Ozark Pool Paddlefish Population Evaluation

2002-2003 Project Progress Report

Project Funded by the State Wildlife Grant #T1
Report STP2003-08

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Photo courtesy of Fred McClure

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1 December 2003

Executive Summary

We studied population characteristics of paddlefish (*Polydon spathula*) in the 4,071-ha Ozark Pool of the Arkansas River during a commercial fishing moratorium. We used large-mesh gill nets (5-, 6-, and 8-inch bar mesh) to sample paddlefish from November 2002 to March 2003. A total of 405 net sets and 8,543 net hours of effort were expended capturing 1,066 unique paddlefish and recapturing 75. Fish were measured for eye-to-fork length, and marked with individually numbered jaw tags. Fish were sampled during three time periods, November-December, January-February, and March-April. A high flow event occurred on March 18th that prompted us to end the study for the year. Using the Schnabel multiple-census estimator, a preliminary estimate of the recruited population is 5,025 fish with 95% confidence interval of 4,505-5,681. Mean catch per unit effort of paddlefish was 2.3 fish/108 m^2 of webbing/24 hours. Catch per unit effort was greatest near the full moon of each month. About 50% of the paddlefish captured were greater than the 36-inch minimum length limit, and length frequency distributions were very similar for 5- and 6-inch bar mesh. Paddlefish were found at a variety of depths, and no relationship exists between the size of paddlefish and depth captured. Recaptures indicated that paddlefish move throughout the navigation pool, and tag loss of the jaw tags appears to be minimal.

Photo of a paddlefish with a jaw tag

Introduction

This paddlefish study was undertaken after the Arkansas Game and Fish Commission closed the Arkansas River west of Dardanelle Dam to paddlefish harvest on January 31, 2002. Initially, we became concerned because commercial fishing pressure greatly increased in the western Arkansas River. Wildlife officers determined that a group of fishermen were wasting fish after several anglers called in with information that dead paddlefish were floating down the river. Wildlife Officers found a large pile of paddlefish carcasses dumped in a nearby ditch. It appears that a few fishermen were using a knife to cut open the belly of the fish to check for eggs and releasing those fish without eggs back into the river with a mortal wound. This is a violation of the laws that pertain specifically to paddlefish and to the laws that prohibit the waste of edible portions of game. Catching the violators proved very difficult because the river is large, making it hard to see or videotape a fishermen illegally cutting a fish and then throwing it back into the river. Fishermen must be "caught in the act" before a case can be prosecuted. Wildlife officers, biologists, and the Commission agreed that the best thing to do was to close the fishery down until the situation could be assessed.

Photo of a dead cut paddlefish

Prior to the commercial fishing closure, annual rotenone data suggested that the Arkansas River paddlefish population had greatly expanded and was contracting again (Figure 1). Observed declines in the last three years suggested commercial fishing pressure might be too high to maintain a healthy population. However, conclusive information was needed to formulate optimal management strategies.

The Arkansas Game and Fish Commission decided to close the Arkansas River paddlefish commercial fishery from Dardanelle Dam to the Oklahoma State line for the rest of the 2001-2002 season on January 31, 2002. This regulation effectively closed three pools of the Arkansas River: Lake Dardanelle, Ozark Pool, and Pool 13. Although a portion of the Arkansas River was closed, the rest of the open waters of the state remained open.

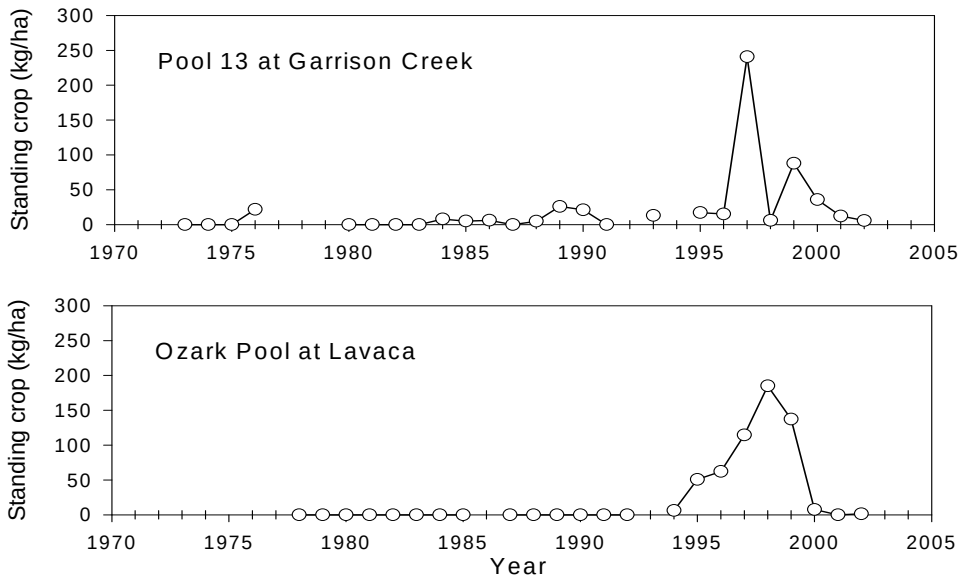

Figure 1. Estimated standing crop of paddlefish for the Arkansas River from 1970 to 2002 at two sites.

For the 2002-2003 commercial fishing season, the three western Arkansas River navigation pools were managed with different harvest regulations. A portion of the fishery was reopened on Lake Dardanelle for the December to April season, a special 10-day season was held on Pool 13, and the Ozark Pool remained closed to commercial harvest. As an added protective measure, the Commission increased the minimum length limit from 30 to 36-inches for the Arkansas River, which is measured from the front of the eye to the fork of the tail (EFL). Managing each of the three navigation pools differently allowed us the opportunity to examine the influence of each management strategy on paddlefish.

The objective of this study was to determine population characteristics of paddlefish in the Ozark Pool during the commercial fishing moratorium and a year after receiving intensive fishing pressure. Specifically, we determined catch rates of paddlefish in Pool 12 (Ozark Pool) of the Arkansas River between Ozark Lock and Dam and Trimble Lock and Dam. We determined catch and length frequency of paddlefish in various net sizes. We also made preliminary estimates of abundance. During the 2003-2004 sampling season, we will determine mortality, survival, growth, sex and fecundity of paddlefish. Therefore, this report is a progress report of work accomplished to date and is not a final report.

Methods

Monofilament gill nets were used to sample paddlefish. All fish captured were marked with a uniquely numbered jaw tag, and the left gill cover was clipped to assess tag loss. Fish were measured on a flat surface for eye-fork length ($\pm$ 1 mm EFL).

Sampling was systematically performed within 4 reaches that were 9-miles in length. Reaches will include an upper reach from navigation mile (NM) NM 293 (Trimble Lock and Dam) to NM 284 (Lavaca Gun Club area), and this reach includes the Vache Grass area. The middle-upper reach will extend from NM 284 to 275 (1-mile above River Ridge), and this reach includes Arbuckle Island. The middle-lower reach will extend from NM 275 to 266 (Citadel Bluff), and this reach includes the high-quality habitat of the Mulberry Bottoms and the White Oak area. The lower reach extends from NM 266 to 257 (Ozark Dam).

Exact sample areas within each reach were initially selected as the deepest areas within the reach or areas defined by wildlife officers as known paddlefish habitat. We also drove around the sample area looking for signs of paddlefish on the surface during calm weather, and we used the depth finder to locate netting sites where several large fish were present. We attempted to set nets in every mile of each reach during the course of the study. Once high-density areas were identified, those areas were intensively fished to maximize the catch and to ensure enough fish were marked.

Our project was set up to follow Pollock's robust sampling to determine density and survival estimates for harvestable size fish susceptible to gill netting (Pine et al. 2003). Sampling was performed during three two-month periods: November to December, January to February, and March to April. However, netting was not performed in April due to high flow conditions starting March 18th. The closed population Schnabel estimator (M_t) was used to develop an estimate of population size (Van Den Avyle and Hayward 1999), although this estimate will be later improved using program MARK, and

data will be analyzed using a continuous-time population models using program CARE-3. Catch per unit effort was calculated as suggested and defined by Paukert and Fisher (2001) as the number of fish collected per 108 m^2 of gill net per 24-hr set.

Results and Discussion

We captured a total of 1,261 paddlefish during the study. A total of 1,066 unique individuals were marked during the project. A total of 75 fish was recaptured during the study – those were fish recaptured among sample periods. A total of 195 paddlefish was observed more than once; many of those were recaptured within a sample period. Using the Schnabel estimator, we estimated population size of catchable fish to be 5,025 fish with 95% confidence interval of 4,505 to 5,681. The probability of capture was estimated as 6% for the 2^{nd} capture period, and it increased to 22% for the 3^{rd} sample period. Catchable fish are generally those susceptible to large-mesh gill nets and are generally greater than 28-inches EFL (711 mm). Mean length of the fish netted was 905 mm EFL (SD = 69 mm, 35.6-inches), and 54% of the catchable population was protected by the 914-mm (36 inches) minimum length limit (Figure 2). Few fish were captured greater than 1,000-mm EFL (39.4 inches) and less than 700-mm EFL (27.6 inches).

Mean length of fish captured was highest in the 5-inch bar mesh, intermediate in the 6-inch mesh, and lowest in 8-inch bar mesh (Table 1). This result is counterintuitive but can be explained biologically. Five-inch mesh captured fewer small paddlefish than 6-inch mesh. Small paddlefish were usually captured by their tail in 6-inch mesh, and this phenomenon has been described in the literature (Paukert and Fisher 1999). Eight-inch mesh is generally ineffective in the Arkansas River, and most fish were captured during one day when a large school of small male fish was found and several 8-inch nets were used that day. Our impression was that 6-inch mesh was the superior mesh size for catching fish, and fish were easy to remove from 6-inch mesh. Five-inch bar mesh often appeared to keep the gills from ventilating since it fit tight around the fish. For fish observed more than once, mean difference among the two length measurements was –1.1 mm with standard deviation of 28 mm. This suggests it is easy to make an error measuring a paddlefish when quickly measuring fish in the field.

Few paddlefish less than 700 mm or greater than 1,100 mm were captured in the Ozark Pool, when compared to the unexploited Arkansas River at Keystone Reservoir, OK (Paukert and Fisher 1999). The largest paddlefish we collected was 1,132 mm EFL, whereas the largest captured in Keystone Reservoir was 1,356 mm EFL.

Mean catch per unit effort (CPUE; fish/108m^2 of netting/24 hours) was 2.31 with standard deviation of 5.9. However, the histogram of CPUE shows that low catch days were common, and that occasionally around the full moon CPUE could greatly increase from 20 to 75 (Figure 3-4). Catch per unit effort was greatest near the full moon (Figure 3-4).

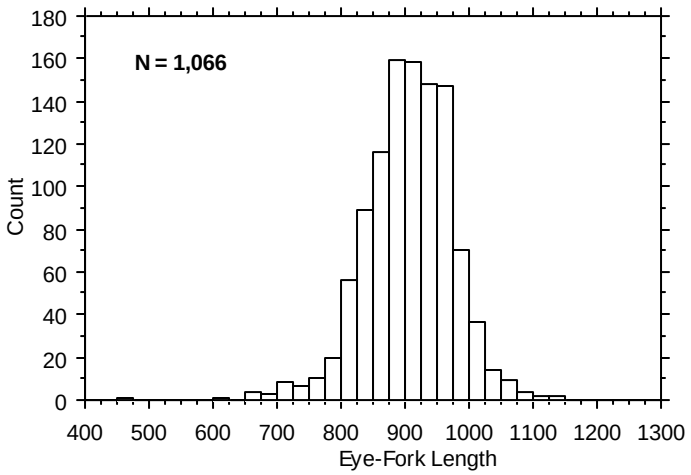

Figure 2. Length frequency of all individual paddlefish captured during 2002-2003 in the Ozark Pool of the Arkansas River.

Table 1. Length of paddlefish captured in various size bar mesh sizes in the Ozark Pool of the Arkansas River during 2002-2003.

Mesh	Mean Length (mm)	Standard Deviation	Count	Minimum Length (mm)	Maximum Length (mm)
127 mm (5 in)	910	66	569	465	1129
152 mm (6 in)	898	71	414	610	1117
203 mm (8 in)	887	81	54	650	1025
Overall	905	69	1066	465	1132

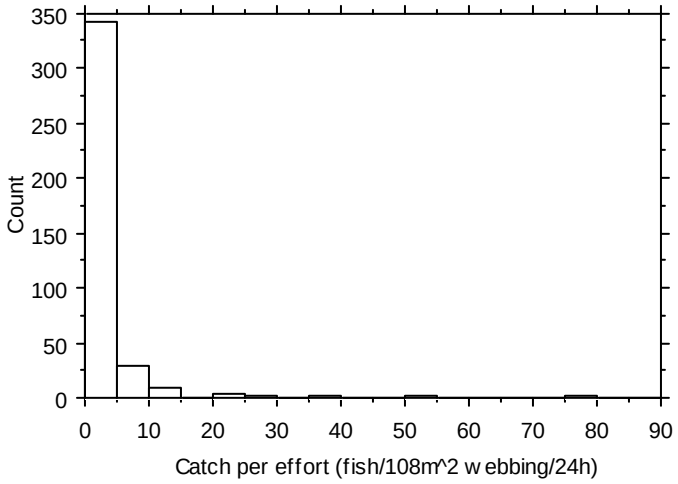

Figure 3. Catch per unit effort (fish/108m^2 of netting/24 hours) of paddlefish captured with gill nets in the Ozark Pool of the Arkansas River during 2002-2003.

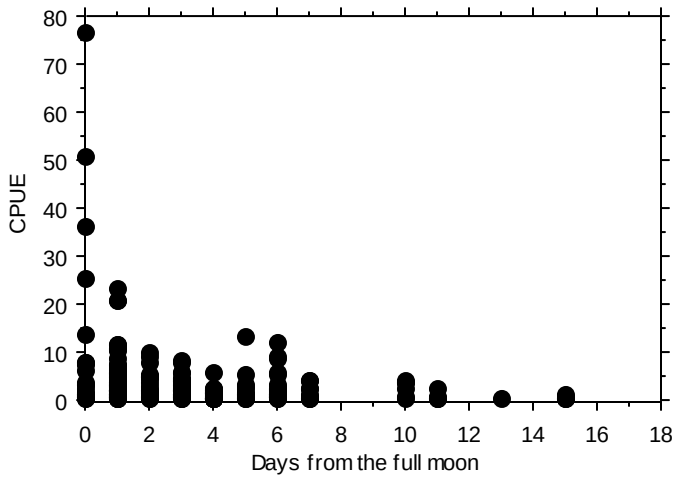

Figure 4. Relationship between catch per unit effort of paddlefish from gill netting in the Arkansas River and the number of days until the full moon.

Table 2. Catch per unit effort of paddlefish in various size gill nets in the Ozark Pool of the Arkansas River during 2002-2003.

Mesh	Mean CPUE	Standard Deviation	Count	Median
127 mm (5 in)	2.74	6.90	224	0.91
152 mm (6 in)	2.22	4.37	95	0.79
203 mm (8 in)	1.05	3.28	68	0
Overall	2.31	5.85	389	0.72

Catch per unit effort was greatest in the 5-inch mesh, intermediate in the 6-inch mesh, and lowest in the 8-inch mesh. Median catch per effort was 0 for 8-inch mesh, so we will not use 8-inch mesh during the 2003-2004 project. However, the catch rates of 5- and 6-inch mesh were similar. Our catch rates and standard deviations were higher than those of unexploited populations of the Arkansas River at Keystone Reservoir in Oklahoma, and they observed mean CPUE ($\pm$ SD) of 0.74 ($\pm$ 1.56) in 5-inch mesh, 0.61 ($\pm$ 0.69) in 6-inch mesh, and 0.46 ($\pm$ 0.74) in 8-inch mesh (Paukert and Fisher 1999). However, study protocols were greatly different between studies, because they set nets randomly and we set nets systematically with emphasis on habitats with concentrations of fish.

Similar to other studies many paddlefish had damaged rostrums, 11% of fish had damaged rostrums and 89% were normal. Those damaged rostrums included those that were short, notched, bent, split in half, or were completely missing. Regardless of rostrum damage, 9% of paddlefish had other anomalies including damaged fins, side, opercle, mandible, healed cuts or missing eyes. Some injuries may be attributable to fish crossing dams, going through the dam turbines, and from fish running into fishing boat and tug boat propellers. The role of disease and genetics in causing rostrum anomalies is unknown.

Paddlefish with a forked rostrum

Paddlefish with a damaged side and one without an eye and rostrum

We sampled almost every mile in the pool, and flooding prevented us from sampling those areas late in the year. Five river miles were not fished during the study because flooding prematurely ended the study (Figure 5), but those areas had habitats that appeared highly unfavorable for paddlefish. Those five miles will be fished during next year.

Most fish were captured in three areas with high population density, and few fish were captured in the strata ranging from River Ridge Park to Lavaca (Figure 6). The three high-density areas were near Bee Bluff, Mulberry Bottoms, and Vache Grass. Although these high-density areas were located at low flow, these exact areas may not be productive at higher rates of flow. Considerable evidence from snagging tag returns suggests paddlefish concentrate below Trimble Lock and Dam 13 during high flow events, but few paddlefish were captured there during low flows.

Anglers reported harvesting 11-tagged paddlefish (1% uncorrected exploitation), mostly after the high water event beginning March 18th. Six were reported from below Trimble Dam in the Ozark Pool, and four were reported from below Ozark Dam in Lake Dardanelle. This suggests after the flood gates were opened on March 18th that the population became open to migration. Commercial fishermen reported harvesting two tagged paddlefish from Lake Dardanelle before March 18th.

Although the fisheries literature suggests paddlefish often use the deepest habitat available, we captured paddlefish at a diversity of available depths (Figures 7-8). Paddlefish were occasionally seen in large groups in shallow water less than 10-ft deep. We did not observe a relationship between the water depth at the place of capture and the size of paddlefish.

Paddlefish are known to be highly migratory. We recaptured paddlefish that had made substantial movements both upstream and downstream (Figure 9), and paddlefish moved the entire range of the 36-mile pool. Mean movement for recaptured paddlefish was 3.6 miles with standard deviation of 6.1 miles.

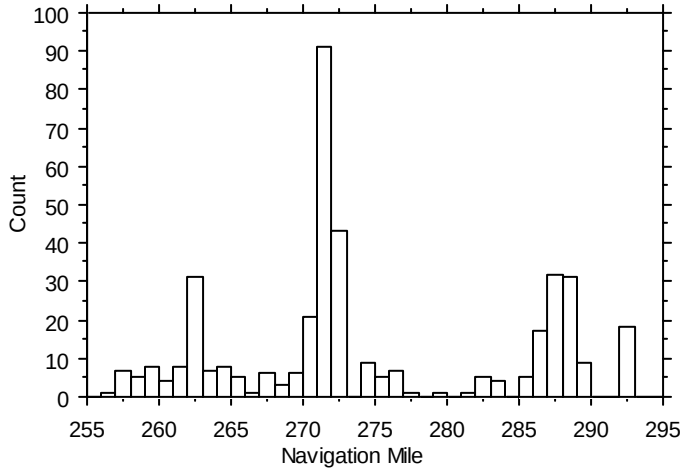

Figure 5. Distribution of net sets in the Ozark Pool of the Arkansas River during 2002-2003 by navigation mile.

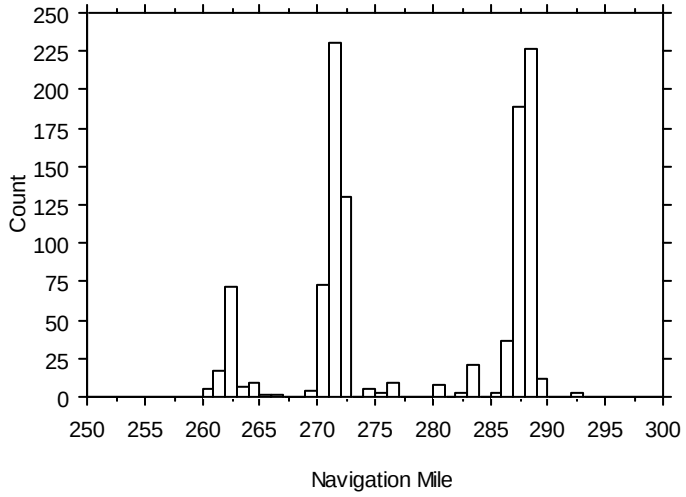

Figure 6. Catch of paddlefish in the Ozark Pool of the Arkansas River during 2002-2003 by navigation or river mile.

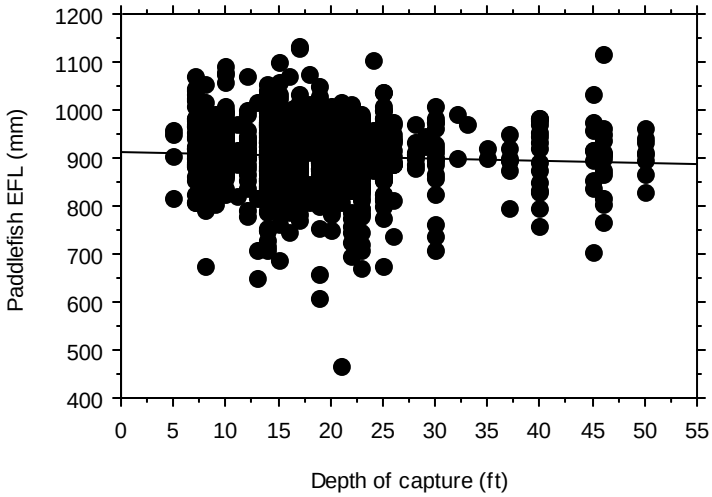

Figure 7. Lack of relationship between the length of paddlefish and the depth of capture in the Ozark Pool of the Arkansas River.

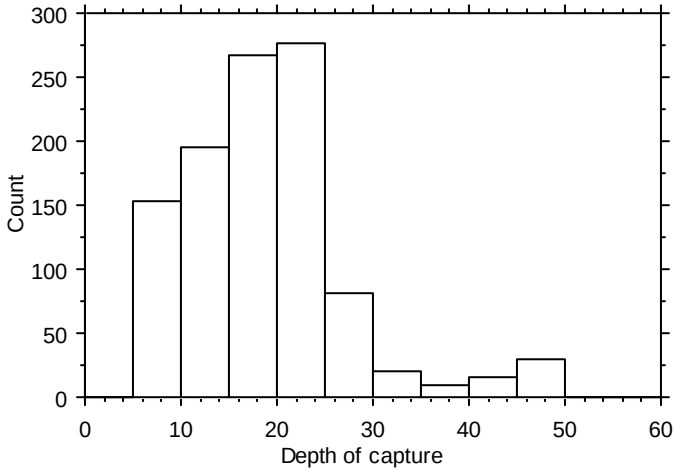

Figure 8. Histogram of the water depth (ft) that paddlefish were captured in the Ozark Pool of the Arkansas River during winter of 2002-2003.

Our population estimation results should be considered tentative until the second year of data is collected and fully analyzed. Many assumptions are used in modeling mark-recapture data that can lead to substantial errors in the population estimate. In our study, we assumed the population is sampled instantaneously for the Schnabel estimator (Model M_t), but sampling was actually carried out over a long two-month period, so future work will include analyzing the data with recently developed continuous-time population models. Another assumption that was violated was constant effort in each time period. We sampled as often as possible without much regard to constant effort assumptions because we thought the population might be very large and obtaining recaptures might be a problem. This assumption was somewhat relaxed by using model M_t, which allows capture probability to vary over time periods. We did not violate the assumption that tags are not lost and are reported, since only one tag was shed during the study. We assumed

that recruitment and migration were negligible, and that assumption was probably violated only to a minor degree. A single paddlefish tagged in the Ozark Pool was recaptured in Lake Dardanelle by a commercial fishermen before March 18th. All animals might not have equal catchability, although that was an assumption of this study. We will assess this assumption later using program MARK. The gill nets we used are highly size selective. Rotenone data suggests that most paddlefish are less than 36 inches, but that is the mean length of capture with gill nets.

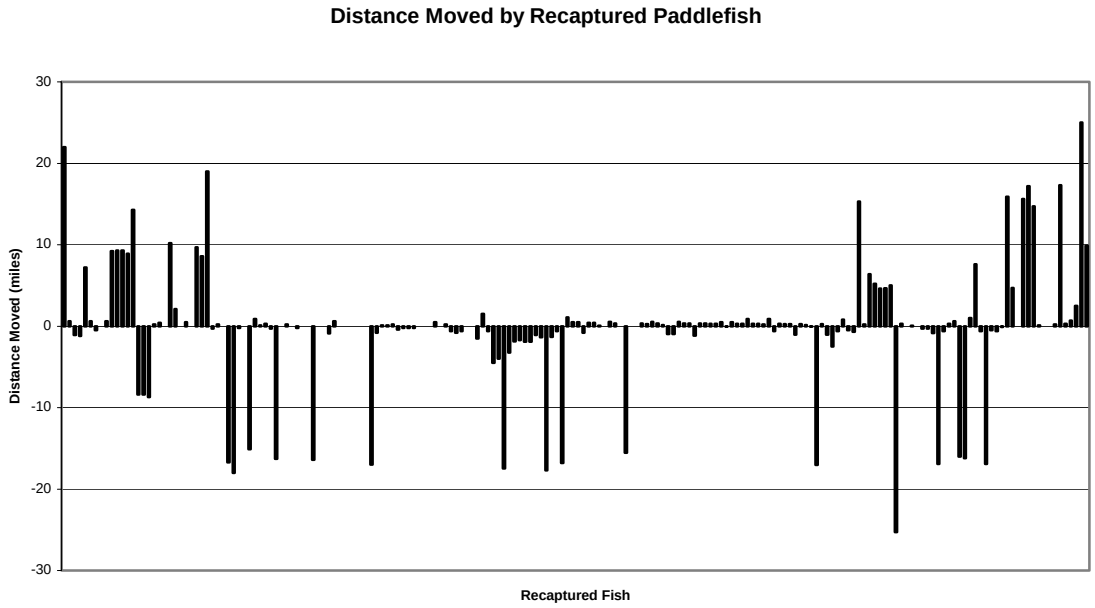

Figure 9. Distance moved by 195 recaptured paddlefish in the 36-mile long Ozark Pool of the Arkansas River.

Future Work

1. Population sampling during 2003-2004 to estimate density, survival and growth.
2. Initiation of the age-and-growth component of the study, including estimation of fecundity and age at maturity. Frank Leone will complete this portion of the study for his graduate degree program at Arkansas Tech University. This component also includes FAST modeling of various potential length limits.
3. Initiation of the telemetry portion of the study to estimate movement and known-fate survival. A contract has been approved to Dr. Joe Stoeckel at Arkansas Tech University to complete this component of the study.
4. Special commercial fishing season in February 2004 will be held to estimate exploitation by commercial fishermen.

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