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Final Report

Influence of Multiple Log Jams on Upstream Passage of Lake Sturgeon during their Spawning Run in the White River, Wisconsin

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This report completes the commitments made in accordance with the reimbursable agreement USFWS DCN 32320-6-J074, between the Bad River Band of Lake Superior Tribe of Chippewa Indians and the U.S. Fish and Wildlife Service - Ashland Fish and Wildlife Conservation Office.

Background

The U. S. Fish and Wildlife Service Ashland Fish and Wildlife Conservation Office (Ashland FWCO) surveyed the adult spawning migration in the lower White River near the confluence with the Bad River from 2001-2004. During that 4-year period an average of 26 adult lake sturgeons was handled annually with similar effort (Ashland FWCO unpublished data). Lake sturgeon successfully reproduced in the White River, Wisconsin in 2001 (Mattes and Nelson 2001). It is not known if lake sturgeon successfully reproduced in the White River from 2002 and 2006.

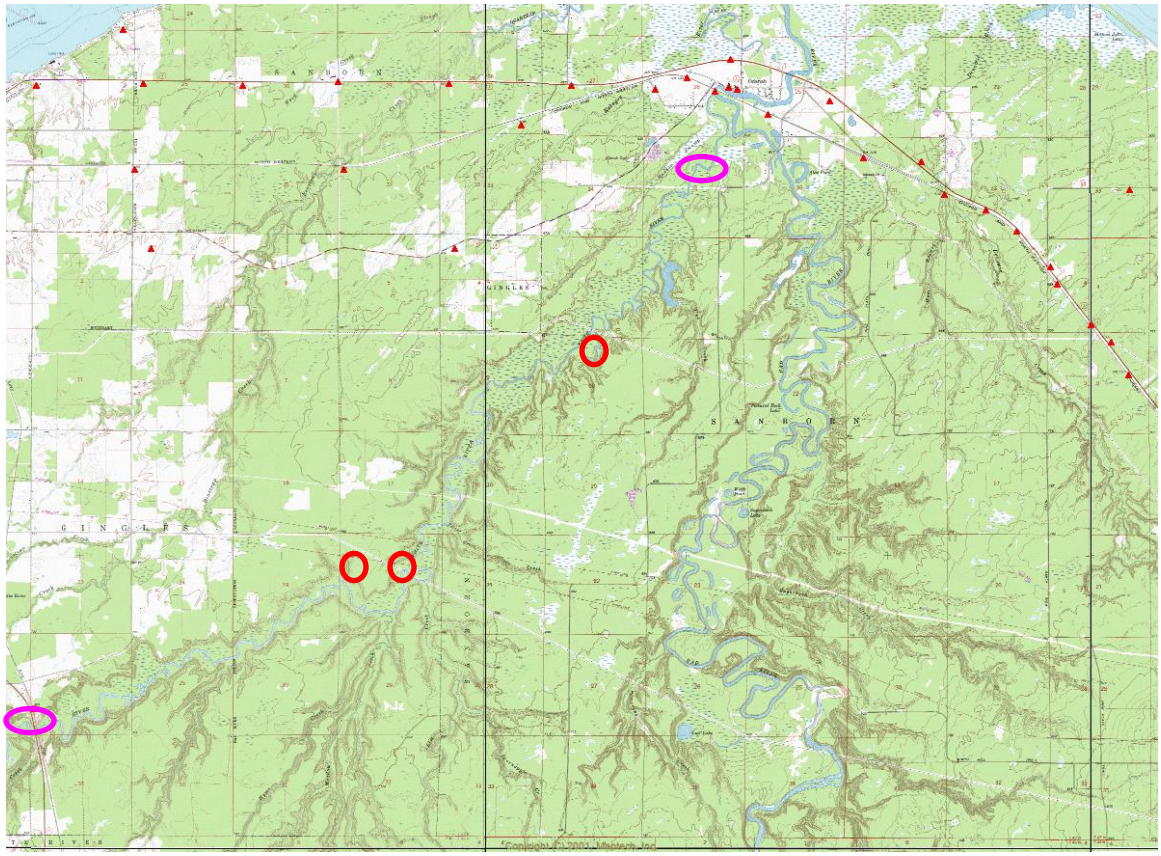
Several log jams formed or enlarged in the White River on the Bad River Indian Reservation in 2001 and accumulated materials through at least 2006 (Figures 1 and 2). The log jams were formed by logs, trees, and large woody debris dislodged and subsequently trapped in several sections of the river. The materials in the log jams accumulated as a result of a malfunction and subsequent emergency water release event at the White River dam in spring 2001, and poorly conducted large scale logging operations along the White River (T. Doolittle, USFWS, pers. comm.).

Biologists from the Bad River Natural Resources Department (Bad River NRD) and Ashland FWCO viewed the log jams during a canoe excursion in September 2005. During that trip biologists postulated that at least one of the three log jams encountered could block the annual lake sturgeon spawning migration. It is not known whether adult sturgeons entering the White

River were able to ascend the river to access spawning habitat upstream of State Highway 13 (STH 13) after 2001.

In 2006 and 2007, the Bad River NRD and Ashland FWCO joined efforts to evaluate the influence of the log jams on the lake sturgeon spawning migration in the White River.

Figure 1. Project area on the White River, Wisconsin from State Highway 13 downstream to the confluence with the Bad River in Old Odanah showing the location of log jams (red circles) and sample locations (pink ovals).



Project Objective

1) To determine if log jams blocked the lake sturgeon spawning migration in the White River in 2006 and 2007, and to recommend corrective actions if necessary.

Figure 2. Upstream end of a large log jam in the White River, Ashland County, Wisconsin.

Methods

We attempted to capture lake sturgeons in the lower river, downstream of the log jams, tag and release them and subsequently attempt to capture them upstream of the log jams, thereby determining if lake sturgeons can pass the log jams.

Adult lake sturgeon capture efforts occurred from April 18 to May 4, 2006 and from April 23 – May 9, 2007. Total effort (net nights) was similar between years. Nets were set in two general locations and dip nets were used in a third location. The lower river net set site was located 11 river kilometers from Lake Superior and 2 river kilometers upstream from the confluence with the Bad River. The upper river net set site was about 100 m upstream of STH 13, twenty-nine km from the confluence with the Bad River.

Gill nets were 25.4 cm stretch mesh (10" inch), 1.9 m high (6 feet) and 31 m long (100 feet). Two, 31 m nets were set for 10 nights at the lower river site between April 18-28, 2006 and for nine nights between April 23 to May 2, 2007. A single 30.5 m net was set for eight nights at the upriver site between April 24 - May 4, 2006 and for seven nights during April 25 – May 9, 2007. Nets were checked and cleaned daily.

In 2007, nets were set three days per week for three weeks to allow for greater coverage of time with similar capture effort. This staggered approach allowed us to sample what we anticipated would be a larger range of water temperature and flow conditions and increase the likelihood of sampling the spawning run or period of downstream larval drift.

Visual observation and dip nets were used to capture lake sturgeons near the White River dam. Crew members walked the stream bank and look for lake sturgeon or their tails which are often exposed in the shallow water.

Each adult lake sturgeon captured was measured to the nearest millimeter for total length, fork length, and girth and to the nearest pound for weight, and checked for previous tags (internal coded wire and passive integrated transponder (PIT) tags, and external Floy and Monel tags). We attempted to determine the sex and spawning condition (hard, ripe, or spent) of each fish captured, and collected a small piece of pectoral fin tissue for genetic analysis. Each sturgeon that did not have an external or PIT tag or whose external tag was in need of replacement (e.g. numbers difficult to read) was given a uniquely numbered internal (PIT) and external Floy tag and released.

Sturgeon capture dates, fish spawning condition, and water temperature data were recorded to determine likely dates of peak spawning.

In addition to capture of adult lake sturgeons we also attempted to capture of larval lake sturgeon during their post hatch drift. Larval sturgeons were sampled with drift nets at the upstream gill net site. Larval drift nets were set on May 8, 10 and 22, 2006 and May 3, 10, and 17, 2007. Net frame was D-shaped measuring 76 cm long at the base and 54 cm high at the center. The net was 318 cm long tapered nylon bag with 1600 um mesh, and a detachable cup at the cod end. Drift nets were set at dark for time periods of about 1 hour and each net was set twice during the night.

Drift nets were set in the main current and anchored in place with hook anchors set on the river bottom about 5 m upstream from the net mouth. The net mouth was lowered into the water after a short delay to allow any debris dislodged by the anchor to drift downstream. At the end of each sample interval one person lifted the mouth of the net out of the water. A second person externally rinsed materials in the net to the cod end and the cup containing the sample was removed. We poured each sample into a white plastic or enamel pan and sorted the contents at the river bank. Larval fish collected were counted and a sub-sample of 50 individuals from each genus was measured for total length each night. Water velocity was measured at the mouth of each net to determine the volume of water sampled.

An Onset thermograph recorded hourly water temperature to the nearest degree from April 19 to

May 24, 2006. Water temperature was also recorded with a hand-held thermometer at each net set and lift in 2006 and 2007. Mean daily discharge data recorded at the USGS gauging station at the White River dam was downloaded from the internet.

Results

Fish

In 2006, gill nets were set overnight for 14 nights and in 2007, for 9 nights. Total capture effort in 2006 was 2,800 feet of gill net (2000 feet at the lower river site and 800 feet upstream of STH 13) and in 2007 capture effort totaled 2,600 feet (1,800 feet at the lower river site and 800 feet upstream of STH 13). We caught 106 adult lake sturgeons during the study. In 2006, 39 individual lake sturgeons were captured and several fish were recaptured one or more times for a total of 49 fish handled. In 2007, 51 individuals were captured and six fish were recaptured for a total of 57 fish handled. In 2006, 47 of the 49 lake sturgeons were caught in the lower river and in 2007, 49 of the 57 were caught at the lower river site. At the upriver site, two lake sturgeons were caught in 2006 and eight were caught in 2007.

We attempted to visually locate and then capture adult sturgeon with dip nets in areas of suitable spawning habitat near the White River dam on April 24-27, 2006.
Two persons spent an hour each over the four days (8 total hours) conducting visual observations for adult lake sturgeon. No sturgeons were observed on the suspected spawning grounds below the White River dam.

No fish captured and released at the lower net site were subsequently captured at the upstream STH 13 site, nor were any of the eight individual lake sturgeons handled at the upstream site subsequently captured downstream. Date and location of lake sturgeon captures is shown in figures 3 and 4. Seven of the 90 individual lake sturgeons captured had been tagged previously by Ashland FWCO or Wisconsin Department of Natural Resources.

The spawning condition of most fish was hard (gametes not ready to be released) indicating they were not yet ready to spawn. Milt was expressed from 14 males in 2006 and 19 in 2007. No fish handled were in a spent (spawning completed) condition in 2006. Three males and one female captured in 2007 were determined to be spent. Date captured, sex and condition of the fish is shown in figures 5 and 6 and total length and sex of fish is shown in figures 7-9.

In the lower river the mean length of lake sturgeons captured was 133.3 cm (52.5 inches) and mean weight was 15.3 kg (33.7 lbs.). At the STH 13 site, mean length was 133.7 cm (52.6 inches) and mean weight was 15.9 kg (35 lbs.). The largest fish captured during the assessment had a total length of 161.0 cm (63.4 inches) and weighed 31.3 kg (69 lbs).

Larval drift nets were fished the nights of May 6, 10, and 22 in 2006 and on May 10 and 17, 2007. Total larval drift net effort was 18 hours in each year. One larval lake sturgeon measuring 18 mm total length was captured on May 7, 2007, while in 2006 no larval sturgeons were collected. Larval sucker species (genus Catostomus) predominated in the catch, seven larval walleye (Sander *vitreus*) and a single longnose dace (Rhinichthys *cataractae*) were also captured.

Flow and Temperature

In 2006, mean daily discharge ranged from 173 - 744 cubic feet per second (cfs) and in 2007 from 197 – 326. On May 3, 2006, discharge increased from 25 cfs to 199 cfs over a 15-minute period and from 25 to 274 cfs over a 30 minute period. Stream discharge during the sample periods is shown in Figure 10.

In 2006, from April 19 to May 22, mean daily water temperature ranged from a low of 45° F on May 13 to a high of 60° F on May 20 (Figure 11). The temperature recorder was not set or did not function properly in 2007. Water temperature data recorded at the time of net set is shown for 2007 (Figure 11).

Discussion

Three large log jams were present in the White River in 2006 and 2007. The largest log jam is located about 19 km upstream from the lower net set location and 10 km downstream from the upper net set location at STH 13. The other two log jams are located 4 km and 12 km downstream from the upper log jam. During a reconnaissance trip on the White River in 2005, Bad River NRD and Ashland FWCO biologists speculated that the large, upper log jam had the potential to physically block passage of large fish like lake sturgeon. Discharge in the White River during the canoe trip in August 2005 was 134 cfs. In contrast, discharge during the study period was 190 cfs or greater and ranged from 190 to about 350 cfs (Figure 9).

Our efforts to recapture fish tagged at one net set location in the other location were unsuccessful precluding us from direct determination of lake sturgeon movement past the log jams. Dates of lake sturgeon capture effort and catch did not suggest a peak spawning event or timing of the migration in either year (Figures 2-4). One of the eight individual lake sturgeons handled at the upstream site was previously tagged. That fish, a male, was captured, tagged and released in the Bad River on May 4, 2004. The date and location of capture in the Bad River confirms that it was able to pass the log jams between 2004 and the 2007 spawning run. It also indicates that it was not a resident fish in the White River.

The individuals lake sturgeons captured upstream of the log jams may have entered the river early in the spring during high flow in late March and early April prior to our capture effort. Mean daily discharge in the White River during the time period immediately prior to our sample effort reached over 1700 cfs in 2006 and over 600 cfs in 2007 (Figure 12). These values are substantially higher than flows experienced during our adult capture effort.

It is improbable that adult lake sturgeons reside in the White River year round. Ashland FWCO and Wisconsin DNR tag return and Ashland FWCO radio telemetry data suggests that adult lake sturgeons enter the Bad and White rivers in the spring to spawn and return to Lake Superior immediately after spawning (Slade et al. 1996, Edwards et al. 1997, Ashland FWCO and Wisconsin DNR unpub. data).

Anglers frequently observe lake sturgeons in spring near the White River dam and reports were received by Ashland FWCO in 2007 and 2008. Ashland FWCO has not received reports of adult lake sturgeons in the White River at other times of the year. During surveys in the lower White River in 2001-2004 we captured spent fish (4 males and 56 females), suggesting that fish had ascended the White River to the spawning grounds and were returning to Lake Superior after spawning. However, it is also possible that the spent fish had moved into the White River from the Bad River. Ashland FWCO tag data has shown fish movement between the two river systems and genetic data indicates a common population (Welsh et al. 2008).

While it does not appear to be happening, if lake sturgeons were trapped in the White River upstream of the log jams river, they could survive unless the water level dropped to a very low level. There are numerous examples of lake sturgeon persisting in fragmented river systems. In the State of Wisconsin several of these are the Namekagon River, the Yellow River (Burnett/Washburn Counties), the Flambeau River, the St. Croix River, the Wisconsin River, and the Menominee River.

While the capture of a larval sturgeon did not provide additional insight into the ability of lake sturgeons to pass the log jams, it did confirm successful reproduction at flow levels substantially lower than in 2001 (Figure 11). Five larval lake sturgeons were captured in 2001 with similar effort to that expended in 2006 and 2007 combined (Mattes and Nelson 2001). Based on the length of the larval lake sturgeon captured in 2007, it had hatched on or about April 30, 2007. At 15° C lake sturgeon eggs develop in 7-10 days (Auer 1982). Water temperature ranged from 11° C to 14.5^{o} C from April 24 to April 30, 2007 at the lower river site. At similar water temperature this lake surgeon was likely spawned 10-12 days earlier, between April 18 and 20 and prior to initiation of our capture efforts.

Lake sturgeon spawning migration typically begins when water temperature reaches the low 50s and spawning occurs in the mid 50s to mid 60s (Harkness and Dymond 1961, Auer 1982, Auer 1996). In both 2006 and 2007, water temperature rose quickly after ice out and reached the mid 50s prior to initiation of our sample effort (Figure 10). Low water level, below average snowfall, and a lack of rainfall contributed to the rapid warming of the water. Based on water temperature, some lake sturgeons may have migrated upstream prior to our capture effort. Unlike 2001, when water temperature gradually rose throughout late April and early May, in 2006 and 2007 water temperature remained relatively constant with the exception of a 10 degree drop in water temperature from May 11-14, 2006 (Figure 10). The significant rain event on May 11, 2006, resulted in a drop in water temperature and increase in discharge, and occurred after most of our sampling effort was completed.

Flow conditions in spring 2006 and 2007 were lower than average for the time period of record (Figure 9). During the majority of the sampling period discharge was 100 - 200 cfs below the 55-year daily median (Figure 9). Despite the lower than average flow, lake sturgeons accessed spawning habitat and successfully reproduced.

In 2001, lake sturgeons were first captured by Ashland FWCO in the White River on May 4 during a period of decreasing discharge and rising water temperature (Figures 10 and 11). Lake

sturgeon were captured through May 18, 2001 when capture effort ceased due to several days of low or no catch and water temperature above the optimal spawning temperature.

It is possible that our 2006 and 2007 sample effort was too early in the season, and we simply missed the peak run. However, spawning was observed at the Bad River lower falls on or about April 24-25 and on May 9, 2006 (Bill Mattes, Great Lakes Indian Fish and Wildlife Commission, pers. comm.). The Bad River and White River spawning sites are similar distances upstream from Lake Superior, 36 and 48 km, respectively. Angler reports also suggest our timing was adequate as nearly a dozen lake sturgeons were observed in the White River downstream of the power house on May 4, 2007.

Recommendations

The presence of lake sturgeon upstream of the log jams, including one fish handled in the Bad River in 2004, confirms that lake sturgeon can get past the log jams. The largest lake sturgeon captured during this project was captured at the STH 13 site indicating that lake sturgeons of all sizes can navigate past the log jams. Despite the lower than normal water levels in 2007, lake sturgeons were able to access the spawning grounds upstream of STH 13. Communication with anglers suggests that lake sturgeons have been able to access spawning habitat near the White River dam in most years since 2001.

The White River log jams in their condition and at flow levels experienced in 2006 and 2007 do not form a barrier to passage of lake sturgeon. In 2005, only one of the three log jams observed was potentially a barrier to lake sturgeon passage. However, due to the extent of the large log jam it is unlikely the materials will break up and dislodge on their own through natural forces. A more likely scenario is that additional large woody debris materials will continue to accumulate. While it is not recommended that resources be utilized to remove the log jams solely for fish passage purposes, the continued accumulation of logs and large debris could increase bank erosion and sediment load to the river. Natural resource agencies should consider options to break up the large log jam to limit stream bank erosion and to prevent future fish passage issues from developing.

Acknowledgements

We thank the following individuals for their contribution to the project through project planning and field assistance, Tom Doolittle, Tom Houle, and Ed Wiggins (Bad River NRD), Greg Fischer (University of Wisconsin Aquaculture Research Center), Jonathan Pyatskowit, Jess Krajniak, Gary Czypinski, and Mark Brouder (Ashland FWCO) and C. Robertson, Jeff Zakovec, and Melissa Kjelvic.

Figure 2. Date of lake sturgeon captures at the lower river (black) and State Highway 13 (gray) sites in 2006. N = 49.

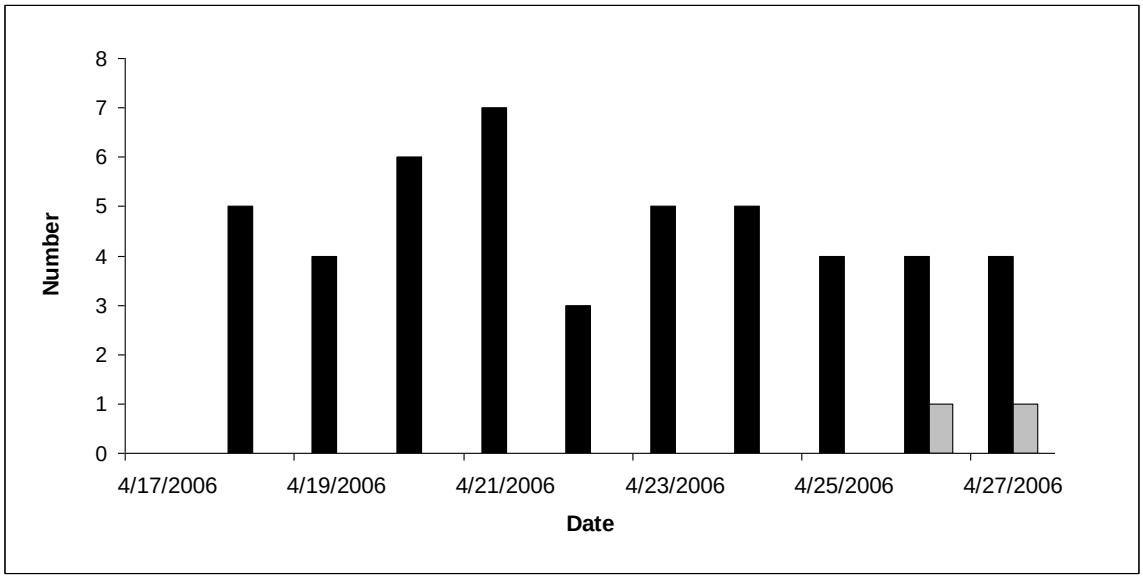


Figure 3. Date of lake sturgeon captures at the lower river (black) and State Highway 13 (gray) sites in 2007. N = 57.

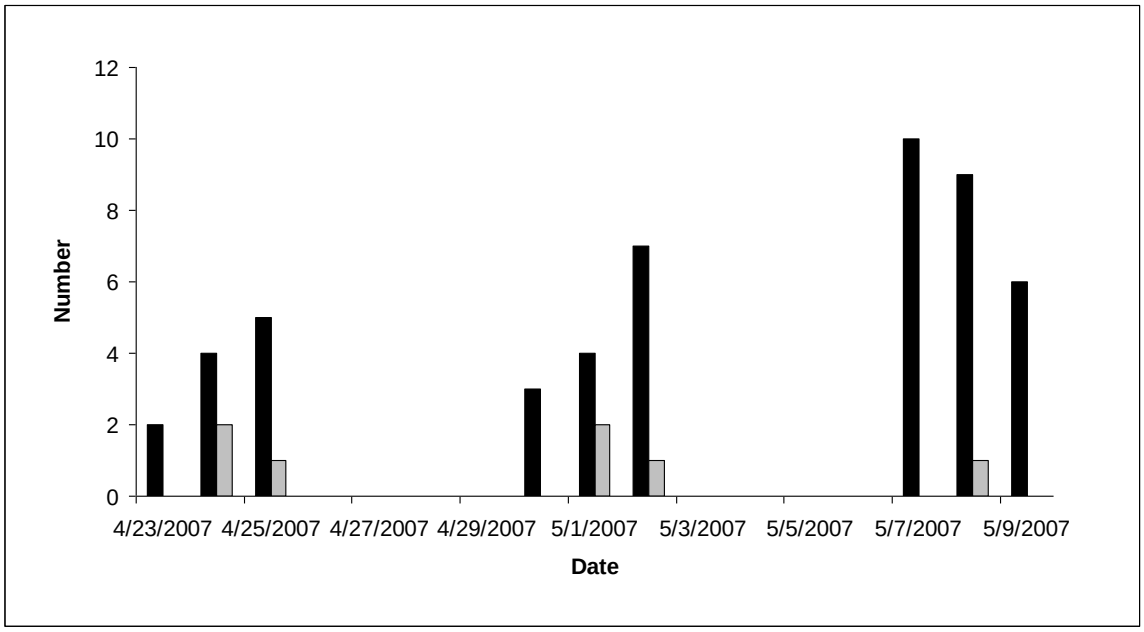


Figure 4. Daily capture and sex (unknowns = black, male = gray, and female = stripe) of lake sturgeons captured in 2006.

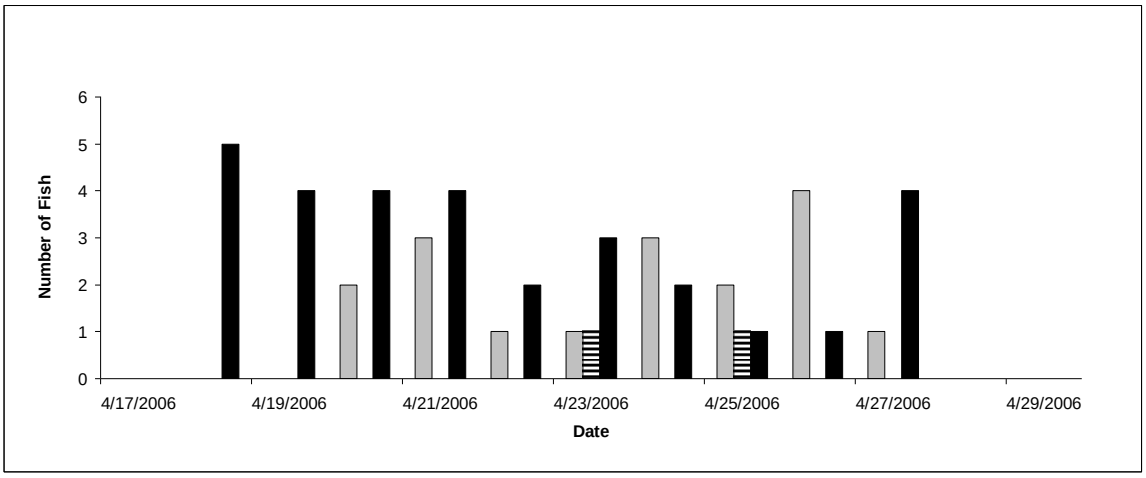


Figure 5. Daily capture and sex (unknowns = black, male = gray, and female = stripe) of lake sturgeons captured in 2007.

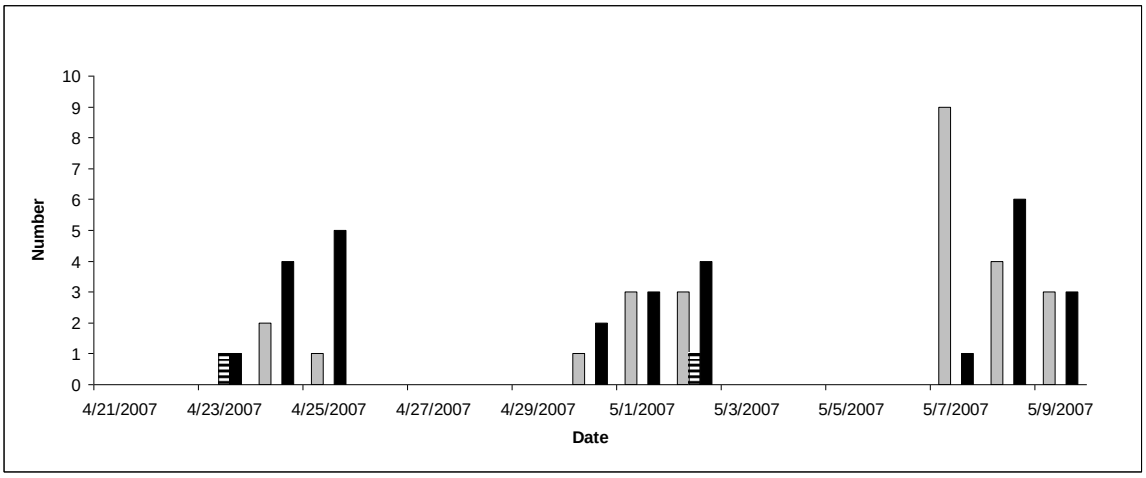


Figure 6. Number and total length of lake sturgeons captured in 2006 (black) and 2007 (gray).

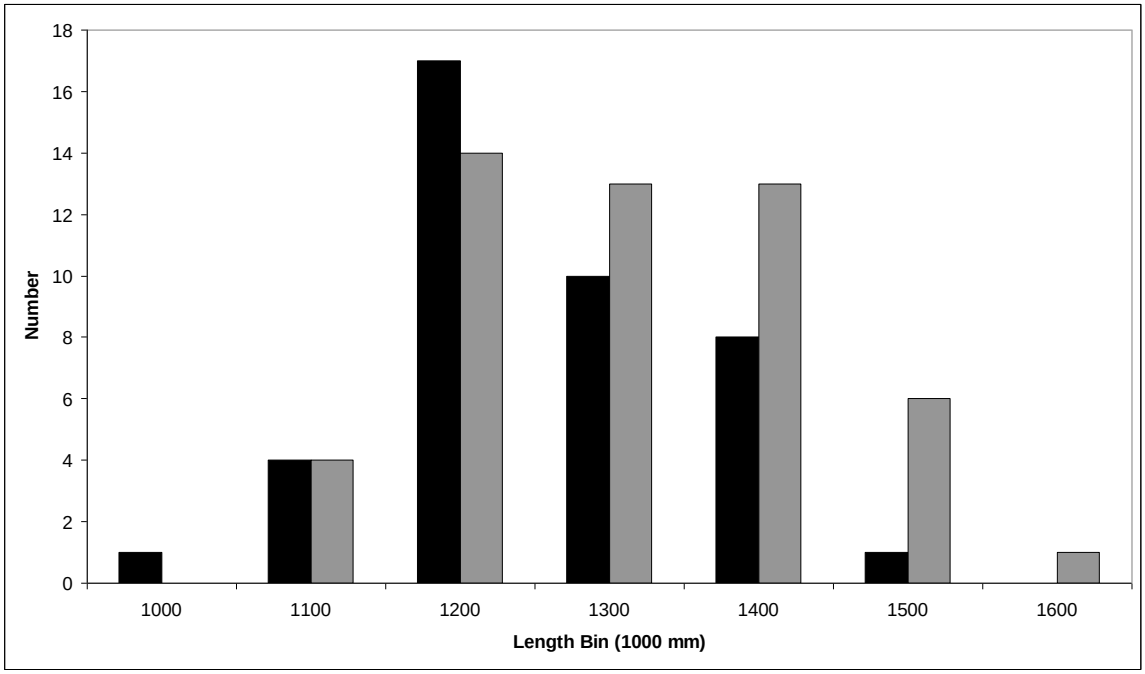


Figure 7. Length and sex (unknowns = black, male = gray, and female = stripe) of lake sturgeons captured in 2006.

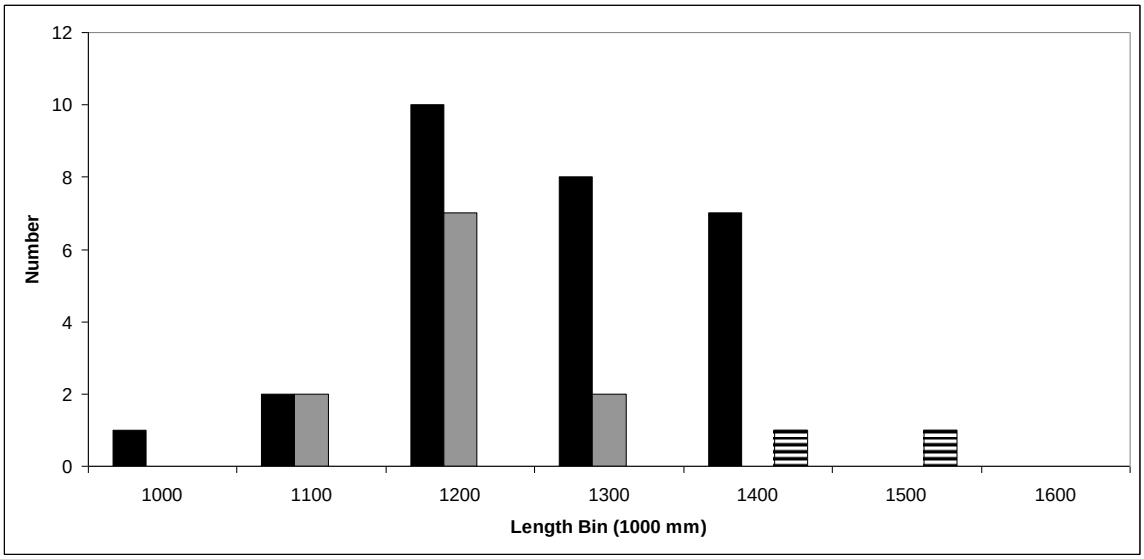


Figure 8. Length and sex (unknowns = black, male = gray, and female = stripe) of lake sturgeons captured in 2007.

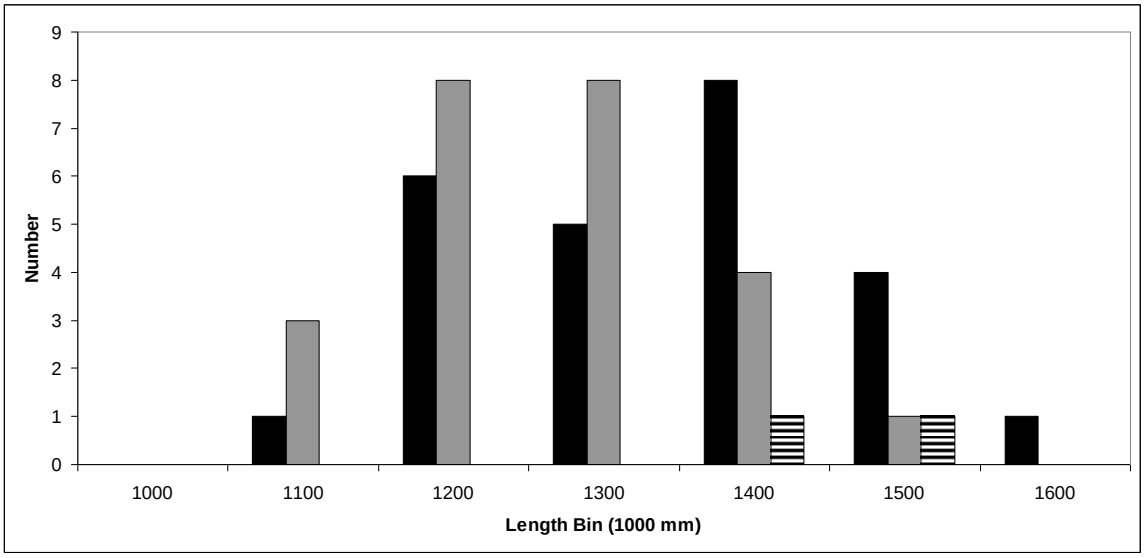


Figure 9. White River discharge for the sample period during 2006 (dashed line) and 2007 (dotted line) compared to the mean discharge for years the 1948-2005 (solid line).

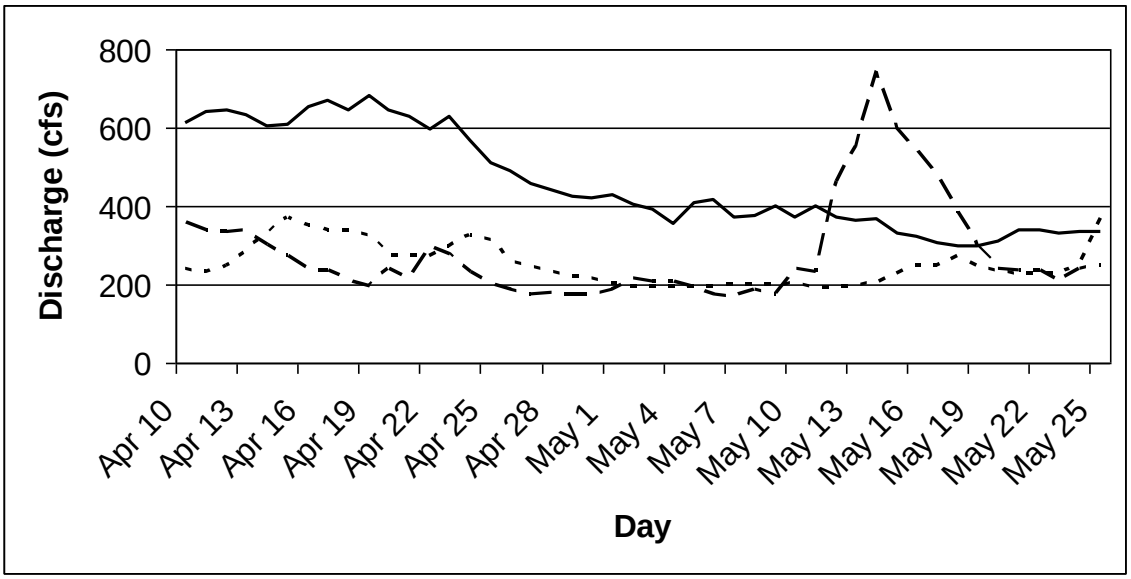


Figure 10. Water temperature in the White River at the lower river site in 2001 (solid line) 2006 (dashed line) and 2007 (dotted line) during spring sample period.

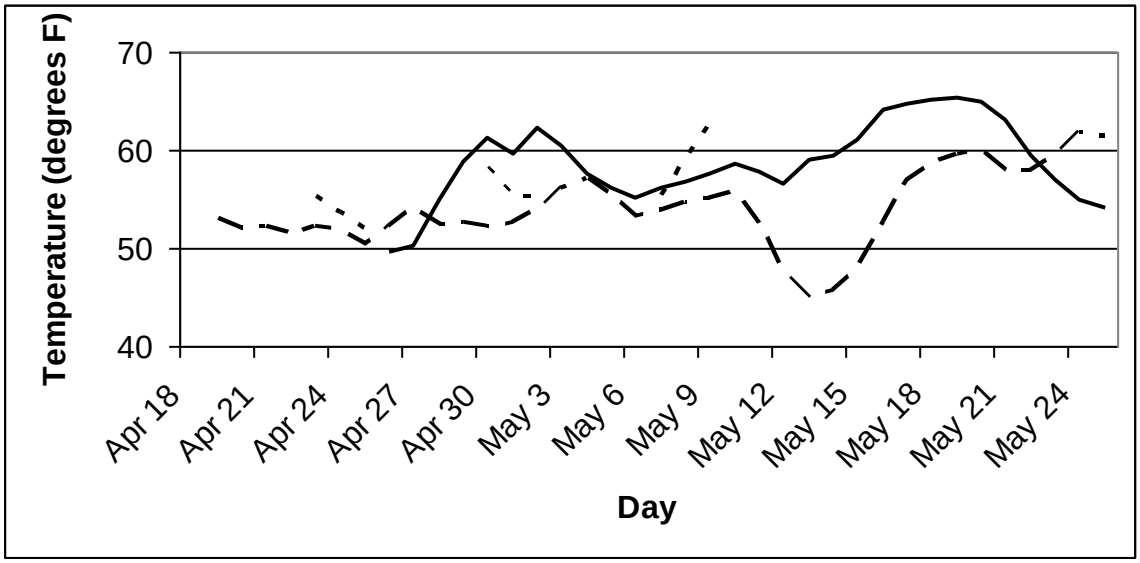


Figure 11. White River discharge for the sample period in 2001 (dashed and dotted line), 2006 (dashed line) and 2007 (dotted line) compared to the mean discharge for years the 1948-2005 (solid line).

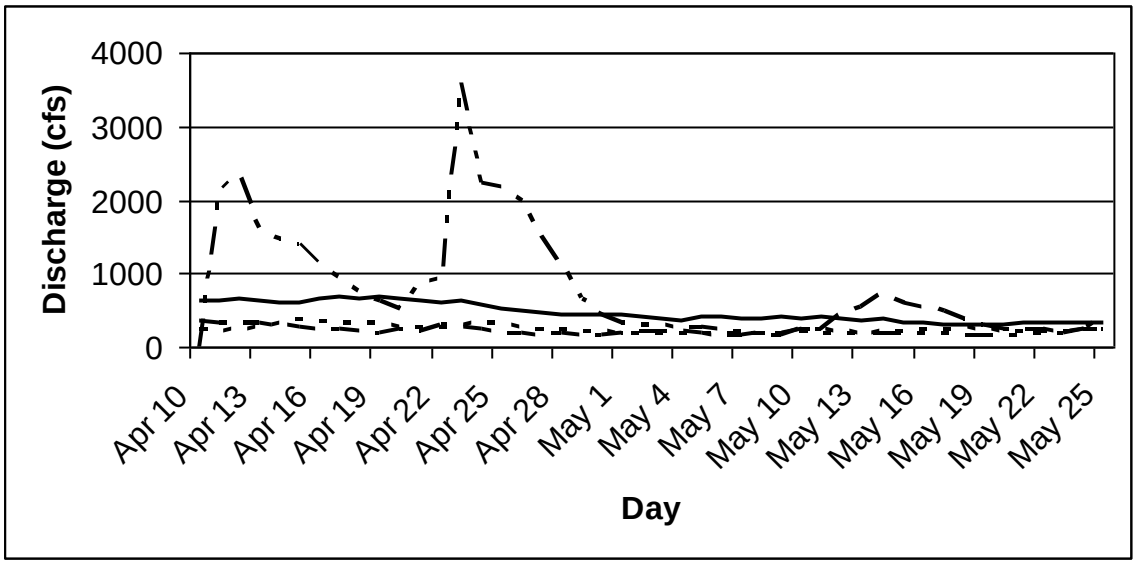
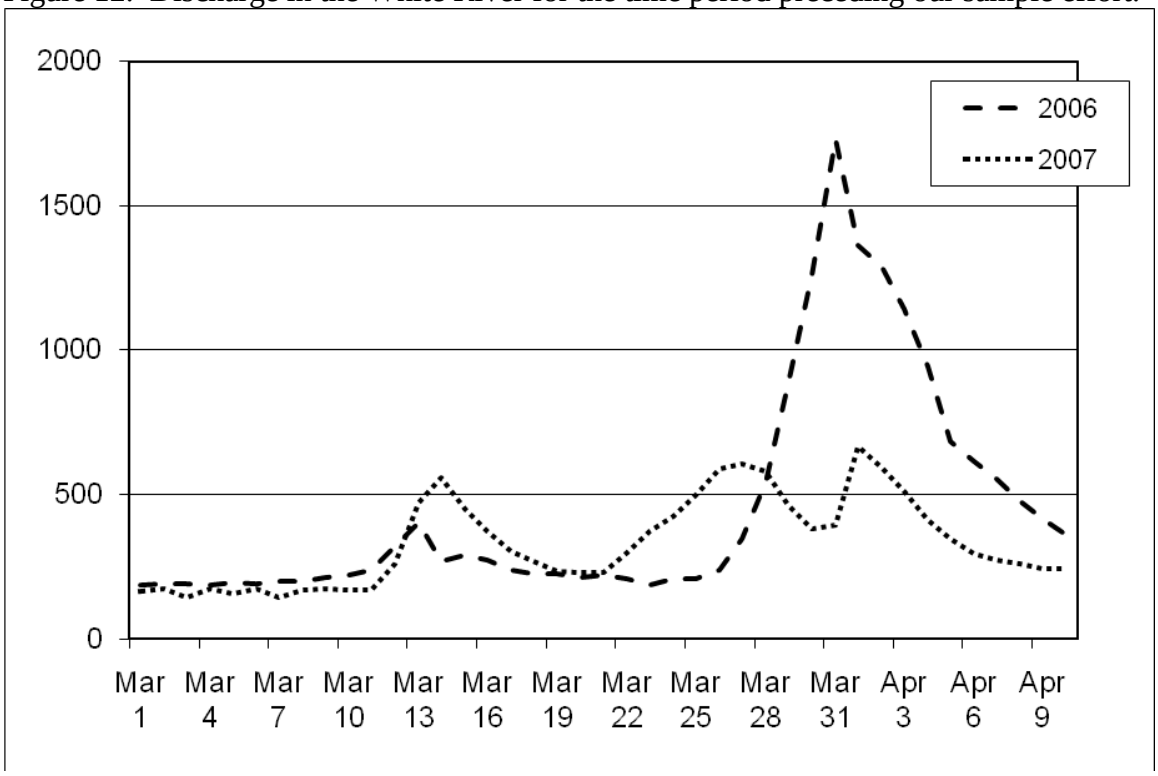


Figure 12. Discharge in the White River for the time period preceding our sample effort.



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