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Movement of Reintroduced Lake Sturgeon in Lake Cumberland

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Abstract

Lake sturgeon *Acipenser fulvescens* were once native to the Mississippi, Ohio, and Cumberland River drainage, but since the 1950's lake sturgeon have been extirpated from the Cumberland River. Commercial harvest, habitat loss, and pollution have all led to large declines and extirpation of lake sturgeon throughout its native range. In 2008, the Kentucky Department of Fish and Wildlife Resources (KDFWR) began reintroducing lake sturgeon back into the Cumberland River and has committed to a 20 year restoration effort. For many restoration efforts, the movement and spatial distribution of stocked fish is the missing link, and remains the knowledge gap in determining if stocking is an appropriate rehabilitation tool. Thirty lake sturgeon were surgically implanted with ultrasonic transmitters and tracked with an array of stationary receivers and actively by boat. No noticeable, consistent movement patterns were observed. Fifty percent of tagged fish moved downriver into Lake Cumberland during various times throughout the study, and the most recent tracking data and stationary receiver logs indicate that the majority of fish are still in Lake Cumberland below the KY Route 90 Bridge. Use of tributaries also showed no consistent patterns throughout the study; however, use was high as 63.3% of tagged lake sturgeon found their way into tributaries. Most notably, fish often remained or returned to stocking sites, displaying high site fidelity towards those areas. Although not enough manual detection exist to quantify habitat use, all detections occurred in inside bend habitats which provide silt/sand substrate and low velocity habitats often preferred by lake sturgeon.

Introduction

Lake sturgeon *Acipenser fulvescens* are listed as threatened in 20 states and 7 Canadian provinces (Williams et al. 1989), and were once abundant throughout the Mississippi River drainage (Harkness and Dymond 1961). Commercial harvest, habitat loss, and pollution have all led to large declines and extirpation throughout its native range (Organ et al. 1978, Hay-Chmielewski and Whelan 1997; Auer 1999; Schram et al. 1999). In Kentucky, lake sturgeon were once native to the Mississippi, Ohio, and Cumberland River drainage, but since the 1950's lake sturgeon have been extirpated from the Cumberland River (Smith 2009). In 2008, KDFWR began reintroducing lake sturgeon back into the Cumberland River (Smith 2009). The current recommendation is that a minimum of 20 year classes should be stocked, due to slow growth rates and late age at maturation (Schram et al. 1999). Therefore, KDFWR has committed to a 20 year restoration effort.

For many threatened and endangered species, such as lake sturgeon, population supplementation or reintroduction is required; however, for these programs to be successful, assessment of how captive fish transition and adapt into the natural environment must be included (Jordan et al. 2006). One way to begin to measure the success of hatchery stocking programs is to measure movement patterns, spatial distribution (i.e., site fidelity, home range) and habitat use after stocking (Benson et al. 2005; Smith and King 2005; Jordan et al. 2006, Oldenburg et al. 2011). For many restoration efforts, the movement and spatial distribution of stocked fish is the missing link, and remains the knowledge gap in determining if stocking is an appropriate rehabilitation tool.

Movement patterns and habitat use have not been identified or described in Lake Cumberland. The objectives of this study were: 1) determine movement patterns of stocked lake sturgeon into Lake Cumberland and 2) determine habitat usage of stocked lake sturgeon into Lake Cumberland.

Study Area

Wolf Creek Dam was built by the U.S. Army Corps of Engineers (USACE) and impounds the Cumberland River to form Lake Cumberland (50,250 acres). Lake Cumberland's primary purpose is flood control, but it is also offers a variety of other uses such as pleasure boating and angling. Summer pool level for Lake Cumberland is 723 ft, but this often fluctuates due to hydropower generation at Wolf Creek Dam. In 2007 the USACE began lowering the lake in fear of a possible breach due to erosion of the Dam. The lake was dropped 43 ft and remained there until 2014 when repairs were completed. This draw down had a major impact on fisheries in the lake, and walleye and striped bass populations both suffered severely. Impacts on lake sturgeon movement, survival, and behavior are unknown.

Telemetry efforts focused on the upper portion of Lake Cumberland; specifically from the US Route 90 Bridge near Burnside Kentucky upriver to the confluence of the Cumberland River and Laurel River and to Alum Ford on the Big South Fork. The study area encompassed major tributaries of the Cumberland River (Laurel River, Rockcastle River, and Buck Creek) and Big South Fork (Little South Fork; Figure 1).

Methods

Fish production and stocking—Eggs were produced from Wisconsin River broodstock lake sturgeon by the Wisconsin Department of Natural Resources at Wild Rose State Fish Hatchery in Wild Rose, Wisconsin each year with the exception of 2013 in which eggs were not attainable. Eggs were then

shipped to Peter Pfeiffer Fish Hatchery in Frankfort, Kentucky where they were allowed to incubate and hatch in 20 gallon circular tanks. Fry were raised on Otohime B2 and C1, and transitioned to frozen bloodworm and krill as they grew to larger sizes. In 2012, poor water quality in the rearing system lead to 100% mortality of lake sturgeon. In August-September each year fish were loaded into hauling trucks and stocked at two sites; the mouth of the Laurel River in the Cumberland River and Alum Ford in the Big South Fork. Tagged fish were stocked at the mouth of Laurel River in the Cumberland River and Turkey Creek boat ramp in the Big South Fork.

Tagging—Thirty lake sturgeon that had been held from the 2008 year class (4 year old fish) at Peter Pfeiffer Fish Hatchery were surgically implanted with Vemco (Bedford, Nova Scotia) ultrasonic transmitters. Fifteen were implanted with Vemco V-16 tags with a 30 second nominal delay (battery life 3.5 years), and the remaining 15 lake sturgeon were tagged with continuous Vemco V-13 tags (battery life 1.0 year). A longitudinal incision was made to the right of the ventral midline, anterior of the pelvic fins, and approximately two-thirds of the distance starting from the pectoral fins back towards the pelvic fins. A transmitter was sterilized with Cidex Plus (Ethicon Inc., Irvine, CA), rinsed in sterile water, and inserted into the body cavity. The incision was closed with sterile Monocryl Plus monofilament sutures and an FS-1 24-mm reverse cutting needle (Ethicon Inc., Irvine, CA). Each tag emitted unique 69 kHz sound trains that allowed for identification of individual fish.

Telemetry—In order to determine movement patterns, lake sturgeon were monitored using a stationary receiver array of Vemco VR2W's from 2012 – 2014. The array monitored movement outside the stocking areas into local tributaries (Laurel River, Rockcastle River, Buck Creek, and Little South Fork) and Lake Cumberland. Twelve stationary receivers were deployed at sites upstream and downstream of the two stocking sites in the Big South Fork and Cumberland River to determine movement out of the stocking areas (Figure 1). Receivers were intended to be downloaded monthly but due to time constraints and increased emphasis on other projects, receivers were downloaded whenever schedules allowed. Data collected from receivers was viewed in Vemco VUE software to analyze movement patterns and distribution. Active tracking by boat using a Vemco VR-100 receiver and 2 Vemco VR-110 directional hydrophones was used in 2013 to collect additional movement and potential habitat use data. When fish were detected using active tracking, GPS coordinates, depth, current velocity (drift speed of boat), and general macrohabitat were recorded. Active tracking was planned to be conducted monthly; however time and schedule issues only allowed for 6 sampling events.

Results

Stocking—From 2007 – 2014, a total of 21,435 lake sturgeon fingerlings were stocked; 12,601 in the Cumberland River and 8,834 in the Big South Fork (Table 1). No lake sturgeon were produced and stocked in 2012 or 2013 due to production issues.

Telemetry—All tagged lake sturgeon were accounted for, and all stationary receivers detected fish throughout the course of the project (Table 2). No noticeable, consistent movement patterns were observed. Two lake sturgeon were detected moving over 35.0 mi, while others stayed in close proximity to stocking sites. Fifty percent of tagged fish moved downstream into Lake Cumberland during various times throughout the study, and tracking data and stationary receiver logs indicated that the majority of fish were still in Lake Cumberland below the KY Route 90 Bridge at the conclusion of the study. It is also apparent that some tagged fish moved upriver of stocking sites (specifically in the Big South Fork); 23.3% of tagged lake sturgeon were last detected at the uppermost receivers in the study area. Use of tributaries also showed no consistent patterns throughout the study; however, use of tributaries in the

months immediately following stocking (April and May 2012) was high as 63.3% of tagged lake sturgeon found their way into tributaries.

Active tracking was only able to be conducted on 6 occasions due to time and schedule constraints. Tracking yielded just 4 detections, all of which were recorded near the edges of the study site. Although not enough manual detections exist to quantify habitat use, all 4 detections occurred in inside bend habitats which typically provide sandy substrate and low velocity habitats often preferred by lake sturgeon.

Discussion

Lake sturgeon in Lake Cumberland displayed no trends in seasonal movement; rather they were located in all areas throughout the study. Barth et al. (2011) also found no significant differences in seasonal movement or habitat use of lake sturgeon in the Winnipeg River. Conversely, many studies have found that lake sturgeon exhibited higher movement in the spring followed by sedentary periods in the summer and low movement throughout fall and winter (Rusak and Mosindy 1997; McKinley et al. 1998; Borkholder et al. 2002; Knights et al. 2002). Reasons for discrepancies between studies are unclear, but are likely the result of differences in environmental factors such as flow, habitat, and prey abundance between systems.

Though lake sturgeon in Lake Cumberland displayed no consistent movement patterns, valuable data regarding habitat usage was still gained. We found that 50.0% of tagged fish were last detected in a completely impounded portion of the study site, and 63.3% of lake sturgeon used tributaries at some point. All of these results are consistent with Knight et al. (2002) and Trested et al. (2011), which reported tagged lake sturgeon in the upper Mississippi River and Grasse River, respectively, were most frequently detected in impounded areas and tributaries. Additionally, we found that many of the fish remained very close to their stocking sites. This suggests that lake sturgeon in Lake Cumberland are exhibiting site fidelity to some extent, and corroborates the findings of multiple studies (Fortin et al. 1993; Rusak and Mosindy 1997; Knights et al. 2002; Holtgren and Auer 2004; Lord 2007; Barth et al. 2011) that suggest lake sturgeon have distinct core usage areas and display high site fidelity. In contrast, Smith and King (2005) found that lake sturgeon did not have high site fidelity; however, they suggested the core areas of activity may be more important for lake sturgeon inhabiting lotic environments, such as the Cumberland River and Big South Fork at the upper ends of the study area. Inaugural trotline sampling was conducted by Herrala (2015) just below the stocking site on the Cumberland River, and results indicated that multiple age-classes and decent numbers of fish were in the area. This further substantiates the finding that lake sturgeon stocked into Lake Cumberland display high site fidelity to stocking areas.

Unfortunately, active tracking was unable to be completed on a regular schedule, and only 6 trips were completed and 4 fish were detected throughout the study. Although not enough detections exist to quantify or make significant conclusions about habitat use, all 4 detections occurred in inside bend habitats. Inside bends have low current velocities and typically provide silt/sand substrate. Lake sturgeon in various systems have been found to associate with silt and sand substrates as well as low current velocities (Knights et al. 2002; Smith and King 2005; Trested et al. 2011).

Management Implications

KDFWR has committed to a 20 year reintroduction effort for lake sturgeon into Lake Cumberland. Results of this study as well as others from various geographical locations show that lake sturgeon (especially juveniles) have the potential for large movements, but exhibit high site fidelity towards stocking areas and often have sedentary periods throughout the year. Initial results from trotline sampling (Herrala 2015) indicated that survival, growth, and condition of stocked lake sturgeon into Lake Cumberland was exceptional, and that the stocking efforts are having the desired effects. Future efforts on lake sturgeon in this area should focus on capturing stocked individuals to monitor relative abundance, survival, growth, and potential natural reproduction that may be occurring.

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Tables and Figures

Table 1. Stocking months, numbers, and average length of lake sturgeon fingerlings stocked in Lake Cumberland.

Site	Year	Month	Number fingerlings	Average length (in)
Cumberland River	2008	April/September	973	7.3
	2009	October	1,973	7.5
	2010	August/September	4,539	6.8
	2011	October	2,150	8.5
	2012		0	
	2013		0	
	2014	October	2,966	8.0
	Total		12,601	7.6
Big South Fork	2008	September	705	7.4
	2009	October	2,004	7.5
	2010	August/September	4,062	6.7
	2011		0	
	2012		0	
	2013		0	
	2014	September	2,063	8.0
	Total		8,834	7.4

Table 2. Lake sturgeon detections collected by VR2 array on the Cumberland River and Big South Fork from 2012 - 2014.

			No. of fish detected											
			Cumberland River Tract								Big South Fork Tract			
Year	Month	Total	Above Laurel River	Laurel River	Below Laurel River	Rockcastle River	Buck Creek	Antioch Bend	27 Bridge	90 Bridge	Burnside Boat Ramp	Below Little South Fork	Little South Fork	Above Little South Fork
2012	Apr		12	1	12	0	0	0	0	1	1	7	8	11
	May		7	0	7	1	6	8	7	5	5	8	5	8
	Jun		2	1	2	0	2	5	4	4	5	4	1	3
	Jul		0	0	0	0	1	2	2	7	2	3	1	1
	Aug		0	0	0	0	2	0	0	2	0	3	0	3
	Sep		1	0	1	0	2	1	1	1	0	0	2	2
	Oct		0	0	0	0	1	6	6	3	0	0	1	1
	Nov		0	0	0	0	0	1	4	5	*	*	1	1
	Dec		0	0	0	0	0	1	0	4	*	*	1	1
2013	Jan		1	1	1	0	0	0	0	3	*	*	0	0
	Feb		1	2	2	0	0	0	0	3	*	*	0	0
	Mar		0	0	0	0	0	1	1	3	*	*	0	0
	Apr		0	0	0	0	0	0	*	0	*	*	0	0
	May		0	0	0	0	1	0	*	0	*	*	0	1
	Jun		0	0	0	0	0	0	*	0	*	*	1	1
	Jul		0	0	0	1	0	0	*	0	*	*	0	2
	Aug		0	0	0	0	0	0	*	0	*	*	0	2
	Sep		0	0	0	0	0	0	*	0	*	*	1	2
	Oct		0	0	0	0	0	0	*	0	*	*	0	1
	Nov		0	0	0	0	0	0	*	0	*	*	0	0
	Dec		0	0	0	0	0	0	*	0	*	*	0	0
2014	Jan		0	0	0	0	0	0	*	0	*	*	0	0
	Feb		0	0	0	0	0	0	*	0	*	*	0	0
	Mar		0	0	0	0	0	0	*	0	*	*	0	0

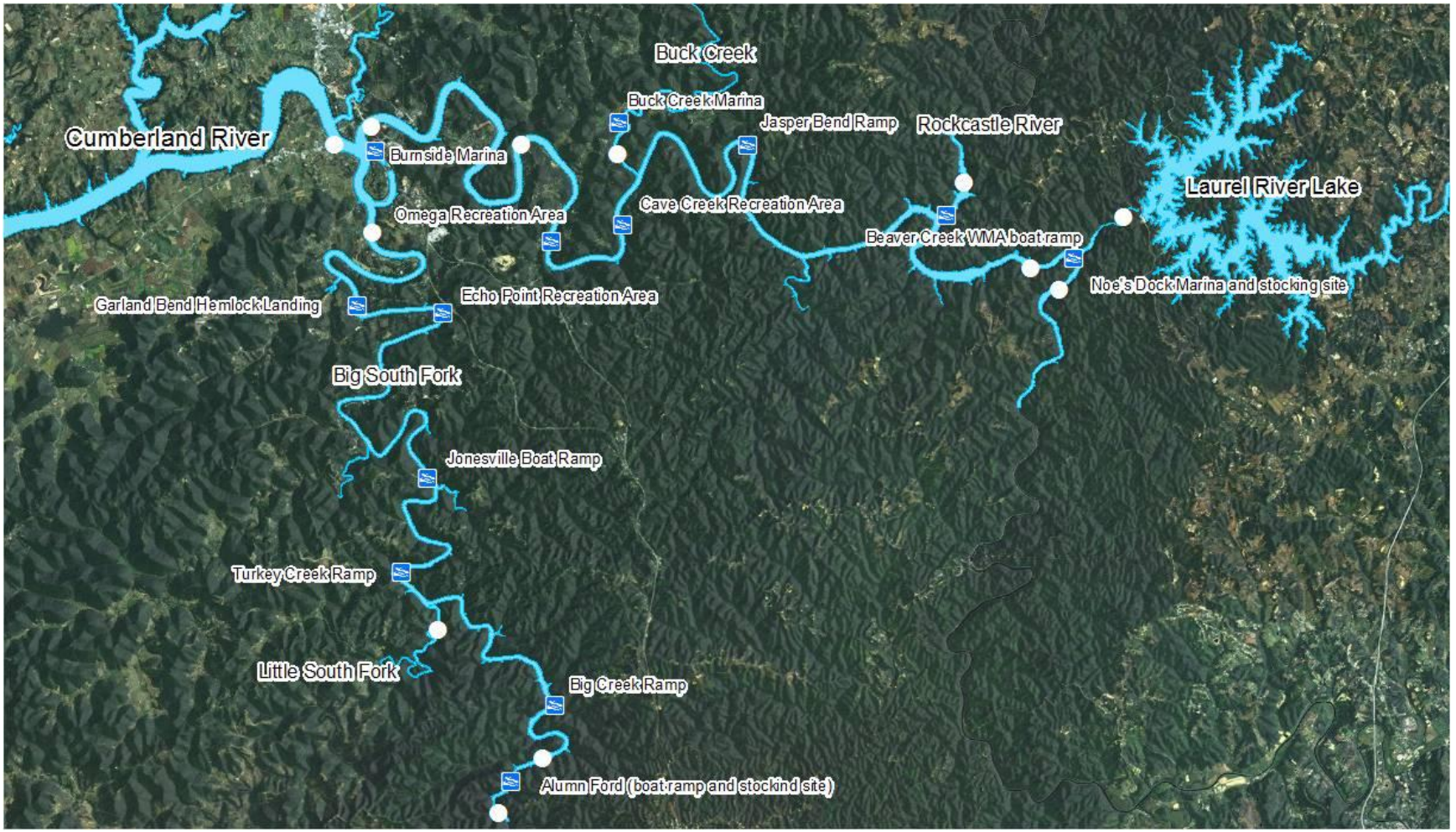

Figure 1. Map of VR2W locations and access sites for the Cumberland River and Big South Fork. White circles represent VR2 locations.