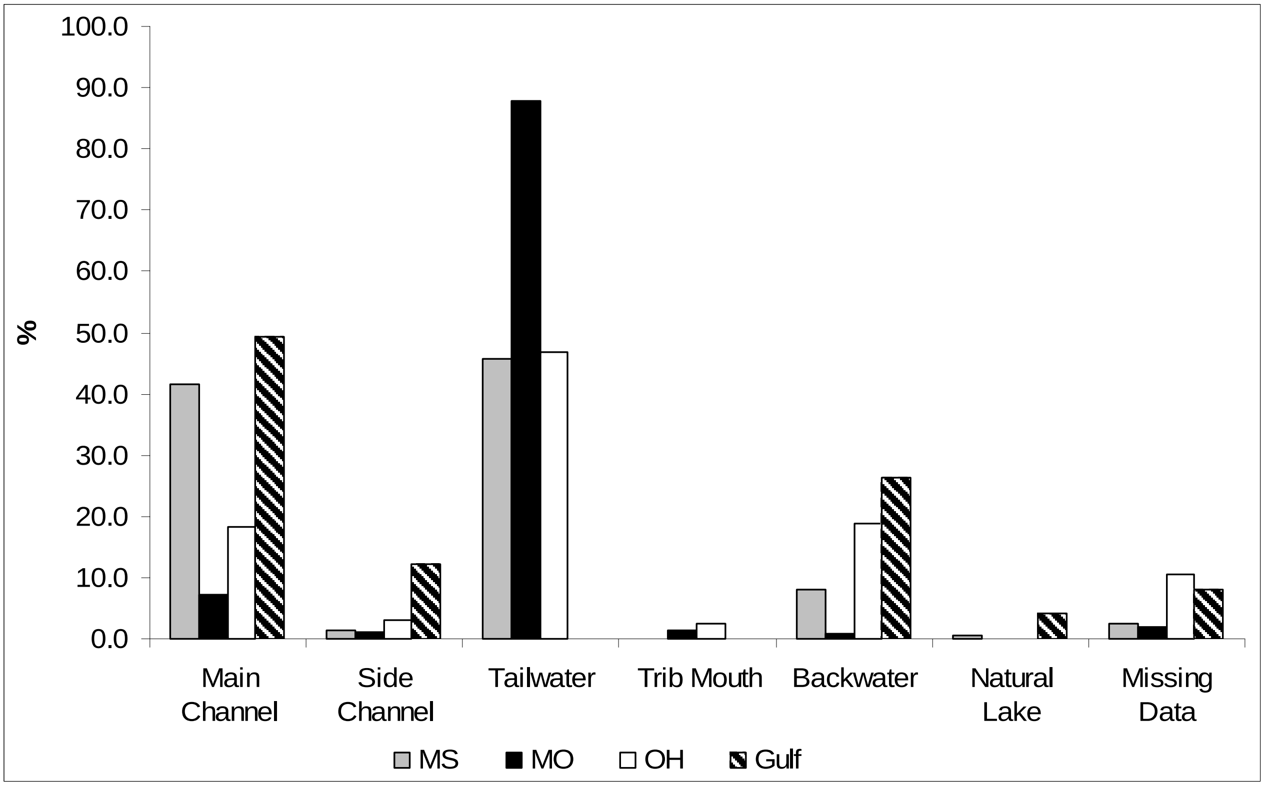

Figure 5. Percent of total paddlefish catch by habitat type and basin for MICRA paddlefish stock assessment project, 1995-2004.

Catch-per-unit-effort

Tables 4-10 give catch-per-unit-effort (CPUE) by gear type for each state in each basin for every year of the study. A total of 29,924 hours of paddlefish sampling effort were expended by states in all four study basins (Gulf – 7,523 hr; Mississippi – 9,169 hr; Missouri – 3,786 hr; Ohio – 9,445 hr) since 1995. The lowest basin-wide CPUE for selected gears was nearly zero for hobbled gill nets in the Gulf basin. Catch-per-unit-effort for hobbled gill nets ranged from 0.9 in the Ohio Basin to 15.5 paddlefish per hour in the Missouri basin (Tables 4 and 5). The highest basin-wide CPUE was for trammel nets in the Missouri River basin with an average of 33 paddlefish per hour across all years of the study. This high average was primarily due to sampling the concentrations of paddlefish below Gavins Point Dam on the South Dakota – Nebraska border. Nebraska was also responsible for the highest individual state/gear/year CPUE with 95 paddlefish per hour in trammel nets in 1997 (Table 6). Basin-wide CPUE for trammel nets was lowest in the Ohio basin with 0.2 paddlefish per hour across years. Gill net CPUE ranged from 0.2 paddlefish per hour in the Mississippi basin to 5.7 paddlefish per hour in the Missouri basin (Tables 7 and 8). The high CPUE for gill nets in the Missouri Basin is also due to the success of Nebraska Game and Parks Commission and South Dakota Department of

Game, Fish and Parks at collecting paddlefish concentrated below Gavins Point Dam. Snagging as a sampling technique is practiced almost exclusively by Iowa Department of Natural Resources. On average, CPUE for snagging was 1.95 fish per hour in the Mississippi River and 1.05 fish per hour in the Missouri River from 1995 through 2004 (Table 9). Electrofishing was used as a sampling tool by several Ohio Basin states and once each in Missouri and Kansas. It appears to be a highly effective means of capturing fish as Ohio Basin states averaged 11.9 paddlefish per hour from 1995 through 2004 (Table 10). However, it is not used routinely by most agencies due to the potential for harming the fish (Scarnecchia et al 1999). Paddlefish are also occasionally captured and reported from rotenone lock surveys, trawls and hoop nets. Hoop nets are generally not used to target paddlefish species and may be detrimental to them. Dieterman et al (2000) estimated that one paddlefish would be killed for every 37 net-days of hoop net effort within the Lower Missouri River.

Table 4. Hobbled gill net CPUE for Ohio River Basin states 1995-2004.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Effort (hour)										
IL	-	-	33.1	176.4	144.4	84.9	71.7	48.6	-	-
IN	-	-	1200.4	1.0	-	-	-	-	-	-
KY	-	-	-	44.1	12.5	3.3	4.7	-	-	-
OH	-	271.1	174.8	76.3	240.5	-	-	30.6	-	87.9
TN	310.0	262.9	75.3	76.1	-	-	-	-	-	0.0
Basin	310.0	534.0	1483.6	373.9	397.4	88.2	76.4	79.2	-	87.9
Catch										
IL	-	-	174	283	276	172	486	81	-	-
IN	-	-	61	7	-	-	-	-	-	-
KY	-	-	-	14	18	5	68	-	-	-
OH	-	90	103	36	134	-	-	28	-	12
TN	88	67	15	16	-	-	-	-	-	-
Basin	88	157	353	356	428	177	554	109	-	12
CPUE										
IL	-	-	5.3	1.6	1.9	2.0	6.8	1.7	-	-
IN	-	-	0.1	7.0	-	-	-	-	-	-
KY	-	-	-	0.3	1.4	1.5	14.6	-	-	-
OH	-	0.3	0.6	0.5	0.6	-	-	0.9	-	0.1
TN	0.3	0.3	0.2	0.2	-	-	-	-	-	-
Basin	0.3	0.3	0.2	1.0	1.1	2.0	7.3	1.4	-	0.1

Table 5. Hobbled gill net CPUE for Gulf Rivers, Mississippi River Basin, and Missouri River Basin states 1995-2004.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Effort (hour)										
Gulf	-	-	1306.9	1529.9	-	-	-	-	-	-
TX	-	-	1306.9	1529.9	-	-	-	-	-	-
MS Basin	355.1	372.0	175.9	36.9	9.6	36.2	9.8	374.4	76.6	22.1
AR	338.9	301.6	-	-	-	-	-	-	-	-
IL	-	-	-	-	6.0	25.0	8.7	20.5	10.1	22.1
MN	16.2	64.0	-	16.2	-	3.9	-	342.7	2.5	-
OK	-	-	128.8	-	-	-	-	-	4.5	-
TN	-	-	5.4	-	-	-	1.1	-	-	-
WI	-	6.4	41.7	20.8	3.6	7.3	-	11.2	59.6	-
MO Basin	39.8	17.4	22.9	73.3	-	249.2	8.8	-	-	-
MO	-	-	-	-	-	237.6	-	-	-	-
SD	39.8	17.4	22.9	73.3	-	11.6	8.8	-	-	-
Catch										
Gulf	-	-	-	-	-	-	-	-	-	-
TX	-	-	6	1	-	-	-	-	-	-
MS Basin	20	89	279	108	50	353	73	17	301	185
AR	16	14	-	-	-	-	-	-	-	-
IL	-	-	-	-	44	353	65	0	245	185
MN	4	9	-	0	-	0	-	16	3	-
OK	-	-	116	-	-	-	-	-	35	-
TN	-	-	0	-	-	-	8	-	-	-
WI	-	66	163	108	6	0	-	1	18	-
MO Basin	120	101	355	303	-	49	77	-	-	-
MO	-	-	-	-	-	1	-	-	-	-
SD	120	101	355	303	-	48	77	-	-	-
CPUE										
Gulf	-	-	-	-	-	-	-	-	-	-
TX	-	-	0.0	0.0	-	-	-	-	-	-
MS Basin	0.1	0.2	1.6	2.9	5.2	9.7	7.4	0.0	3.9	8.4
AR	0.0	0.0	-	-	-	-	-	-	-	-
IL	-	-	-	-	7.4	14.1	7.5	0.0	24.3	8.4
MN	0.2	0.1	-	0.0	-	0.0	-	0.0	1.2	-
OK	-	-	0.9	-	-	-	-	-	7.8	-
TN	-	-	0.0	-	-	-	7.1	-	-	-
WI	-	10.3	3.9	5.2	1.7	0.0	-	0.1	0.3	-
MO Basin	3.0	5.8	15.5	4.1	-	0.2	8.8	-	-	-
MO	-	-	-	-	-	0.0	-	-	-	-
SD	3.0	5.8	15.5	4.1	-	4.1	8.8	-	-	-

Table 6. Trammel net CPUE for Mississippi River Basin, Missouri River Basin and Ohio River Basin states 1995-2004.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
					Effort (hour)					
MS Basin	382.8	106.5	267.1	172.6	101.1	6.6	42.7	5.0	0.3	18.1
IL	374.4	106.5	267.1	172.6	101.0	6.2	42.7	5.0	0.3	18.1
MN	2.3	-	-	-	-	-	-	-	-	-
WI	6.1	-	-	-	0.1	0.4	-	-	-	-
MO Basin	4.9	7.4	79.5	8.0	7.6	1.7	-	2.4	0.5	-
IA	-	-	73.3	1.8	1.8	1.7	-	1.1	0.5	-
NE	0.9	7.4	6.2	5.7	5.9	-	-	1.4	-	-
SD	4.0	-	-	0.4	-	-	-	-	-	-
OH Basin	19.8	-	-	3.1	-	7.0	7.3	-	-	-
IL	19.8	-	-	-	-	7.0	7.3	-	-	-
IN	0.0	-	-	3.1	-	-	-	-	-	-
					Catch					
MS Basin	166	266	429	261	282	16	77	13	3	49
IL	161	266	429	261	280	14	77	13	3	49
MN	1	-	-	-	-	-	-	-	-	-
WI	4	-	-	-	2	2	-	-	-	-
MO Basin	56	391	623	301	371	110	-	90	1	-
IA	-	-	39	19	10	110	-	14	1	-
NE	45	391	584	282	361	-	-	76	-	-
SD	11	-	-	0	-	-	-	-	-	-
OH Basin	0	-	-	3	-	0	0	-	-	-
IL	0	-	-	-	-	0	0	-	-	-
IN	0	-	-	3	-	-	-	-	-	-
					CPUE					
MS Basin	0.4	2.5	1.6	1.5	2.8	2.4	1.8	2.6	9.0	2.7
IL	0.4	2.5	1.6	1.5	2.8	2.3	1.8	2.6	9.0	2.7
MN	0.4	-	-	-	-	-	-	-	-	-
WI	0.7	-	-	-	15.0	4.8	-	-	-	-
MO Basin	11.4	53.2	7.8	37.7	48.6	66.0	-	37.0	2.0	-
IA		-	0.5	10.4	5.7	66.0	-	12.9	2.0	-
NE	48.2	53.2	95.0	49.2	61.4	-	-	56.3	-	-
SD	2.8	-	-	0.0	-	-	-	-	-	-
OH Basin	0.0	-	-	1.0	-	0.0	0.0	-	-	-
IL	0.0	-	-	-	-	0.0	0.0	-	-	-
IN		-	-	1.0	-	-	-	-	-	-

Table 7. Gill net CPUE for Gulf Rivers and Mississippi River Basin states 1995-2004.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
					Effort (hour)					
Gulf	-	557.2	335.1	97.3	836.0	525.2	824.0	725.1	526.8	230.5
LA	-	246.1	335.1	8.0	836.0	406.9	789.0	-	-	-
OK	-	-	-	89.3	-	118.3	35.0	725.1	526.8	230.5
TX	-	311.2	-	-	-	-	-	-	-	-
MS Basin	510.4	918.9	725.1	931.4	824.4	496.2	491.4	190.1	233.8	-
IL	10.1	8.3	0.9	-	9.8	0.8	-	0.8	-	-
LA	-	-	-	-	-	-	256.5	-	-	-
MN	97.9	23.8	-	6.7	-	7.9	-	12.1	-	-
MO	-	42.7	11.3	-	-	-	-	-	-	-
MS	-	341.3	-	-	403.7	-	-	-	-	-
OK	379.5	503.0	713.0	869.5	392.8	480.9	231.5	177.0	233.8	-
WI	23.0	-	-	55.3	18.0	6.6	3.4	0.3	-	-
					Catch					
Gulf	-	194	169	25	143	151	90	139	134	38
LA	-	174	169	1	143	89	65	-	-	-
OK	-	-	-	24	-	62	25	139	134	38
TX	-	20	-	-	-	-	-	-	-	-
MS Basin	136	97	40	52	330	42	74	67	27	-
IL	6	56	0	-	188	0	-	2	-	-
LA	-	-	-	-	-	-	0	-	-	-
MN	2	0	-	0	-	5	-	0	-	-
MO	-	5	12	-	-	-	-	-	-	-
MS	-	18	-	-	29	-	-	-	-	-
OK	128	18	28	15	45	36	73	65	27	-
WI	0	-	-	37	68	1	1	0	-	-
					CPUE					
Gulf	-	0.3	0.5	0.3	0.2	0.3	0.1	0.2	0.3	0.2
LA	-	0.7	0.5	0.1	0.2	0.2	0.1	-	-	-
OK	-	-	-	0.3	-	0.5	0.7	0.2	0.3	0.2
TX	-	0.1	-	-	-	-	-	-	-	-
MS Basin	0.3	0.1	0.1	0.1	0.4	0.1	0.2	0.4	0.1	-
IL	0.6	6.8	0.0	-	19.1	0.0	-	2.7	-	-
LA	-	-	-	-	-	-	0.0	-	-	-
MN	0.0	0.0	-	0.0	-	0.6	-	0.0	-	-
MO	-	0.1	1.1	-	-	-	-	-	-	-
MS	-	0.1	-	-	0.1	-	-	-	-	-
OK	0.3	0.0	0.0	0.0	0.1	0.1	0.3	0.4	0.1	-
WI	0.0	-	-	0.7	3.8	0.2	0.3	0.0	-	-

Table 8. Gill net CPUE for Missouri River Basin and Ohio River Basin states 1995-2004.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
					Effort (hour)					
MO Basin	180.6	30.8	3.0	5.7	28.3	95.2	65.5	256.2	1817.1	-
MO	69.8	-	3.0	2.0	-	43.6	46.9	209.2	1794.1	-
NE	37.2	5.3	-	2.2	11.6	6.3	18.6	3.6	3.5	-
SD	73.6	25.5	-	1.5	16.7	45.3	-	43.4	19.5	-
OH Basin	214.6	2683.8	521.9	615.8	543.7	368.9	274.3	249.2	97.0	324.5
IL	6.8	23.5	-	-	-	37.7	9.6	66.0	31.8	199.4
IN	196.0	2016.4	232.7	303.7	107.2	181.6	189.8	23.3	55.3	79.4
KY	-	558.4	289.2	268.1	407.4	149.6	74.8	70.1	-	45.8
OH	9.5	54.8	-	-	-	-	-	89.9	9.9	-
PA	-	30.8	-	-	-	-	-	-	-	-
TN	2.3	-	-	-	-	-	-	-	-	-
WV	-	-	-	44.0	29.1	-	-	-	-	-
					Catch					
MO Basin	571	290	0	93	372	240	255	537	528	-
MO	76	-	0	0	-	6	2	12	14	-
NE	299	83	-	24	74	174	253	290	324	-
SD	196	207	-	69	298	60	-	235	190	-
OH Basin	107	456	309	559	370	882	354	773	429	524
IL	4	35	-	-	-	30	24	351	389	277
IN	98	376	197	253	132	105	96	31	33	100
KY	-	45	112	278	221	747	234	287	-	147
OH	5	0	-	-	-	-	-	104	7	-
PA	-	0	-	-	-	-	-	-	-	-
TN	0	-	-	-	-	-	-	-	-	-
WV	-	-	-	28	17	-	-	-	-	-
					CPUE					
MO Basin	3.2	9.4	0.0	16.5	13.1	2.5	3.9	2.1	0.3	-
MO	1.1	-	0.0	0.0	-	0.1	0.0	0.1	0.0	-
NE	8.0	15.7	-	10.9	6.4	27.8	13.6	80.6	93.0	-
SD	2.7	8.1	-	47.6	17.9	1.3	-	5.4	9.7	-
OH Basin	0.5	0.2	0.6	0.9	0.7	2.4	1.3	3.1	4.4	1.6
IL	0.6	1.5	-	-	-	0.8	2.5	5.3	12.3	1.4
IN	0.5	0.2	0.8	0.8	1.2	0.6	0.5	1.3	0.6	1.3
KY	-	0.1	0.4	1.0	0.5	5.0	3.1	4.1	-	3.2
OH	0.5	0.0	-	-	-	-	-	1.2	0.7	-
PA	-	0.0	-	-	-	-	-	-	-	-
TN	0.0	-	-	-	-	-	-	-	-	-
WV	-	-	-	0.6	0.6	-	-	-	-	-

Table 9. Snagging CPUE for Mississippi River Basin and Missouri River Basin states 1995-2004.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Effort (hour)										
MS Basin	91.0	208.8	96.3	152.0	131.3	46.5	119.5	150.8	124.0	110.3
IA	24.0	199.3	96.3	152.0	131.3	46.5	119.5	150.8	124.0	110.3
IL	22.4	-	-	-	-	-	-	-	-	-
TN	44.6	9.5	-	-	-	-	-	-	-	-
MO Basin	400.0	-	4.0	-	20.0	10.7	31.5	-	32.0	-
IA	400.0	-	4.0	-	20.0	10.7	31.5	-	32.0	-
Catch										
MS Basin	213	209	108	294	179	36	206	482	347	363
IA	2	202	108	294	179	36	206	482	347	363
IL	8	-	-	-	-	-	-	-	-	-
TN	203	7	-	-	-	-	-	-	-	-
MO Basin	11	-	11	-	2	31	0	-	15	-
IA	11	-	11	-	2	31	0	-	15	-
CPUE										
MS Basin	2.3	1.0	1.1	1.9	1.4	0.8	1.7	3.2	2.8	3.3
IA	0.1	1.0	1.1	1.9	1.4	0.8	1.7	3.2	2.8	3.3
IL	0.4	-	-	-	-	-	-	-	-	-
TN	4.5	0.7	-	-	-	-	-	-	-	-
MO Basin	0.0	-	2.8	-	0.1	2.9	0.0	-	0.5	-
IA	0.0	-	2.8	-	0.1	2.9	0.0	-	0.5	-

Table 10. Electrofishing CPUE for Missouri River and Ohio River Basin states 1995-2004.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
					Effort (hour)					
OH Basin	19.0	16.7	10.4	15.6	5.6	2.4	-	-	0.8	2.0
IL	5.2	6.3	0.5	2.0	-	2.4	-	-	0.8	0.0
IN	13.8	10.1	2.3	9.5	4.9	-	-	-	-	2.0
KY	-	0.4	7.6	4.1	0.7	-	-	-	-	-
TN	-	2.8	-	-	-	-	-	-	-	-
MO Basin	-	-	-	1.5	-	-	0.9	-	-	-
KS	-	-	-	1.5	-	-	-	-	-	-
MO	-	-	-	-	-	-	0.9	-	-	-
					Catch					
OH Basin	156	107	99	137	141	52	-	-	11	3
IL	9	52	3	7	-	52	-	-	11	-
IN	147	52	57	123	128	-	-	-	-	3
KY	-	2	39	7	13	-	-	-	-	-
TN	-	1	-	-	-	-	-	-	-	-
MO Basin	-	-	-	84	-	-	4	-	-	-
KS	-	-	-	84	-	-	-	-	-	-
MO	-	-	-	-	-	-	4	-	-	-
					CPUE					
OH Basin	8.2	6.4	9.5	8.8	25.1	21.5	-	-	14.0	1.5
IL	1.7	8.3	6.0	3.5	-	21.5	-	-	14.0	-
IN	10.6	5.2	25.3	12.9	26.2	-	-	-	-	1.5
KY	-	5.0	5.1	1.7	17.7	-	-	-	-	-
TN	-	0.4	-	-	-	-	-	-	-	-
MO Basin	-	-	-	54.8	-	-	4.5	-	-	-
KS	-	-	-	54.8	-	-	-	-	-	-
MO	-	-	-	-	-	-	4.5	-	-	-

Catch-per-unit-effort was also examined for each bar mesh size (inches) for the three types of nets used in this study in each basin (Tables 11 and 12). Highest mean CPUE across all basins was 63.5 paddlefish per hour for 3-in. mesh trammel nets in the Missouri Basin, 14.4 paddlefish per hour for 3.25-in. mesh gill nets in the Mississippi Basin, and 6.3 paddlefish per hour for 3.5-in. mesh hobbled gill nets in the Missouri Basin. The best average catch rate in the Ohio Basin was 3.0 fish per hour in 4-in. hobbled gill nets (Table 12).

Table 11. CPUE of paddlefish for trammel net bar mesh sizes (inches) in each river basin 1995 – 2004.

Mesh (bar in.)	MISS	MO	OH	GULF
Effort (hour)				
2.5	0.4	-	-	-
2.75	1.1	-	-	-
3	357.0	27.4	13.2	-
3.25	25.8	-	-	-
3.5	136.8	84.6	-	-
4	482.1	-	21.3	-
5	90.5	-	2.6	-
Catch				
2.5	3	-	-	-
2.75	19	-	-	-
3	378	1739	0	-
3.25	73	-	-	-
3.5	482	204	-	-
4	203	-	1	-
5	16	-	2	-
CPUE				
2.5	7.2	-	-	-
2.75	17.5	-	-	-
3	1.1	63.5	0.0	-
3.25	2.8	-	-	-
3.5	3.5	2.4	-	-
4	0.4	-	0.0	-
5	0.2	-	0.8	-

Table 12. CPUE of paddlefish for gill net and hobbled gill net mesh sizes for each basin 1995 – 2004.

Bar Mesh (inches)	Gill Nets				Hobbled Gill Nets			
	GULF	MISS	MO	OH	GULF	MISS	MO	OH
Effort (hour)								
0.75	-	8.8	-	-	-	-	-	-
1	-	8.8	-	-	-	-	-	-
1.25	-	8.8	-	-	-	-	-	-
1.5	-	8.8	632.6	-	-	-	-	-
2	-	8.8	647.2	11.3	-	-	-	-
3	8.0	151.6	688.3	26.0	-	54.6	59.3	4.0
3.25	-	1.3	-	2.0	-	-	-	-
3.5	-	101.4	92.2	14.2	-	234.6	104.2	1.0
4	203.0	1495.2	811.7	275.6	-	86.3	-	404.2
4.25	-	-	7.4	-	-	-	-	-
5	3501.1	3292.1	23.2	5420.9	2836.8	821.5	10.3	2944.4
6	893.3	222.3	1.0	22.2	-	142.9	-	69.6
7	-	-	-	-	-	-	-	7.3
8	22.5	7.5	-	-	-	128.8	-	-
Catch								
0.75	-	0	-	-	-	-	-	-
1	-	0	-	-	-	-	-	-
1.25	-	0	-	-	-	-	-	-
1.5	-	0	5	-	-	-	-	-
2	-	0	3	1	-	-	-	-
3	4	42	2232	10	-	8	357	0
3.25	-	18	-	3	-	-	-	-
3.5	-	189	533	21	-	234.6	104.2	1.0
4	21	111	96	398	-	86.3	-	404.2
4.25	-	-	8	-	-	-	-	-
5	881	486	14	4428	7	600	7	1097
6	129	17	0	59	-	63	-	21
7	-	-	-	-	-	0	-	0
8	33	13	-	-	-	116	-	0
CPUE								
0.75	-	0.0	-	-	-	-	-	-
1	-	0.0	-	-	-	-	-	-
1.25	-	0.0	-	-	-	-	-	-
1.5	-	0.0	0.0	-	-	-	-	-
2	-	0.0	0.0	0.1	-	-	-	-
3	0.5	0.3	3.2	0.4	-	0.1	6.0	0.0
3.25	-	14.4	-	1.5	-	-	-	-
3.5	-	1.9	5.8	1.5	-	3.5	6.3	1.0
4	0.1	0.1	0.1	1.4	-	0.1	-	3.0
4.25	-	-	1.1	-	-	-	-	-
5	0.3	0.1	0.6	0.8	0.0	0.7	0.7	0.4
6	0.1	0.1	0.0	2.7	-	0.4	-	0.3
7	-	-	-	-	-	-	-	0.0
8	1.5	1.7	-	-	-	0.9	-	-

PADDLEFISH SIZE COMPARISONS

Data from healthy paddlefish with lengths and weights were queried from the ACCESS database and imported to SAS for analysis. As the data did not approximate a normal population, the body lengths were log transformed before analysis. Analysis of Variance (ANOVA) and Duncan's multiple range test were used to test for significant differences in mean paddlefish body length between states, basins, habitats, and gear. While all models showed significant differences between the classes tested, all results had low R squared values, indicating that the models explained little of the differences in mean lengths. This is a common problem in large datasets with large standard deviations (Zar 1996).

By Basin

Mean lengths of paddlefish were compared within and between each of the four general MICRA basins (Table 13). In the Gulf Basin, a Duncan multiple range test revealed Oklahoma paddlefish are significantly larger (832.4 mm) than those in Louisiana and Texas (761.1 and 795.0 mm respectively). In the Mississippi Basin, Wisconsin and Oklahoma have the largest paddlefish (933.8 and 873.1 mm respectively), whereas, Missouri paddlefish are significantly smaller (587.9 mm) than all other states in the basin. In the Missouri Basin, South Dakota paddlefish are the largest at 931.8 mm, whereas Missouri paddlefish are the smallest at 644.6 mm. In the Ohio Basin, Tennessee and West Virginia paddlefish are the largest (844.8 and 822.3 mm respectively) and Illinois paddlefish are the smallest (719.5 mm). Overall, paddlefish collected in the Missouri Basin have the largest mean body length (803.5 mm), followed by the Gulf (784.8 mm) and Mississippi basins (698.6 mm) with the Ohio Basin (759.8 mm) being the smallest.

Table 13. Comparison of mean lengths of healthy paddlefish collected from different states within each basin 1995 – 2004 (All P<0.0001). GP indicates the paddlefish fishery below Gavins Point Dam which is jointly managed by the states of Nebraska and South Dakota. Duncan groupings with the same letters indicate comparisons that are not significantly different (P ≥ 0.05), whereas groupings with different letters are significantly different (P < 0.05).

Basin	State	N	Mean Length	Std Deviation	Range	Duncan grouping
GULF	LA	766	761.1	114.1	410-1320	B
	OK	376	832.4	92.5	400-1160	A
	TX	22	795.0	124.2	340-965	B
MISS	AR	39	624.2	101.9	410-810	CD
	IA	2045	637.1	152.8	240-1400	CD
	IL	2081	682.3	127.8	165-1124	C
	LA	11	539.7	164.9	372-890	E
	MN	24	850.1	152.1	599-1105	AB
	MO	7	587.9	76.3	470-686	D
	MS	80	778.0	114.9	337-1035	B
	OK	546	873.1	160.1	465-1550	A
	TN	200	496.5	77.1	360-780	E
	WI	425	933.8	119.7	452-1210	A
MO	GP	4274	805.2	122.7	280-1310	C
	IA	261	744.1	101.6	381-1054	D
	KS	65	836.4	87.4	607-1040	B
	MO	67	644.6	152.1	177-994	E
	NE	208	807.5	105.8	563-1221	C
	SD	124	931.8	156.0	545-1342	A
OHIO	IL	1939	719.5	134.1	168-1130	C
	IN	1680	786.0	143.3	368-1150	B
	KY	1793	771.8	111.2	319-1054	B
	OH	310	763.2	96.9	390-1050	B
	TN	100	844.8	115.9	415-1140	A
	WV	43	822.3	91.1	620-980	A
ALL	GULF	1164	784.8	112.7	340-1320	B
	MISS	5458	698.6	173.1	165-1550	D
	MO	4999	803.5	125.8	177-1342	A
	OHIO	5865	759.8	131.6	168-1150	C

By Habitat

The habitat stratum codes identified by field biologists were grouped into three major categories; river, reservoir, and backwater. River habitat consisted of samples collected in the main channel or main channel border, side channel or side channel border, tributary mouth/confluence, and tailwater zone (e.g. below Gavins Point Dam) of a river or stream. Reservoir habitat consisted of samples collected in offshore or shoreline areas of reservoirs, as well as in natural occurring lakes. Backwater habitat consisted of samples collected in backwater areas of rivers and reservoirs including contiguous, isolated, offshore, and shoreline backwaters.

In each of the four basins, paddlefish collected from reservoir habitat had a significantly larger mean body length then those collected in backwater or river habitat (Table 14). Overall, paddlefish collected from reservoir habitat had a mean body length of 838.0 mm, significantly larger than paddlefish collected in backwater (768.6 mm) and river (749.4 mm) habitats ($P < 0.0001$; Table 14)).

Table 14. Comparison of mean lengths of healthy paddlefish collected from different habitats within each basin 1995 – 2004 (All P<0.0001). Duncan groupings with the same letters indicate comparisons that are not significantly different (P ≥ 0.05), whereas groupings with different letters are significantly different (P < 0.05).

Basin	Habitat	N	Mean Length	Std Deviation	Range	Duncan Grouping
GULF	Backwater	383	722.5	107.55	410-985	C
	Reservoir	31	852.0	138.11	680-1320	A
	River	757	806.0	95.91	340-1270	B
MISS	Backwater	432	691.1	119.44	337-1075	B
	Reservoir	311	824.4	165.07	510-1550	A
	River	4963	685.6	180.71	9-1400	B
MO	Backwater	40	752.0	121.33	538-1105	B
	Reservoir	11	1153.2	179.88	805-1370	A
	River	5071	805.3	130.37	177-1408	B
OHIO	Backwater	1402	805.5	131.73	214-1150	B
	Reservoir	37	846.7	99.77	610-1020	A
	River	5254	747.7	126.05	168-1311	C
ALL	Backwater	2257	768.6	134.45	214-1150	C
	Reservoir	390	838.0	167.09	510-1550	A
	River	16045	749.4	153.31	9-1408	B

By Gear

Mean lengths of paddlefish were compared among the most common gear types (electrofishing (EF), combination of gill nets and trammel nets (NETS), and snagging (SNAG); Table 15) and, more specifically, net types (gill nets, hobbled gill nets, and trammel nets; Table 16).

Nets captured significantly larger paddlefish (779.7 mm) than electrofishing and snagging (673.7 and 624.8 mm respectively; $P < 0.0001$; Table 15). Specifically, gill nets captured significantly larger paddlefish (795.7 mm) than hobbled gill nets (776.2 mm) and trammel nets (749.5 mm; $P < 0.0001$; Table 16). A comparison of mesh sizes for gill and trammel nets reveals that, in general, as mesh size increases mean body length of paddlefish increases. For trammel nets, 3 inch bar mesh captured the largest paddlefish whereas 2.75 inch bar mesh captured the smallest (Table 17). For gill nets, the body length of paddlefish increased linearly as mesh size increased ($R^2 = 0.2423$; Table 18). For hobbled gill nets, 8 inch bar mesh collected the largest paddlefish (945.6 mm) with 4 inch bar mesh collecting the smallest (722.2 mm; Table 19).

Table 15. Comparison of mean lengths of paddlefish collected with different gears (electrofishing (EF), combination of gill nets and trammel nets (NETS), and snagging (SNAG) 1995 – 2004 ($P<0.0001$). Duncan groupings with the same letters indicate comparisons that are not significantly different ($P \geq 0.05$), whereas groupings with different letters are significantly different ($P < 0.05$).

Gear	N	Mean Length	Std Error	Duncan Grouping
EF	950	673.7	4.8	B
NETS	17832	779.1	1.1	C
SNAG	2803	624.8	2.8	A

Table 16. Comparison of mean lengths of paddlefish collected with different nets 1995 – 2004 ($P<0.0001$). Duncan groupings with the same letters indicate comparisons that are not significantly different ($P \geq 0.05$), whereas groupings with different letters are significantly different ($P < 0.05$).

Gear	N	Mean Length	Std Error	Duncan Grouping
Gill Nets	9784	795.7	1.4	C
Hobbled Gill Nets	4960	776.2	2.0	B
Trammel Nets	3125	749.5	2.5	A

Table 17. Comparison of mean lengths of paddlefish collected with different trammel net mesh sizes 1995 – 2004 ($P<0.0001$). Duncan groupings with the same letters indicate comparisons that are not significantly different ($P \geq 0.05$), whereas groupings with different letters are significantly different ($P < 0.05$).

Trammel Mesh	N	Mean Length	Std Error	Duncan Grouping
2.75	19	543.2	31.9	A
3	2117	777.8	3.0	F
3.25	73	638.1	16.3	AB
3.5	686	692.1	5.3	DE
4	204	713.8	9.7	CE
5	18	676.9	32.8	BCD

Table 18. Comparison of mean lengths of paddlefish collected with different gill net mesh sizes 1995 – 2004 (P<0.0001). Duncan groupings with the same letters indicate comparisons that are not significantly different (P ≥ 0.05), whereas groupings with different letters are significantly different (P < 0.05).

Gill Mesh	N	Mean Length	Std Error	Duncan Grouping
1.5	5	474.8	57.7	AH
2	4	699.3	64.6	ABCDEFG
3	2237	800.9	2.7	BLM
3.25	21	616.7	28.2	CH
3.5	736	753.3	4.8	DI
4	626	772.6	5.2	EIJ
4.25	8	1276.4	45.6	O
5	5805	799.4	1.7	FKM
6	205	790.5	9.0	GJKL
8	46	924.9	19	N

Table 19. Comparison of mean lengths of paddlefish collected with different hobbled gill net mesh sizes 1995 – 2004 (P<0.0001). Duncan groupings with the same letters indicate comparisons that are not significantly different (P ≥ 0.05), whereas groupings with different letters are significantly different (P < 0.05).

Hobbled Mesh	N	Mean Length	Std Error	Duncan Grouping
3	356	824.4	8.2	A
3.5	1477	754.6	4	B
4	1201	722.2	4.5	D
5	1694	782.5	3.8	C
6	84	784.7	16.9	ABC
8	116	945.6	14.4	E

Length Frequency

A variety of gear types were used throughout the participating MICRA states (Table 20). Overall, gill nets and hobbled gill nets captured 795.7 and 776.2 mm paddlefish respectively, whereas electrofishing, seines, and snagging captured 673.7, 696.6, and 624.8 mm paddlefish respectively (Table 20). Figures 6 through 9 below compare the four most common sampling methods (snagging, trammel nets, gill nets, and hobbled gill nets) within each of the four major MICRA basins (Gulf, Mississippi, Missouri, and Ohio).

Overall, gill nets and hobbled gill nets catch a more uniform range of paddlefish sizes and were more successful at collecting a larger number of paddlefish than other gear types (Figures 6-9); however, this could be because gill nets and hobbled gill nets contributed to over 50% of all the effort in each of the basins (Figure 4).

Table 20. Mean body length (mm ± standard deviation) of paddlefish separated by gear and by basin.

Gear	Basin				
	Gulf	Mississippi	Missouri	Ohio	Overall
Electrofishing	-	608.0 (195.16) N = 88	756.6 (98.01) N = 2	665.3 (181.24) N = 860	673.7 (177.09) N = 950
Gill Nets	789.6 (101.89) N = 1056	794.8 (195.37) N = 2833	804.3 (134.06) N = 941	792.3 (113.79) N = 4954	795.7 (128.75) N = 9784
Hobbled Gill Nets	815.3 (217.03) N = 7	789.3 (155.47) N = 1036	818.6 (136.87) N = 1621	747.6 (117.81) N = 2296	776.2 (138.19) N = 4960
Seine	-	699.1 (114.07) N = 4	679.8 (32.84) N = 27	-	696.6 (106.90) N = 31
Snagging	871.0 (135.76) N = 2	613.1 (159.01) N = 244	733.8 (171.74) N = 2502	663.8 (87.68) N = 55	624.8 (162.82) N = 2803
Trammel Nets	-	656.8 (125.02) N = 1948	805.5 (127.47) N = 1174	612.3 (35.22) N = 3	749.5 (145.59) N = 3125
Unknown	761.3 (122.50) N = 341	770.4 (189.96) N = 115	803.4 (176.81) N = 37	818.8 (152.39) N = 10	772.7 (143.58) N = 503
Combined	783.8 (107.68)	696.4 (178.21)	805.2 (136.81)	765.7 (130.12)	758.3 (151.92)

Gulf Basin

Paddlefish were collected using gill nets, hobbled gill nets, and snagging, as well as other unidentified methods. Figure 6 below illustrates the size distribution of paddlefish collected with snagging, gill nets, and hobbled gill nets. Gill nets had the highest catch rate in this basin ($\bar{x}$ = 789.6 mm; N = 1056).

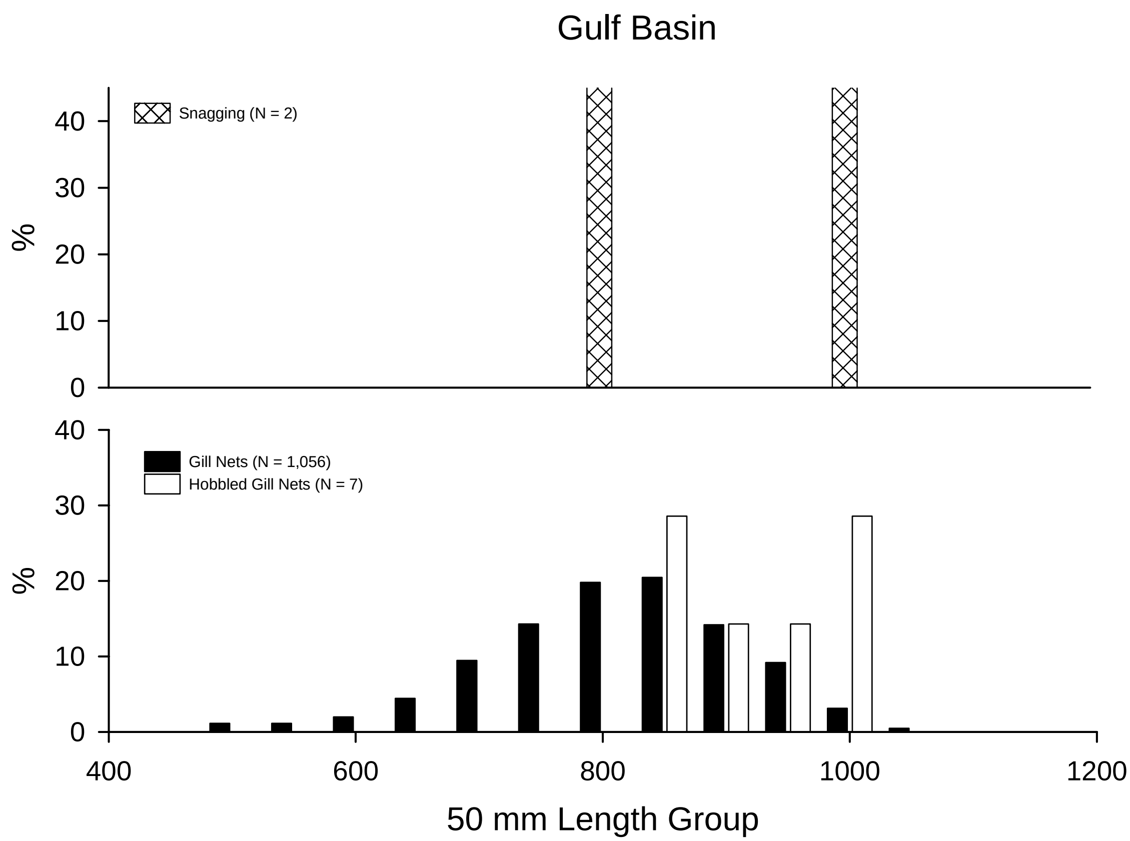

Figure 6. Percent length frequency distributions for paddlefish collected by snagging, gill nets, and hobbled gill nets in the Gulf Basin.

Mississippi Basin

In the Mississippi Basin paddlefish were collected with electrofishing, gill nets, hobbled gill nets, seines, snagging, and trammel nets, as well as with other unidentified methods. Among the most common methods, mean body length for paddlefish caught by snagging and trammel nets was 613.1 mm and 656.8 mm respectively and 794.8 and 789.3 mm for gill nets and trammel nets respectively. Gill nets and hobbled gill nets collected the greatest number and widest range of paddlefish sizes (Figure 7).

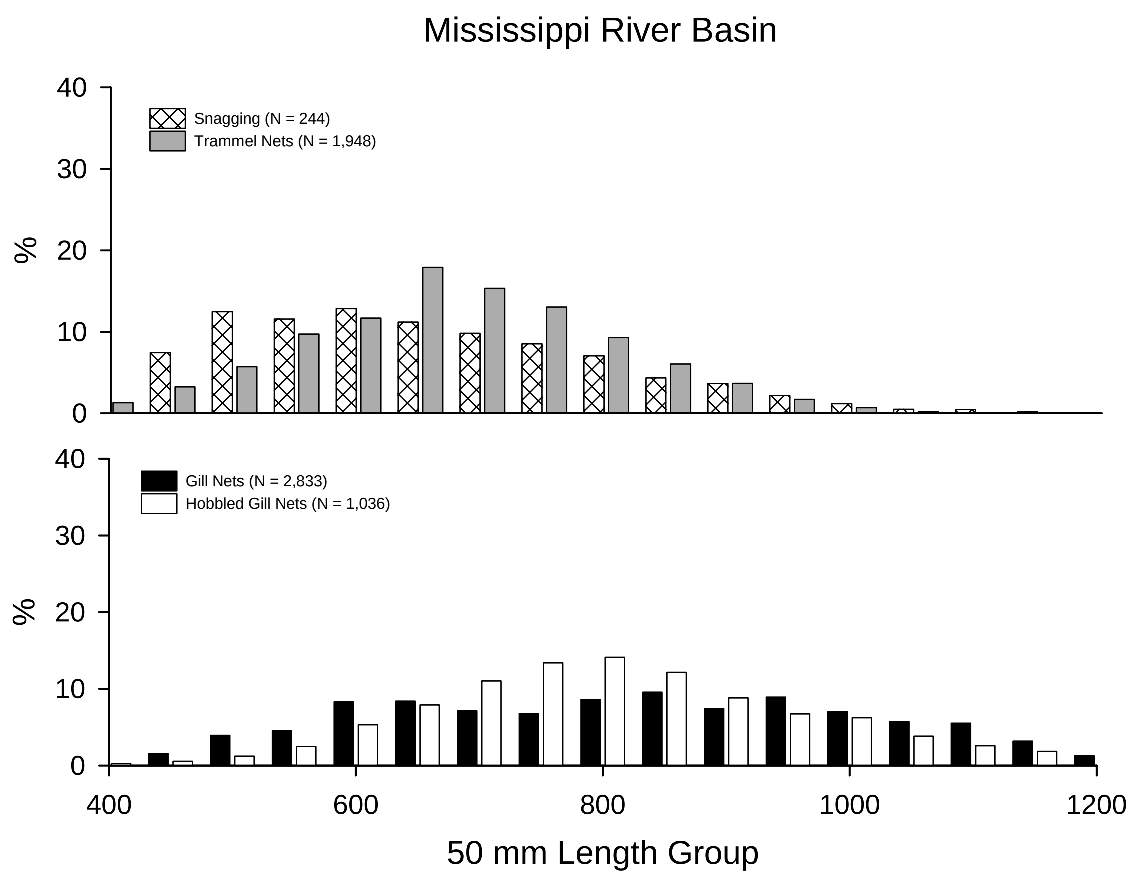

Figure 7. Percent length frequency distributions for paddlefish collected by snagging, trammel nets, gill nets, and hobbled gill nets in the Mississippi River Basin.

Missouri Basin

The most common methods for collecting paddlefish in the Missouri Basin were snagging, trammel nets, gill nets, and hobbled gill nets. Among these, trammel, gill, and hobbled gill nets caught the greatest number and widest range of paddlefish sizes (Figure 8).

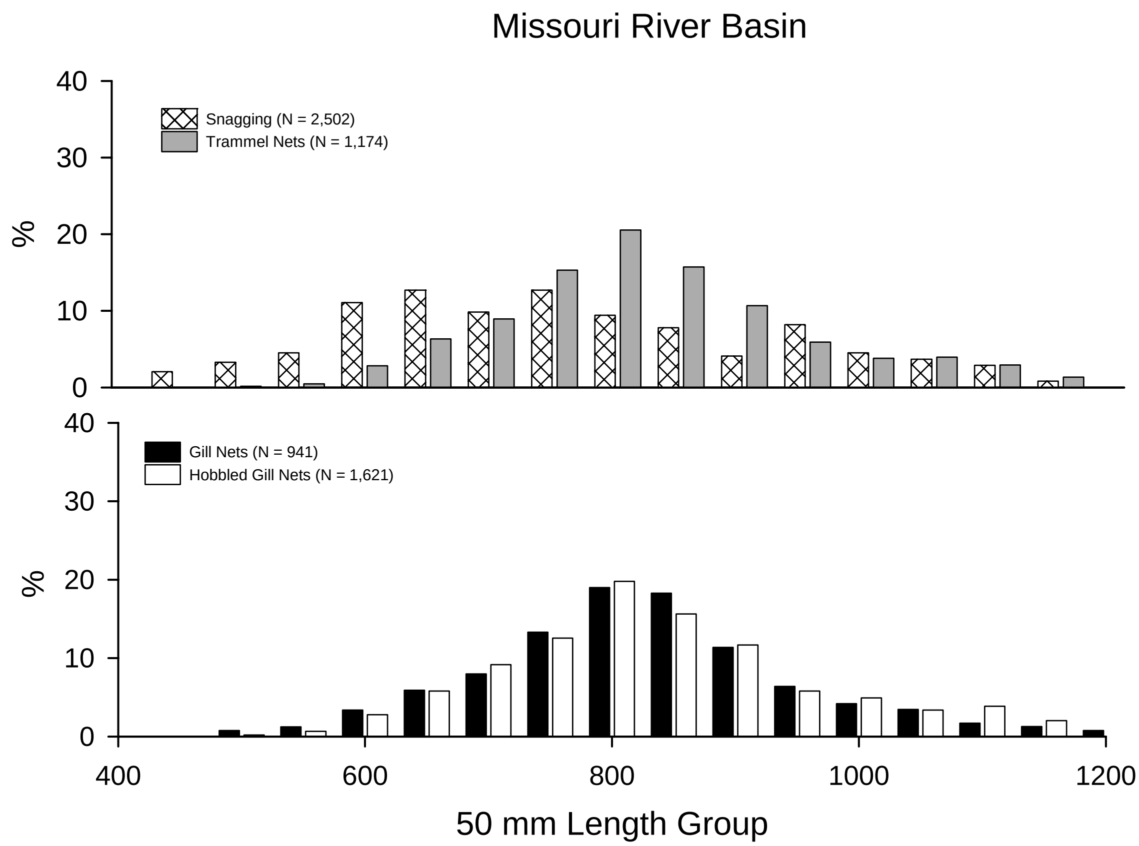

Figure 8. Percent length frequency distributions for paddlefish collected by snagging, trammel nets, gill nets, and hobbled gill nets in the Missouri River Basin.

Ohio Basin

Gill nets and hobbled gill nets caught the greatest number and widest variety of paddlefish sizes in the Ohio basin (Figure 9). However, relative to gill and hobbled gill nets there was little effort using snagging and trammel nets (Figure 4).

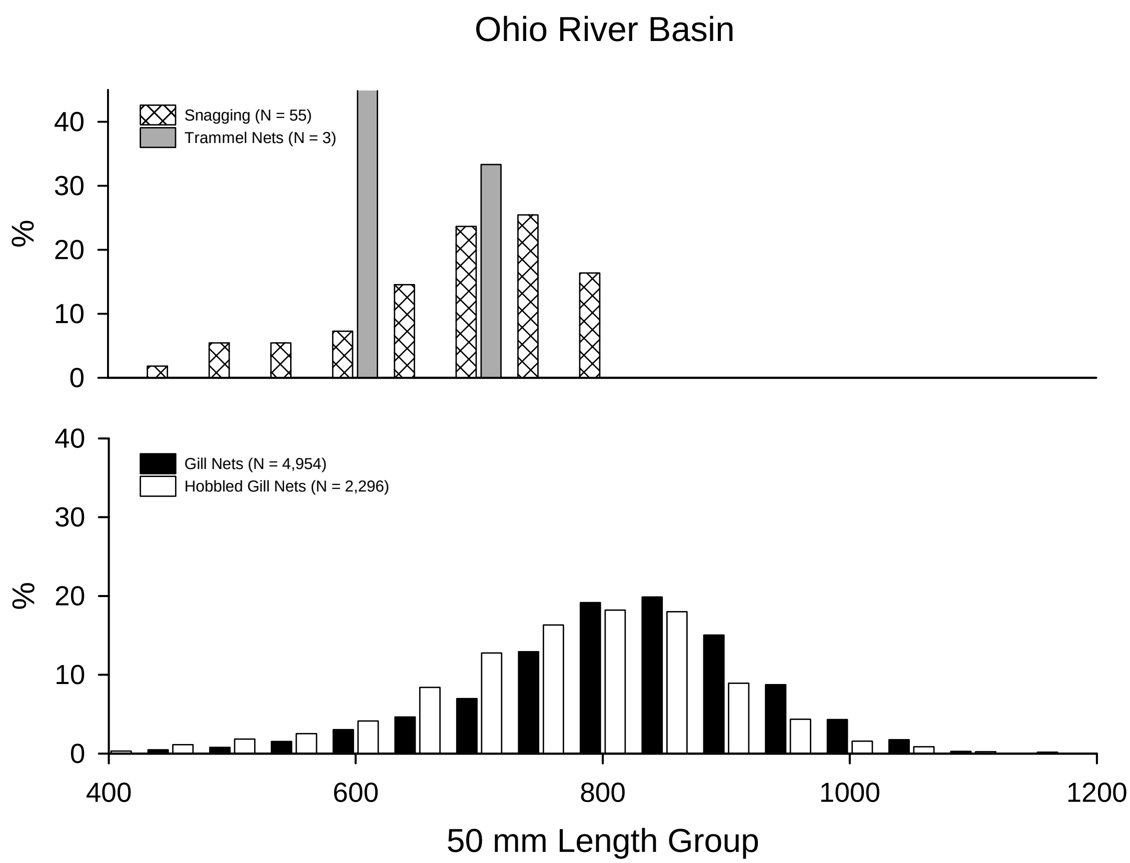

Figure 9. Percent length frequency distributions for paddlefish collected by snagging, trammel nets, gill nets, and hobbled gill nets in the Ohio River Basin.

PADDLEFISH CONDITION (Wr)

Analysis of relative condition is a refined method for comparing populations by substituting population-specific length-weight relationships with a standard for the species (Anderson and Neumann 1996; Ney 1999). Therefore, the condition (Wr) of a fish can be determined by comparing the weight of the fish with its length relative to some standard. Ney (1999) noted that standard weight (Ws) equations have been published for more than 40 freshwater fish species. Brown and Murphy (1993) developed standard weight equations for paddlefish based on captures throughout the Midwestern United States. They found that sexual dimorphism was apparent in paddlefish weight and body length and, therefore, developed standard weight equations for male, female, and combined paddlefish. They recommended the use of sex-defined standards for calculation of standard weight whenever possible; however, this was not possible with the MICRA data. Because most fish in the MICRA database were not identified as either male or female, we used the combined paddlefish standard weight calculation, as follows:

$$\log_{10} Ws = -5.027 + 3.092 \times \log_{10} BL$$

$$Wr = \frac{W}{Ws} \times 100$$

Where Ws is the standard weight (g), -5.027 is the intercept, 3.092 is the slope (allometric growth), and BL is the fork length (mm). In the second equation, Wr is the relative weight (condition) and is determined by the ratio between weight (W) and standard weight (Ws) multiplied by 100. A fish that is at optimum condition will have a Wr equal to 100. When Wr is less than 100 the fish is considered to have a less than optimum length to weight ratio that could be a result of seasonality, sex, lack of food, age, or competition. When Wr is 100 or greater, the fish is considered to be in excellent condition (Anderson and Neumann 1996).

Relative weights of paddlefish were examined for locations within each basin where fish were consistently and routinely sampled by project biologists. These locations included the Bayou-Nezpique (GFBN) and Mermentau Rivers (GFME), Missouri River below Gavins Point Dam (MOGP), Mississippi River in Pools 13 and 14 (MSP1) and Pool 26 (MSP2), Ohio River in Myers Pool (OHMP) and Smithland Pool (OHSP), and throughout the Wabash River (WABA). Mississippi River pools 13 and 14 were combined in this analysis because of general proximity and low sample size.

Many of these areas are also of interest due to the potential impacts of Asian carp species on the condition of paddlefish. Schrank et al (2003) examined the competitive interactions between age-0 bighead carp and age-0 paddlefish in mesocosms. Both large river species are planktivores with similar gill raker spacing. Age-0 paddlefish exhibited the greatest decrease in relative growth when bighead carp were present indicating carp can negatively affect paddlefish growth when food resources are limited.

Paddlefish catches varied among each of the five locations (Table 21); however, mean Wr (Table 22) did not change significantly over time ($R < 0.16$). Paddlefish collected from the Ohio River at Smithland Pool (OHSP) had the highest mean Wr ($\bar{x}$ = 90.69, SE ± 0.09; Table 22), whereas, paddlefish collected from the Missouri River below Gavins Point Dam (MOGP) had the lowest mean Wr ($\bar{x}$ = 75.67, SE ± 0.05; Table 22).

Table 21. Number of paddlefish collected from 1990 to 2004 from locations on the Gulf Coast in the Bayou-Nezpique (GFBN) and Mermentau Rivers (GFME), Missouri River below Gavins Point Dam (MOGP), Mississippi River in Pools 13 and 14 (MSP1) and Pool 26 (MSP2), Ohio River in Myers Pool (OHMP) and Smithland Pool (OHSP), and throughout the Wabash River (WABA).

	GFBN	GFME	MOGP	MSP1	MSP2	OHMP	OHSP	WABA
1990	0	23	0	0	0	0	0	0
1991	5	37	0	0	0	0	0	0
1992	22	36	0	0	0	0	0	0
1993	2	0	0	0	0	0	0	0
1994	48	13	0	0	0	0	0	0
1995	28	0	703	2	22	136	0	118
1996	0	169	734	197	222	285	43	57
1997	18	148	917	96	156	253	18	170
1998	0	52	606	289	168	333	113	314
1999	139	4	722	145	322	151	146	389
2000	51	0	236	36	354	71	708	192
2001	36	0	328	204	116	88	682	110
2002	0	0	475	401	141	0	8	101
2003	0	0	489	295	238	0	23	129
2004	0	0	0	260	227	0	258	55
Total	349	482	5210	1925	1966	1317	1999	1635

Table 22. Mean (± SE) Wr of paddlefish collected from 1990 to 2004 from locations on the Gulf Coast in the Bayou-Nezpique (GFBN) and Mermentau Rivers (GFME), Missouri River below Gavins Point Dam (MOGP), Mississippi River in Pools 13 and 14 (MSP1) and Pool 26 (MSP2), Ohio River in Meyers Pool (OHMP) and Smithland Pool (OHSP), and throughout the Wabash River (WABA).

	GFBN	GFME	MOGP	MSP1	MSP2	OHMP	OHSP	WABA
1990	-	84.96 (1.47)	-	-	-	-	-	-
1991	85.49 (4.58)	91.11 (1.17)	-	-	-	-	-	-
1992	90.13 (1.57)	93.15 (1.21)	-	-	-	-	-	-
1993	86.93 (1.50)	-	-	-	-	-	-	-
1994	89.64 (1.18)	85.23 (1.54)	-	-	-	-	-	-
1995	86.88 (1.71)	-	76.97 (0.52)	90.22 (5.27)	89.53 (2.28)	90.09 (0.98)	-	79.32 (1.19)
1996	-	85.53 (0.68)	72.67 (0.44)	82.35 (0.56)	79.5 (0.63)	87.69 (0.64)	94.85 (3.03)	76.87 (1.45)
1997	78.4 (2.04)	81.44 (0.60)	73.51 (0.40)	83.7 (0.74)	84.7 (0.71)	87.11 (0.57)	93.49 (2.83)	78.75 (0.79)
1998	-	75.38 (1.04)	71.29 (0.48)	77.15 (0.38)	84.1 (0.70)	83.77 (0.57)	87.46 (0.90)	78.96 (0.63)
1999	80.84 (0.76)	79.98 (3.32)	73.46 (0.48)	82.78 (0.69)	82.7 (0.57)	87.13 (0.89)	82.52 (0.83)	84.81 (0.65)
2000	84.26 (0.97)	-	70.89 (0.75)	73.16 (1.00)	85.28 (0.48)	88.05 (1.13)	86.05 (0.43)	71.96 (0.65)
2001	82.22 (0.94)	-	88.65 (0.96)	83.48 (0.68)	92.72 (0.94)	98.59 (1.07)	79.79 (0.30)	72.35 (1.00)
2002	-	-	78.77 (0.66)	82.24 (0.40)	93.12 (0.86)	-	126.06 (14.47)	79.5 (1.25)
2003	-	-	74.83 (0.46)	79.47 (0.57)	85.01 (0.73)	-	89.01 (2.88)	86.39 (1.29)
2004	-	-	-	96.59 (0.61)	92.34 (0.90)	-	77.01 (0.60)	73.71 (0.90)
Mean (±SE)	84.98 (0.21)	84.60 (0.18)	75.67 (0.05)	83.11 (0.09)	86.90 (0.09)	88.92 (0.11)	90.69 (0.09)	78.26 (0.10)

Figures 9-16 below contain box plots comparing Wr of paddlefish collected from 1990 to 2004 from locations in the Bayou-Nezpique (GFBN) and Mermentau Rivers (GFME), Missouri River below Gavins Point Dam (MOGP), Mississippi River in pools 13 and 14 (MSP1) and pool 26 (MSP2), Ohio River in Myers Pool (OHMP) and Smithland Pool (OHSP), and throughout the Wabash River (WABA). The box represents the interquartile range, the solid black line indicates the median, and vertical lines represent the range of observed values. Mild outliers, as described by Freund and Wilson (2003), are illustrated by the open circles and extreme outliers have been removed from the dataset. Differences in mean Wr between years for each location where tested using an analysis of variance and post hoc groupings were made using a Duncan multiple range test. Duncan groupings are indicated by the letters above each year. Years with the same letters indicate comparisons that are not significantly different ($P \geq 0.05$), whereas years with different letters are significantly different ($P < 0.05$).

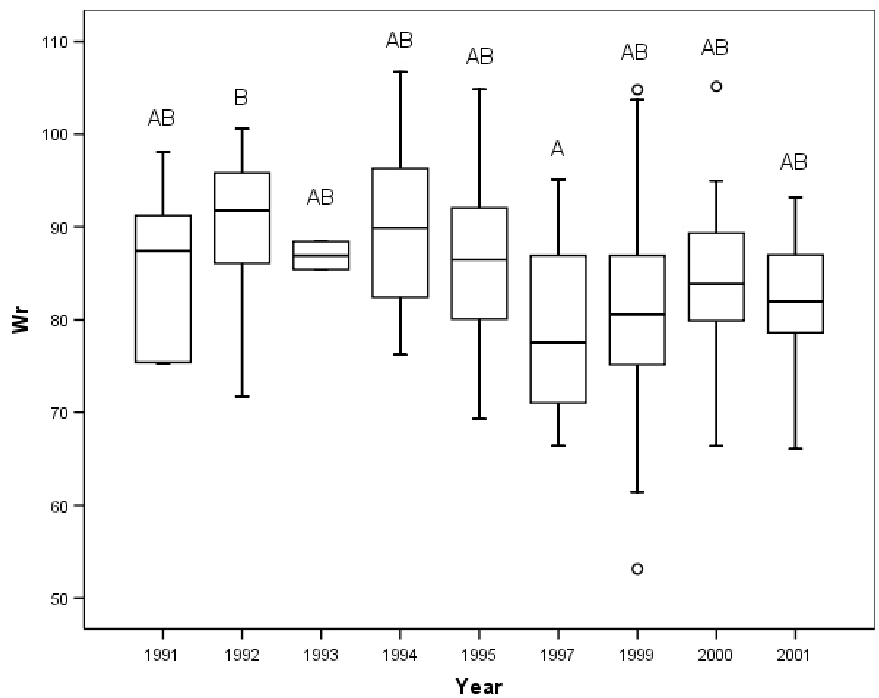

Figure 10. Box plot of relative weight (Wr) by year for paddlefish collected in the Bayou-Nezpique River (GFBN).

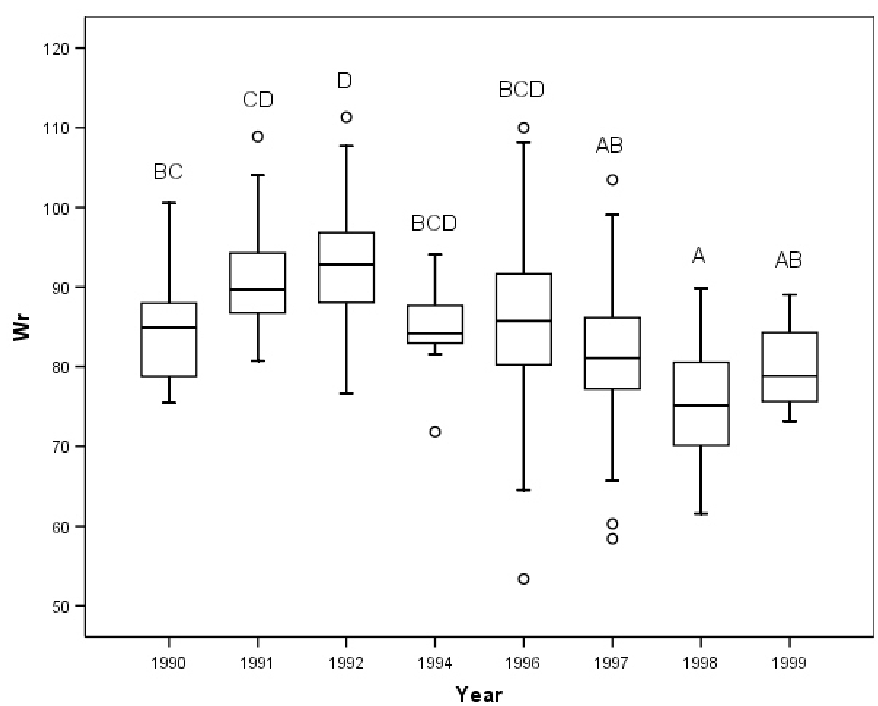

Figure 11. Box plot of relative weight (Wr) by year for paddlefish collected in the Mermentau River (GFME).

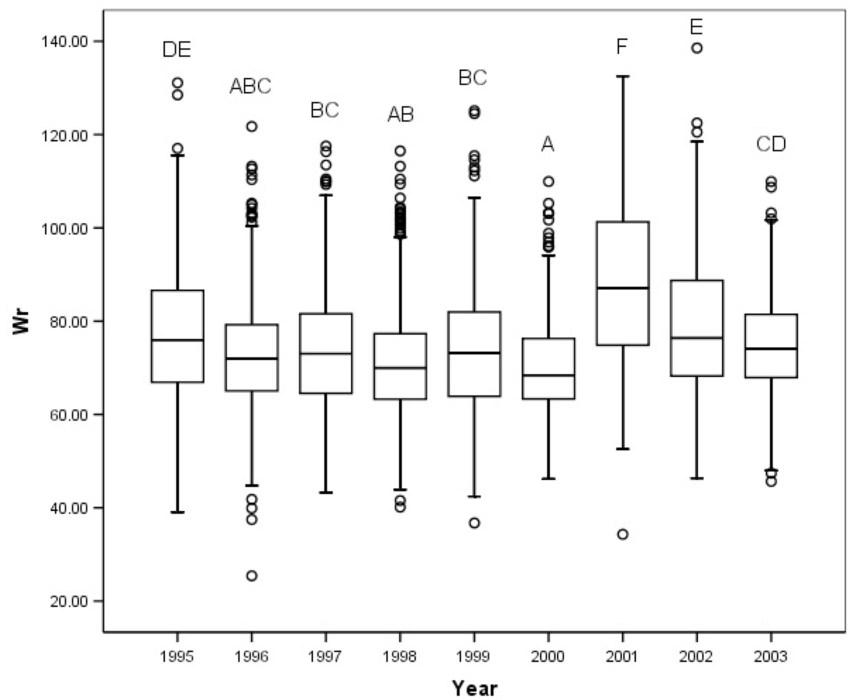

Figure 12. Box plot of relative weight (Wr) by year for paddlefish collected in the Missouri River below Gavins Point Dam (MOGP).

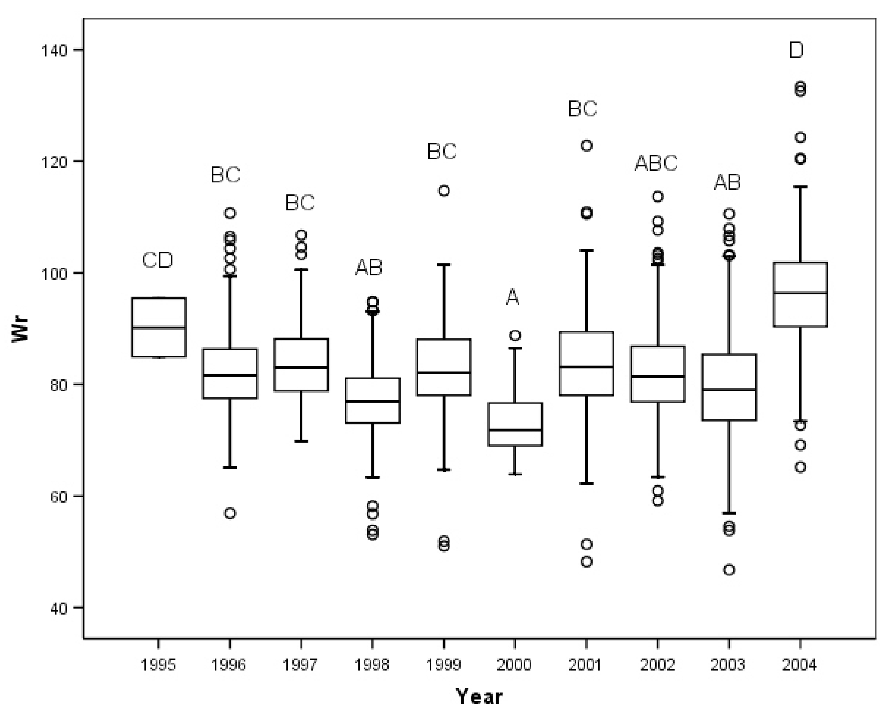

Figure 13. Box plot of relative weight (Wr) by year for paddlefish collected in Pools 13 and 14 of the Mississippi River (MSP1).

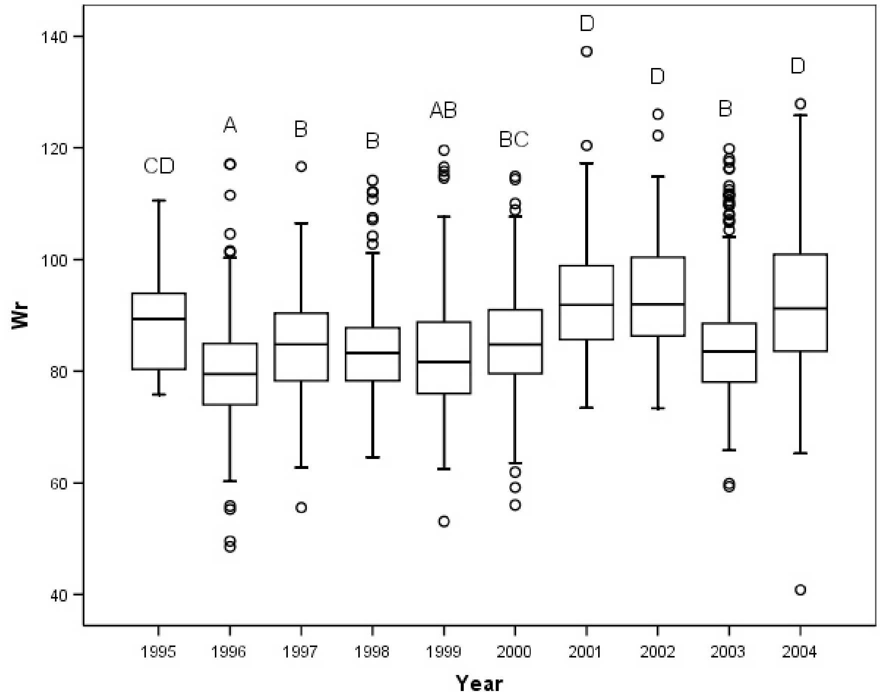

Figure 14. Box plot of relative weight (Wr) by year for paddlefish collected in Pool 26 of the Mississippi River (MSP2).

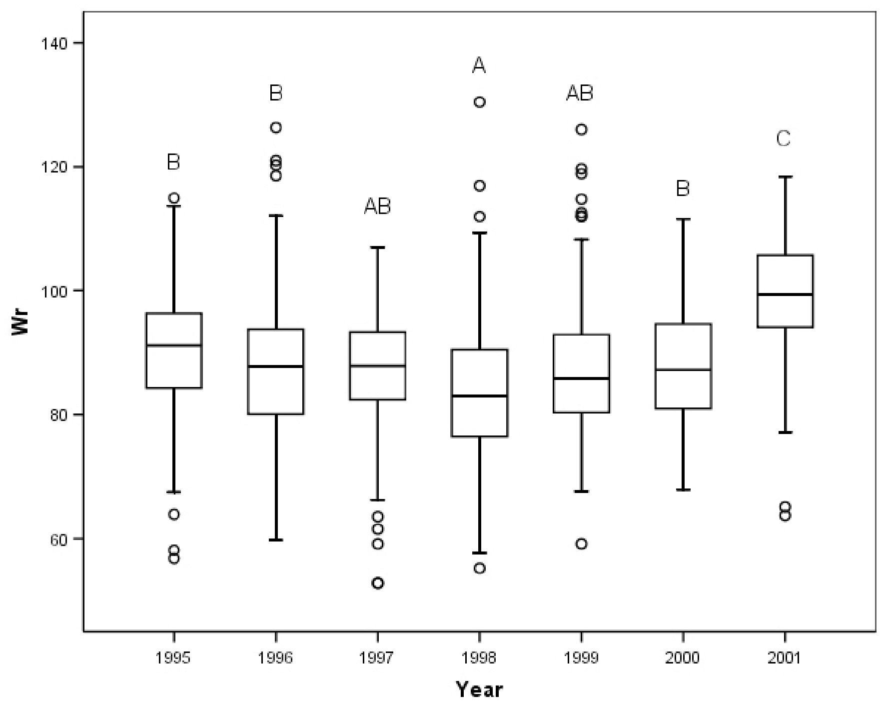

Figure 15. Box plot of relative weight (Wr) by year for paddlefish collected in Myers Pool of the Ohio River (OHMP).

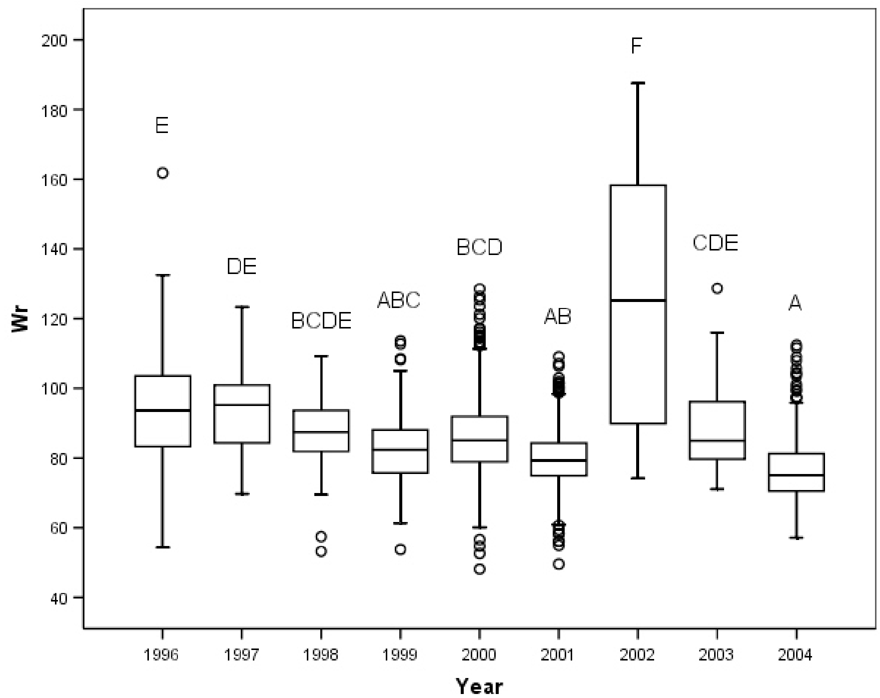

Figure 16. Box plot of relative weight (Wr) by year for paddlefish collected in Smithland pool of the Ohio River (OHSP).

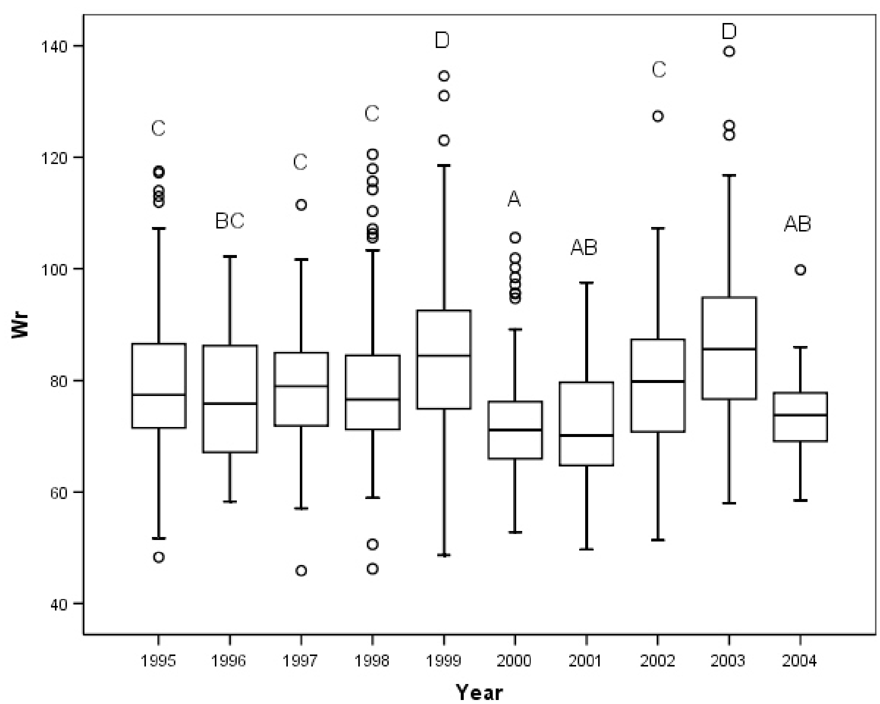

Figure 17. Box plot of relative weight (Wr) by year for paddlefish collected throughout the Wabash River (WABA).

HATCHERY STOCKED FISH

State and federal hatcheries stocked just under 1.8 million paddlefish from 1988 through 2005 with coded wire tags (Figure 17; Table 23). Forty-four percent were stocked by the state of Texas to re-establish paddlefish populations in that state. Thirty-five percent supplemented reservoir fisheries in Missouri, Oklahoma, and the Dakotas. Five percent were stocked to re-establish populations in the Upper Ohio Basin tributary rivers.

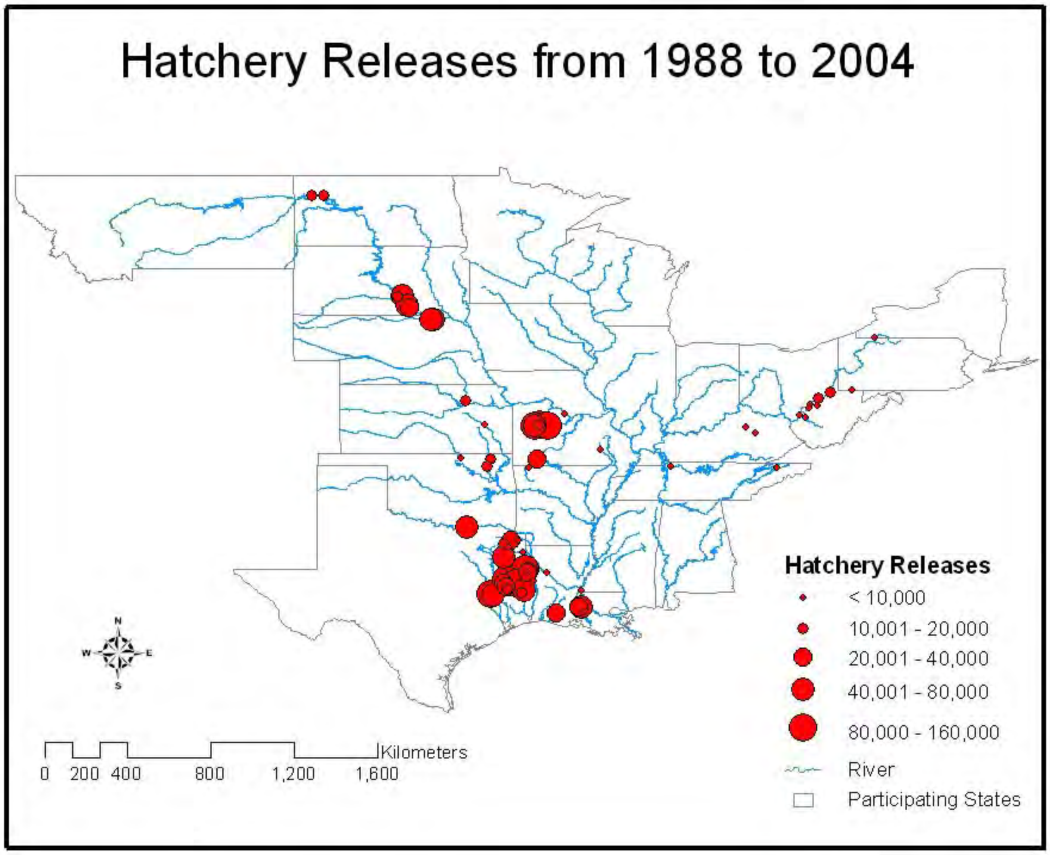

Figure 18. Hatchery releases from 1988 to 2004. All paddlefish were tagged with coded wire tags.

State and federal hatcheries stocked 29763 fish without tags for various reasons, including better than expected production of fish and equipment failure. When we add the number of fish presumed untagged due to tag retention estimates, 217684 fish were stocked without coded-wire tags from 1988 through 2004. These recaptured fish were presumed of wild origin.

Tag Retention Rates

The ability to retain CWTs in hatchery-reared paddlefish through the stocking process is paramount to the success of this project. Pitman and Isaac (1995) documented CWT loss from paddlefish at 29% for tags in the tip of the rostrum and 4% for tags in the side of the rostrum for fish held in concrete raceways for 72 hours. Paddlefish in intensive culture operations tend to injure their rostrum by constantly striking it against the tank walls. Guy et al (1996) determined tag loss was 77% for paddlefish held 51 days in rectangular fiberglass tanks but only 3% for fish held 96 days in ponds. They also recommended CWTs be implanted 2 mm deep into the tip of the rostrum, slightly off the central axis to allow biologists and anglers to minimize the portion of the rostrum removed for tag retrieval. MICRA recommended tagging paddlefish slightly off center in the rostrum tip (Heinricher Oven 1995). While more benign tag recovery is possible from areas such as the dorsal fin or opercular flap reduced tag retention and longer fish handling times during tagging outweighed those options (Fries 2001).

Waters et al (1997) found the relative position of coded wire tags in paddlefish rostrums changed from 9.7 % of the total rostrum length to 18.6% as a function of rostrum growth rate. This tag movement would probably be highest in age-0 paddlefish and decline as the age of the tagged fish increases. This indicates biologists would need to scan a slightly larger area further up the rostrum when examining a fish for tags.

Short-term retention rates were recorded for 67 of the 479 stocking events reported to MICRA. Retention rates varied from 35 to 100 percent. The 35% values were reported for two stockings of fish in Kansas in 1994. Fish from these stockings have large knob-like rostrum tips from tank culture. These low retention rates may be due to rostrum condition. The overall average short-term retention rate for MICRA stockings (not including Kansas fish) is 90.3%.

Missouri Department of Conservation (personal communication, Trish Yasger, Missouri Department of Conservation) found paddlefish retention rates of 98.7% in fish kept in hatchery ponds for eight months. Mortality of the fish was high (66%) due to bird predation. While 500 fish were stocked into two ponds for the retention test, only 168 fish remained in the pond after eight months. One hundred sixty-six paddlefish retained their coded wire tags.

Tag retention rates were assigned to hatchery stockings in the following fashion (Table 24). If a hatchery reported a retention rate for a specific date and other lots of fish were tagged on the same date, the same rate was applied. If retention rates are available for the stocking year, mean retention rate from the same stocking year was applied to each stocking. In South Dakota, average stocking retention rates were used for stockings prior to the MICRA collection effort. Average MICRA retention rate was used when retention wasn't reported after 1995. Missouri increased quality control of their tagging procedures in 2000. The MICRA average was used prior to 2000 while the pond retention rate was used for 2000 and beyond. In the event a state has not reported any retention rates for their hatcheries, the average of the MICRA stocking events (90.3%) was used.

Assessing Contributions of Hatchery Stocks

State and federal hatchery managers are eager to learn what impact their efforts are having on the nation's paddlefish populations. Paddlefish are stocked in states to either bolster rare or extirpated populations or to maintain reservoir populations in areas which would not adequately support paddlefish spawning and reproduction.

New York stocked 3353 paddlefish in the Kinzua reservoir between 1998 and 2001. Advice solicited from the committee membership regarding the parameters of New York's stocking program included both support for continued stocking and suggestion to increase the numbers of fish stocked. Only one fish is reported as returned from these stockings when it was found dead. No sampling effort to assess growth or survival of these hatchery stockings has been reported to MICRA.

West Virginia stocked 21994 fish between 1996 and 2004. While seven of these fish have been recaptured, four were submitted as commercially harvested from the Ohio basin and one each was recovered in biologist sampling in 1997, 1998 and 1999. No wild fish sampling has been reported by West Virginia biologists from 2000 on. Many of the stocked paddlefish in other areas have not successfully recruited to the sampling gears for nearly five years, it is safe to assume the stocked fish may now be catchable. The state should begin efforts to locate the adult fish.

South Dakota stocked 188161 fish prior to the inception of the MICRA partnership efforts and continued to stock fish in 2000 and 2001 in Lewis and Clark and Francis Case reservoirs. Only 14 of their 77 reported collection efforts occurred in these reservoirs; many of these efforts were made to secure broodstock for subsequent stockings. The majority of South Dakota's sampling efforts occur below Gavins Point Dam in support of the jointly managed snag fishery. South Dakota has a long history of assessing the health of their reservoir fisheries, however, data is not available in the context of this database to make an adequate assessment of the contributions of hatchery produced fish to paddlefish populations of these reservoirs. A substantial number of paddlefish stocked by South Dakota prior to 1995 were recaptured below Gavins Point Dam from 1995-2003. South Dakota stockings accounted for on average 4.6 percent of the fish harvested in the joint Nebraska/South Dakota fishery. This ranged from a low of 1.1 percent in 2003 to a high of 8.5 percent in 1997. When biologist catches were also considered these stocked fish accounted for an average of 6.7 percent of paddlefish encountered below the dam. This ranged from a low of 2.2 in 2003 to 12.7 percent in 1997.

Texas stocked 695,611 fish between 1991 and 2001. Texas biologists made 99 sampling trips in 1997 and 1998 to examine fish growth and survival. Only thirty-six paddlefish were collected in 3148 hours of sampling effort. Five of these fish were recaptures. Two fish were recaptured by biologists in 1994, before MICRA reporting requirements were in place. Betsill (1999) reported that Texas biologists collected only 20 paddlefish in targeted river reaches of the Angelina, Neches, Sabine and Trinity Rivers during five years of gill netting between 1991 and 1998. It is unlikely that paddlefish stockings in these rivers established self-sustaining populations in the reaches upstream of the lowermost dams (Betsill 1999).

Survival estimates for stocked paddlefish are largely unknown. Graham (1986) indicated that Missouri witnessed better survival rates for paddlefish exceeding 254 mm in total length as these fish were better able to escape predation. Average, minimum, and maximum lengths of stocked fish were recorded for 179 stocking events. Average lengths were less than the recommended value in 168 batches of hatchery fish in the MICRA database. The reported minimum length of paddlefish only exceeded 254 mm in 28 stocking events. It is plausible that some of these paddlefish did not survive to gear recruitment sizes.

Hoxmeier and DeVries (1997) found juvenile paddlefish extensively used oxbow areas in the Lower Alabama River. These fish did not migrate to channel areas until they reached 650 mm eye-to-fork length (EFL). Biologists monitoring Missouri River fish populations collected two size ranges of fish. Juvenile paddlefish (9-87 mm EFL) are caught with otter trawls in slack waters behind wing dikes. Adult paddlefish are occasionally captured in gill nets and hoop nets (personal communication, Corey Lee, U.S. Fish and Wildlife Service). Fish in the size ranges stocked by state and federal hatcheries are simply not found in the Lower Missouri River. Agencies endeavoring to evaluate the success of their stocking programs may need to consider utilizing alternative gear types or assessing additional off-channel habitats to increase their catch of young paddlefish in Mississippi Basin rivers.

Table 23. Hatchery releases of coded wire tagged paddlefish, 1988-2004. Missouri's original 1997 hatchery stocking datasheets and reference tags never reached the tag processing center, therefore, stocking numbers are unknown.

State	Pre-1995	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	TOTAL
						GULF BASIN						
LA	-	351	2265	8605	4186	47976	17789	10060	43084	6253	23836	164405
OK	-	-	-	-	-	5757	21216	770	16792	4421	-	48956
TX	348722	107463	69912	97453	88163	34735	24637	-	-	-	-	771135
						MISSISSIPPI BASIN						
AR	-	-	707	-	14889	-	-	-	-	-	-	17388
KS	10470	928	-	-	-	-	-	-	-	-	1857	13255
LA	-	-	-	-	-	5630	-	1778	-	-	-	7408
MO	-	5027	2016	?	10710	3509	-	14973	-	-	-	36235
OK	11814	2013	112	10282	2037	8837	3216	-	-	-	-	38311
TN	-	-	-	5388	-	-	-	-	-	-	-	5388
						MISSOURI BASIN						
KS	6460	5557	-	-	-	-	100	-	-	-	-	12117
MO	-	21984	17307	?	37039	40580	-	130361	-	-	-	247271
ND	-	9093	-	9944	-	-	-	-	-	-	-	19037
SD	188161	28934	12436	13821	13271	24256	2510	-	-	-	-	304478
						OHIO BASIN						
KY	-	-	-	-	-	-	-	800	-	1000	-	1800
NY	-	-	-	-	46	535	132	1878	762	-	-	3353
PA	-	8806	6577	13208	-	760	10830	8297	5688	1604	-	55770
TN	-	5816	-	2	-	-	-	-	-	-	-	5818
WV	-	1	1977	1410	1522	2	-	-	4586	5193	6873	21564
TOTAL	565677	195173	113309	160113	171863	172577	80430	168917	70912	39560	32556	1773689

Table 24. Hatchery releases of coded wire tagged paddlefish corrected for retention estimates, 1988-2004. Missouri's original 1997 hatchery stocking datasheets and reference tags never reached the tag processing center, therefore, stocking numbers are unknown

State	Pre-1995	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	TOTAL
						GULF BASIN						
LA	-	351	2199	8355	4065	46434	12723	9768	41835	6072	23145	154946
OK	-	-	-	-	-	5600	16549	524	13769	3625	-	40067
TX	313895	96717	61391	87708	79347	34145	22409	-	-	-	-	695611
						MISSISSIPPI BASIN						
AR	-	-	638	-	15063	-	-	-	-	-	-	15701
KS	3665	909	-	-	-	-	-	-	-	-	1820	6394
LA	-	-	-	-	-	5467	4550	1726	-	-	-	11743
MO	-	4539	1820	?	9671	3169	-	13521	-	-	-	32720
OK	10587	1671	112	9504	1980	7989	2508	-	-	-	-	34352
TN	-	-	-	5066	-	-	-	-	-	-	-	5066
						MISSOURI BASIN						
KS	2261	5446	-	-	-	-	98	-	-	-	-	7805
MO	-	19852	15628	?	33446	36644	-	117716	-	-	-	223286
ND	-	8002	-	8751	-	-	-	-	-	-	-	16753
SD	158983	22829	11230	12480	11984	21903	2279	-	-	19043	-	260732
						OHIO BASIN						
KY	-	-	-	-	-	-	-	722	-	903	-	1625
NY	-	-	-	-	42	483	119	1696	688	-	-	3028
PA	-	8542	4078	12416	-	728	9855	7467	5176	1604	-	49866
TN	-	5207	-	2	-	-	-	-	-	-	-	5209
WV	-	1	1898	1354	1461	2	-	-	4403	4985	7011	21114
TOTAL	489391	174066	98995	145636	157058	162564	71091	153140	65871	36233	31976	1586018

HARVEST

In addition to recaptures made by project biologists, tag recoveries are made in the stock assessment project from the return of paddlefish rostrums in sport and commercial fisheries. In the early years, MICRA pursued prize donations from tackle, net and boat companies as an incentive for voluntary participation by sport and commercial anglers. This program is no longer occurring. It is unclear if reinstituting a prize program would increase rostrum returns. Project biologists do not feel it would improve data significantly.

Harvest returns are handled differently by each project participant. Nebraska and South Dakota distribute harvest return labels and response postcards to each of their licensed paddlefish anglers in their archery and snagging seasons. Anglers are then encouraged to leave the rostrums from harvested fish at drop-off locations. Postcards returned to the state agencies allow them to estimate total harvest for each season (Mestl et al 2005). Missouri Department of Conservation snagging season creel clerks began checking paddlefish rostrums for coded wire tags on their three large reservoirs (Lake of the Ozarks, Table Rock Lake and Harry S Truman Lake) in 2001. They remove rostrums from tagged fish for submission to MICRA. Harvested fish numbers are not currently available in the MICRA database. Missouri Department of Conservation statistical staff are analyzing creel survey data to determine population estimates in those three reservoirs. Much of the reported paddlefish harvest is from commercial fishing in the Ohio Basin. Rostrums are submitted voluntarily by commercial anglers to biologists in bulk. These collections of rostrums contain general information which may include a range of areas within the Basin or a range of time such as several months in a year (in many cases an entire season's worth of data).

Data collected for every harvested fish should include length, weight, health and presence/absence of all tag types, however, reporting of information and returns of rostrums is voluntary throughout the Mississippi Basin and is therefore uncontrolled. Project biologists continue to establish and maintain relationships with their user groups to ensure this voluntary return of information.

Tables 25 and 26 contain harvest data received from project biologists. This data accompanied harvest labels returned with rostrum sections to the Carterville FRO. Tags were detected in 0.9 to 100 percent of the rostrums submitted as reported. When comparing numbers between the two tables, it is apparent that in some years the number of rostrums checked for coded wire tags exceeds the number of recaptures by several orders of magnitude. In other years, the number of rostrums checked is equal to the number of recaptures. This indicates the true harvest number is not reflected in the MICRA paddlefish stock assessment database. This data must be evaluated by the state biologists for accuracy. Kentucky Department of Fish and Wildlife harvest records, which vary from MICRA database records, are identified in Tables 25 and 26 as KY2. Individual label returns need to be evaluated to correct the MICRA database. Additionally, the database is currently structured to record information for numbers of fish checked for tags and numbers of recaptures, but does not have a format to include harvest numbers from other sources. As each of the basin groups is collectively gathering data and writing basin management reports, improvements will be made to quality of harvest data in the MICRA database.

Table 25. Sport and commercial harvest of paddlefish as reported on harvest labels for the MICRA paddlefish stock assessment project, 1995-2004. GP is the area below Gavins Point Dam jointly managed by the states of Nebraska and South Dakota. This data is combined at their request. KY2 is data from Kentucky Department of Fish and Wildlife records.

State	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Unknown	TOTAL
Mississippi Basin												
IL	215	-	590	361	1277	417	421	238	261	341	29	4150
MO	-	-	1935	161	1135	424	-	18	-	-	-	3655
TN	-	-		47	-	-	-	-	-	-	-	47
Missouri Basin												
MO	2	-	27	-	-	-	-	307	-	-	-	29
GP	-	-	141	290	144	43	168	69	-	-	-	855
Ohio Basin												
IL	-	-	-	-	139	-	-	-	-	-	-	139
IN	0	1628	2046	1746	635	1315	1267	1190	433	643*	-	10903
KY	-	-	374	949	134	1083	3	25	14	-	-	2582
KY2	-	1200	573	949	1204	1672	944	4275	7264	4647*	-	
OH	-	-	-	-	-	-	6	-	-	-	-	6
Unknown Basin												
Unknown	-	-	-	-	-	-	-	-	-	-	-	12
TN	519	-	-	-	-	-	-	-	-	-	-	519
TOTAL	911	22	5156	3816	3668	3322	2023	1615	338	341	31	

* data provided by state agency but not in MICRA database as of report date.

Table 26. Coded wire tag recaptures of sport and commercial harvested paddlefish as reported on harvest labels for the MICRA paddlefish stock assessment project, 1995-2004. GP is the area below Gavins Point Dam jointly managed by the states of Nebraska and South Dakota. This data is combined at their request. KY2 is data from Kentucky Department of Fish and Wildlife records.

State	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Unknown	TOTAL
Mississippi Basin												
IL	1	-	6	2	24	2	13	1	6	13	2	-
MO	-	-	3	2	5	4	-	18	-	-	-	14
TN	-	-	-	0	-	-	-	-	-	-	-	-
Missouri Basin												
MO	0	-	0	-	-	-	-	23	-	-	-	0
GP	-	-	59	52	0	0	0	6	-	-	-	117
Ohio Basin												
IL	-	-	-	-	0	-	-	-	-	-	-	0
IN	-	8	18	5	4	21	8	22	2	3*	-	91
KY	-	-	0	6	17	5	3	25	14	-	-	70
KY2	-	0	3	5	13	13	11	12	20	33*	-	-
OH	-	-	-	-	-	-	6	-	-	-	-	6
Unknown Basin												
Unknown	-	-	-	-	-	-	-	-	-	-	-	0
TN	3	-	-	-	-	-	-	-	-	-	-	3
TOTAL	179	22	128	118	67	32	30	98	85	13	2	-
% of harvest	19.7	100	2.5	3.1	1.8	0.9	1.5	6.1	25.1	3.8	6.5	-

* data provided by state agency but not in MICRA database as of report date.

RECAPTURES

To date, 2160 fish have been recaptured with coded wire tags either through biologist sampling or angling efforts and placed in the stock assessment database (Figure 19). Eighty of these tags cannot be used to link fish to their previous captures due to problems with the tags (Table 27). An additional 88 tags collected by biologist snagging in Iowa between 2002 and 2004 are not present in the database and cannot be linked to a specific fish due an absence of a fish number on the recapture sample envelope. This missing information prohibits tagging center staff from identifying the individual fish and its recapture location.

Table 27. Identifiable errors with recaptured coded wire tags.

Error	No. of Occurrences
No tag when rostrum received in lab	60
Tag lost in lab	3
Unreadable tag	10
Fish tagged w/ practice spool tag	7

During the late 1990s project biologists in some states began to recognize that some paddlefish were being recaptured during the same collection event or in closely occurring collection events. These biologists began fin clipping paddlefish to identify recent recaptures. While they did not remove the coded wire tag for reading, they did mark the paddlefish datasheet with a “YES” for coded wire recapture. In some cases “YES” was also the response placed in the CWTMARK column, even though a new coded wire tag was not placed in the fish. The database managers discovered this practice after several years when it was determined that querying the CWTRECAP data field for “YES” responses did not deliver the same number of recaptured fish as are present in the recapture table. Reference tags were also not present for fish which did not truly receive a new coded wire tag. As can be seen in Table 28, both the number of fish tagged with CWTs and recaptured are now overestimated when a simple query is run on these fields. These data fields need to be corrected to reflect fish actually tagged and recaptured.

Table 28. Number of fish identified by project biologists as recaptured with coded wire tags.

BASIN	STATE	RECAPTURES
Gulf	LA	9
	OK	62
	TX	4
Mississippi	IA	385
	IL	57
	MN	4
	OK	227
	WI	90
Missouri	IA	21
	KS	122
	MO	1
	NE	300
	SD	297
Ohio	IL	127
	IN	139
	KY	38
	OH	42
	TN	24
	WV	2

One thousand thirty-five of the linkable fish were stocked by hatcheries while 955 fish were presumed wild origin fish. Some fish (89) could not be directly linked to their previous capture or stocking event. Twenty-five of these fish were stocked by the state of Missouri in 1995. The same batch code went into all three Missouri paddlefish reservoirs. It was believed that the fish could be identified to site by tag length. Additionally, Missouri's 1997 hatchery sheets never arrived at the Tagging Center. Eight recaptures are believed to be from their 1997 stockings, however, specific stocking sites cannot be determined. The remaining 64 fish cannot be directly linked to a specific hatchery or original marking event because of duplicate tag codes. While the database may not be able to link these fish, in some cases assumptions can be made. For example, South Dakota and Texas used the same batch code numbers for several stockings in their waters prior to the coordinated efforts of the MICRA group. To ensure proper analysis of this dataset using program MARK software, it is important to have multiple recaptures of individual fish at multiple times. Thirty-one fish were recaptured two times. Two of these fish were in Iowa's Mississippi River sampling. Five were in the Ohio Basin; one in Ohio and the other four in IN/IL. The remaining recaptured fish were from the jointly managed NE/SD Gavins Point tailwater population. One South Dakota fish was recaptured three times.

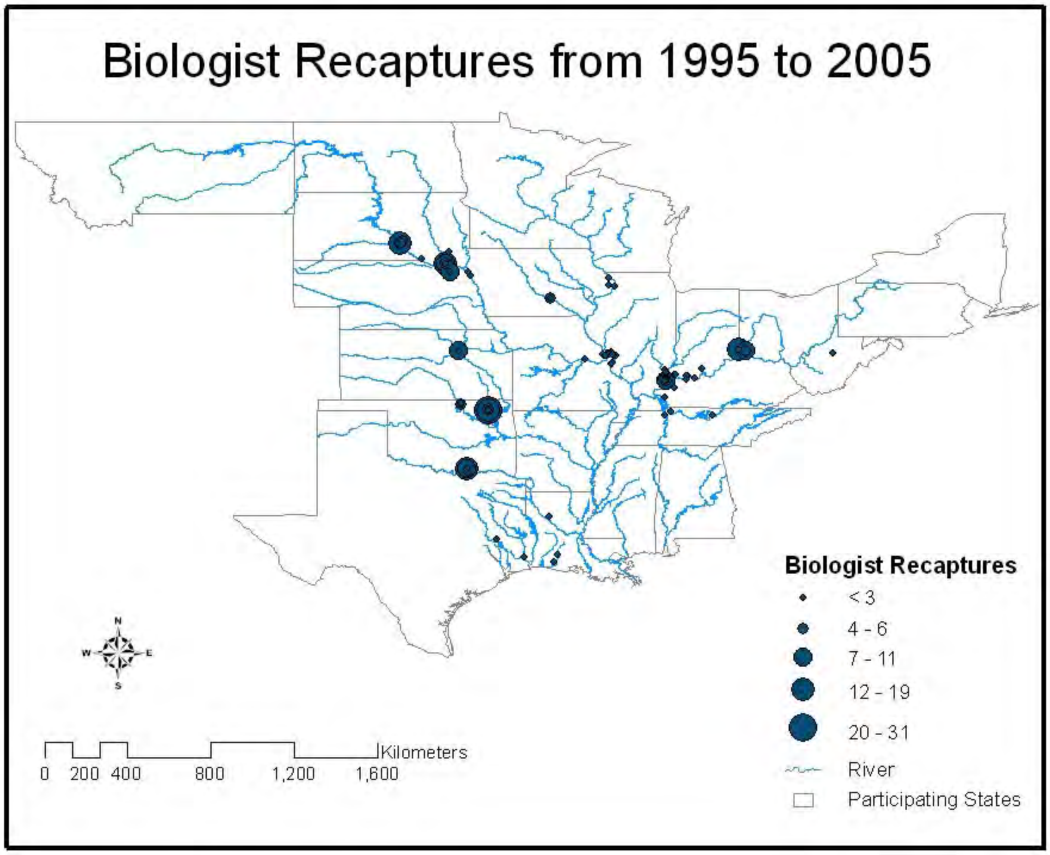

Figure 19. Paddlefish recaptured by project biologists from 1995 to 2005.

MOVEMENT

Similar to results of peer-reviewed paddlefish telemetry studies, the majority of wild origin fish tagged as part of the MICRA stock assessment project were recaptured in the same location as their original tagging event. Stancill et al (2002) found paddlefish exhibited site fidelity in Lake Francis Case, South Dakota (2002). Two-thirds of male paddlefish and one-third of females tracked with ultrasonic transmitters returned to their original capture site during at least one of the two subsequent spawning seasons. All paddlefish in the reservoir moved downstream and congregated in the lower reservoir reaches in the post-spawning and winter periods. Zigler et al (2003) found that while substantial numbers of paddlefish in the Wisconsin River migrated downstream from Prairie du Sac dam, they rarely left that tributary to enter the Mississippi River.

Thirty-two paddlefish moved within their original tagging basin (Table 29). Most of these fish moved into an adjacent water body.

Table 29. Movements of wild origin fish within their original tagging basin (not including fish movements within the Ohio River mainstem).

River	Tagging Location	Tagging River Mile	Tagging Date	Recapture Location	Recapture River Mile	Recapture Date
Gulf Basin						
Mermentau		37	08/26/97	Bayou Nezpique	6	03/20/01
		37	09/05/96	Bayou Nezpique	6	02/23/99
		37	09/10/96	Bayou Nezpique	6	02/23/99
		37	06/03/97	Bayou Nezpique	6	02/23/99
Sabine		270	05/20/97	Bayou Nezpique	6	02/22/00
Mississippi Basin						
Black		0	10/31/95	Mississippi Lock & Dam 12	557	03/28/01
Mississippi	Melvin Price Dam	200	02/07/96	Kaskaskia/ Lock & Dam tailwaters		04/01/96
	Melvin Price Dam	200	02/07/96	Kaskaskia/ Lock & Dam tailwaters		04/01/96
Running Reelfoot			05/09/95	Kaskaskia Confluence		07/31/97
Missouri Basin						
Missouri	Niobrara confluence	840	05/14/96	Gavins Point	811	10/26/97
	Niobrara		05/14/96	Gavins Point	811	07/23/01
	Gavins Point	811	05/22/96	Bagnell Dam on Osage		03/15/97
	James	801	05/07/97	Gavins Point	811	10/12/03
	Big Sioux	2	02/16/00	Gavins Point	811	10/14/01
	Gavins Point	811	06/18/98	Hermann	98	11/16/00
	Gavins Point	811	04/26/95	Big Sioux	2	02/16/00
	Gavins Point	811	06/12/97	Big Sioux	2	02/16/00
	Gavins Point	811	07/01/99	Big Sioux	2	02/16/00
	Gavins Point	811	06/02/98	Big Sioux	2	02/16/00
	Gavins Point	811	11/17/98	Big Sioux	2	02/16/00
Osage	Lake of Ozarks		09/12/96	Gavins Point	811	09/16/03
	Lake of Ozarks		1994	Gavins Point	811	06/17/03
Ohio Basin						
Tennessee	Haddox Ferry	16	03/13/02	Ohio/Smithland Pool		02/21/03
	Haddox Ferry	16	03/13/02	Ohio/Smithland Pool		12/12/02
Cumberland	Ferguson Creek	5	10/25/00	Ohio/Smithland Pool		02/07/03
Wabash	New Harmony	51	02/06/97	Ohio/Smithland Pool		02/06/03
	Harmony Dam Island	42	02/07/97	Ohio/Smithland Pool		01/23/03
	New Harmony Bridge	52	03/18/99	Ohio/Smithland Pool		12/26/02
	Harmony Dam Island	42	04/03/96	Ohio/Smithland Pool		10/08/96
Ohio	Myers Pool Hovey Lake	840	09/30/98	Wabash/New Harmony		02/24/04
	Myers Pool Hovey Lake	840	06/19/95	Wabash/ New Harmony Bridge		02/05/99
	Wabash	25	03/04/96	Tennessee/ Kentucky Lake		10/18/03

The most interesting movements occurred in the Ohio River mainstem (Table 30). Almost half of the 266 paddlefish recaptured in the Ohio River mainstem moved between reservoir pools. One fish moved upstream six reservoir pools from Smithland pool to Markland pool. Twenty-one fish were recaptured in the Ohio mainstem by commercial fishers who did not report a specific location; therefore, movement could not be assessed for these fish. Commercial anglers fish ‘hot spots’ on the Ohio River and are not eager to share location information. Additionally, anglers will submit rostrums from multiple locations in a single batch, so specific location for each fish is unknown. Dams on the Ohio River do not appear to deter fish movement in the same fashion as dams on the upper Missouri and Mississippi Rivers. Myers, Newburgh and Cannelton dams have similar configurations with no hydroelectric unit, two standard locks and a fixed weir. The fixed weir of these dams is often overtopped during the winter and spring. Markland Dam has a hydroelectric unit and lacks a fixed weir, so it is not often overtopped. During a dry winter season none of the Ohio River dams are overtopped, which leaves each reservoir pool, Hovey Lake and the Wabash River functioning as discrete units. During a normal winter rainy season, Myers, Newburgh, and Cannelton dams are often overtopped and connected with Hovey Lake and the Wabash River. During a wet winter rainy season, all of the Ohio River mainstem dams are overtopped and fish can move anywhere (personal communication, Tom Stefanavage, Indiana Department of Natural Resources).

Only 16 wild origin paddlefish left their original tagging basin and moved to another basin (Table 31). Limited additional movements of fish bearing jawtags have occurred between basins as well. This minimal movement of fish between basins appears to verify the definition of many of the existing paddlefish management areas made by project biologists. A majority of these fish (11) moved from the Missouri River Basin below Bagnell Dam on the Osage River and Gavins Point Dam on the Missouri River to be recaptured in the Middle Mississippi or Kaskaskia Rivers in the Mississippi Basin.

While wild origin fish appear to exhibit site fidelity, hatchery stocked fish do not seem to exhibit similar site loyalty. Seventy-six percent of the recaptured paddlefish stocked in Tuttle Creek Reservoir on the Blue River in Kansas were found below Gavins Point Dam on the Nebraska/South Dakota border. One was collected in the Mississippi River on the Missouri border. As paddlefish have been noted to travel great distances (Russel 1986) and respond to water flows for spring spawning migrations (Paukert and Fisher 2001), these fish were likely drawn to water flows from Gavins Point Dam.

Table 30. Movements of paddlefish tagged with coded-wire tags in the Ohio River mainstem. The grey boxes show paddlefish captured in the same pool in which they were originally tagged. Boxes to the right indicate upstream movement while boxes to the left indicate downstream movement.

Tagged Pool	Recaptured Pool															
	52	Smithland	Olmsted	Myers	Newburgh	Cannelton	McAlpine	Markland	Meldahl	Greenup	Byrd	Racine	Belleville	Willow Island	Hannibal	unknown
52	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Smithland	-	13	-	6	3	7	-	1	-	-	-	-	-	-	-	5
Olmsted	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Myers	-	10	-	64	29	10	-	1	-	-	-	-	-	-	-	6
Newburgh	-	-	-	-	7	11	-	-	-	-	-	-	-	-	-	2
Cannelton	-	1	-	3	3	14	-	2	-	-	-	-	-	-	-	1
McAlpine	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-
Markland	-	-	-	1	1	2	-	42	-	-	-	-	-	-	-	7
Meldahl	-	-	-	-	-	1	-	3	-	-	-	-	-	-	-	-
Greenup	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-
Byrd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Racine	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Belleville	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
Willow Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hannibal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-

Table 31. Movements of coded wire tagged wild paddlefish from one river basin to another.

TAGGING BASIN	Tagging River	Tagging Location	Tagging River Mile	Tagging Date	RECAPTURE BASIN	Recapture River	Recapture Location	Recapture River Mile	Recapture Date
Missouri	Missouri	Gavins	811	06/14/95	**Mississippi**	Kaskaskia	Lock & Dam tailwaters		12/01/99
Missouri	Missouri	Gavins	811	10/14/95	**Mississippi**	Kaskaskia	Lock & Dam tailwaters		03/12/98
Missouri	Missouri	Gavins	811	05/01/95	**Mississippi**	Kaskaskia	Lock & Dam tailwaters		12/01/96
Missouri	Osage	Bagnell Dam	179	04/24/95	**Mississippi**	Kaskaskia	Lock & Dam tailwaters		04/22/99
Missouri	Osage	Bagnell Dam	179	04/27/95	**Mississippi**	Kaskaskia	Lock & Dam tailwaters		06/12/98
Missouri	Osage	Bagnell Dam	179	04/27/95	**Mississippi**	Kaskaskia	Lock & Dam tailwaters		03/97
Missouri	Missouri	Gavins	811	unsure	**Mississippi**	DesMoines			02/04/99
Missouri	Missouri	Gavins	811		**Mississippi**	Mississippi	Missouri		
Missouri	Missouri	Gavins	811	06/02/97	**Mississippi**	Mississippi	Ilinois Cape Girardeau		11/02/03
Missouri	Missouri	Gavins	811	07/05/95	**Mississippi**	Mississippi	Ilinois	199	02/08/96
Mississippi	Mississippi	Lake Whittington		01/11/99	**Ohio**	Ohio			03/19/02
Missouri	Osage	Bagnell Dam	179	04/06/95	**Mississippi**	Mississippi		116	01/13/00
Mississippi	Mississippi	Melvin Price Dam	200	02/07/96	**Missouri**	Missouri	Gavins	811	11/01/01
Ohio	Ohio	McAlpine Dam	606	04/09/97	**Missouri**	Missouri	Gavins Point	811	unknown
Mississippi	Black		257	03/03/97	**Ohio**	Ohio	Smithland Pool		02/06/03
Mississippi	Mississippi	Below Golden Eagle Ferry	228	03/03/97	**Ohio**	Ohio	Smithland Pool		02/06/03

MARK/RECAPTURE ANALYSIS

In general, mark/recapture projects use the following assumptions: randomly selected individuals are marked and released, the marked individuals mix freely with unmarked individuals in the population, marks are permanent and recognizable, and marked animals have the same probability of recapture as the unmarked individuals. The ratio of marked to unmarked individuals is used to estimate abundance. The estimation method used depends on the nature of the data collected and the assumptions of the situation.

Due to the parameters of the MICRA stock assessment project, our data violates the assumptions of both demographic and geographic closure. Paddlefish have spawned, migrated, and died during the duration of the project. The Jolly-Seber method is designed to estimate population sizes for biologically realistic open populations (Krebs 1999). Mark-recapture data is placed in a Method B table which lists the time of last capture, time of capture, total animals caught, marked, and released. In an intensive mark-recapture program, most of the marked fish collected would have been marked in the previous sampling event; therefore the number of marked animals should be largest along the subdiagonal of the table. In mark-recapture studies with less intensive sampling or very large populations, more recaptures will appear above the subdiagonal since marked fish will evade capture for several sampling periods (Krebs 1999). Method B tables were constructed for sampling locations within each of the major river basins associated with the MICRA paddlefish stock assessment project. It is readily apparent that the subdiagonals of the tables do not contain the largest number of fish, indicating that we have either large populations or need more intensive sampling efforts. Population estimates were derived, where applicable, using the Jolly-Seber full model in the Programs for Ecological Methodology software program, Version 6.1 (Krebs 1999). Confidence limits on these estimates were quite large due in part to our limited number of recaptures. Additionally, the Jolly-Seber model assumes that fish migration from a sampling area is permanent (Barker and White 2001). Once a fish has left the marked population, it is considered gone without the option of return. Zehfuss et al (1999) used radiotelemetry to test the emigration assumptions of their gulf sturgeon study area and found that Jolly–Seber and Schnabel capture–recapture models were unbiased if fish had a high probability of returning to the sampling area after temporary emigration. A review of our paddlefish movement information indicated this is true. Assumptions about emigration in each project area need to be made by project biologists based on data from this and other paddlefish projects to further refine population models.

Most mark-recapture studies are designed to utilize one form of recapture data. This is generally either live captures of marked animals or band recoveries from harvested animals as in Brownie et al (1985). However, Barker and White (2001) determined that while mixing live and dead encounters increased the complexity of a population model, it considerably improved the precision of the parameter estimates. Many of the identified population areas in the stock assessment project have both live recaptures from biologist sampling and dead recaptures from commercial and sport angler harvests, MARK analysis would provide a much more precise estimate of the population size. Basin workgroups need to discuss sampling and harvest data in detail to develop binary coded encounter histories for their fish. In this encounter history format a pair of indicator variables (LD) are defined for each encounter period. The L variable of each pair indicates whether or not the animal was captured in that trapping event while the D variable specifies if live or dead encounters of the animal occurred between trapping sessions (White and Burnham 1999). The following synopses provide information on mark-recapture histories and where possible rough population estimates for selected areas using the Jolly-Seber. Project participants are encouraged to work with their basin groups, academic professionals, and database managers to pursue Program MARK population estimates. Program MARK will allow biologists to estimate all of the probabilities underlying the encounters of marked animals (Cooch and White 2001).

Gulf Basin

Mermentau River

Insufficient sampling data and reported recaptures negated explanation of this population (Table 32). Increased numbers of recaptures in Louisiana's outstanding 2001 through 2004 dataset may allow population estimates for this river system. Some 1996 fish were recaptured the following year; however, more Mermentau fish were recaptured in Bayou Nezpique than in the Mermentau. Future efforts to examine these populations may need to consider these two water bodies as holding a single population of fish. The storm surge following Hurricane Katrina increased salinity and dropped dissolved oxygen levels in the Mermentau River decimating the paddlefish population (personal communication, Bobby Reed, Louisiana Department of Wildlife and Fisheries).

Table 32. Mark-recapture data for paddlefish, of presumed wild origin, collected from the Mermentau River.

Time of last capture	Time of Capture				
	1995	1996	1997	1998	1999
	Biologist	Biologist	Biologist	Biologist	Biologist
1995	0	0	0	0	0
1996		0	3	0	0
1997			0	0	0
1998				0	0
1999					0
Total recaptures	0	0	3	0	0
Total marked	0	174	149	52	4
Total caught	0	173	145	52	4

Mississippi Basin

Des Moines River

Iowa sampled three years in the Des Moines River; 1998, 1999 and 2001. Five fish originally tagged in 1998 were recaptured in 1999 (Table 33). The Peterson estimation method is the simplest method to estimate population size in 1998, however, the assumption of a short time period would be violated. The Peterson estimate is 437 fish in the catchable population with 95% confidence intervals of 238 to 1488 fish. Peterson population estimates are unreliable and highly biased when the number of recaptures is less than seven. While the Jolly-Seber method would be a more appropriate estimator for this population, the Des Moines River dataset lacks enough recaptures of fish in subsequent years to apply the formula. Although the limited dataset implies paddlefish in the Des Moines River may be unique to that system; more sampling is necessary to determine population size.

Table 33. Mark-recapture data for paddlefish, of presumed wild origin, collected from the Des Moines River.

Time of last capture	**Time of Capture**			
	1998	1999	2000*	2001
	Biologist	Biologist	Biologist	Biologist
1998	0	5		0
1999		0		0
2000*				0
2001				0
Total recaptures	0	5		0
Total marked	76	30		10
Total caught	76	33		10
Adj. release (100%)	76	30		10
Adj. release (90%)	68	27		9

* No sampling occurred in 2000

Mississippi River pools 13, 14, and 26

Limited movement of paddlefish occurred between pools of the Upper Mississippi River. One fish moved from Pool 5A into Pool 14 (Table 34). One fish each moved from Pool 8, Pool 14, and the Black River into Pool 13 (Table 35). Fish from Pool 26 were not collected elsewhere, nor were fish originally tagged in other locations collected in this Pool (Table 36).

Unfortunately, 88 paddlefish recaptured by Iowa Department of Natural Resources staff can not be linked to a recapture location as the rostrums were submitted to the tag processing center without sufficient information. This poses additional future implications when developing individual fish encounter histories for MARK analysis as fish with multiple recaptures will not be counted as such.

Jolly-Seber population estimates for Pool 13, assuming 90% tag retention ranged from 266 fish in 2000 to 2626 fish in 2003 (Table 37). Recapture numbers from Pool 14 were insufficient to run a Jolly-Seber population model. Recaptures from Pool 26 included returns from the commercial harvest of paddlefish. Harvest numbers and recaptures were combined with biologist catch and recaptures in the Jolly Seber model. This increased the total number caught in the model while the number of fish marked and released did not change. This may be partially responsible for the wide range of population estimates for this pool. Estimates included a low of 471 fish in 1997 and a high of 87013 the following year (Table 38). The 1996 estimate of four fish is due to the extremely low number of fish collected by biologists that year and should not be considered a valid estimate. Moving this data to a binary format which includes a terminal code for harvested fish for MARK analysis will improve the precision of the population estimates.

Table 34. Mark-recapture data for paddlefish, of presumed wild origin, collected by biologists (B) and by other means (O) from pool 14 of the Mississippi River.

Time of last capture	Time of Capture									
	1996	1997	1998	1999		2000	2001	2002	2003	2004
	B	B	B	B	O	B	B	B	B	B
1996	0	0	11	0	1*	0	0	0	0	0
1997		0	0	0	0	0	0	0	0	0
1998			1	4	0	0	0	0	0	0
1999				0	0	0	0	0	0	0
2000						0	0	0	1	0
2001							0	0	0	0
2002								0	1	0
2003									0	0
2004										0
Total recaptured	0	0	12	4	1	0	0	0	2	0
Total marked	79	2	222	23		30	1	168	218	60
Total caught	83	2	283	23		30	1	176	233	60
Adj. release (100%)	79	2	221	23		30	1	168	218	60
Adj. release (90%)	71	2	199	21		27	1	151	196	54

* From pool 5A of the Mississippi River

Table 35. Mark-recapture data for paddlefish, of presumed wild origin, collected from pool 13 of the Mississippi River.

Time of last capture	Time of Capture											
	1995	1996	1997	1998	1999		2000	2001		2002	2003	2004
	Biologist	Biologist	Biologist	Biologist	Biologist	Other	Biologist	Biologist	Other	Biologist	Biologist	Biologist
1995	0	0	0	0	0	0	0	1	1***	0	0	0
1996		3	3	0	1	1*	0	4	0	0	0	1
1997			2	1	7	0	0	0	0	0	0	0
1998				0	1	1**	0	0	0	0	0	0
1999					0	0	0	11	0	2	0	0
2000							0	1	0	1	0	0
2001								0	0	5	0	0
2002										0	3	4
2003											0	2
2004												0
Total recaptured	0	3	5	1	9	2	0	17	1	8	3	7
Total marked	2	104	82	8	100		5	177		240	76	283
Total caught	2	119	94	9	123		6	205		274	88	303
Adjusted release (100%)	2	101	80	8	100		5	177		240	76	283
Adjusted release (90%)	2	91	72	7	90		5	159		216	68	255

* From pool 8 of the Mississippi River
** From pool 14 of the Mississippi River
*** From the Black River

Table 36. Mark-recapture data for paddlefish, of presumed wild origin, collected by biologists (B) and harvested (H) from pool 26 of the Mississippi River.

Time of last capture	Time of capture																			
	1995		1996		1997		1998		1999		2000		2001		2002		2003		2004	
	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H
1995	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996			0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997					0	0	0	0	1	4	1	0	0	2	0	0	1	0	0	0
1998							0	0	2	0	2	1	0	1	1	0	0	0	0	0
1999									0	0	1	1	0	2	0	0	0	1	2	0
2000											2	1	3	2	0	1	4	1	0	1
2001													1	2	1	0	1	1	0	3
2002															0	0	0	0	0	2
2003																	2	2	0	5
2004																			0	0
Total recaptured	0	1	0	1	0	2	0	0	3	4	6	3	4	9	2	1	8	5	2	11
Total marked	18		2		156		171		160		310		118		118		246		135	
Total caught	23		2		706		498		995		558		397		246		325		283	
Adj. release (100%)	17		2		156		171		160		307		115		118		242		135	
Adj. release (90%)	15		2		140		154		144		276		104		106		218		122	

Table 37. Population estimates for pool 13 of the Mississippi River.

Year	100% Tag Retention				90% Tag Retention			
	N	95% CI	Survival	95% CI	N	95% CI	Survival	95% CI
1995	-	-	5.100	-	-	-	4.600	0.9225-1
1996	1224	195-31739	0.594	0.2446-1	1104	184-27996	0.597	0.2481-1
1997	1568	567-7676	0.448	0.1212-1	1420	519-6881	0.443	0.1227-1
1998	320	78-2816	0.736	0.1942-1	285	71-2449	0.762	0.2062-1
1999	648	325-2045	0.265	0.1081-0.7041	595	304-1838	0.295	0.1202-0.7793
2000	266	54-3062	3.155	0.8877-1	266	54-3062	2.876	0.8200-1
2001	1553	634-6715	0.129	0.0253-0.7719	1415	588-6014	0.132	0.0269-0.7598
2002	1165	375-10687	0.486	0.1266-1	1073	361-9457	0.485	0.1272-1
2003	2922	774-22596	-	-	2626	702-20156	-	-

Table 38. Population estimates for pool 26 of the Mississippi River.

Year	100% Tag Retention				90% Tag Retention			
	N	95% CI	Survival	95% CI	N	95% CI	Survival	95% CI
1995	-	-	0.147	0.0458-0.4822	-	-	0.167	0.0519-0.5386
1996	4	2-13	0.571	0.2002-1	4	2-13	0.571	0.2002-1
1997	471	471-99648	1.240	0.5043-1	471	471-74852	1.246	0.5078-1
1998	96557	16676-1367515	0.516	0.1913-1	87013	15063-1230260	0.518	0.1931-1
1999	23422	9535-93182	0.712	0.2890-1	21181	8678-83735	0.713	0.2906-1
2000	19399	8176-72344	0.384	0.1554-1	17495	7403-64978	0.388	0.1583-1
2001	7557	3311-26978	1.905	0.5181-1	6875	3033-24362	1.894	0.5167-1
2002	36927	10425-248627	0.467	0.1154-1	33222	9402-223134	0.470	0.1165-1
2003	10856	4189-46461	-	-	9813	3805-41807	-	-

Kaw Reservoir

Recaptures and log-recaptures of 1994 hatchery stocked fish were plotted against year to determine survival rates of the fish (Ricker 1975). The plot of the logarithms of recaptures falls in a straight line indicating survival rates were uniform over this period. The line has a slope of -0.04012 log-units per year, corresponding to a survival rate of 91.2 percent (Figure 20). Natural mortality of paddlefish has previously been documented at less than nine percent of fish in the unfished South Cross Creek impoundment on the Cumberland River, Tennessee (Boone and Timmons 1995) and at eight percent for paddlefish in Kentucky Lake, Tennessee (Timmons and Hughbanks 2000). Runstrom et al (2001) estimated total annual mortality in an unexploited Mississippi River population to be 27%.

Adult paddlefish collected by biologists in Kaw Lake were marked with monel jaw tags. Only two of these fish were subsequently recaptured. Kaw Lake data should be moved to MARK analysis to correctly incorporate hatchery stockings and multiple recapture histories of fish stocked with coded wire tags and subsequently recaptured with jaw tags. Further sampling to increase recaptures should also occur.

Table 39. Mark-recapture data for paddlefish collected from Kaw Reservoir on the Arkansas River. CWT indicates coded wire tag recaptures and JWT indicates jawtag recaptures.

Time of last capture	**Time of Capture**											
	1994	1995	1996	1997	1998	1999		2000		2001	2002**	2003
	CWT	CWT	CWT	CWT	CWT	CWT	JWT	CWT	JWT	CWT		CWT
1994	0	4	5	8	3	7	0	4	0	2		0
1995		0	0	0	0	0	1	0	0	0		0
1996			0	0	0	0	0	0	0	0		0
1997				0	0	0	0	0	0	0		0
1998					0	0	0	1	0	0		0
1999						0	0	0	0	0		0
2000								0	1	0		0
2001										0		0
2002												0
2003												0
Total recaptured	0	4	5	8	3	7	1	5	1	2	0	0
Total marked	16310*	99	18	13	8	22		17		4	0	0
Total caught	0	127	18	13	9	24		17		5	0	3
Total jawtagged	0	99	18	13	8	22		17		4	0	0
Adj. release (100%)	16310*	99	18	13	8	22		16		4	0	0
Adj. release (90%)	14679*	0	0	0	0	0		0		0	0	0

* Hatchery stocked fish
** No sampling occurred in 2002

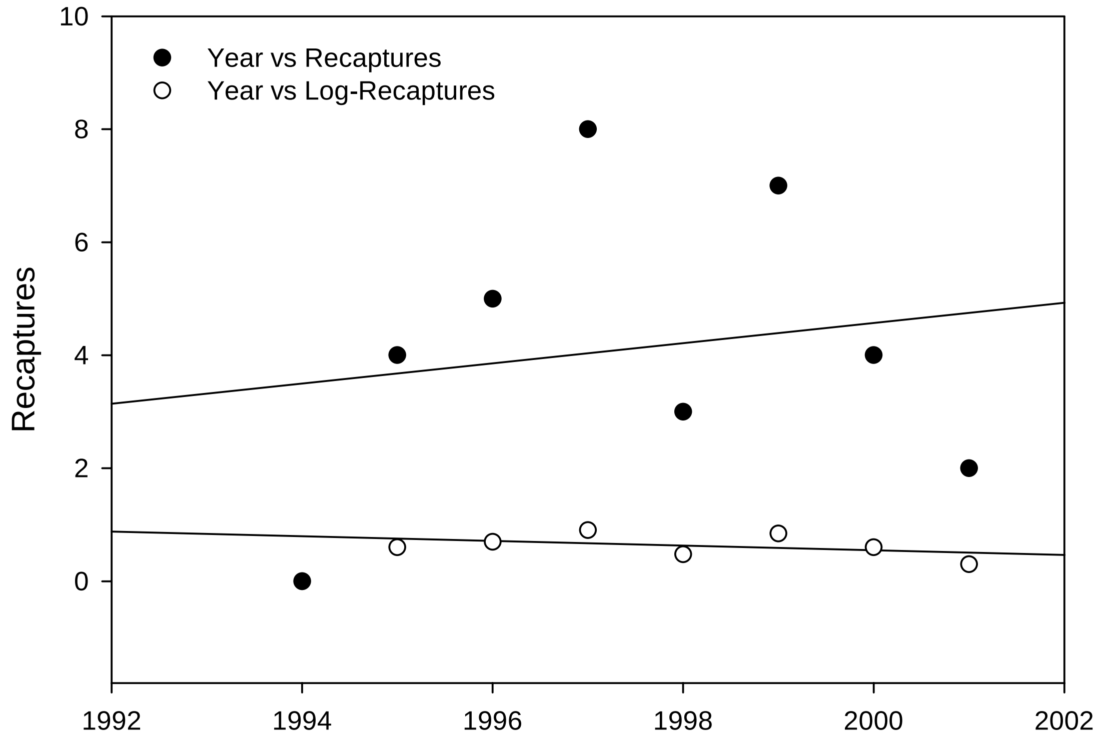

Figure 20. Survival of hatchery stocked paddlefish recaptured in Kaw Reservoir, Oklahoma.

Oolagah Reservoir

Oolagah Reservoir represents a unique case for analysis as paddlefish were not present in the reservoir prior to stocking in 1994. This presents the opportunity for biologists to look at long term tag retention rates in the wild. As seen in Table 40, while 15 fish were collected by project biologists in 1999 only six were reported to be coded wire tag recaptures. As one additional fish was recaptured with an unreadable tag, this leaves a total of eight fish which did not register as recaptured fish. These fish should all be carrying tags in the absence of a natural local population. In total, nine recaptured fish tags could not be read or were missing from the pieces of rostrums returned to the tagging center. Additionally, two recapture tags could not be linked to their original tagging event due to a tag number mismatch. Similar to Kaw Reservoir adult fish captured by biologists are subsequently tagged with jaw tags.

Attempts to determine survival rates of 1994 fish stocked into Oolagah Reservoir provided confusing results, as the slope of the log-recaptures by year line (0.0407) was a positive number (Figure 21). This is likely due to the larger number of recaptures from this stocking class which were recaptured in 2002 and 2003. Oklahoma biologists are working with Dr. Craig Paukert of Kansas State University to analyze their paddlefish data.

Table 40. Mark-recapture data for paddlefish collected from Oolagah Reservoir, Oklahoma. CWT indicates coded wire tag recaptures and JWT indicates jawtag recaptures.

Time of last capture	Time of Capture														
	1994*	1995*	1996*	1997	1998	1999		2000		2001		2002		2003	
				CWT	CWT	CWT	JWT	CWT	JWT	CWT	JWT	CWT	JWT	CWT	JWT
1994*				6	3	4	0	1	0	11	0	7	0	0	0
1995*															
1996*															
1997				0	0	13	0	6	0	15	0	11	0	1	0
1998					0	0	1	4	0	8	0	7	0	0	0
1999						0	0	3	1	8	1	14	1	0	0
2000								0	0	0	0	6	0	0	0
2001										0	0	0	0	0	0
2002												0	0	0	2
2003														0	2
Total recaptured				6	3	17	1	14	1	42	1	45	1	1	4
Hatchery releases	5974	0	112	10282	2037	8837		3216		0		0		0	
Total jawtagged				15	5	20		18		50		57		26	
Total caught				15	6	21		19		55		65		27	
Adj. release**	5974	0	112	10297	2042	8857		3234		50		57		24	
Adj. release***	5735	0	108	9884	1960	8501		3103		43		49		22	

* No sampling occurred in 1994, 1995, and 1996

** Based on 100% tag retention for both CWT and JWT

*** Based on 85.9% retention rate for CWT and 96% retention rate for JWT

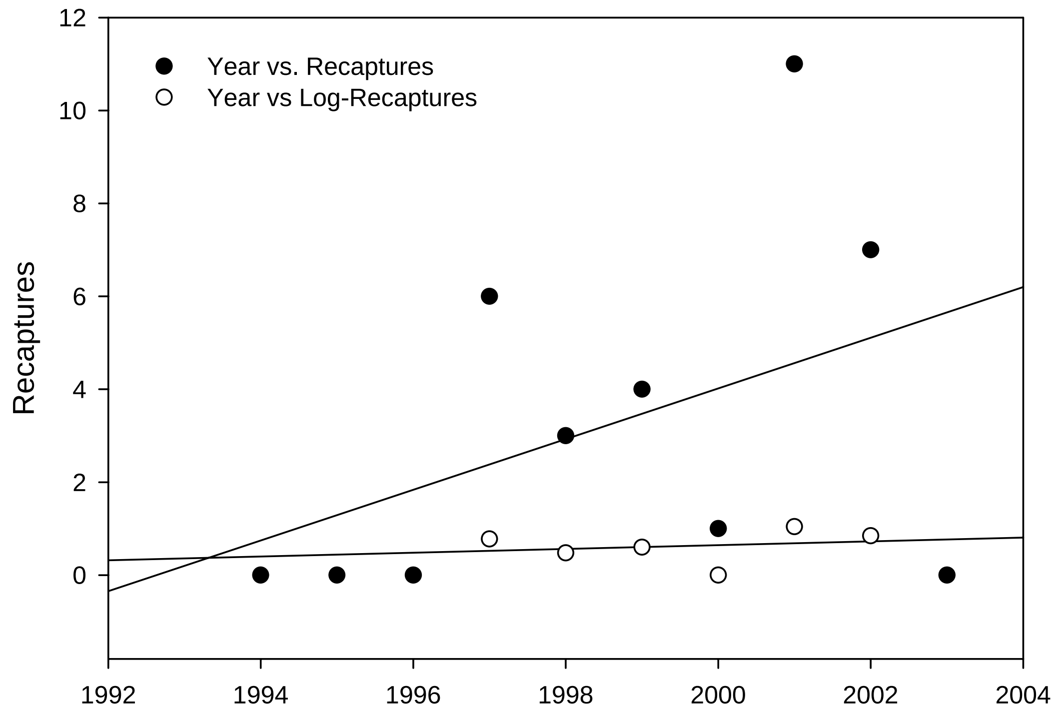

Figure 21. Survival of hatchery stocked paddlefish recaptured in Oolagah Reservoir, Oklahoma.

Missouri Basin

Missouri River below Gavins Point Dam

The largest dataset in the MICRA paddlefish stock assessment project covers paddlefish below Gavins Point Dam on the Missouri River. This stretch of river hosts the jointly managed Nebraska/South Dakota paddlefish fishery. Three hundred fifty-five wild origin paddlefish were recaptured either by biologist sampling or by archery and snagging anglers. The Method B table for this dataset is largely complete, indicating fish were recaptured from almost every sampling year in each of the subsequent sampling years (Table 41).

Fish recaptured in the same season they were tagged were removed from the total number of marked fish since one assumption of the Jolly-Seber model is that fish can not be recaptured until the subsequent marking period. The number released was also adjusted to reflect a 90% coded wire tag retention rate. The total number of fish caught includes fish collected by biologists as well as fish harvested in the archery and snagging seasons. This provided population estimates ranging from a low of 34557 in 2001 to a high of 170734 in 1999 (Table 42). Similar to the other areas examined, confidence intervals around these numbers are large. Biologists from Nebraska and South Dakota will be working with Dr. Mark Pegg of the University of Nebraska-Lincoln in spring 2006 to develop more precise population estimates using Program MARK.

Table 41. Mark-recapture data for paddlefish, of presumed wild origin, collected by biologists (B) and harvested (H) by means of archery and snagging from the Missouri River below Gavins Point Dam.

Time of last capture	Time of Capture																	
	1995		1996		1997		1998		1999		2000		2001		2002		2003	
	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H
1995	0	27	12	16	7	3	5	5	2	2	0	0	1	3	4	1	1	4
1996			1	30	11	9	6	6	0	2	0	2	5	2	1	1	3	5
1997					0	14	8	10	7	3	0	3	2	4	2	1	5	2
1998							2	8	3	0	0	6	4	1	3	1	5	2
1999									0	0	3	1	5	8	1	4	4	3
2000											0	1	1	4	3	1	4	1
2001													0	1	3	3	6	7
2002															1	4	4	7
2003																	0	2
Total recaptures	0	27	13	46	18	26	21	29	12	7	3	13	18	23	18	16	32	33
Total marked	642		677		880		652		711		261		323		525		508	
Total caught*	2888		2566		1955		1911		2133		1342		1498		1422		1856	
Adj. release (100%)	642		677		880		652		711		261		323		525		508	
Adj. release (90%)	578		609		792		587		640		235		291		473		457	

* Total collected by biologists plus the combined harvest from archery and snagging

Table 42. Population estimates for the Missouri River below Gavins Point Dam.

Year	100% Tag Retention				90% Tag Retention			
	N	95% CI	Survival	95% CI	N	95% CI	Survival	95% CI
1995	-	-	0.815	0.5605-1	-	-	0.820	0.5653-1
1996	46335	30460-87750	0.979	0.6658-1	41937	27661-79095	0.982	0.6694-1
1997	77404	51292-144062	0.874	0.5491-1	69861	46370-129753	0.877	0.5518-1
1998	81509	53128-155509	0.752	0.4537-1	73582	48043-140078	0.753	0.4549-1
1999	189421	116426-394043	0.629	0.3501-1	170734	105055-354680	0.630	0.3515-1
2000	130277	72738-313254	0.581	0.3079-1	117473	65699-281850	0.584	0.3105-1
2001	38184	24340-75591	1.739	0.8696-1	34557	22096-68147	1.741	0.8726-1
2002	109492	61599-260485	-	-	98804	55664-234655	-	-

Ohio Basin

Ohio River

All fish collected in the Ohio River mainstem and Great Miami River were included in the Method B mark-recapture table (Table 43) and Jolly-Seber population estimates. Fish in the Wabash River were considered a distinct population unit due to limited movement of recaptured fish between the Wabash and Ohio Rivers. Harvested fish were added to the total number of fish caught. Harvest values used reflect numbers currently present in the MICRA stock assessment database. Further refinement of these values with harvest numbers held by Ohio Basin agencies will improve population estimates. Fish recaptured in the same marking year were subtracted from the total number of marked fish. Average population estimates assuming a 90% retention rate for coded-wire tags ranged from a low of 33318 fish in 1996 to a high of 549677 fish in 2000 (Table 44). Program MARK software should be used to assess this dataset taking into account terminal recaptures to improve precision of population estimates.

Concern was expressed by the Ohio River Fish Management Team in their Sub-Basin Management Plan that the Ohio River Basin may be experiencing unsustainable levels of commercial harvest (Henley et al 2001). However, their estimates were based on ages from a small sample of fish collected by sport anglers in one location in 1996. Harvest estimates based on commercial reports of pounds of harvested fish were 11,711 paddlefish in 1999 and 29,194 in 2000. Pairing population estimates derived from the Jolly-Seber model to reported harvest would indicated that 34% of the population was harvested in 1999 while only 5% was harvested in 2000. Obviously, an improved population model is needed.

Table 43. Mark-recapture data for paddlefish, of presumed wild origin, collected from the Ohio River. CWT indicates coded wire tag recaptures and JWT indicates jawtag recaptures. The total number of fish caught from 1996 through 2004 includes the total number of fish collected by biologists and harvested by sport and commercial anglers.

Time of last capture	Time of Capture																														
	1995	1996		1997		1998		1999				2000				2001				2002				2003				2004			
	CWT	CWT		CWT		CWT		CWT		JWT		CWT		JWT		CWT		JWT		CWT		JWT		CWT		JWT		CWT		JWT	
	B	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H	B	H
1995	1	6	7	2	5	2	0	7	1	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
1996		3	1	7	16	7	5	8	2	0	0	1	5	0	0	1	2	0	0	0	7	0	0	0	3	0	0	0	0	0	0
1997				3	2	9	2	7	10	0	0	3	3	0	0	1	3	0	0	0	8	0	0	0	1	0	0	0	0	0	0
1998						3	2	12	7	0	0	0	6	0	0	3	6	0	0	0	8	0	0	1	0	0	0	2	0	0	0
1999								7	2	0	0	0	5	0	0	2	3	0	0	10	5	0	0	1	0	0	0	0	0	1	0
2000												1	3	11	0	1	2	5	0	0	7	1	0	0	3	4	0	0	0	0	0
2001																1	0	6	0	0	5	1	0	0	2	1	0	1	0	1	0
2002																				0	2	0	0	0	0	0	3	0	0	1	1
2003																								0	0	2	0	0	0	3	0
2004																												0	0	5	0
Total recaptured	1	9	8	12	23	21	9	41	22	0	0	5	22	11	0	10	16	11	0	11	43	2	0	2	9	7	3	3	0	6	1
Total marked	331	693		612		612		610				829				840				507				303				509			
Total caught	331	2226		3428		3307		1519				3227				2110				952				950				1853			
Adj. release (100%)	330	676		600		556		574				800				814				501				294				493			
Adj. release (90%) Jawtags excluded	297	608		540		500		514				720				733				228				263				346			

Table 44. Population estimates for the Ohio River.

Year	100% Tag Retention				90% Tag Retention			
	N	95% CI	Survival	95% CI	N	95% CI	Survival	95% CI
1995	-	-	0.671	0.4287-1	-	-	0.705	0.4508-1
1996	35204	20427-81107	0.799	0.5544-1	33318	19357-76695	0.767	0.5301-1
1997	78107	52275-143612	0.741	0.5045-1	68253	45641-125787	0.767	0.5181-1
1998	120266	79501-224750	0.969	0.6150-1	109913	72321-206941	0.928	0.5796-1
1999	39517	26632-71831	1.227	0.7243-1	34337	-	2.401	-
2000	321808	197211-672263	1.381	0.7028-1	549677	298912-1373412	1.207	0.4575-1
2001	298037	168376-703321	0.351	0.1311-1	468859	220598-1456122	-	-
2002	31380	15010-96320	0.237	0.0628-1	-	-	-	-
2003	25451	9313-119218	-	-	-	-	-	-

Wabash River

The Ohio River Fish Management Team's technical committee determined in 2001 that the Wabash River mainstem was a separate management unit from the Ohio River mainstem (Henley et al 2001). Wabash River fish were generally smaller and less robust when compared to fish from the Ohio River mainstem and Hovey Lake. The Ohio Basin biologists can generally tell when they collect a recently departed Hovey Lake fish in the Wabash or recently arrived Wabash fish in Hovey Lake because the fish look so different (personal communication, Tom Stefanavage, Indiana Department of Natural Resources).

Fifty-three fish with linkable tag codes were recaptured in the Wabash system. Three of these fish were originally tagged in the Ohio River. Program Jolly could not be used across the full range of Wabash data to estimate population sizes because the data violates two assumptions of the program. Recaptures from each tagging year must be collected in subsequent sampling events (years). No fish tagged in 2001 were recaptured in 2002 or 2003. Additionally, no recaptures occurred in 1997. Program JOLLY was used to estimate the Wabash population with 95% Confidence Limits for the 1996 through 1999 capture seasons. Estimates were determined both for the data as presented in Table 45 and with the data corrected for a 90% tag retention rate (Table 46). Jawtag numbers were included in this estimation with the assumption that tag retention was 100 percent.

Table 45. Mark-recapture data for paddlefish, of presumed wild origin, collected from the Wabash River. Columns labeled Ohio include recaptures of fish from the Ohio River.

Time of last capture	Time of Capture															
	1995	1996	1997	1998	1999		2000	2001	2002		2003		2004			
	Biologist	Biologist	Biologist	Biologist	Biologist	Ohio	Biologist	Biologist	Biologist	Jawtag	Biologist	Jawtag	Biologist	Ohio	Jawtag	Jawtag Ohio
1995	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
1996		1	0	2	2	1	0	0	0	0	0	0	0	0	0	0
1997			1	2	2	0	1	1	0	0	0	0	0	0	0	0
1998				6	5	0	6	2	3	0	2	0	0	1	0	0
1999					4	0	3	0	3	0	3	0	0	0	0	0
2000							2	0	0	0	1	0	0	0	0	1
2001								1	0	0	0	0	0	0	0	1
2002									0	1	0	1	0	0	0	0
2003											0	0	0	0	1	0
2004													0	0	0	0
Total recaptured	0	1	1	11	13	2	12	4	6	1	6	1	0	1	1	2
Total marked	117	62	162	329	377		192	108	75		134		46			
Total caught	118	62	172	351	392		193	110	101		138		56			
Adjusted release (100%)	117	61	161	323	373		190	107	99		138		54			
Adjusted release (90%)	105	55	145	290	335		171	96	99		138		54			

Table 46. Population estimates for the Wabash River.

Year	100% Tag Retention				90% Tag Retention			
	N	95% CI	Survival	95% CI	N	95% CI	Survival	95% CI
1995	-	-	0.106	0.0156-0.8622	-	-	0.107	0.0159-0.8511
1996	781	112-22464	1.839	0.5698-1	706	105-19902	1.838	0.5712-1
1997	23355	3726-376315	0.473	0.1591-1	21048	3369-338403	0.473	0.1601-1
1998	8213	3010-38602	1.449	0.4349-1	7408	2734-34593	1.452	0.4370-1
1999	26076	8736-136742	-	-	23462	7884-122715	-	-

DISCUSSION

The greatest success of the paddlefish stock assessment project has been the identification of paddlefish population areas and the willingness of project participants from different state and federal agencies to work together to develop management plans for the species.

After ten years of stocking and sampling paddlefish in large rivers throughout the country, sufficient data exists to estimate population sizes and exploitation rates in some areas such as the Ohio Basin and Gavins Point tailwater fishery. It is time for the basin workgroups and the Paddlefish/Sturgeon Committee to take a hard look at this project and re-examine its goals and feasibility. For example, although one of the major goals originally defined by the Paddlefish/Sturgeon Committee was the identification of paddlefish habitat, this goal was largely unaddressed. The majority of paddlefish sampling effort has occurred in mainstem rivers below dams. Additionally, this effort consisted mostly of large mesh gill nets and trammel nets which targeted adult fish. A random sampling of large river habitats was simply unfeasible. Project participants striving to tag the targeted goal of 300 wild fish per year simply couldn’t afford to invest the time and money required to determine habitat preferences of a range of size classes of paddlefish with any statistical significance in the Mississippi Basin. The identification of habitat usage by paddlefish should be dropped as a goal of the stock assessment project and moved to smaller scale telemetry study efforts in the basins. On the other hand, we are currently limited in our ability to perform some population statistics as age data is not a part of the MICRA paddlefish stock assessment database. Basin workgroups are encouraged to utilize age data obtained through other studies to assign ages to paddlefish in this project for ongoing analysis.

The following recommendations provided by the database managers presume the cooperative stock assessment efforts of the Paddlefish/Sturgeon Committee will continue in some form.

Recommendations

Develop funding and support mechanisms to support continued coded wire tagging mark and recapture activities.

Mark-recapture studies require a substantial commitment of time and money to generate reliable data (Barker and White 2001). Over 40 million salmon are tagged with coded wire tags annually in the Pacific Northwest. Each of the state fish and game agencies additionally support a tag recovery lab to remove and read coded wire tags from salmon heads. The Pacific Salmon Marking Center operates a staff of three full-time programmers and analysts at a cost of $500K per year. The Marking Center maintains a website which allows people to query the coded wire tagging and sampling effort data (http://www.rmis.org/index.html). MICRA received $200K of Reverted DJ Funds in seed funding from IAFWA to begin this project in 1995, however, a similar level of funding should have been applied to the project in each of the subsequent years. Numerous attempts to fund this project through various funding sources occurred over the last ten years; none of which were successful.

Should MICRA elect to continue the paddlefish stock assessment project increased time, funds and equipment would be required to allow state biologists to increase the numbers of fish collected and recaptured and to continue to tag hatchery stocked fish. Sampling gear should be standardized within basins to improve comparability of data across space and time. Additional funds to supply states with appropriate numbers of coded wire tag detector wands or creel clerks to increase returns from sport and commercial fisheries should also be considered. Ideally, the MICRA stock assessment project would employ one full time technician to enter data and read tags and one biologist/statistician to handle the database management and analysis. The committee would also move the project database to a web searchable format to increase timely access to data.

At a minimum the backlog of 2004 and 2005 datasheets, reference tags, and recaptures should be entered into the MICRA database. Partnerships with statisticians in state, federal or academic institutions to perform MARK analysis of mark-recapture data should be encouraged.

Determine tag retention rate for jawtags

Several states moved through the course of this project from tagging fish solely with CWTs to tagging wild caught adult fish with jawtags. This shift was made for many reasons including: delays in receiving tagging information, change in tag code with each subsequent recapture, concerns regarding long-term retention rates and potential impacts of multiple rostrum cuts to remove CWTs from recaptured fish. Additionally, jawtags could be observed and recorded by anglers without tag sensing equipment. While there are many anecdotal reports of paddlefish recaptured with jawtags after extensive time periods, there are no published reports of retention rates for jawtags in paddlefish. Tishomingo National Fish Hatchery in Oklahoma held paddlefish tagged with monel jaw tags for fifteen days in 1994 to assess retention and mortality rates. These fish had a 96% retention rate; however none of the fish have been recaptured to date. States interested in continuing or beginning to use jawtags for mark-recapture paddlefish studies should determine retention rates for these tags. It may even be possible to estimate retention rates from recaptures of fish double tagged with coded wire tags.

Analyze mark-recapture data with MARK software
Program MARK provides parameter estimates from marked animals when they are re-encountered at a later time. Re-encounters can be from dead recoveries (e.g., the animal is harvested), live recaptures (e.g. the animal is re-trapped or re-sighted), radio tracking, or from some combination of these sources of re-encounters (White and Burnham 1999). Basin workgroups will need to collectively query data within specific population boundaries and develop encounter histories for individual fish. Assumptions will need to be made regarding sampling frequency, retention rates, harvest values, seasonality of samples. In the absence of a project statistician, partnerships with university staffs familiar with mark-recapture analysis and population dynamics are encouraged.

Increase sampling efforts in those areas most likely to produce sufficient recaptures for analysis
In an ideal mark-recapture study with repeated sampling events animals from each tagging event should be recaptured in every subsequent sampling event. Mobrand Biometrics also identified the need for MICRA to increase the number of multiple recaptures of individual fish. The one location where numbers of fish recaptured seems truly sufficient for population estimates is the Gavins Point tailwater. More recaptures are need to assess populations throughout the project.

Increase or begin sampling efforts in areas where state and federal hatcheries are stocking fish
The states of New York and West Virginia should begin to sample their stocked water bodies to assess their success in establishing year classes of fish. In general, stocked fish appear to be recruiting to most of the sampling gears five years after stocking. Similarly, South Dakota Department of Game, Fish and Parks has stocked fish for fifteen years in Lewis and Clark Lake and Lake Francis Case. Reported sampling in these water bodies has largely been limited to broodstock collections.

Improve quality of data from harvested fish where possible

The majority of recaptured fish were collected in the Ohio River Basin commercial fishery and the joint Nebraska/South Dakota snagging fishery. In almost all cases fish recaptured in this fashion are lacking length and weight information. In most cases specific recapture location is also missing. Very little information from Missouri’s snag fishery exists in the database. The Missouri Department of Conservation should consider distributing harvest labels to snagging anglers in a similar fashion to Nebraska Game and Parks Commission and the South Dakota Department of Game, Fish and Parks. Where possible, state agencies are encouraged to try and increase the voluntary information received from their anglers. Additionally, improvements harvest estimates need to be made to the MICRA database to improve precision of population estimates.

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Appendix A:

Selected tables from this report, were updated for the MICRA Paddlefish/Sturgeon Sub-Committee Meeting

January 20th-21st, 2010

Tables updated on January 8th 2010 by,

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Table 1. Number of sampling trips completed by MICRA participants to assess paddlefish from 1995 – 2009. "GP" indicates the jointly managed Gavin's Point Dam Fishery.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	TOTAL
Gulf Basin																
LA	2	21	20	2	7	6	9	18	5	3	1	5	-	-	-	99
OK	-	-	-	12	6	4	2	14	9	6	12	13	7	10	7	102
TX	-	19	61	19	-	-	-	-	-	-	-	-	-	-	-	99
Mississippi Basin																
AR	6	4	-	-	-	-	-	-	-	-	1	-	-	-	-	11
IA	1	15	28	28	18	9	21	34	22	23	20	14	8	9	-	250
IL	37	7	24	13	28	15	18	14	11	18	10	-	2	-	-	197
LA	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	3
MN	31	25	-	8	-	6	-	49	1	-	-	-	-	-	-	120
MO	-	2	4	2	-	-	-	-	-	-	-	-	-	-	-	8
MS	-	2	2	1	4	1	-	-	-	-	-	-	-	-	-	10
OK	3	1	11	4	4	5	5	2	9	8	8	9	5	30	26	130
TN	3	1	1	-	-	-	1	-	-	-	-	-	-	-	-	6
WI	18	5	16	16	10	4	1	7	9	-	-	-	-	-	-	86
Missouri Basin																
IA	1	-	3	3	3	3	1	2	3	-	2	-	-	8	3	32
KS	-	1	-	1	-	1	-	-	-	-	1	-	-	-	-	4
MO	16	-	1	2	-	10	5	15	10	-	1	1	26	36	-	123
GP	17	15	18	14	16	8	4	9	7	8	6	-	8	15	17	162
NE	-	3	1	-	-	1	-	3	1	-	-	-	20	16	10	55
SD	-	7	1	3	1	5	2	2	1	4	2	-	-	1	9	38
Ohio Basin																
IL	6	15	17	22	28	21	18	19	14	19	19	24	5	1	1	229
IN	9	24	13	16	9	3	4	1	2	9	11	-	-	-	-	101
KY	9	23	19	22	26	13	6	8	2	6	2	7	4	-	10	157
OH	2	6	2	2	2	-	-	2	1	2	-	3	2	2	-	26
PA	-	2	-	-	-	-	-	-	-	-	10	14	-	-	-	26
TN	18	16	3	1	-	-	-	-	1	-	1	-	-	-	-	40
WV	-	-	3	3	2	1	-	-	-	-	-	-	-	-	-	9
TOTAL	179	214	248	194	164	116	97	200	109	107	107	90	87	128	83	2123

Table 2. Number of paddlefish collected for the MICRA Paddlefish Stock Assessment Program, 1995-2009. "GP" indicates the jointly managed Gavin's Point Dam Fishery.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	TOTAL
Gulf Basin																
LA	29	185	220	53	143	89	65	185	60	50	30	54	-	-	-	1163*
OK	-	-	-	25	81	29	25	139	134	157	111	60	64	159	91	1075
TX	-	29	6	1	-	-	-	-	-	-	-	-	-	-	-	36
Mississippi Basin																
AR	16	29	-	-	-	-	-	-	-	-	61	-	-	-	-	106
IA	2	207	120	368	179	36	216	494	347	378	260	296	138	103	-	3144
IL	119	320	218	230	475	355	134	142	247	266	86	2	-	-	-	2594
LA	-	-	-	-	-	-	-	1	14	1	-	-	-	-	-	16*
MN	6	9	-	-	-	5	-	16	3	-	-	-	-	-	-	39
MO	-	5	26	14	-	-	-	-	-	-	-	-	-	-	-	45
MS	-	23	20	18	48	24	-	-	-	-	-	-	-	-	-	133
OK	128	18	144	15	45	69	73	65	1656	1627	1139	198	629	423	943	7172
TN	203	7	-	-	-	-	8	-	-	-	-	-	-	-	-	218
WI	17	76	163	145	74	1	1	1	18	-	-	-	-	-	-	496
Missouri Basin																
IA	11	-	50	51	12	141	-	14	16	-	12	-	-	16	12	335
KS	-	4	-	84	-	45	-	-	-	-	6	-	-	-	-	139
MO	158	-	-	1	-	11	7	17	19	-	1	1	48	123	-	386
GP	752	719	920	626	741	246	330	523	490	496	171	-	439	711	757	7921
NE	-	28	19	-	-	19	-	76	24	-	-	-	117	138	364	785
SD	-	53	-	19	4	44	44	18	15	42	23	-	-	4	19	285
Ohio Basin																
IL	13	87	177	298	281	256	510	432	400	277	300	499	260	4	8	3802
IN	245	428	315	386	326	105	119	31	33	112	540	-	-	-	-	2640
KY	221	155	183	304	259	753	321	287	2	148	80	134	30	-	86	2963
OH	6	90	103	36	134	-	-	132	7	30	-	62	53	35	-	688
PA	-	-	-	-	-	-	-	-	-	-	-	3	4	-	-	7
TN	105	70	26	16	-	-	-	-	1	-	3	-	-	-	-	221
WV	-	-	6	29	26	-	-	-	-	-	-	-	-	-	-	61
TOTAL	2031	2542	2716	2719	2828	2228	1853	2573	3486	3584	2823	1309	1782	1716	2280	36470

*LA collected 293 individuals, 1990-1994.

Table 3. Number of paddlefish collected, marked with coded wire tag and released as part of the MICRA Paddlefish Stock Assessment Program, 1995-2009. "GP" indicates the jointly managed Gavin's Point Dam Fishery.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	TOTAL
Gulf Basin																
LA	-	177	192	53	39	42	23	53	39	38	14	-	-	-	-	670
OK	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
TX	-	26	1	-	-	-	-	-	-	-	-	-	-	-	-	27
Mississippi Basin																
AR	7	24	-	-	-	-	-	-	-	-	-	-	-	-	-	31
IA	2	188	108	306	153	35	188	442	320	358	238	291	-	-	-	2629
IL	119	315	213	216	471	353	134	142	246	256	86	-	-	-	-	2551
LA	-	-	-	-	-	-	-	1	10	-	-	-	-	-	-	11
MN	5	9	-	-	-	5	-	13	3	-	-	-	-	-	-	35
MO	-	5	25	14	-	-	-	-	-	-	-	-	-	-	-	44
MS	-	17	20	18	41	24	-	-	-	-	-	-	-	-	-	120
OK	-	-	72	-	-	-	-	-	1	-	-	-	-	-	-	73
TN	203	7	-	-	-	-	8	-	-	-	-	-	-	-	-	218
WI	17	69	137	90	65	1	1	1	13	-	-	-	-	-	-	394
Missouri Basin																
IA	11	-	50	51	12	140	-	14	16	-	12	-	-	-	-	306
KS	-	4	-	8	-	45	-	-	-	-	6	-	-	-	-	63
MO	158	-	-	1	-	9	6	6	18	-	-	-	1	-	-	199
GP	682	686	894	611	711	242	324	457	486	483	165	-	-	-	-	5741
NE	23	19	-	-	-	19	-	73	-	24	-	-	-	-	-	158
SD	-	53	-	19	4	44	44	18	14	39	23	-	-	-	-	258
Ohio Basin																
IL	12	85	167	277	271	254	502	179	389	252	287	218	-	-	-	2893
IN	245	428	310	359	318	94	104	27	30	40	459	-	-	-	-	2414
KY	221	145	182	280	242	719	317	242	-	137	77	15	-	-	-	2577
OH	6	89	102	35	129	-	-	117	7	1	-	3	-	-	-	489
PA	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
TN	102	53	21	11	-	-	-	-	-	-	-	-	-	-	-	187
WV	-	-	6	28	20	-	-	-	-	-	-	-	-	-	-	54
TOTAL	1813	2399	2500	2378	2476	2026	1651	1785	1592	1628	1368	527	1	0	0	22144

Table 4. Number of paddlefish collected, marked with a jawtag and released as part of the MICRA Paddlefish Stock Assessment Program, 1995-2009. "GP" indicates the jointly managed Gavin's Point Dam Fishery.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	TOTAL
Gulf Basin																
LA	28	7	23	-	5	14	29	-	7	5	21	49	-	-	-	188*
OK	-	-	-	20	72	29	25	107	121	67	78	53	52	134	78	836
TX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Mississippi Basin																
AR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
IA	-	-	-	-	-	-	-	-	-	-	-	-	129	99	-	228
IL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
LA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0*
MN	-	-	-	-	-	5	-	13	2	-	-	-	-	-	-	20
MO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
MS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
OK	99	18	28	13	42	68	65	57	1571	1457	1023	167	576	390	877	6451
TN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
WI	-	58	133	94	59	1	1	1	13	-	-	-	-	-	-	360
Missouri Basin																
IA	-	-	-	-	-	-	-	-	-	-	-	-	-	15	9	24
KS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
MO	-	-	-	-	-	-	-	-	-	-	-	-	2	94	-	96
GP	8	-	-	-	-	-	-	-	-	-	-	-	431	603	723	1765
NE	-	-	-	-	-	-	-	-	-	-	-	-	116	131	239	486
SD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	17
Ohio Basin																
IL	-	-	-	-	-	10	296	428	380	271	284	465	251	2	8	2395
IN	-	-	-	-	-	-	8	-	30	108	533	-	-	-	-	679
KY	-	-	-	-	99	585	316	285	1	137	77	130	29	-	80	1739
OH	-	-	-	-	-	-	-	132	7	30	-	60	44	34	-	307
PA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
TN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
WV	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	5
TOTAL	135	83	184	127	282	712	740	1023	2132	2075	2016	924	1630	1502	2031	15596

*LA jawtagged 283 individuals prior to 1995

Table 5. Hatchery releases of coded wire tagged paddlefish, 1988-2009.

	Pre-1995	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009*	TOTAL
Gulf Basin																	
LA	-	351	2,265	8,605	4,186	47,976	17,789	10,060	43,084	6,613	23,954	-	3,837	-	-	-	168,720
OK	-	-	-	-	-	5,757	21,216	770	16,792	4,421	28,237	29,378	10,920	2,029	-	-	119,520
TX	348,772	107,463	69,912	97,453	88,163	34,735	24,637	-	-	-	-	-	-	-	-	-	771,135
Mississippi Basin																	
AR	-	-	707	-	16,681	-	-	-	-	-	-	-	-	-	-	4,989	22,377
KS	16,930	928	-	-	-	-	-	-	-	-	1,857	5,970	8,074	-	3,000	-	36,759
LA	-	-	-	-	-	5,630	-	1,778	-	-	-	4,326	6,412	-	-	-	18,146
MO	-	5,027	2,016	-	10,710	3,509	3,631	14,973	-	5,964	-	1,866	-	10,449	1,000	-	59,145
OK	5,840	7,987	112	10,282	2,037	8,837	3,216	-	-	-	-	-	-	1,028	6,296	-	45,635
TN	-	-	-	5,388	-	-	-	-	-	-	-	-	-	-	-	-	5,388
Missouri Basin																	
KS	-	5,557	-	-	-	-	100	-	-	-	-	-	-	-	-	-	5,657
MO	39,181	21,984	17,307	5,644	37,039	40,580	18,086	130,561	-	29,990	-	2,725	-	54,523	233,631	-	631,251
ND	-	9,093	-	9,944	-	-	-	-	-	-	-	-	-	-	-	-	19,037
SD	188,161	28,934	12,436	13,821	13,271	24,256	2,510	-	-	21,089	2,077	62,895	49,554	-	-	-	419,004
Ohio Basin																	
KY	-	-	-	-	-	-	-	800	-	1,000	-	-	-	-	-	-	1,800
NY	-	-	-	-	46	535	132	1,878	762	778	803	1,433	367	177	-	-	6,911
PA	-	8,806	6,577	13,208	-	760	10,830	8,297	5,688	1,604	6,326	11,533	-	-	2,712	-	76,341
TN	-	5,816	-	2	-	-	-	-	-	-	-	-	450	-	1,326	-	7,594
WV	-	1	1,977	1,410	1,522	2	125	200	4,386	7,943	7,353	-	2,003	140	-	-	27,062
TOTAL	598,884	201,947	113,309	165,757	173,655	172,577	102,272	169,317	70,712	79,402	70,607	120,126	81,617	68,346	247,965	4,989	2,441,482

*All 2009 data may not yet be submitted..

Table 6. Recaptures of coded wire tagged paddlefish by MICRA partners during biological sampling, 1995-2009. "GP" indicates the jointly managed Gavin's Point Dam Fishery.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	TOTAL
Gulf Basin																
LA	-	-	3	-	3	1	1	3	1	1	1	4	-	-	-	18
OK	-	-	-	-	-	-	-	11	12	30	47	30	15	116	71	332
TX	-	4	1	-	-	-	-	-	-	-	-	-	-	-	-	5*
Mississippi Basin																
AR	-	-	-	-	-	-	-	-	-	-	18	-	-	-	-	18
IA	-	3	4	13	20	-	17	8	4	8	21	20	18	7	-	143
IL	-	2	-	-	8	13	7	2	9	6	6	-	1	-	-	54
MO	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
MS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
OK	4	5	13	6	24	18	44	49	11	11	2	4	18	3	7	219
Missouri Basin																
IA	-	-	-	1	-	13	-	-	1	-	-	-	-	1	-	16
KS	-	3	-	-	-	10	-	1	-	-	-	-	-	-	-	14
MO	-	-	-	1	-	1	-	-	-	-	1	-	-	4	-	7
GP	3	59	44	100	36	25	33	9	29	46	19	-	7	35	9	454
NE	-	-	-	-	2	-	-	-	2	-	-	-	-	72	131	207
SD	-	-	-	5	2	11	27	-	-	22	1	-	-	4	15	87
Ohio Basin																
IL	-	1	1	11	13	13	8	9	6	3	8	10	2	1	1	87
IN	1	6	11	21	36	4	4	-	2	3	7	3	-	-	-	98
KY	-	-	-	-	2	5	4	-	-	-	1	3	-	-	-	15
OH	-	2	15	2	12	-	-	12	-	-	-	5	3	1	-	52
PA	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
TN	-	2	2	2	-	-	-	-	1	-	3	-	-	-	-	10
WV	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	3
TOTAL	8	87	95	163	159	114	145	104	78	130	136	79	65	244	234	1841

*Two coded wire tag recaptures occurred in LA, Gulf Basin in 1994.

Table 7. Recaptures of coded wire tagged paddlefish by sport and commercial anglers, 1995-2009. “GP” indicates the jointly managed Gavin’s Point Dam Fishery.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	TOTAL
Mississippi Basin																
IA	-	-	2	-	-	-	-	-	-	-	4	-	-	-	-	6
IL	1	5	4	2	26	3	13	1	6	13	-	-	1	-	-	75
MO	-	3	3	3	2	0	6	18	50	52	65	93	1	-	-	296
Missouri Basin																
MO	-	-	1	-	2	1	4	23	-	25	61	38	9	16	28	208
GP	173	166	105	101	157	84	63	49	62	83	114	150	67	142	115	1631
ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Ohio Basin																
IN	-	5	18	5	4	21	8	17	2	3	15	3	-	-	-	101
KY	-	-	6	6	15	13	3	29	14	5	28	7	-	-	-	126
OH	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	6
TN	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-	5
TOTAL	177	179	139	117	206	122	103	137	134	181	287	291	78	160	144	2455

Table 8. Recaptures of jawtagged paddlefish by MICRA partners during biological sampling, 1995-2009. “GP” indicates the jointly managed Gavin’s Point Dam Fishery.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	TOTAL
Gulf Basin																
LA	2	2	-	1	1	-	1	1	-	-	-	-	-	-	-	8*
OK	-	-	-	-	3	-	-	6	12	16	12	2	1	11	9	72
Mississippi Basin																
IA	-	-	-	-	2	1	-	1	-	-	-	1	3	3	-	11
LA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0*
MN	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	3
OK	-	-	-	-	2	2	1	1	22	34	8	6	10	2	4	92
WI	-	18	29	51	14	-	-	-	-	-	5	-	-	-	-	117
Missouri Basin																
IA	-	-	-	-	-	1	-	-	-	-	-	-	-	1	3	5
MO	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
GP	3	7	6	5	3	-	1	-	-	2	-	-	5	14	25	71
NE	-	3	-	-	-	-	-	-	-	-	-	-	1	6	38	48
SD	-	1	-	4	-	2	-	-	-	1	-	-	-	-	-	8
Ohio Basin																
IL	-	-	-	-	-	1	4	4	7	6	15	33	9	2	-	81
IN	-	-	-	-	-	1	-	-	1	4	6	-	-	-	-	12
KY	-	-	-	-	-	11	5	2	1	3	3	4	1	-	2	32
OH	-	-	-	-	1	-	-	-	-	-	-	2	9	1	-	13
TOTAL	5	31	35	61	26	19	12	17	44	66	49	48	39	41	81	574

*LA captured an additional 8 jawtagged paddlefish in the Gulf Basin and 2 jawtagged paddlefish in the Mississippi Basin, prior to 1995.

Table 9. Recaptures of jawtagged paddlefish by sport and commercial harvest, 1999-2009. "GP" indicates the jointly managed Gavin's Point Dam Fishery.

	Unknown	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	TOTAL
Mississippi Basin													
KY*	-	-	2	-	5	4	5	6	5	6	1	-	34
Missouri Basin													
KY*	-	-	-	-	-	1	1	1	-	-	1	-	4
GP	-	1	-	-	-	-	1	-	-	-	-	-	2
Ohio Basin													
KY*	-	-	42	31	73	62	41	57	23	16	11	3	359
Unknown Basin													
KY*	5	-	2	3	18	15	5	1	-	1	-	-	50
TOTAL	5	1	46	34	96	82	53	65	28	23	13	3	449

*All but two jawtags (GP) were reported through angler phone-in to Kentucky.

Table 10. Movements of coded wire tagged paddlefish from one basin to another.

Release Basin	Release River	Release Pool/Site	Release Year	Recapture Basin	Recapture River	Recapture Pool/Site	Recapture Year
Wild Caught Paddlefish							
Mississippi	Black		1997	Ohio	Ohio	Smithland Tailwater	2003
Mississippi	Mississippi	L & D 12 - Bellevue	1999	Missouri	Missouri	Gavin's Point Dam Tailwater	2004
Mississippi	Mississippi	26 - Golden Eagle Ferry	1998	Missouri	Missouri		2004
Mississippi	Mississippi	26 - Golden Eagle Ferry	1998	Missouri	Missouri	Gavin's Point Dam Tailwater	2000
Mississippi	Mississippi	26 - Golden Eagle Ferry	2000	Missouri	Missouri	Gavin's Point Dam Tailwater	2002
Mississippi	Mississippi	26 - Golden Eagle Ferry	2001	Ohio	Ohio	Smithland Tailwater	2003
Mississippi	Mississippi	26 - Trail Dike	2002	Missouri	Missouri	Gavin's Point Dam Tailwater	2006
Mississippi	Mississippi	27 - Melvin Price Dam	2000	Missouri	Missouri	Gavin's Point Dam Tailwater	2005
Mississippi	Mississippi	27 - Melvin Price Dam	2004	Ohio	Ohio	Smithland Tailwater	2005
Mississippi	Mississippi	Lake Whittington	1999	Ohio	Ohio		2002
Missouri	Missouri	Below Gavin's Point Dam	1995	Mississippi	Kaskaskia	Kaskaskia Lock & Dam Tailwater	1999
Missouri	Missouri	Below Gavin's Point Dam	1995	Mississippi	Kaskaskia	Kaskaskia Lock & Dam Tailwater	1996
Missouri	Missouri	Below Gavin's Point Dam	1995	Mississippi	Kaskaskia	Kaskaskia Lock & Dam Tailwater	1998
Missouri	Missouri	Below Gavin's Point Dam	1995	Mississippi	Mississippi		1996
Missouri	Missouri	Below Gavin's Point Dam	1997	Mississippi	Mississippi		2000
Missouri	Missouri	Below Gavin's Point Dam	1997	Mississippi	Mississippi	Chain Of Rocks	2003
Missouri	Missouri	Below Gavin's Point Dam	1998	Ohio	Ohio	Smithland Tailwater	2006
Missouri	Missouri	Below Gavin's Point Dam	2003	Mississippi	Mississippi	Golden Eagle Ferry	2004
Missouri	Osage	Bagnell Dam	1995	Mississippi	Kaskaskia	Kaskaskia Lock & Dam Tailwater	1997
Missouri	Osage	Bagnell Dam	1995	Mississippi	Kaskaskia	Tailwater	1999
Missouri	Osage	Bagnell Dam	1995	Mississippi	Kaskaskia	Kaskaskia Lock & Dam Tailwater	1998
Missouri	Osage	Bagnell Dam	1995	Mississippi	Mississippi		2000
Ohio	Ohio	Cannelton - Mcalpine Dam	1997	Missouri	Missouri	Gavin's Point Dam Tailwater	
Ohio	Ohio	JT Myers - Hovey Lake	1998	Missouri	Missouri	Gavin's Point Dam Tailwater	2006
Ohio	Ohio	Smithland - JT Myers Dam	2002	Missouri	Missouri	Gavin's Point Dam Tailwater	2005
Hatchery Raised Paddlefish							
Missouri	Osage	Truman Lake	1994	Ohio	Ohio	Smithland Tailwater	2006

Table 11. Frequency and movements of wild caught and coded wire tagged paddlefish within the basin they were released.

# of Events	Release River	Release Pool/Site	Recapture River	Recapture Pool/Site
		Gulf Basin		
6	Mermentau	1 - Old River Loop	Bayou Nezpique	North Of I-10
4	Mermentau	1 - Old River Loop	Mermentau	1 - Old River Loop
2	Bayou Nezpique	North Of I-10	Mermentau	1 - Old River Loop
1	Bayou Nezpique	North Of I-10	Bayou Nezpique	North Of I-10
1	Neches	6	Neches	#5
		Mississippi Basin		
96	Mississippi	L & D 12 - Bellevue	Mississippi	L & D 12 - Bellevue
76	Mississippi	Pool 26	Mississippi	Pool 26
13	Mississippi	Lock And Dam 13	Mississippi	Lock And Dam 13
10	Mississippi	27 - Melvin Price Dam	Mississippi	L & D 12 - Bellevue
9	Illinois	Alton - Swan Lake	Mississippi	Pool 26
9	Mississippi	Lock And Dam 13	Mississippi	14
6	Mississippi	27 - Melvin Price Dam	Mississippi	Pool 26
5	Des Moines	Red Rock Reservoir Dam	Des Moines	Red Rock Dam
5	Mississippi	Lock And Dam 13	Mississippi	L & D 12 - Bellevue
4	Mississippi	14	Mississippi	14
3	Illinois	Alton - Swan Lake	Illinois	Alton
2	Black	8	Mississippi	L & D 12 - Bellevue
2	Illinois	Alton - Swan Lake	Mississippi	
2	Illinois	Alton - Swan Lake	Mississippi	Melvin Price Tailwaters
2	Mississippi	L & D 12 - Bellevue	Mississippi	14
2	Mississippi	Pool 26		
2	Mississippi	Pool 26	Mississippi	Melvin Price Tailwaters
2	Mississippi	27 - Melvin Price Dam	Kaskaskia	Kaskaskia Lock & Dam Tailwaters
2	Black	Below Clearwater Lake	Black	Lower Black River
1	Cedar	Palisades Kepler	Cedar	Palisades Kepler
1	Illinois	Alton - Swan Lake	Mississippi	Pool 26
1	Illinois	Alton - Swan Lake	Mississippi	Pool 26
1	Illinois	Alton - Swan Lake	Mississippi	L & D 12 - Bellevue
1	Illinois	Alton - Swan Lake	Mississippi	Walker Dike
1	Mississippi	L & D 12 - Bellevue	Mississippi	Lock And Dam 13
1	Mississippi	Lyon's Bridge	Mississippi	14
1	Mississippi	Pool 26	Illinois	Alton
1	Mississippi	Pool 26	Mississippi	Below Perry Island
1	Mississippi	Pool 26	Mississippi	Chain Of Rocks
1	Mississippi	Pool 26	Mississippi	Mason Island
1	Mississippi	Pool 26	Illinois	Market Park
1	Mississippi	27 - Melvin Price Dam	Illinois	Alton Pool
1	Mississippi	27 - Melvin Price Dam	Mississippi	
1	Mississippi	5a - McNally	Mississippi	14

1	Running Reelfoot	-	Kaskaskia	Confluence
		Missouri Basin		
858	Missouri	Below Gavin’s Point Dam -	Missouri	Gavin’s Point Dam Tailwater
7	Big Sioux	I-29 Bridge/Mouth Of Missouri River	Missouri	Gavin’s Point Dam Tailwater
5	Missouri	Below Gavin’s Point Dam -	Big Sioux	I-29 Bridge/Mouth Of Missouri River
3	Missouri	Lake Francis Case - White River Mouth	Missouri	Lake Francis Case
2	Missouri	Niobrara Confluence	Missouri	Gavin’s Point Dam Tailwater
1	Big Sioux	I-29 Bridge/Mouth Of Missouri River	Big Sioux	I-29 Bridge/Mouth Of Missouri River
1	James	- James River Chute	Missouri	Gavin’s Point Dam Tailwater
1	Missouri	- Fort Randall Dam	Missouri	Ft Randall Tailwater
1	Missouri	Below Gavin’s Point Dam -	Missouri	Fort Leavenworth
1	Missouri	Below Gavin’s Point Dam -	Missouri	Green Diamond
1	Missouri	Below Gavin’s Point Dam -	Missouri	Hermann
1	Missouri	Below Gavin’s Point Dam -	Missouri	River Mile 713-720
1	Missouri	Below Gavin’s Point Dam -	Osage	Bagnell Dam
1	Missouri	Lake Francis Case - White River Mouth	White	
		Ohio Basin		
67	Ohio	JT Myers - Hovey Lake	Ohio	Hovey Lake
57	Wabash	New Harmony Bridge	Wabash	New Harmony Bridge
33	Ohio	JT Myers - Hovey Lake	Ohio	Cannelton Dam Tailwaters
23	Ohio	Smithland - JT Myers Dam	Ohio	Smithland Tailwater
21	Great Miami	Markland - Great Miami River Mouth	Great Miami	Markland Pool
20	Ohio	Markland - Horseshoe Lake	Ohio	Horseshoe Lake
18	Great Miami	Markland - Great Miami River Mouth	Ohio	Horseshoe Lake
16	Ohio	Newburgh - Indian Creek Confluence	Ohio	Cannelton Dam Tailwaters
15	Ohio	Cannelton - McAlpine Dam	Ohio	Cannelton Dam Tailwaters
13	Ohio	Smithland - JT Myers Dam	Ohio	Cannelton Dam Tailwaters
11	Ohio	Smithland - JT Myers Dam	Ohio	JT Meyers Dam
9	Ohio	JT Myers - Hovey Lake	Ohio	JT Meyers Dam
9	Ohio	JT Myers - Hovey Lake	Ohio	Newburgh Dam Tailwater
8	Wabash	New Harmony Bridge	Ohio	Smithland Tailwater
6	Ohio	JT Myers - Hovey Lake	Ohio	Smithland Tailwater
6	Ohio	Smithland - JT Myers Dam	Ohio	
5	Ohio	Smithland - JT Myers Dam	Ohio	Hovey Lake
5	Wabash	Harmony Dam Island	Ohio	Smithland Tailwater
4	Ohio	JT Myers - Hovey Lake	Ohio	
4	Ohio	JT Myers - Hovey Lake	Ohio	All Over Ohio River
4	Ohio	Smithland - JT Myers Dam	Ohio	McAlpine Lock & Dam Tailwaters

3	Cumberland	Barkley - South Cross Creek	Cumberland	South Cross Creek
3	Ohio	Cannelton - McAlpine Dam	Ohio	Hovey Lake
3	Ohio	JT Myers - Hovey Lake	Wabash	New Harmony Dam
3	Ohio	Markland - Horseshoe Lake	Ohio	Markland Pool
3	Ohio	Smithland - JT Myers Dam		
3	Wabash	Pitcher Lake Drainage	Wabash	Pitcher Lake Drainage
2	Cumberland	Cordell Hull Dam	Cumberland	Cordell Hull Dam
2	Cumberland	Cordell Hull Dam	Cumberland	Old Hickory Reservoir
2	Ohio	52 - Smithland Dam	Ohio	Smithland Tailwater
2	Ohio	Cannelton - McAlpine Dam	Ohio	
2	Ohio	Cannelton - McAlpine Dam	Ohio	JT Meyers Dam
2	Ohio	Cannelton - McAlpine Dam	Ohio	Meldahl Dam Tailwaters
2	Ohio	Cannelton - McAlpine Dam	Ohio	New Albany
2	Ohio	JT Myers - Hovey Lake	Ohio	McAlpine Lock & Dam Tailwaters
2	Ohio	JT Myers - Newburgh Dam Tailwater	Ohio	Cannelton Dam Tailwaters
2	Ohio	JT Myers - Newburgh Dam Tailwater	Ohio	McAlpine Lock & Dam Tailwaters
2	Ohio	Markland - Meldahl Dam	Ohio	
2	Ohio	Markland - Meldahl Dam	Ohio	New Albany
2	Ohio	McAlpine - Markland Dam	Ohio	Markland Pool
2	Ohio	Meldahl - Greenup Dam	Ohio	Meldahl Dam Tailwaters
2	Ohio	Newburgh - Indian Creek Confluence	Ohio	McAlpine Lock & Dam Tailwaters
2	Ohio	Smithland - JT Myers Dam	Ohio	Alton
2	Ohio	Smithland - JT Myers Dam	Ohio	Newburgh Dam Tailwater
2	Ohio	Smithland - JT Myers Dam	Wabash	New Harmony Dam
2	Tennessee	Haddox Ferry	Ohio	Smithland Tailwater
2	Wabash	Harmony Dam Island	Wabash	New Harmony Bridge
1	Allegheny	2		
1	Cumberland	Barkley - South Cross Creek	Ohio	Smithland Tailwater
1	Cumberland	Barkley Dam		
1	Cumberland	Ferguson Creek	Cumberland	Ferguson Creek
1	Cumberland	Ferguson Creek	Ohio	Smithland Tailwater
1	Cumberland	Old Hickory Dam	Cumberland	Old Hickory Reservoir
1	Great Miami	Markland - Great Miami River Mouth	Ohio	Hovey Lake
1	Great Miami	Markland - Great Miami River Mouth	Ohio	McAlpine Lock & Dam Tailwaters
1	Ohio	Cannelton - McAlpine Dam	Ohio	Kentucky Lake
1	Ohio	Cannelton - McAlpine Dam	Ohio	Newburgh Dam Tailwater
1	Ohio	Dashields	Ohio	Section 3
1	Ohio	Greenup - Byrd Dam	Ohio	Markland Pool
1	Ohio	Greenup - Byrd Dam	Ohio	New Albany
1	Ohio	JT Myers - Hovey Lake	Ohio	Horseshoe Lake
1	Ohio	JT Myers - Hovey Lake	Ohio	Indian Creek Confluence

1	Ohio	JT Myers - Hovey Lake	Ohio	New Albany
1	Ohio	Markland - Cincinnati Area	Ohio	Markland Pool
1	Ohio	Markland - Great Miami River Mouth	Ohio	Newburgh Dam Tailwater
1	Ohio	Markland - Horseshoe Lake	Ohio	Meldahl Dam Tailwaters
1	Ohio	Markland - Horseshoe Lake	Ohio	Newburgh Dam Tailwater
1	Ohio	Markland - Meldahl Dam	Ohio	Meldahl Dam Tailwaters
1	Ohio	McAlpine - Markland Dam	Ohio	Cannelton Dam Tailwaters
1	Ohio	McAlpine - Markland Dam	Ohio	Newburgh Dam Tailwater
1	Ohio	Meldahl - Greenup Dam	Ohio	Cannelton Dam Tailwaters
1	Ohio	Meldahl - Greenup Dam	Ohio	Markland Pool
1	Ohio	Newburgh - Indian Creek Confluence	Ohio	All Over Ohio River
1	Ohio	Newburgh - Indian Creek Confluence	Ohio	Indian Creek Confluence
1	Ohio	Newburgh - Indian Creek Confluence	Ohio	JT Meyers Dam
1	Ohio	Smithland - JT Myers Dam	Ohio	All Over Ohio River
1	Ohio	Smithland - JT Myers Dam	Ohio	Meldahl Dam Tailwaters
1	South Cross Creek		Cumberland	South Cross Creek
1	Wabash	Harmony Dam Island	Ohio	Cannelton Dam Tailwaters
1	Wabash	Harmony Dam Island	Ohio	JT Meyers Dam
1	Wabash	Harmony Dam Island	Wabash	Harmony Dam Island
1	Wabash	Mt Vernon Bridge	Tennessee	Kentucky Lake
1	Wabash	New Harmony Bridge	Ohio	Newburgh Dam Tailwater
1	Wabash	New Harmony Bridge	Wabash	
1	Wabash	New Harmony Bridge	Wabash	Church Hill Island
1	Wabash	Pitcher Lake Drainage	Wabash	New Harmony Bridge

Table 12. Frequency and movements of hatchery released, coded wire tagged, paddlefish within the basin they were released.

# of Events	Release River	Release Pool/Site	Recapture River	Recapture Pool/Site
		Gulf Basin		
273	Red	Lake Texoma	Red	Lake Texoma
54	Red	Lake Texoma	Washita	Lake Texoma
4	Mermentau	Lake Arthur	Bayou Nezpique	North I-10
2	Mermentau	Lake Arthur	Mermentau	Lake Arthur
2	Sabine		Sabine	Toledo Bend Reservoir
1	Angelina		Angelina	Sam Rayburn Reservoir
1	Mermentau	Lake Arthur	Bayou Nezpique	North I-11
1	Neches		Neches	#6 And #7
1	Trinity		Trinity	
		Mississippi Basin		
277	White	Table Rock Lake	White	Table Rock Lake
180	Verdigris	Oolagah	Verdigris	Oolagah
32	Arkansas	Kaw Lake	Arkansas	Kaw Lake
17	White	Beaver Lake	White	Beaver Lake
2	Black		Black	Lower Black River
2	Verdigris	Oolagah	Graines Creek	Eufaula
1	Arkansas	Kaw Lake	Verdigris	Oolagah
1	Arkansas	Kaw Lake	Walnut	Udall
1	Verdigris	Oolagah	Arkansas	Kaw Lake
1	Verdigris	Oolagah	South Canadian	Eufaula
		Missouri Basin		
598	Missouri	Lewis and Clark Lake	Missouri	Gavin's Point Dam Tailwater
291	Missouri	Lake Francis Case	Missouri	Gavin's Point Dam Tailwater
189	Missouri	Lake Francis Case	Missouri	Fort Randall Dam Tailwater
163	Blue	Turtle Creek Reservoir	Missouri	Gavin's Point Dam Tailwater
109	Missouri	Lake Francis Case	Missouri	Lake Francis Case
99	Osage	Truman Lake	Osage	Truman Lake
75	Missouri	Lake Francis Case	White	
31	Missouri	Lake Francis Case	Missouri	Big Bend Tailwaters
30	Missouri	Lake Francis Case	Missouri	
24	Missouri	Lewis And Clark Lake	Missouri	
23	Osage	Lake Of The Ozarks	Osage	Bagnell Dam
18	Osage	Lake Of The Ozarks	Osage	Lake Of The Ozarks
17	Osage	Truman Lake	Osage	Lake Of The Ozarks
6	Blue	Turtle Creek Reservoir		
6	Blue	Turtle Creek Reservoir	Big Sioux	I-29 Bridge/Mouth Of Missouri River
6	Blue	Turtle Creek Reservoir	Missouri	
6	Blue	Turtle Creek Reservoir	Republican	Milford Dam Spillway
6	Osage	Truman Lake	Osage	Bagnell Dam
5	Missouri	Lewis And Clark Lake	Missouri	Fort Randall Dam Tailwater
4	Osage	Truman Lake	Missouri	Gavin's Point Dam Tailwater

3	Missouri	Lake Francis Case	Missouri	Green Diamond
3	Osage	Lake Of The Ozarks	Missouri	Gavin’s Point Dam Tailwater
2	Blue	Turtle Creek Reservoir	Blue	Turtle Creek Reservoir
1	Blue	Turtle Creek Reservoir	Missouri	Middle Decatur
1	Missouri	Lake Francis Case	Republican	Milford Dam Spillway
1	Missouri	Lewis And Clark Lake		Bunyon's Bar
1	Osage	Lake Of The Ozarks	Osage	Bonnot's Mill
1	Osage	Truman Lake	Osage	Bonnot’s Mill
1	White		Missouri	Gavin’s Point Dam Tailwater
		Ohio Basin		
5	Holston	Cherokee Reservoir	Holston	Cherokee Reservoir
4	Allegheny	Kinzua	Allegheny	Kinzua
1	Allegheny	Kinzua		Dam Tailwater
1	Allegheny	Kinzua		East Side Near State Line
1	Allegheny	Kinzua	Allegheny	Section 17
1	Allegheny	Kinzua	Allegheny	Templeton
1	Allegheny	Kinzua	Allegheny	Webb’s Ferry
1	Cumberland	Old Hickory Reservoir	Ohio	Smithland Tailwater
1	Kentucky	Pool 3	Ohio	Cannelton
1	Mononaghela	Opiesha	Monongahela	Section 5
1	Ohio	Belleville	Ohio	Belleview
1	Ohio	Belleville	Ohio	Greenup
1	Ohio	Belleville	Ohio	Meldahl
1	Ohio	Gallapolis, Greenup	Ohio	Racine Lock
1	Ohio	Hannibal	Ohio	Hannibal
1	Ohio	Pool 1	Monongahela	Section 4
1	Ohio	Pool 2	Allegheny	Section 21
1	Ohio	Racine	Little Hocking	
1	Allegheny		Ohio	McAlpine Tailwater
1	Ohio	Racine	Ohio	Racine Lock