PADDLEFISH *(POLYODON SPATHULA)* SURVEY RESULTS IN THE MISSISSIPPI RIVER FROM ST. PAUL TO RED WING

Paddlefish gillnetted in Mississippi River below US Lock and Dam 3 in May of 2000

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Abstract: In 2000 and 2002, paddlefish surveys were conducted in the tailwaters of US Lock and Dams (L&D) 1-3. At L&D 3, the cumulative catch consisted of 6-paddlefish *(Polyodon spathula),* 4-lake sturgeon *(Acipenser fulvescens)*, 11-shovelnose sturgeon *(Scaphirhynchus platorynchus),* 2-flathead catfish *(Pylodictis olivaris),* 1-white bass *(Morone chrysops)*, 1-walleye *(Sander vitreus)* and 1-common carp *(Cyprinus carpio)*. At L&D 2, the catch included 1-shovelnose sturgeon and 2-flathead catfish.

Introduction

The paddlefish is a threatened species in both Minnesota and Wisconsin where it reaches the northern periphery of its range in the Mississippi River drainage. Anecdotal accounts report paddlefish were once abundant in the Mississippi River from Lake Pepin southward. However, impacts from water pollution, commercial navigation projects (i.e., channel constriction, dredging, and lock and dams) and over fishing caused a dramatic and long-term decline, which persisted late into the twentieth century.

Beginning in the mid 1970s, commercial operators that used seines 1000-2000 feet in length and 25-40 feet deep, began reporting an increasing frequency of paddlefish in their incidental catches. This trend has continued at least through the mid 1990s. Anglers have also reported the incidental snagging of paddlefish in the Mississippi River from St. Paul to La Crosse and in the Minnesota River upstream to Mankato. In contrast, fish biologists, who utilize standardized sampling gears (i.e., experimental gill nets, trap nets, and electrofishing) in fish surveys, rarely encounter paddlefish (Schmidt 1995).

Following the success Ann Runstrom, US Fish and Wildlife Service (USFWS) – La Crosse Fisheries Resources Office, had in sampling paddlefish with large mesh gillnets in the Mississippi and lower Wisconsin and Chippewa Rivers, very limited surveys were attempted in the Minnesota and lower St. Croix rivers. These efforts produced a new record from the Minnesota River for black buffalo *(Ictiobus niger)*, which is a special concern species, but no paddlefish were sampled using Runstrom's gear and methods.

In May 2000, with the collaboration of the US Fish and Wildlife Service and funding through a MDNR Research Conservation Grant, surveys began for paddlefish in the tailwaters of L&D 1-3 on the Mississippi River near St. Paul, Hastings and Red Wing, respectively.

Methods and Materials

Gillnets were used in the scour holes below the dam portion of the lock and dams. The gillnet lead line was anchored on each end with railroad irons and buoys were tied to the riverside of the float line. The bank side of the gill net was either tied to exposed tree roots or the anchor was tightly wedged into riprap. While the boat was reversed perpendicular to shore, two people would deploy a folded gillnet from a tub on the bow's deck. At the end of the gillnet, two anchors were tied to the lead line and a buoy with a long rope to the float line. Before releasing the buoy, the boat operator lined up the two ends of the net allowing the current to form a substantial "bag" in the middle. While maintaining tension on the net, a second buoy and rope was tied in tandem to the first to assure that there was sufficient rope to reach the surface. Where there was available habitat, an additional gillnet was set either from the opposite bank or downstream. To prevent mortality, gillnets were set no longer than 90 minutes and only during cooler water periods which generally excludes all sampling from June through August.

The USFWS gillnets were 300 feet long and 24 feet deep with a 5 inch mesh (10 inch stretch). MDNR gillnets purchased for this study were 150 feet long and 15 feet deep with the same mesh size as the USFWS gillnets. There was also one haul with a commercial seine (1000 feet long and 30 feet deep with a 5 inch mesh) in the St. Croix River at Prescott, WI (Figure 1).

Finally, limited snagging was attempted below L&D 2 and 3 in 2002 following the same methods the Iowa DNR (IDNR) uses at the Bellevue Research Station. Tackle consisted of heavy action rods with roller tip guides and bait casting reels with 30-pound test monofilament line (Figure 2). Three 5/0 treble hooks were tied approximately 8 feet apart, and depending on the current, either a 4 or 8-ounce sinker, was tied to the end of the line. A fish sonar set on manual

Figure 1. Seine haul in St. Croix River near Prescott, WI.

Figure 2. Snagging in Mississippi River near Bellevue, IA.

mode was used to locate paddlefish which appear as large arches on the graph suspended a short distance off the bottom. Up to three snaggers dropped their lines to the bottom and reeled in slack with the tip of the pole just above the water's surface. The pole was then yanked upward extending both arms above shoulders and then lowering the tip to the surface and repeating the cycle. The boat operator used the sonar to hold position over paddlefish. When a fish was snagged, the pole and reel was used to exert constant, steady pressure to prevent any slack in the line. Meanwhile the other snaggers reeled in lines to avoid tangling.

Fish processing included recording the eye fork length (EFL) in mm of paddlefish (eye to center of fork in tail) using a sewing tape, weight in kg using either a body sling or stretcher, propeller strike injuries; and the number of attached lampreys, fresh disc wounds and healed scars (Figure 3). The tip of the rostrum was checked with an electronic hand probe for a magnetically coded tag. When no tag was detected, one was injected using a dispensing gun (Figure 4). The paddlefish sampled with the USFWS were also jaw tagged (Figure 5) which would identify recaptures without the need to remove the rostrum tag. Clipped anal fins (Figure 6) identified IDNR recaptures and the hand probe was used to locate and surgically remove old rostrum tags to later determine codes. However, a new tag was injected before release. Processed paddlefish were held in the water by the caudal peduncle and gently rocked back and forth to circulate water through gills and released at their first attempt to escape.

Total length (TL) in mm (tip of snout to tip of depressed caudal fin) was recorded on incidental species, but the USFWS restricted tagging to lake sturgeon, shovelnose sturgeon and flathead catfish.

Figure 3. Silver lamprey *(Ichthyomyzon unicuspis)* disc wound.

Figure 4. Injecting magnetic tag into rostrum.

Figure 5. USFWS jaw tag.

Figure 6. IDNR anal fin clip.

Results

Due to budget cuts, USFWS support (i.e., personnel, boats and gillnets) was available only during the 2000 field season. These essential components were replaced in time for the 2002 field season with assistance of MDNR personnel, boat and vehicle loans from other programs and gillnets purchased with grant funds.

Figure 7. Paddlefish gillnetted below L&D 3 in May of 2000.

In the study area, paddlefish (Figure 7) and lake sturgeon were sampled only below L&D 3 in May 2000 using USFWS gillnets (300 feet long and 24 feet deep). The EFL of 6 paddlefish ranged from 810-1135 mm and the TL of the 4 lake sturgeon ranged from 1125-1430 mm. Shovelnose sturgeon and flathead catfish were sampled with both USFWS and MDNR gillnets at L&D 2 & 3 in 2000 and 2002. TL ranges were 302-904 and 710-990 mm, respectively (Table 1).

One gillnet set at the Ford Dam (L&D 1) did not sample any fish. One large fish was snagged below L&D 2 but could not be identified before escape. No fish were sampled with the commercial seine in the St. Croix River.

Fin clips were preserved in 95% ethyl alcohol from shovelnose sturgeon and flathead catfish and deposited in the James Ford Bell Museum of Natural History tissue collection where the samples will be available for genetic research.

Table 1. Fish species gillnetted below Lock and Dams 2 and 3.

SPECIES	SITE	DATE	TOTAL LENGTH	FORK LENGTH	TAG NUMBER	TISSUE SAMPLE
paddlefish	US Lock and Dam 3	5/4/2000		810	802	no
paddlefish	US Lock and Dam 3	5/23/2000		1135	803	no
paddlefish	US Lock and Dam 3	5/23/2000		1055	804	no
paddlefish	US Lock and Dam 3	5/23/2000		910	805	no
paddlefish	US Lock and Dam 3	5/26/2000		925	806	no
paddlefish	US Lock and Dam 3	5/26/2000		990	807	no
lake sturgeon	US Lock and Dam 3	5/4/2000	1245		5084	no
lake sturgeon	US Lock and Dam 3	5/23/2000	1255		5086	no
lake sturgeon	US Lock and Dam 3	5/23/2000	1125		5126	no
lake sturgeon	US Lock and Dam 3	5/26/2000	1430		5096	no
shovelnose sturgeon	US Lock and Dam 3	5/4/2000	660		99	no
shovelnose sturgeon	US Lock and Dam 3	5/23/2000	805		N/A	no
shovelnose sturgeon	US Lock and Dam 3	5/23/2000	805		N/A	no
shovelnose sturgeon	US Lock and Dam 3	5/23/2000	795		N/A	no
shovelnose sturgeon	US Lock and Dam 3	5/23/2000	894		N/A	no
shovelnose sturgeon	US Lock and Dam 3	5/23/2000	761		N/A	no
shovelnose sturgeon	US Lock and Dam 3	5/26/2000	761		451	no
shovelnose sturgeon	US Lock and Dam 3	5/26/2000	801		453	no
shovelnose sturgeon	US Lock and Dam 3	5/26/2000	787		454	no
shovelnose sturgeon	US Lock and Dam 3	5/3/2002	904		N/A	yes
shovelnose sturgeon	US Lock and Dam 2	5/20/2002	302		N/A	yes
shovelnose sturgeon	US Lock and Dam 3	5/24/2002	750		N/A	yes
flathead catfish	US Lock and Dam 3	5/26/2000	710		5125	no
flathead catfish	US Lock and Dam 3	5/26/2000	990		5131	no
flathead catfish	US Lock and Dam 2	5/20/2002	795		N/A	yes
flathead catfish	US Lock and Dam 2	5/20/2002	912		N/A	yes

Discussion

History of Study Area: The Mississippi River today is far different than the natural, free flowing river that remained largely intact through the Civil War. During summer low flows there was no continuous channel and the depth of the river from St. Paul to the mouth of the Chippewa River (ca 150 miles) averaged 16-18 inches. A myriad of side channels provided connectivity to backwater lakes and sloughs (Anfinson 2003).

Commercial navigation projects radically changed the Mississippi River during the late 1800s when thousands of wing dams were constructed to narrow and deepen the main channel and closing dams isolated backwaters. Few fish lived in the extensive dead zones created by mills at St. Anthony Falls where tons of sawdust were dumped annually and settled out downstream as massive debris bars that required dredging to keep the river open for navigation. During summer low flows, 5.8 gallons of river water diluted one gallon of raw sewage from metropolitan sewers, stockyards, and meat packing plants. Dissolved oxygen dropped to zero during the summer between St. Paul and Hastings, and not surprising, commercial catches of fish between Wabasha and Winona fell 75% from 1922-1929. Finally, the completion of the lock and dam system in the 1930s transformed the upper Mississippi River into a series of lakes, and also, barriers to many fish species that had historically migrated upstream to spawning habitats.

Habitat and Fish Passage: This study targeted almost exclusively tailwater habitats, however, Zigler et al (1999, 2003, and 2004) reported paddlefish in the Upper Mississippi River also utilize off-channel areas where depths are greater than 6 meters with little or no current (<5 centimeters/second). In Pool 5A, paddlefish preferred tailwater and impounded areas, however, tailwater use declined during the winter. In Pool 8, paddlefish preferred floodplain lakes and secondary channels. However, the latter was the single most used habitat for all seasons except spring when the preference shifted to tailwaters. In the tailwaters of L&D 7, which have both

roller and tainter gates, paddlefish exhibited a strong preference for the tainter side of the dam where velocities are assumed to be lower.

Zigler et al (2004) documented 53 passages through dams (20 upstream and 33 downstream). Most occurred during spring flood pulses when gates are raised out of the water creating open river conditions and the head between the two pools is minimal. In their study area, the high head of L&D 5 had the least open river conditions while the low head of L&D 5A had the most and L&D 7 and 8 were intermediate in frequency.

Suitable habitats for paddlefish varied greatly in Mississippi River Pools 1-3. The tailwaters of L&D 1 (Pool 2) had a maximum depth of 15 feet and extended a very short distance from the spillway (Figure 8). The depth and area of the habitat appeared to be an insufficient area to support paddlefish, however, three paddlefish were electroshocked at this location in 1990 (Jack Enblom, MDNR, personal communication). The distance to L&D 2 is 32 river miles. This reach includes one major tributary, the Minnesota River, and a number of shallow backwater lakes. Paddlefish were reported in the Minnesota River near Mankato in 1991, St. Peter in 1992, Burnsville in 1993 (Schmidt 1995) and North Redwood in 2004 (Bobbi Chapman, MDNR personal communication). In Pool 2 of the Mississippi River, a creel census recorded a paddlefish snagged at the Wacouta Bridge near South St. Paul in 1992 (Jeff Gorton, MDNR personal communication). A paddlefish severely injured from a propeller strike was observed floating in the main channel about one mile upstream of L&D 2 in 2003 (Mike Davis, MDNR personal communication). And a commercial operator reported seining several juvenile paddlefish in Pig's Eye Lake (River Mile 835) during a very high water period in the spring of 1997 (Jack Enblom, MDNR personal communication).

Figure 8. US Lock and Dam 1 in the Twin Cities.

The tailwaters at L&D 2 (Pool 3) was approximately 50 feet deep and covered a large area downstream of the gates (Figure 9). L&D 3 is 18 miles downstream. There are no major tributaries in this reach, but does include two large backwater lakes, North and Sturgeon. The maximum depth of the latter is now 19 feet. A commercial operator reported paddlefish formerly occurred here when the depths were greater and covered a larger area of the lake (Schmidt 1995). There are other deep habitats associated with cuts connecting these lakes to the Mississippi River, but may be too small and velocities too high for paddlefish to utilize. A fish passage channel will be built at L&D 3 and make this reach more accessible to paddlefish, however, the project has been delayed due to budget cuts.

Figure 9. US Lock and Dam 2 near Hastings.

The tailwaters in the north channel of L&D 3 (Pool 4) was over 70 feet deep. Both anglers and commercial operators have reported catching paddlefish from the dam downstream past the island that divides the two channels. L&D 4 is 44 miles downstream making this reach the longest of the three pools in the study area and contains, by far, the greatest amount and diversity of paddlefish habitat. Major tributaries in this reach include the Cannon River where a paddlefish was illegally snagged below the Byllesby Dam in 2002, and the Chippewa River where the USFWS has surveyed paddlefish and also studied the movements of radio tagged fish. Some of the earliest records of paddlefish in Minnesota come from Lake Pepin, which is 23 miles long, encompasses 25,060 acres and has a maximum depth of 60 feet. At the head and foot of the lake, there are also several backwater lakes and secondary channels. Occurrences for

this reach are too numerous to report here, however, all known records of paddlefish from 1990-2003 are displayed in Figure 10. The large cluster of occurrences in Lake Pepin are primarily radio telemetry records. Another cluster in Polander Lake near Winona are USFWS seining records.

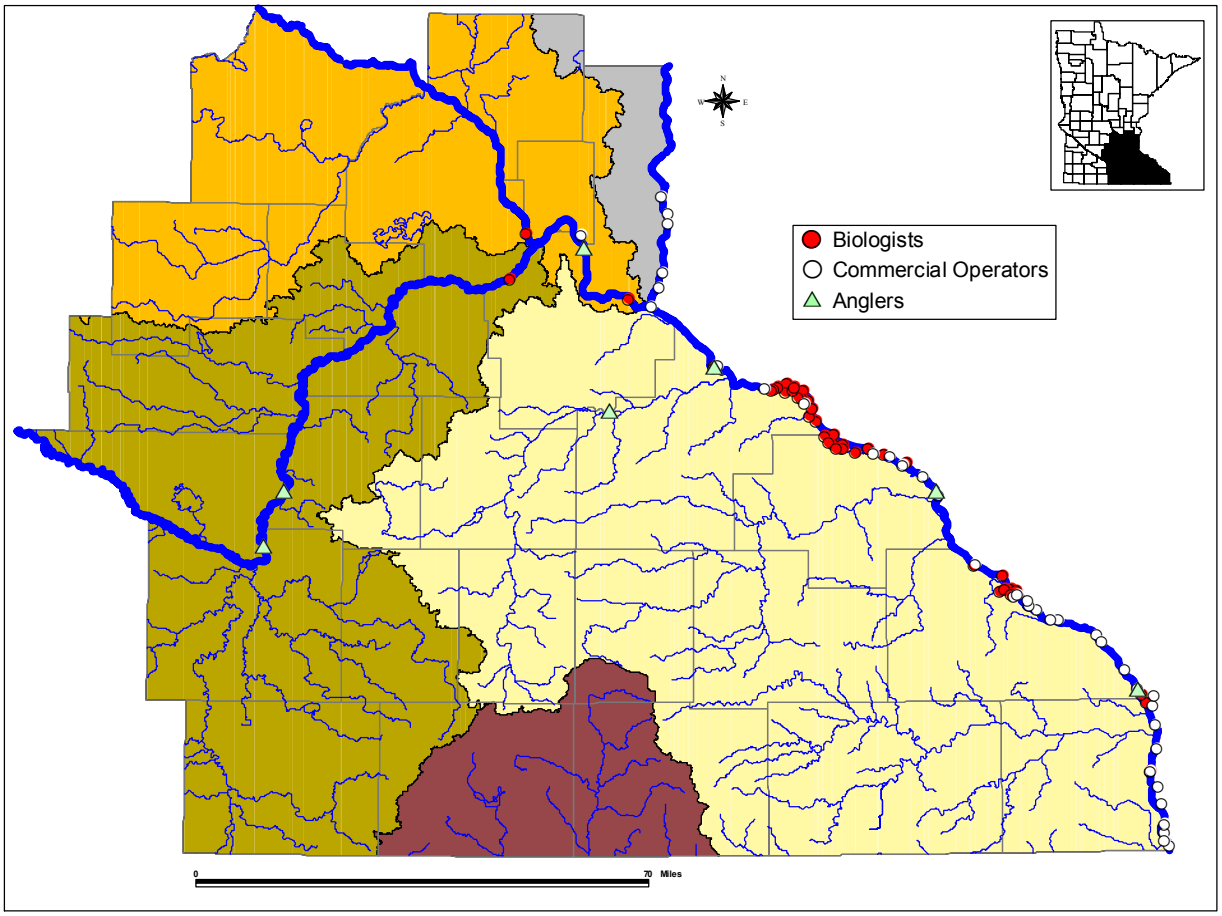


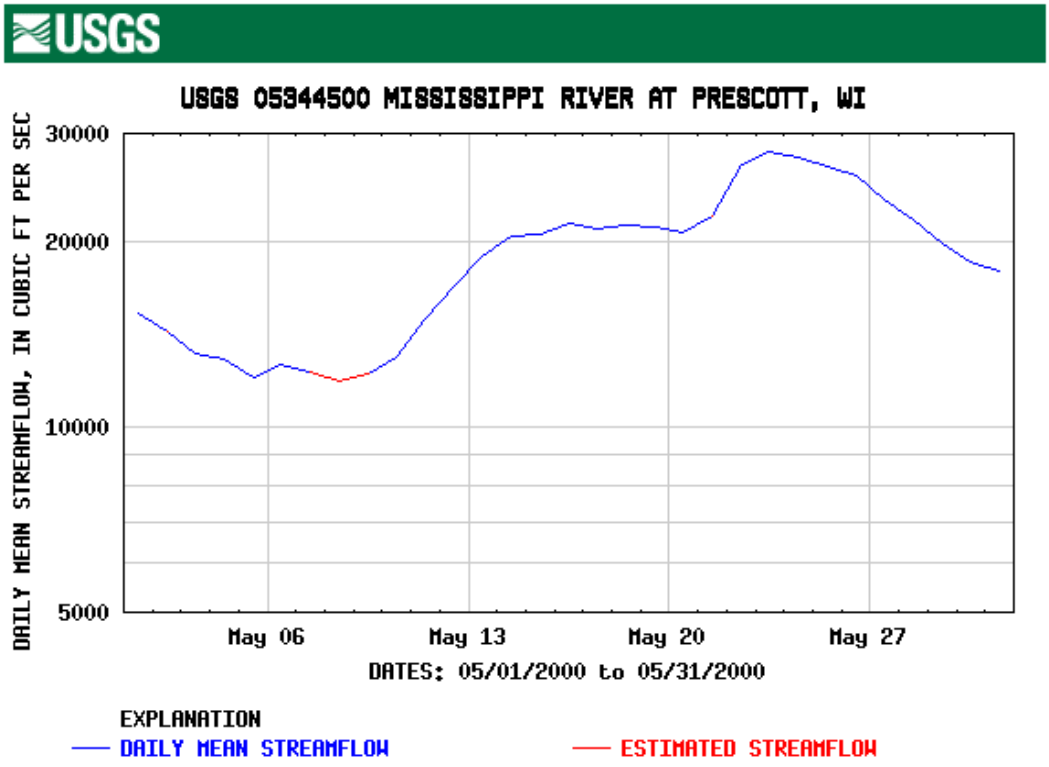
Figure 10. Paddlefish occurrences 1990-2003.

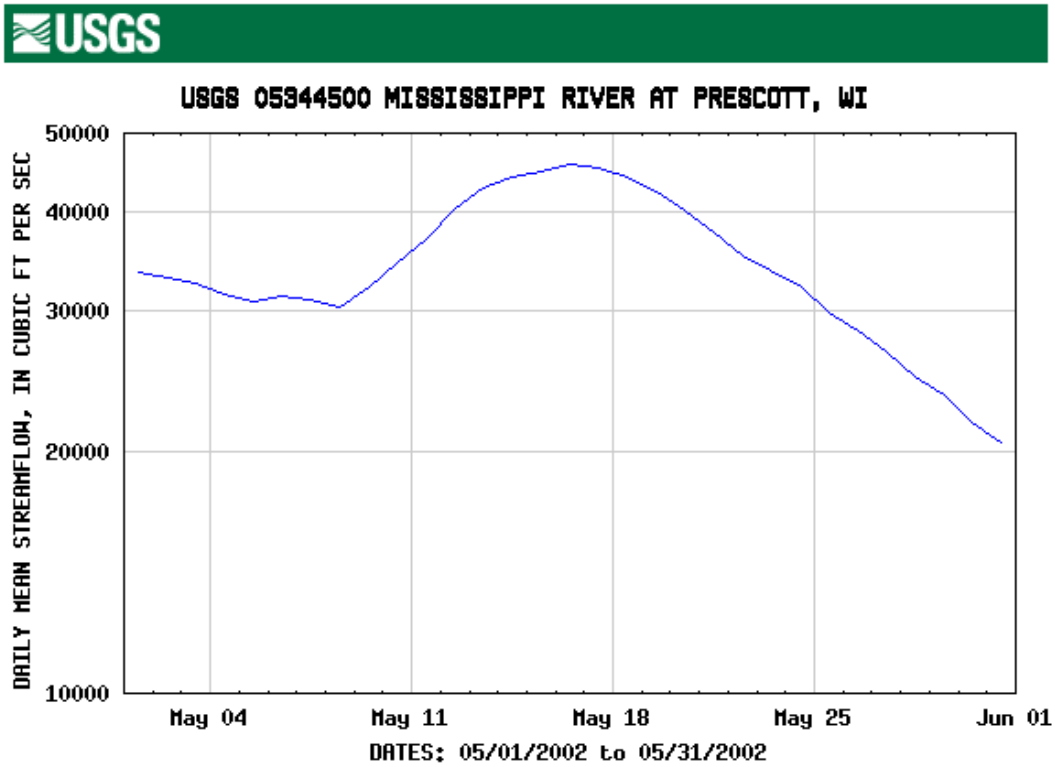
Sampling Gear Assessment: Different gillnets were utilized in 2000 and 2002. The longer and deeper USFWS nets have been effective on paddlefish in the Mississippi River downstream of L&D 3. However, without a side by side comparison, the efficacy of the smaller gillnets cannot be determined.

Stream flow was one documented variable that was different between the two years. The average flow for May in the Mississippi River at Prescott, WI was 32,830 cubic feet/second (cfs) based on US Geological Survey (USGS) data from 1928-2002. In May 2000, the flow was below normal averaging 18,800 cfs for the month and ranged from approximately 13,000 to 29,000 cfs from May1-31 (Figure 11). In 2002, the monthly average flow was slightly above normal at 34,280 cfs and ranged from about 20,000 to 46,000 cfs (Figure 12).

Based on known occurrences, commercial seines are the most effective gear to sample paddlefish in the lower St. Croix and Mississippi Rivers, but generally during cooler water periods (Schmidt 1995). However, the water temperature during the one attempt on 19 September 2000 in the St. Croix at Prescott, WI was abnormally warm this late in the season and no paddlefish or any other species were sampled. Nevertheless, commercial seine hauls would provide an excellent opportunity to collect data on paddlefish and other rare large river species at minimal expense and effort, using seasonal fish census clerks assigned to commercial operators as on-board observers.

The Iowa Department of Natural Resources (IDNR) Bellevue Research Station has successfully used snagging to monitor paddlefish in tailwaters of Mississippi L&D 12 and 13 for several years. This method requires few personnel, very little equipment, and also, samples paddlefish of all sizes including juveniles down to at least 16 in EFL, which would normally pass through the five-inch mesh gillnets (Figures 13 and 14).





Figures 11 and 12. May stream flows for 2000 and 2002.

Figures 13 and 14. Paddlefish snagged below US Lock and Dam 12 near Bellevue, IA.

Some of the highlights of IDNR data collected from 1996-2003 include the following:

- Snagging sampled 1833 paddlefish during the period.
- February and March were the most productive months to snag paddlefish when the total catch ranged from 6-180 and 18-187 fish, respectively (Table 2). December and May produced the smallest numbers of paddlefish ranging from 2-25 and 5-10 fish, respectively.
- Paddlefish were most abundant in 2002 when 468 were snagged at a catch rate of 3.45 fish/rod hour. The lowest densities were in 2000 when the catch rate for 37 fish was 0.7 fish/rod hour. And the average for 7 years was 1.7 fish/rod hour.
- In 1996, the EFL of 63 paddlefish sampled in the tailwaters of L&D 12 averaged 21.1 inches (in) and ranged from 16-42 in. In 1997, ninety-eight paddlefish averaged 25.5 in and ranged from 18-33 in plus one fish >40 in.

Table 2. IDNR paddlefish data from Mississippi River L&D 12 and 13.

FIELD SEASON	1996	1997	1998	1999	2000	2001	2002	2003	TOTAL
December Catch		2						25	27
January Catch	21						222	172	415
February Catch	38	12	180	160	6		178	28	602
March Catch	104	68	113	18	31	187	68	114	703
April Catch	16			1		19		35	71
May Catch		5				10			15
Total Catch	179	87	293	179	37	216	468	374	1833
Number Tagged	163	73	229	154	35	174	414	345	1587
Number Recaptured	17	15	13	19	9	18	24	34	149
Effort (hours)	170	95	144	83	53	122	135.6	138	940.6
Fish/rod hour	1.05	0.92	2.04	2.16	0.7	1.77	3.45	2.71	

One final sampling method that was not used in this study targets young of the year paddlefish from 5-16 inches (Kozfkay et al 2002). Paddlefish in this age class have never been reported in Minnesota and only rarely in Wisconsin's Chippewa River. In the early 1990s, biologists found young of the year paddlefish feeding at the surface of Lake Sakakawea, ND were unable to dive while fleeing approaching boats because their rostrum acted like an airplane wing and could be captured with a dipnet from the bow of a survey boat (Figure 15). In 1995, the "boat-chase" technique was further refined and standardized in the Fort Peck reservoir, MT where biologists were attempting to assess the annual spawning success of paddlefish. Based on their initial findings through 1999, paddlefish spawning appears to be more successful in years when turbidity is high and stream flows are above normal for an extended period from May through early July. This method may also be effective in Lakes Pepin and St. Croix and lentic habitats of Mississippi River Navigation Pools.

Figure 15. Young of the year paddlefish survey in the Fort Peck Reservoir, MT

Recommendations

Currently, Minnesota has no state endangered fishes and the paddlefish is the only threatened species. Populations should be assessed on a regular basis and actively managed. Actions pursued should include:

- Identify and rank research topics for future studies.
- Secure funding for future work possibly through state wildlife grants.
- Evaluate success of stocking programs in other states and review the feasibility and cost of producing fingerlings (Figure 16) from a local population. Paddlefish are relatively easy to culture and rear under hatchery conditions and exhibit extremely rapid growth rates during their first year (Dave Mueller, River of Life Hatchery personal communication).

Figure 16. Hatchery reared paddlefish fingerling.

- Annually contact both MDNR and WDNR fisheries offices and commercial operators within the species' range for incidental catch and mortality reports.

- Select and implement one or more survey methods described in this report for a long term monitoring program.
- Explore cooperative study and survey partnerships with MDNR Fisheries, Wisconsin DNR (WDNR) Bureau of Endangered Resources, MDNR and WDNR Long Term Resource Monitoring Programs, USFWS La Crosse Fisheries Resource Office, U. S. Geological Survey and regional universities.

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Literature Cited

Anfinson, J. O. 2003. The river we have wrought – a history of the upper Mississippi. University of Minnesota Press. 365 pp.

Kozfkay, J., D. Scarnecchia, K. Gilge and B. Wiedenheft. 2002. Solving the puzzle of Fort Peck's young paddlefish. Montana Outdoors. Montana Wildlife, Fish and Parks. Vol. 33. No. 2. pp. 26-31.

Schmidt. K. P. 1995. The distribution and status of paddlefish *(Polyodon spathula)* in Minnesota. North American Native Fishes Association. 33 pp.

Zigler, S. J., M. R. Dewey, and B. C. Knights. 1999. Diel movement and habitat use by paddlefish in Navigation Pool 8, upper Mississippi River. North American Journal of Fisheries Management 19:180-187.

Zigler, S. J., M. R. Dewey, B. C. Knights, A. L. Runstrom, and M. T. Steingraeber. 2003. Movement and habitat use by radio-tagged paddlefish in the upper Mississippi River and tributaries. North American Journal of Fisheries Management 23:189-205

Zigler, S. J., M. R. Dewey, B. C. Knights, A. L. Runstrom, and M. T. Steingraeber. 2004. Hydrologic and hydraulic factors affecting passage of paddlefish through dams in the upper Mississippi River. Transactions of the American Fisheries 133: 160-172.