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KOOTENAI RIVER WHITE STURGEON SPAWNING AND RECRUITMENT EVALUATION

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Kootenai River White Sturgeon Spawning and Recruitment Evaluation

Project Progress Report

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By

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TABLE OF CONTENTS

Page

ABSTRACT....1
INTRODUCTION....2
GOAL....2
OBJECTIVE....2
STUDY SITE....3
METHODS....3
Water Levels, Discharge, and River Temperature....3
Adult White Sturgeon Sampling....3
Adult White Sturgeon Telemetry....4
Artificial Substrate Mat Sampling....5
Larval White Sturgeon Sampling....6
Juvenile White Sturgeon Sampling....6
RESULTS....6
Water Levels, Discharge, and River Temperature....6
Adult White Sturgeon Sampling....7
Adult White Sturgeon Telemetry....7
Artificial Substrate Mat Sampling....8
Larval White Sturgeon Sampling....8
Juvenile White Sturgeon Sampling....9
DISCUSSION....9
RECOMMENDATIONS....10
ACKNOWLEDGMENTS....11
LITERATURE CITED....26
APPENDICES....28

LIST OF TABLES

Page

Table 1. Sampling effort and number of adult and juvenile white sturgeon captured in the Kootenai River, Idaho, February 27, 2007 to November 6, 2007. 12

Table 2. Vital statistics from Kootenai River adult white sturgeon marked with Vemco sonic tags as part of a telemetry study, Kootenai River, Idaho, 2003-2007.....13

Table 3. Number of detections of female white sturgeon expected to spawn in 2007 that were within a 125 m radius of the centroid of the VRAP buoy array, Kootenai River, 2007. 14

Table 4. Results from static interaction analyses testing association of fixed kernel utilization distributions (UD) between mature female white sturgeon and the spatial footprint of the boulder matrix. Note that for 2006 the analysis tests whether fish used the area that was altered in 2007. Concordance between UDs was assessed at n = 100 randomly selected points within the area of overlap ($P \leq 0.05$) (From Parsley et al. 2008b).....15

Table 5. Location (strata, rkm), depth (m), effort, white sturgeon egg catch and CPUE (hours) by standard artificial substrate mats, Kootenai River, Idaho, 2007.....15

Table 6. Stages of white sturgeon eggs captured by artificial substrate mats, Kootenai River, Idaho, 2007.....16

Table 7. Summary of 2007 white sturgeon larval sampling effort and volume sampled by gear type and location, Kootenai River, Idaho.....17

Table 8. Idaho Department of Fish and Game juvenile hatchery white sturgeon gill net sampling effort by sampling location for July through September 2007. 18

Table 9. Idaho Department of Fish and Game juvenile hatchery white sturgeon gill net sampling effort by mesh size for July through September 2007.....18

Table 10. Summary statistics of recaptured juvenile hatchery white sturgeon (N = 204) from 2007 gill net sampling, Kootenai River, Idaho. 19

Table 11. Wild juvenile white sturgeon captured in gillnets in 2007, Kootenai River, Idaho.....19

LIST OF FIGURES

Figure 1. Location of the Kootenai River, Kootenay Lake, Lake Koocanusa, and major tributaries. The river distances from the northernmost reach of Kootenay Lake are in river kilometers (rkm) and are indicated at important access points. 20

Figure 2. Mean daily flow patterns in the Kootenai River at Bonners Ferry, Idaho from 1928-1972 (pre-Libby Dam), 1973-1990 (post-Libby Dam) and 1991-2007 (post-Libby Dam with augmented flows, May 1 through June 30). 21

Figure 3. Mean daily discharge (m^3/sec) and temperature (°C) for Kootenai River at Bonners Ferry, Idaho, 2007. 21

Figure 4. Location of Vemco VR2 receivers in Kootenai River/Lake system, Idaho and British Columbia, Canada, 2007. 22

Figure 5. Egg mat placement study site for 2007 Kootenai River white sturgeon egg mat study, Kootenai River, Idaho. 23

Figure 6. Telemetry locations of eight reproductively mature female white sturgeon in 2006. The boulder matrix area, created in 2007, is noted here since our intent was to investigate use of the unmodified area prior to the habitat improvement project. The polygon surrounding the fish positions shows the area of overlap with the boulder matrix. The light gray circle represents a radius of 125 m from the centroid of the buoy array (From Parsley et al. 2008b). 24

Figure 7. Telemetry locations of 14 reproductively mature female white sturgeon in 2007 and the location of the boulder matrix as constructed. The polygon surrounding the fish locations shows the area of overlap with the boulder matrix. The light gray circle represents a radius of 125 m from the centroid of the buoy array (from Parsley et al. 2008b). 25

LIST OF APPENDICES

Appendix 1. Study site locations for Kootenai River white sturgeon spawning study, Kootenai River, Idaho, 2007.....29

Appendix 2. Random numbers generated table for determining egg mat placement locations for Kootenai River white sturgeon spawning study, Kootenai River, Idaho, 2007.....30

Appendix 3. Migration of eight female white sturgeon, all of which are believed to have spawned in the Kootenai River, Idaho, 2007.....32

Appendix. 4 Numbers and recapture rates of hatchery produced white sturgeon juveniles (progeny of wild brood stock) released into the Kootenai River and Kootenay Lake in Idaho, Montana, and British Columbia between 1990 and December 2007 (from Kootenai Tribe of Idaho and Idaho Department of Fish and Game Annual Reports 1990-2006). This table includes tagged and/or measured fish only.....40

Appendix 5. Juvenile hatchery releases with no tag added or measurements taken through March 31, 2007: combined hatcheries. 41

Appendix 6. Year class, number captured, capture locations, fork length (cm), total length (cm), and weight (kg) of hatchery released juvenile sturgeon captured with gill net from Kootenai River, Idaho, through 2007.....42

Appendix 7. Number of aged wild juvenile white sturgeon captured by year class in the Kootenai River, Idaho, since 1977. 50

Appendix 8. Number of wild juvenile white sturgeon captured annually in the Kootenai River, Idaho, since 1977. 51

ABSTRACT

The objective of this research was to determine the environmental requirements for successful spawning and recruitment of the Kootenai River white sturgeon *Acipenser transmontanus* population. Annual tasks include monitoring and evaluating the response of various life stages of Kootenai River white sturgeon to mitigation flows supplied by the United States Army Corps of Engineers (Corps). On June 6, Libby reservoir inflows peaked at 1,977 m^3/s (69,800 ft^3/s) and the reservoir filled to elevation 750 m (2,454 feet) by July 22. Outflow discharge peaked in late May at 725 m^3/s (25,600 ft^3/s), was reduced to 425 m^3/s (15,000 ft^3/s) during the remainder of the spawning season, and then increased slightly to 481 m^3/s (17,000 ft^3/s) for July and August. By September, flows were reduced to 255 m^3/s (9,000 ft^3/s) and declined steadily throughout the fall. Sampling for adult Kootenai River white sturgeon in 2007 began in February and continued into October. One hundred thirty adult white sturgeon were captured with 4,963 hours of angling and set-lining effort. Thirteen adult white sturgeon were tagged in spring 2007, and 24 of the current or previously tagged adult sturgeon exhibited a spawning migration in 2007. Twenty-one of these 24 (88%, 13 females) migrating adults were recorded at river kilometer (rkm) 240.9, just above Deep Creek, yet only 13 (54%, eight females) of the migrating adults went upstream as far as rkm 244.5 (Ambush Rock). Additionally, 25 percent (six fish of which four were females) went above the Hwy. 95 Bridge in Bonners Ferry into the braided reach. In 2007, we obtained 1,668 locations in the Vemco radio-linked acoustic positioning system (VRAP) array from 14 mature female white sturgeon between May 9 and June 21. The sturgeon in 2007 were not associated with the Shorty's Island pilot study rock structure. We sampled for sturgeon eggs with egg mats at nine sites within the traditional post-Libby Dam spawning reach (rkm 227.0–245.5). Sampling occurred between May 7 and July 6, and 72 eggs were collected. No eggs were collected on the Shorty's Island pilot study rock structure, and most of the eggs were collected just outside the structure near rkm 229.1. Based on the stages of the 72 eggs collected, we estimate that white sturgeon spawned during at least 12 days in 2007. We sampled for white sturgeon embryos and larvae between June 18 and August 8 and spent a total of 946 hours sampling at seven sites between rkm 225.0 and 245.1. A total of 152 fish larvae were collected, but larval sturgeon were not part of the catch in 2007. The highest catch came from the mid-column D-ring nets, and most were collected in late June. Most of the catch was larval *Catostomidae*. We sampled for juvenile white sturgeon with gillnets between July and September 2007. We sampled 20 sites and captured 441 hatchery reared juvenile white sturgeon and seven wild juvenile white sturgeon with 578 h of effort. The Rock Creek area (rkm 215.0) had the highest catch with 23 percent of the individuals, but the highest catch rates of 1.8 fish per net hour came from the Ambush Rock area (rkm 245.0).

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INTRODUCTION

The Kootenai River white sturgeon *Acipenser transmontanus* population is comprised mainly of old-aged adults, and significant recruitment has not occurred since the 1970s. Although the specific causes of recruitment failure remain unclear, years of study suggest that mortality occurs between embryo and larval stages. Over a decade of artificial substrate mat sampling has indicated that from nine to 20 spawning events occur annually, and many viable embryos are produced (Paragamian and Wakkinen 2002). Most of the post-Libby Dam spawning events have been documented in areas where substrate conditions appear to be unsuitable for egg incubation and larval rearing (Paragamian et al. 2001), and only one larvae and very few wild juveniles have been collected despite years of intensive sampling. However, recent bathymetry, sediment transport, shear stress, and velocity studies suggest Libby Dam era flows are unable to scour pockets of existing cobbles and gravels where white sturgeon presently spawn (McDonald et al. 2006). Research to date suggests that egg and/or larval suffocation, predation, and/or other mortality factors associated with these early life stages contribute to persistent recruitment failure (Kock et al. 2006). Hatchery-reared juveniles (as young as 9 months of age at release) have average annual growth rates of 6.4 cm per year, and second year survival rates exceed 90% (Ireland et al. 2002). Since 1991, Libby Dam has released spring flows intended to benefit Kootenai River white sturgeon (hereafter white sturgeon) spawning by increasing discharge above 630 m^3/s for 42 d.

One strategy being considered to restore this endangered population is to enhance existing spawning areas by the placement of substrates more suited for sturgeon egg attachment and incubation. As with any habitat enhancement project, questions arose regarding the permanence of the work. Therefore, a small-scale project was planned to provide information on the feasibility of larger spawning habitat enhancement projects in the Kootenai River. The Kootenai River White Sturgeon Recovery Team considered a number of options for size and placement of the small-scale project. It was agreed that the surface area would be approximately 1,200 m^2 and that it would be constructed at a known white sturgeon spawning area near Shorty's Island (river km 231; 48° 45’ 52” N, 116° 23’ 12” W). Construction in the Shorty's Island reach began in July 2006 and was completed by September. Placement of individual boulders in the matrix was done by clamshell bucket on a crane from the top of the levee bordering the river. Thus, the distal edge of the matrix was limited by the length of the crane boom. The result was a linear matrix of large boulders located roughly parallel to the river edge and parallel but adjacent to the spawning location. After construction, the minimum water depth over the boulders was expected to be approximately 1 m at typical flows during the spawning period.

GOAL

The goal of the Kootenai River white sturgeon investigations is to recover the population to a self-sustained fishable population.

OBJECTIVE

Our study objective was to determine environmental requirements for successful spawning and recruitment of Kootenai River white sturgeon. The main task of this program is to

monitor the response of all life stages of white sturgeon to mitigative flows from Libby Dam provided by the United States Army Corps of Engineers (Corps).

STUDY SITE

The Kootenai River originates in Kootenay National Park, British Columbia (BC), Canada. The river flows south into Montana and turns northwest at Jennings, near the site of Libby Dam, at river kilometer (rkm) 352.4 (Figure 1). Kootenai Falls, 42 rkm downstream of Libby Dam, may be an impassable barrier to white sturgeon. As the river flows through the northeast corner of Idaho, there is a gradient transition at Bonners Ferry. Upstream from Bonners Ferry, the channel has an average gradient of 0.6 m/km, and the velocities are often higher than 0.8 m/s. Downstream from Bonners Ferry, the river slows to velocities typically less than 0.4 m/s, the average gradient is 0.02 m/km, and the channel deepens as the river meanders north through the Kootenai River Valley. The river returns to BC at rkm 170.0 and enters the South Arm of Kootenay Lake at rkm 120.0. The river leaves the lake through the West Arm of Kootenay Lake and flows to its confluence with the Columbia River at Castlegar, BC. A natural barrier at Bonnington Falls (now a series of four dams) has isolated the Kootenai River white sturgeon from other populations in the Columbia River basin for approximately 10,000 years (Northcote 1973). The basin drains an area of 49,987 km^2 (Bonde and Bush 1975). Regulation of the Kootenai River following the construction of Libby Dam in 1974 changed the natural hydrograph and temperatures of the river. Spring flows were reduced to about a third, and flows during winter are now three to four times higher (Figure 2). Temperatures are now cooler in summer and warmer in winter.

METHODS

Water Levels, Discharge, and River Temperature

Kootenai River stage, discharge, and water temperature data at Bonners Ferry were obtained from the US Army Corps of Engineers (USACE/Corps) (Figure 3). In 2007, United States Fish and Wildlife Service (USFWS) in cooperation members of the Kootenai River White Sturgeon Recovery Team (KRRT) proposed to the Corps a System Operational Request FWS #1 while operating under strict variable flow (VARQ) flood control guidelines. Under VARQ, higher, more stable summer discharges are provided to the extent possible with the available water to meet white sturgeon and bull trout ESA responsibilities (USFWS 2006) in an attempt to mimic a more natural river hydrograph. The intent was to provide 566-708 m^3/s (20,000-25,000 ft^3/s) through the dam turbines without decreasing water temperatures by more than 1.5°C for up to two weeks to benefit migrating and spawning white sturgeon. Discharges during white sturgeon spawning in 2007 were expected to be near normal because snowpack in the basin was near 100% of normal.

Adult White Sturgeon Sampling

Adult white sturgeon were collected by angling or setlines from February through October 2007 following the methods of Paragamian et al. (1996). From February through April, most of the sampling occurred in the staging areas at rkm 205 and 215. These areas are backwater habitats and have depths in excess of 20 m and low current velocities (<0.05 m/s). Later in the spring, areas further upstream closer to the spawning locations were sampled more

frequently (near rkm 229). Fall 2007 sampling occurred in the spring staging areas and near the Kootenai River delta at rkm 120. We biopsied adult sturgeon to determine sex and level of maturity (Conte et al. 1988; Van Eenennaam and Doroshov 1988). Male and female white sturgeon expected to spawn in 2007 or later were tagged with Vemco model V16 sonic transmitters and released (see telemetry section). Some adult female white sturgeon expected to spawn in 2007 were transported to the Kootenai Tribe of Idaho (KTOI) Hatchery for hatchery production. Gametes from ripe male white sturgeon were collected in the field by extraction through the urogenital opening with a syringe. Gametes were placed in a Ziploc® bag, transported to the KTOI Hatchery, and stored in a refrigerator. White sturgeon sperm is viable for only 48 hours after extraction, so we did not collect male gametes until a female was initially induced to ovulate.

Adult White Sturgeon Telemetry

Monitoring daily and seasonal movements of white sturgeon throughout the Kootenai River/Lake system continues to be a high priority of this investigation. Beginning in 2003 and continuing into 2007, we deployed an array of passive Vemco model VR2 sonic receivers from Kootenay Lake, BC upstream to near the Montana border in Idaho (Figure 4). We deployed receivers in areas where fish pass through but do not usually hold for long periods to avoid redundant data collection. Most sites were below river bends or along straight reaches that allow for good signal reception but are reasonably free of drifting debris and out of potential vandals' sight. Each receiver was tethered to a float to keep the hydrophone off the substrate, anchored to a cement block, and chained to the riverbank. Receivers are downloaded by connecting proprietary hardware (VR2PC) through a computer serial port to an external port on the receiver. Data are transferred through the serial port to proprietary software for analysis. This array allows continuous monitoring of sturgeon movements within the Kootenai river system and into Kootenay Lake.

Through a contract with United States Geological Survey (USGS) Biological Resources Division, an acoustic telemetry positioning system (VRAP, Vemco, Shad Bay, Nova Scotia) was deployed in 2006 and 2007 in the Shorty's Island white sturgeon spawning reach (Figure 5) to determine adult white sturgeon movements before and after the habitat enhancement. The lineal distance between the moorings and the base station was approximately 6.4 km (4 miles). The mooring for the primary buoy was located outside of the main current flow and was fixed with two anchors, one upstream and one downstream, to reduce buoy movement. The other two moorings were located in the current and needed only one anchor each (Rust and Wakkinen 2008). The VRAP system is typically able to furnish position information with a resolution in the range of 1 to 2 meters within the buoy triangle. Receivers on the buoys collect transmitter detections from the tagged animal, information about these detections is dispatched by radio to a base station, and a position is calculated and displayed in real-time. When an acoustic signal from a transmitter was received, the geographic coordinates of the transmitter were calculated based on hyperbolic equations and time of arrival of transmitter pulse strings at each hydrophone using the vendor-provided software. These coordinates were then used for display and analysis within a geographic information system (GIS). The geographic coordinates of each buoy were repeatedly checked using global positioning system (GPS) receivers. Klimley et al. (2001) provide a thorough description of theory and operation of the positioning system used in this study, and Parsley et al. (2008a) describe the use of a VRAP system to obtain information on white sturgeon movements in the lower Columbia River, USA.

We evaluated fish use of the area before (2006) and after (2007) construction of the small-scale habitat alteration project via static interaction analysis (Doncaster 1990). Joint space occupancy between the fish and the boulder matrix was assessed by determining concordance in overlap of the distribution of fish with the geographic footprint of the boulder matrix (Figures 6 and 7). Static interaction models developed by Doncaster (1990), which are nonparametric and independent of sample size, have been the basis for many studies of joint space use. Within each year, we tested the null hypothesis that the distribution of mature female sturgeon and the area occupied by the boulder matrix were not associated. For our analyses, we used only locations of mature female fish expected to spawn during 2006 or 2007, and we used only locations that were within a radius of 125 m from the centroid of the triangle formed by the three buoys. This avoided confounding the analyses with locations from nonspawning fish and ensured that the fish locations we analyzed were in close proximity to the area of the small-scale habitat enhancement project. Stationary transmitters deployed to assess precision and accuracy of the positioning system revealed no concerns for this analysis.

Space use by mature female white sturgeon in the river reach was measured by the computation of a fixed kernel utilization distribution (UD; Worton 1989) with least-squares cross-validation smoothing from the telemetry point locations for each year. We combined the locations from all mature female fish for each year to create a UD describing their use of the river reach. We created a point data file to represent the boulder matrix as constructed in 2007 by randomly assigning 1,000 points to a polygon bounding the matrix and created a UD for this area. The UDs were created using the Animal Movements Analyst Extension (version 2.51; Hooge et al. 2002) in ArcView 3.3. A minimum convex polygon bounded the point data and provided an assessment of overlap between the fish and the boulder matrix. Spearman's rank correlation coefficient was used to assess concordance in overlap of areas (Doncaster 1990). For 2006, the analysis tests whether fish used the area that was altered in 2007. Concordance in overlap of UDs was assessed at 100 randomly selected locations within the area of overlap.

Artificial Substrate Mat Sampling

Artificial substrate mats were used to document white sturgeon spawning in the Kootenai River (McCabe and Beckman 1990). In 2007, a stratified random study design was used to evaluate egg distribution and timing for the white sturgeon spawning season. The main purpose of this study is to evaluate potential egg deposition and spawning on the Shorty's Island pilot study rock structure (see previous section) and determine the distribution and timing of egg deposition within the post-Libby Dam spawning reach downstream from Bonners Ferry (Figure 5). Mats were checked daily and all eggs were removed from the mats. Eggs were stored in formalin and brought back to the field station and information noted as to date and location of the collection. All eggs were staged by viewing at 120X under a dissecting microscope to estimate spawn date by the methods described by Beer (1981).

Nine study sites were selected between river kilometers 227 and 245.5. These sites were selected based on historical egg distribution studies and represent locations where the highest densities of eggs have been collected (Paragamian et al. 2002) (Appendix 1). At each site, six substrate mats were randomly placed within each study reach. To coincide with the dimensions of the Shorty's Island pilot study rock structure, each egg-sampling site is 120 m long by 10 m wide. Our study design included a random numbers function of Excel to generate the geographic locations for the placement of each mat within each site (Appendix 2). The center of each of the nine sites was marked by a distinct buoy at the latitude-longitude locations given on Appendix 1. Once arriving at this location, Appendix 2 was used to determine the

placement location of each successive mat. For example, using Appendix 2, on May 7 mat 1 will be placed 3 m upstream and 3 m to the right (when looking upstream) of the starting point. On May 8, after mat 1 was checked for the presence of eggs, we would return to the starting location, marked by the distinct buoy, and mat 1 was placed 29 m downstream and 1 m right of the starting point. The guidelines in Appendix 2 for determining egg mat placement location were used for all nine sites each day.

Larval White Sturgeon Sampling

In 2007, larval white sturgeon sampling was conducted using ½-m nets at midwater column depths and at the surface, and D-ring nets at the bottom of the Kootenai River. Nets were fished passively in the river current with a boat anchored in the thalweg or nets were towed downstream at speeds exceeding the river current. Lead weights ranging from 2.7 to 9.1 kg (6-20 lbs) were attached to midcolumn and bottom nets in order to reach desired depths. A diver's depth watch was attached to the mid column nets to record specific depth within the water column. A General Oceanics model 2030R flow meter was attached to the mouth of each net to record rotor revolutions, which was used along with net diameter and sampling time to give the total volume of water sampled. In addition to the standard boat sampling, later in the season after river discharge decreased, ½-m nets and D-ring nets were anchored with 100 kg cement blocks in shallow water and fished overnight and left unattended until the following morning. Larval sampling took place at various times of the day between rkms 227.5 and 262.0 in July and August 2007.

Juvenile White Sturgeon Sampling

We used weighted multifilament gill nets with 2.5, 3.8, 5.1, 6.4, 7.6, and 10.2 cm stretch mesh to sample juvenile and young-of-the-year (YOY) sturgeon in the Kootenai River. Sampling was conducted in August and September 2007 and followed the methodology of Paragamian et al. (1996). We sampled 20 different sites between rkm 170.0 and 245.0. Gill nets were set during the daytime and checked every hour to reduce mortality of sampled fish, and all fish were released alive. From 1992 to 2004, prior to release, each fish was passive integrated transponder (PIT) tagged and a pattern of scutes removed, which provided a unique mark for each brood year. In 2005 and 2006, most (92%) of the released juvenile white sturgeon were not PIT tagged, although scutes were removed from each fish released. All hatchery reared juvenile sturgeon released in the Kootenai River after 2007 were PIT tagged and had scutes removed in a pattern unique to the brood year and rearing facility. We recorded fork (FL) and total length (TL), weight, PIT tag numbers, fish condition, and scute removal patterns (to determine release date and location of hatchery fish) for each sampled fish. Pectoral fin ray sections were removed from all wild juvenile white sturgeon for age determination.

RESULTS

Water Levels, Discharge, and River Temperature

On June 6, 2007, Libby reservoir (Lake Koocanusa) inflows peaked at 1,977 m^3/s (69,800 ft^3/s) and the reservoir filled to elevation 750 m (2,454 feet) by July 22. Outflow discharge peaked in late May at 725 m^3/s (25,600 ft^3/s), was reduced to 425 m^3/s (15,000 ft^3/s) during the remainder of the spawning season, and then increased slightly to 481 m^3/s (17,000

ft^3/s) for July and August. By September, flows were reduced to 255 m^3/s (9,000 ft^3/s) and declined steadily throughout the fall (Figure 3).

Water temperatures began increasing slowly in late March from 4 to 5°C and by late April began increasing rapidly into the beginning of the spawning season (Figure 3). By May, temperatures were over 8°C and oscillated between 8 and 11°C during the spawning season. By mid-August, water temperatures reached their maximum of 16°C. Unlike previous years, water temperature increased steadily throughout the spawning season, and increases in discharge did not dramatically decrease temperatures at Bonners Ferry.

Adult White Sturgeon Sampling

Between February 27 and November 6, 2007, we expended a total of 4,963 h to capture 33 adult white sturgeon by angling and 97 adult white sturgeon with setlines. Two juvenile white sturgeon were captured while angling for adults and one juvenile white sturgeon was captured while setlining for adults (Table 1. The adult sturgeon catch per unit effort (CPUE) was 0.084 fish per rod h for angling and 0.02 fish per setline h for setlines (Table 1). Ninety-one (70%) of the 130 adult white sturgeon collected were recaptures from previous years (Table 1). Thirty-seven adult white sturgeon were biopsied by IDFG during adult sampling; 20 were females, five were males, and sex could not be determined from 12 individuals. Nine of the 20 females biopsied were stage F4 (mature eggs), one was stage F3 (developing eggs), two were stage F2 (immature eggs), five were attritic and reabsorbing eggs, and specific stage could not be determined from the remaining three females. Four of the biopsied males were stage M8 (mature testes), and specific stage could not be determined from one male. KTOI Hatchery personnel also captured and biopsied adult white sturgeon for their propagation operations; Lewandowski (2007) provides adult capture information.

Adult White Sturgeon Telemetry

Adult white sturgeon movements were analyzed after downloading location data from 56 stationary Vemco VR2 sonic receivers located from rkm 18.0, near the mouth of the Lardeau River in Kootenay Lake, BC, upstream to rkm 275.5, just below the Montana Idaho border (Figure 4). Thirteen adult white sturgeon were tagged with Vemco sonic transmitters in spring 2007, four were tagged in fall 2006 that were expected to spawn in 2007, and 50 adult white sturgeon had active Vemco sonic transmitters from previous years or were not expected to spawn in spring 2007 (Table 2). Ten of the adult white sturgeon tagged in spring 2007 were fitted with Vemco pressure sensor tags so depth could be determined as fish entered the VRAP array. To date, 67 adult sturgeon have been tagged with Vemco sonic transmitters (Table 2).

Twenty-four tagged adult white sturgeon (14 females) were in spawning condition and exhibited a spawning migration. This is defined as fish observed in spawning condition in 2007 or expected to be in spawning condition based on previous biopsies, which moved upstream to at least the lower end of the spawning reach (rkm 228.0). All 24 of these tagged adults moved upstream as far as rkm 232. Twenty-one (88%, 13 females) of the migrating adults were recorded at rkm 240.9 just above Deep Creek, yet only 13 (54%, eight females) of the migrating adults went upstream as far as rkm 244.5 (Ambush Rock). Additionally, 25 percent (two males, four females) went above the Hwy. 95 Bridge in Bonners Ferry into the braided reach. One female white sturgeon went upstream above Bonners Ferry into the braided reach and was recorded at rkm 249.6, the furthest upstream migration any tagged white sturgeon has been recorded since IDFG began telemetry studies in 1991.

Appendix 3 shows the temperature and discharge conditions during the movement histories of eight female white sturgeon that exhibited a spawning migration in 2007. Some of these individuals were tagged in previous years.

In 2006, the VRAP buoys were placed in the river on April 27. The buoys were removed from the water on May 15 because of the potential for loss or damage due to forecasted high water and associated debris and placed back on the moorings on May 25 (Rust and Wakkinen 2008). Forecasted high water again resulted in removal of the buoys on June 10. They were placed back in the river on June 36 and remained until July 13. In 2007, the VRAP buoys were placed in the river on April 20 and removed on June 29.

In 2006, we obtained 526 locations for eight mature female sturgeon (range 2-320; Figure 6) from April 28 through June 10. The polygon bounding the fish locations overlapped 54.1% of the area that the boulder matrix would occupy in 2007. In the area of overlap, concordance of UDs was significant (Table 4). Thus, we rejected the null hypothesis that the UDs were not associated (Table 4); instead, the UDs were negatively associated. That is, in 2006 the mature female sturgeon avoided the area where the boulder matrix was ultimately constructed. In 2007, we obtained 1,668 locations from 14 mature female white sturgeon (range 13-483; Table 3; Figure 7) during May 9 through June 21. The polygon bounding the fish locations overlapped 93.5% of the area of the boulder matrix. Despite the high degree of overlap, concordance of UDs was not significant, and we accepted the null hypothesis that the UDs were not associated (Table 4). The mature female sturgeon locations in 2007 were not associated with the constructed boulder matrix.

Artificial Substrate Mat Sampling

We deployed a stratified random sampling regime for substrate mat monitoring in 2007 and sampled nine different geographic river sections within the traditional post-Libby Dam spawning reach (rkm 227.0–245.5). We sampled 3,139 mat days between May 7 and July 6 and collected 72 eggs at six of the nine sites. No eggs were collected on the Shorty's Island pilot study rock structure, thus precluding statistical analysis, but the highest catch came just outside the structure near rkm 229.1 (Table 5). The first eggs were collected on May 22, and the last eggs were collected on June 19 (Table 6). Most of the eggs ranged from stages 12 to 19, and only two eggs could not be staged. Based on the stages of the 72 eggs collected approximately 73 percent of the eggs were viable, and based on the ages of the viable eggs we estimate that white sturgeon spawned during at least 12 days in 2007 (Table 6).

Larval White Sturgeon Sampling

Larval sturgeon have never been collected in the Kootenai River in D-ring or conical ½-m plankton nets. In 2007, we sampled for white sturgeon embryos and larvae between June 18 and August 8 (Table 7). We spent a total of 946 h sampling at seven sites between rkm 225.0 and 245.1 (Table 7). Effort was distributed evenly among the seven sites and 152 fish larvae were collected, but larval sturgeon were not part of the catch in 2007. The highest catch came from the D-ring nets, and even though larvae were collected at all depths, effort was not uniform among the gear types (Table 7). Additionally, most of the larval fish were collected in late June, but at least some larvae were collected throughout the sampling period. Most of the catch was larval *Catostomidae*.

Juvenile White Sturgeon Sampling

Beginning in 1990 and continuing to the present, the KTOI hatchery has released over 128,000 juvenile white sturgeon (Appendices 4 and 5). We sampled for juvenile white sturgeon with gillnets between July and September 2007. We sampled 20 sites and captured 441 hatchery reared juvenile white sturgeon and seven wild juvenile white sturgeon with 578 h of effort (Tables 1 and 8). The Rock Creek area (rkm 215.0) had the highest catch with 23 percent of the individuals but the highest catch rates of 1.8 fish per net h came from the Ambush Rock area (rkm 245.0) (Table 8). The catch was well distributed among the 20 sites, and juvenile white sturgeon were collected throughout the river. One hundred twenty-six of the individuals were collected in the 2.5 cm gillnets, but the highest catch rates were in the 3.8 cm nets (Table 9). The average fork and total length of the hatchery reared juvenile white sturgeon was 42.9 cm FL and 49.8 cm TL (n = 204), and weight of juvenile sturgeon averaged 0.51 kg (Table 10). Appendix 4 lists the details on sizes and numbers and recapture rates of tagged and/or measured hatchery juvenile white sturgeon released in the Kootenai River since 1990. Appendix 5 provides the numbers of untagged and/or not measured juvenile hatchery releases through March 31, 2007. Appendix 6 provides the specific growth parameters of hatchery-released juveniles captured in 2007.

Seven wild juvenile white sturgeon were captured while gill netting in 2007 (Table 11). The TL of these seven individuals ranged from 36.6 to 56.7 cm, and weights ranged from 0.18 to 0.71 kg (Table 11). Three of the individuals were collected in the 1.5 cm stretch nets (Table 11). Three different year classes were represented with two individuals assigned to the 2000 year class, four individuals assigned to the 2003 year class, and one individual to the 2004 year class (Table 11). Appendix 7 shows the year class assignments from a sample of the wild juvenile white sturgeon collected between 1957 and 2007 that could be aged. Appendix 8 shows the number of wild juvenile white sturgeon collected annually from 1977 to 2007.

DISCUSSION

The role of discharge (in itself) on sturgeon upstream migration extent remains uncertain. In 2007, although local inflow began in March, discharge from Libby Dam began to increase in mid-April, much earlier than previous years, and water temperatures were still less than 6°C. Yet, most of the sturgeon spawning migration did not begin until mid-May after water temperatures increased above 8°C and discharge was actually reduced (Appendix 3; Figure 3). Although this supports the previous results described by Paragamian and Wakkinen (2002) regarding temperature, the effect of discharge on migration distance remains unknown. In spring 2005, several tagged spawning adult sturgeon were located in the Bonners Ferry area before any increased volume from Libby Dam or from local inflow had occurred (Rust et al. 2007). In the past, as water volume released at Libby Dam during the spring freshet increased, water temperatures at Bonners Ferry decreased, and this cold shower can cause spawning female sturgeon to cease spawning and move downstream out of the spawning reach into warmer water (Paragamian et al. 2001). In 2006 and 2007, biologists at Libby Dam (Greg Hoffman, USACE, personal communication) began installing selective withdrawal gates in the Libby Dam forebay so the warmest water available could be released during the spring spawning season. Ways to judge the effectiveness of this include monitoring the upstream extent of the spawning migrations, evaluating the number of spawning sturgeon, or evaluating behavior of spawning female sturgeon. During 2006 and 2007, based on Vemco continuous passive telemetry monitoring techniques, a significant portion of our tagged sturgeon population migrated above Bonners Ferry into at least the lower end of the braided reach. In 2007, 25

percent (six) of the tagged fish moved into this reach and one female was documented upstream as far as rkm 249.6. This may be significant because the habitat conditions (gravel and cobble) in these areas more closely resemble those of other successfully recruiting populations. It is unknown if the warmer water released as a result of the selective withdrawal gate had any effect on the upstream migration extent of sturgeon in 2007 but this operation should be continued when possible.

Spawning above Bonners Ferry was not documented in 2007. Sampling for eggs in this area is difficult because the water velocities are higher and boat anchors do not hold well in the shifting gravel. Developing an egg sampling strategy for this reach should be a priority.

The Vemco VRAP system proved to be a useful tool for determining movements of adult sturgeon in a specific reach of the Kootenai River. Based on the results of the 2006-2007 VRAP study, white sturgeon did not key in on the rock structure and relative use of the structure was low. Additionally, our substrate mat sampling failed to document any spawning on the structure despite an intense effort. The main purpose of creating the rock structure was to test physical and hydrological parameters such as sedimentation rates and subsidence. The original location for the structure was in the thelweg of the channel, closer to where most of the post-Libby Dam spawning occurs. Had this structure been built where it was originally planned, the biological and physical responses may have been different.

Finding successful spawning habitats and understanding early life history requirements are still the biggest gaps in our understanding of Kootenai River white sturgeon. The embryo releases in 2005 and 2006 were an important first step in selecting sites, determining logistics and developing sampling techniques, and began focusing our recovery efforts on early life history studies. With spawning stock limitations and hatchery production still having priority, other early life history studies may be a better use of a limited resource and should be considered for 2008. Embryos hatched in the KTOI hatchery facility and released as one to four day olds over sites similar to the embryo release sites may yield different but equally important information on distribution, drift, growth and survival and will further test suitable substrate hypothesis and guide the future direction of our recovery efforts.

RECOMMENDATIONS

1. As soon as water temperature reaches 7°C after April 1, provide flows of 425 m^3/s at Bonners Ferry with stable or increasing temperature using the selective withdrawal gate system at Libby Dam to initiate and maintain spawning migration of Kootenai River white sturgeon.

2. Provide minimum flows of 630 m^3/s for 42 d (as prescribed for spawning and rearing in the Kootenai River White Sturgeon Recovery Plan, USFWS 1999) at Bonners Ferry once water temperatures of 8-10°C are reached to stimulate spawning and optimize egg/larval survival of Kootenai River white sturgeon.

3. Release one- to four-day-old free embryos at one of five sites in the canyon or braided reaches to evaluate drift, distribution, and survival over gravel and cobble substrates.

4. Statistically test the probability of adult white sturgeon moving to or above Bonners Ferry. Further analysis could assess temperature, flow, stage, and temporal differences.

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Table 1. Sampling effort and number of adult and juvenile white sturgeon captured in the Kootenai River, Idaho, February 27, 2007 to November 6, 2007.

	Hours of effort	Number of juvenile sturgeon caught (No. of recaptures)	Number of adult sturgeon caught (No. of recaptures)	Juvenile CPUE (fish/h)	Adult CPUE (fish/h)
Gillnet	577.7	441(205)	0	0.7633	—
Angling	393.8	2(1)	33(21)[ab]	0.0051	0.0838
Setline	4,569.3[c]	1(1)	97(70)[c]	0.0002	0.0212
Total	5,540.8	444(207)	130(91)		

[a] There were an additional two adults captured (one recapture) during angling effort by BCME staff for IDFG from March 12–13, 2007 and another four adult recaptures and one juvenile recapture on September 25, 2007. There was an additional one adult recapture by IDFG on June 7, 2007. Complete effort hours were not recorded.

[b] There were an additional 104 captures (102 adults, 82 were recaptures; two juveniles, both recaptures) by KTOI during spring broodstock angling efforts from February 21–June 19, 2007.

[c] Based on 24-hour sets. Includes 88.3 setline hours by BCME staff for IDFG and seven adult captures (all recaptures).

Table 2. Vital statistics from Kootenai River adult white sturgeon marked with Vemco sonic tags as part of a telemetry study, Kootenai River, Idaho, 2003-2007.

Tag year	Sex/Development Stage	Release Date	Release RKM	Fish #	Fork Length (cm)	Total Length (cm)	Weight (kg)	Vemco Code
2003	F-2	8/26/03	119.0	2117	173.0	195.5	37.8	52
2003	na	9/8/03	19.0	1471	181.0	205.0	45.0	51
2004	F-3[a]	9/7/04	121.0	22212	204.0	229.0	78.8	259
2004	M-8	9/7/04	121.0	22214	179.5	203.0	48.6	261
2004	M	9/7/04	121.0	1791	141.0	163.0	22.5	264
2004	na	9/7/04	121.0	1792	138.0	164.0	26.0	265
2004	F-3	9/8/04	121.0	22211	186.0	213.0	56.3	260
2004	M-8	9/8/04	121.0	22210	169.0	191.0	38.3	262
2004	M-8	9/8/04	121.0	22222	182.0	204.0	45.9	263
2004	M-8	9/8/04	121.0	690	168.5	190.0	38.3	266
2004	M-8	10/4/04	119.0	22213	195.5	220.0	54.9	257
2005	F-4	3/10/05	204.0	53853	170.0	197.0	41.0	275
2005	F-2	3/16/05	215.0	53855	215.0	241.0	na	277
2005	F-4	3/29/05	215.0	53872	165.0	191.0	48.0	274
2005	F-3	3/29/05	215.0	53871	182.0	209.0	47.0	276
2005	F-3	4/12/05	215.0	53863	182.0	200.0	59.0	273
2005	F-4	4/26/05	215.0	947	142.0	162.0	26.0	272
2005	F-4[b]	4/28/05	226.5	958	189.0	220.0	58.0	280
2005	F-1	5/18/05	230.7	348	161.0	184.0	na	278[c]
2005	M-8	6/08/05	229.0	906	166.0	191.0	35.0	281
2005	M-8	6/08/05	229.0	330	179.0	206.0	43.0	279
2005	M-8	6/08/05	229.0	53894	189.0	217.0	70.0	271
2005	F-4[d]	6/28/05	243.0	2117	170.0	196.0	40.0	52
2005	M-7	9/26/05	215.0	406	168.0	192.0	43.0	50
2005	F-4[b]	9/26/05	215.0	345	164.0	189.0	52.0	269
2005	F-4[b]	9/26/05	215.0	535	177.0	204.0	57.0	270
2005	F-4	9/27/05	215.0	1578	178.0	200.0	40.0	267
2005	U[e]	9/27/05	215.0	804	105.0	132.0	14.0	87
2005	F-4	9/27/05	215.0	1795	185.0	208.0	54.0	268
2005	M-7	9/27/05	215.0	1794	197.0	224.0	63.0	258
2006	F-4	3/23/06	207.0	1824	166.0	189.0	36.9	9dt[f]
2006	F-1	3/28/06	190.0	202	185.0	212.0	48.6	292
2006	M	3/28/06	185.0	939	147.0	171.0	21.2	294
2006	M	3/28/06	185.0	65	167.0	193.0	27.9	290
2006	F-4[b]	3/30/06	215.0	1305	158.0	182.0	36.9	3dt
2006	F-4[b]	4/4/06	205.0	22218	169.0	195.0	37.2	10dt
2006	M-8	4/4/06	187.5	86	161.0	195.0	33.3	7dt
2006	M-8	4/6/06	215.0	139	175.0	202.0	43.5	1dt
2006	F-4[b]	4/10/06	205.0	1828	185.0	215.0	56.0	6dt
2006	F-4[b]	4/13/06	215.0	1833	196.0	228.0	65.0	8dt
2006	F-4[b]	4/19/06	215.0	1837	194.0	223.0	65.9	4dt
2006	F-4[b]	4/25/06	215.0	1840	186.0	217.0	53.3	288
2006	M-8	4/26/06	204.0	987	151.0	174.0	25.5	291
2006	M-8	5/4/06	229.0	2230	214.0	243.0	54.2	2dt
2006	M-8	5/4/06	229.0	1842	155.0	179.0	30.5	295
2006	F-4[e]	5/4/06	229.0	22212	208.0	236.0	- -	293
2006	F-4	5/9/06	229.0	2227	170.0	190.0	37.2	287
2006	M-8	6/1/06	235.5	679	155.0	177.0	27.3	5dt
2006	M-9	6/6/06	229.0	1847	167.0	187.0	40.3	286

Table 2. Continued.

Tag year	Sex/Development Stage	Release Date	Release RKM	Fish #	Fork Length (cm)	Total Length (cm)	Weight (kg)	Vemco Code
2006	M-9	6/7/06	229.0	7917	145.0	165.0	23.3	289
2006	F3	10/5/06	215.0	57035	172.0	194.0	42.75	296
2006	F3	10/5/06	215.0	57033	179.0	210.0	48.15	298
2006	F3	10/8/06	215.0	57034	182.0	205.0	54.0	301
2006	F4	10/24/06	215.0	1854	185.0	213.0	60.0	297
2007	F4[g]	3/12/07	120.0	57869	207.0	235.0	82	17dt
2007	F4[g]	3/13/07	120.0	850	207.0	230.0	95	13dt
2007	F4[g]	3/14/07	123.0	2216	194.0	220.0	67	303
2007	F4[g]	3/14/07	120.0	152	178.0	197.0	65	305
2007	F4[g]	3/14/07	137.0	2198	170.0	192.0	51.3	20[h]
2007	F4[b]	3/28/07	215.0	891	193.0	221.0	61.8	16dt
2007	M8	3/28/07	205.0	252	172.0	208.0	49.7	15dt
2007	F4[b]	3/29/07	215.0	57880	185.0	214.0	65.9	14dt
2007	F4[b]	3/29/07	215.0	57881	162.0	186.0	47.0	18dt
2007	F4[b]	3/29/07	215.0	57882	172.0	193.0	49.3	12dt
2007	M8	3/29/07	215.0	57883	167.0	191.0	--	11dt
2007	M8	4/3/07	215.0	2268	167.0	190.0	33.2	19dt
2007	M8	4/10/07	215.0	162	188.0	218.0	58.2	302

[a] This fish was re-tagged with Vemco 293 in May 2006, no mention of old Vemco 259.
[b] F-1 eggs present.
[c] Fish recaptured twice in 2007, Vemco scar looked good.
[d] Fish recaptured; no mention of sonic tag.
[e] Unknown sex / development; 3-year tag.
[f] dt = depth sensitive tag.
[g] F-4 eggs present.
[h] This is the second deployment of this tag code.
[i] No weight taken.

Table 3. Number of detections of female white sturgeon expected to spawn in 2007 that were within a 125 m radius of the centroid of the VRAP buoy array, Kootenai River, 2007.

Transmitter ID	Number of detections
278	107
298	18
301	121
297	152
16	30
17	123
13	21
20	21
303	40
305	94
12	483
14	79
18	366
304	13

Table 4. Results from static interaction analyses testing association of fixed kernel utilization distributions (UD) between mature female white sturgeon and the spatial footprint of the boulder matrix. Note that for 2006 the analysis tests whether fish used the area that was altered in 2007. Concordance between UDs was assessed at *n* = 100 randomly selected points within the area of overlap (P ≤0.05) (From Parsley et al. 2008b).

	Area (m^2)	% overlap with comparison UD	r_s	t	df	P
2006						
UD_{Fish}	22,720	54.1				
UD_{Matrix}	1,367	3.3				
Overlap	740					
			-0.4232	-4.62	98	0.00001
2007						
UD_{Fish}	26,473	93.5				
UD_{Matrix}	1,367	4.8				
Overlap	1,278					
			-0.1193	-1.19	98	0.23692

Table 5. Location (strata, rkm), depth (m), effort, white sturgeon egg catch and CPUE (hours) by standard artificial substrate mats, Kootenai River, Idaho, 2007.

Study Strata	River location (rkm)	Depth range (m)	Total mat hours	Number white sturgeon eggs	CPUE (hours)
1	245.5	1.2-8.5	8,490.4	13	0.0015
2	245.0	2.4-9.2	8,411.5	0	—
3	239.5	5.5-22.9	8,542.8	14	0.0016
4	236.5	2.7-9.5	8,543.3	15	0.0018
5	235.5	3.1-14.9	8,355.8	2	0.0002
6 (in rock area)	230.6	8.8-18.0	7,479.4	0	—
7 (outside rock area)	230.6	1.8-7.9	8,602.9	0	—
8	229.1	6.7-15.9	8,448.5	27	0.0032
9	227.0	1.2-17.1	8,481.8	1	0.0001
All		1.2-22.8	75,356.2	72	0.0010

Table 6. Stages of white sturgeon eggs captured by artificial substrate mats, Kootenai River, Idaho, 2007.

Buoy no. start	Temp. °C	Location	Date pull	End time	Total eggs	Egg stage 12	13	14	15	16	18	19	Dead	Other	Eggs unstageable	Notes	Estimated Spawn date
49	7.96	4	5/22/07	11:10	2								2				
496	8.15[a]	8	5/25/07	12:58	4	3	1										0(5/25)
418	9.94	3	5/30/07	13:48	1					1							15(5/29)
37	10.17	3	5/31/07	9:12	10								9		1		
80	10.17	8	5/31/07	- -	3		2							1		missing	3(5/31)
299	10.17	8	5/31/07	12:08	6	6											0(5/31)
31	11.67	3	6/2/07	6:28	3	3											0(6/2)
496	13.05[a]	8	6/4/07	12:14	9				1	6	1	1					33(6/3), 27(6/3), 8(6/4), 14(6/3)
39	11.62[a]	1	6/6/07	8:37	7				6	1							14(6/5), 8(6/6)
34	10.85[a]	1	6/7/07	9:49	6			2	2				1	1		missing	8(6/7), 5(6/7)
20	10.85[a]	4	6/7/07	11:43	1	1											0(6/7)
120	10.85[a]	4	6/7/07	11:22	2	1	1										3(6/7)
151	13.05[a]	4	6/4/07	11:51	9			1	4	1			3				8(6/7), 5(6/7)
299	10.69[a]	8	6/8/07	10:57	1		1										3(6/8)
899	11.11	5	6/10/07	9:36	1								1				
899	10.83	5	6/12/07	13:05	1								1				
1	11.82[a]	9	6/18/07	12:41	1		1										3(6/18)
75	11.67	4	6/19/07	12:57	1		1										3(6/19)
496	11.67	8	6/19/07	14:10	4				1				2		1		8(6/19)
			Total collected:		72	14	7	3	14	9	1	1	19	2	2		
			Total staged:		70	14	7	3	14	9	1	1	19	2			
			Total unstageable:		2										2		

[a] Temperature taken at BFEI temperature gage.

Table 7. Summary of 2007 white sturgeon larval sampling effort and volume sampled by gear type and location, Kootenai River, Idaho.

Gear Type	Location (river kilometer)	Sampling Dates	Catch[a]	No. Sites	Effort (hours)		Volume (m^3) sampled	
					Mean (SD)	Total	Mean (SD)	Total
Surface, D-ring	225.0	6/25-6/27	15	8	9.1(8.0)	72.7	3,048.1(1,575.4)	24,385.0
	229.0	7/17-7/25	17	10	5.6(0.7)	56.3	3,844.8(559.8)	38,447.6
	243.0	7/31-8/8	4	10	6.0(1.3)	59.8	4,067.2(734.0)	40,671.8
	243.7	6/21	4	2	25.1(0.3)	50.1	2,071.5(1,030.9)	4,142.9
	244.0	9/19-6/20	0	4	6.3(1.7)	25.3	3,521.5(1,040.1)	14,086.1
	244.9	7/3-7/4	4	2	15.1(15.5)	30.2	2,706.6(371.1)	5,413.3
	245.1	7/3-7/5	10	4	9.7(10.3)	38.9	4,678.1(2,685.1)	18,712.2
Mid-column, D-ring	225.0	6/25-6/27	22	8	9.1(8.1)	72.6	2,988.0(2,203.0)	23,904.2
	229.0	7/17-7/25	4	10	5.7(0.7)	57.1	4,589.7(662.7)	45,896.7
	243.0	7/31-8/8	5	10	6.1(1.2)	60.5	3,884.5(716.0)	38,845.3
	244.0	6/19-6/21	20	6	13.1(10.3)	78.8	3,440.3(932.4)	20,641.7
	245.1	7/4-7/5	3	4	5.3(0.4)	21.3	4,673(409.6)	18,694.1
Surface, Meter	244.0	6/18	0	4	3.2(0.8)	12.9	4,263.7(1,038.0)	17,055.0
Mid-column, Meter	244.0	6/18	0	10	9.0(9.3)	90.4	3,558.0(891.9)	35,580.3
Benthic, D-ring	225.0	6/25-6/27	15	8	9.1(8.4)	72.5	2,182.7(3,280.0)	17,461.5
	229.0	7/17-7/25	2	12	4.6(1.1)	55.6	1,526.7(817.8)	18,320.7
	243.0	7/31-8/8	17	16	3.7(1.3)	58.5	671.3(395.4)	10,740.0
	243.7	6/21	2	2	25.6(0.1)	51.2	200.9(231.1)	401.8
	244.0	6/19-6/20	0	4	6.2(1.8)	24.7	974.7(681.5)	3,898.9
	245.1	7/4-7/5	7	4	5.6(0.7)	22.4	1,214.6(766.0)	4,858.5
Benthic, Meter	244.0	6/18	1	4	3.3(1.1)	13.2	2,259.1(1,042.1)	9,063.3
Combined	All	6/18-8/8	152	136	7.0(6.0)	946.2	2,871.7(1,816.7)	390,552.3

[a] Catch was entirely species other than white sturgeon.

Table 8. Idaho Department of Fish and Game juvenile hatchery white sturgeon gill net sampling effort by sampling location for July through September 2007.

River Kilometer	Number of sets	Hours of Effort	Number of adults captured	Number of juveniles captured	Sturgeon catch per unit of effort
170.0	16	19.5	0	6	0.3072
182.0	20	22.8	0	5	0.2191
185.0	17	23.8	0	5	0.2105
188.0	21	20.9	0	5	0.2389
190.0	20	24.1	0	5	0.2076
192.0	20	22.4	0	8	0.3571
193.0	20	23.6	0	24	1.0177
193.5	54	57.3	0	50	0.8723
203.5	20	24.9	0	20	0.8038
205.0	44	46.8	0	57	1.2171
207.0	44	49.5	0	38	0.7672
207.5	20	20.0	0	18	0.9008
215.0	54	66.4	0	105	1.5813
219.0	16	19.3	0	0	—
225.0	32	38.5	0	10	0.2597
234.5	12	13.8	0	1	0.0726
240.5	18	17.3	0	2	0.1157
241.0	12	13.7	0	1	0.0729
244.5	16	19.3	0	19	0.9836
245.0	30	33.7	0	62	1.8379
Total	506	577.7	0	441	0.7634

Table 9. Idaho Department of Fish and Game juvenile hatchery white sturgeon gill net sampling effort by mesh size for July through September 2007.

Gillnet Mesh Size (cm)	Number of sets	Hours of effort	Number of adults captured	Number of juveniles captured	Sturgeon catch per unit of effort
1.3 stretch	127	146.3	0	70	0.4785
1.9 stretch	84	95.6	0	60	0.6276
2.5 stretch	120	137.4	0	126	0.9170
3.8 stretch	70	76.6	0	90	1.1749
5.0 stretch	44	49.8	0	58	1.1647
6.4 stretch	16	18.7	0	2	0.1069
7.6 stretch	39	47.7	0	33	0.6918
Experimental	6	5.8	0	2	0.3447

Table 10. Summary statistics of recaptured juvenile hatchery white sturgeon (N = 204) from 2007 gill net sampling, Kootenai River, Idaho.

	Statistic	FL (cm)	TL (cm)	WT (kg)
Recaptures N = 204	Average	42.9	49.8	0.51
	Standard deviation	9.8	11.3	0.38
	Minimum	19.6	23.6	0.04
	Maximum	70.0	81.1	2.14

Table 11. Wild juvenile white sturgeon captured in gillnets in 2007, Kootenai River, Idaho.

Date	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)	Mesh size (cm)	Year class
7/30	244.5	35.30	40.70	0.23	1.5	2003
7/31	215.0	35.10	41.20	0.18	1.5	2003
7/31	215.0	31.30	36.60	0.20	1.5	2004
8/7	207.0	35.70	38.90	0.24	0.75	2000
8/7	207.0	36.60	42.20	0.23	0.75	2003
8/9	215.0	36.0	41.50	0.23	0.50	2003
8/13	203.5	48.20	56.70	0.71	1.0	2000

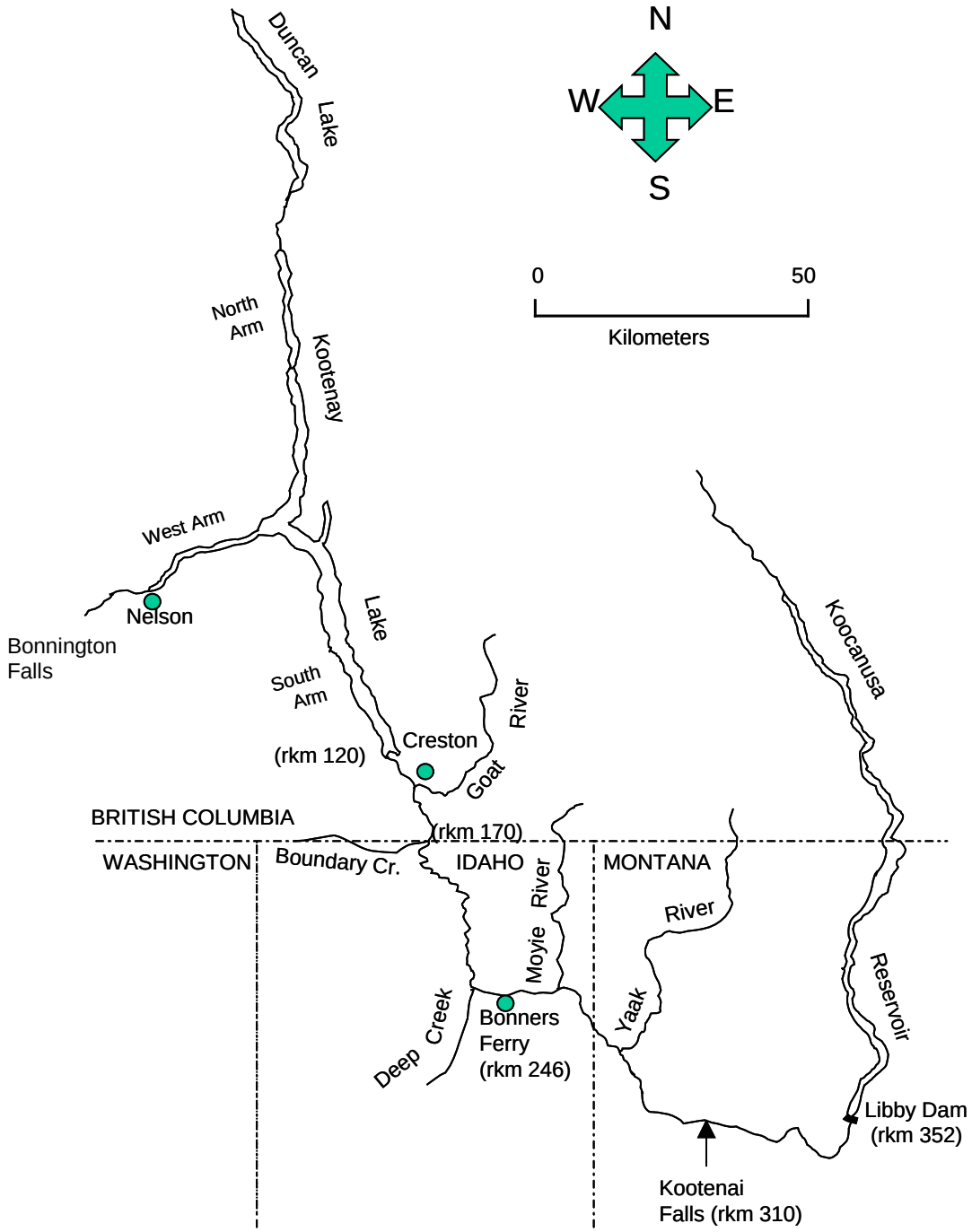

Figure 1. Location of the Kootenai River, Kootenay Lake, Lake Koocanusa, and major tributaries. The river distances from the northernmost reach of Kootenay Lake are in river kilometers (rkm) and are indicated at important access points.

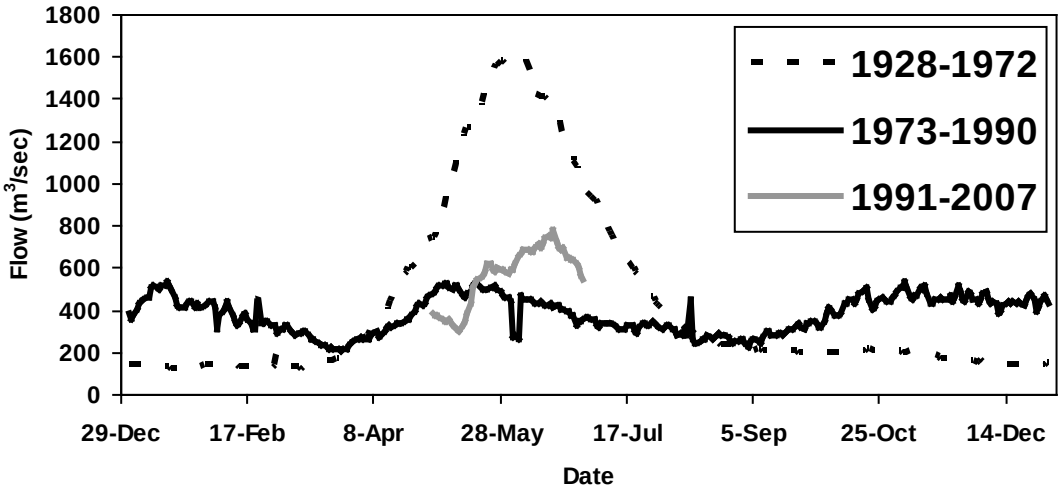

Figure 2. Mean daily flow patterns in the Kootenai River at Bonners Ferry, Idaho from 1928-1972 (pre-Libby Dam), 1973-1990 (post-Libby Dam) and 1991-2007 (post-Libby Dam with augmented flows, May 1 through June 30).

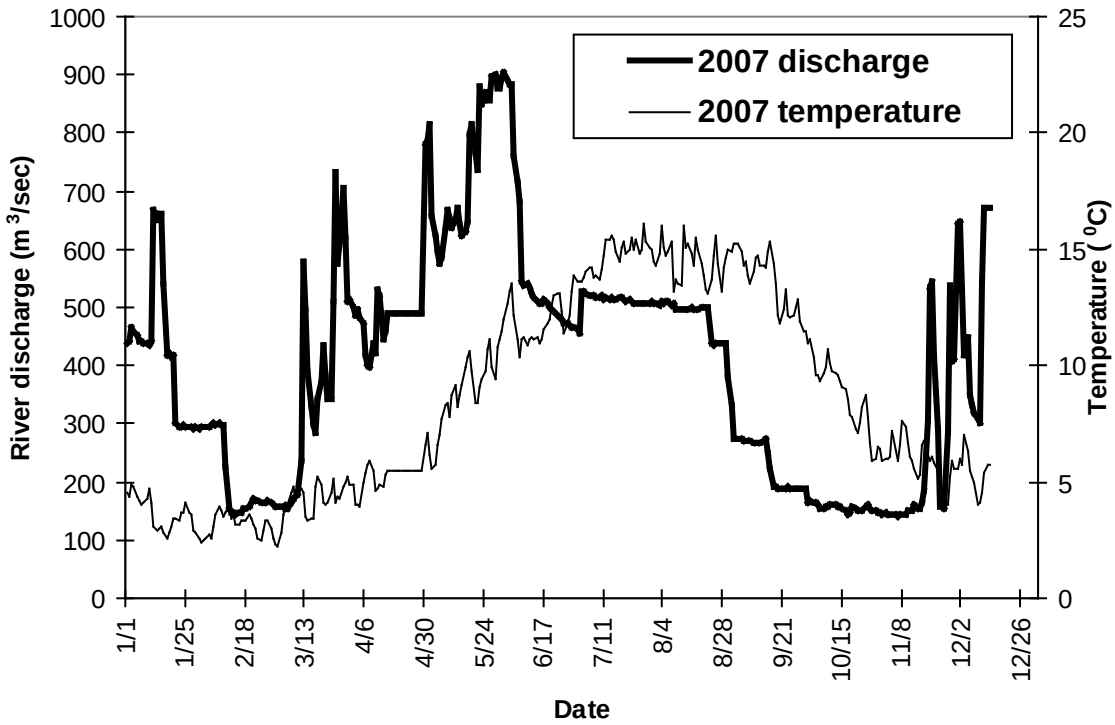

Figure 3. Mean daily discharge (m^3/sec) and temperature (°C) for Kootenai River at Bonners Ferry, Idaho, 2007.

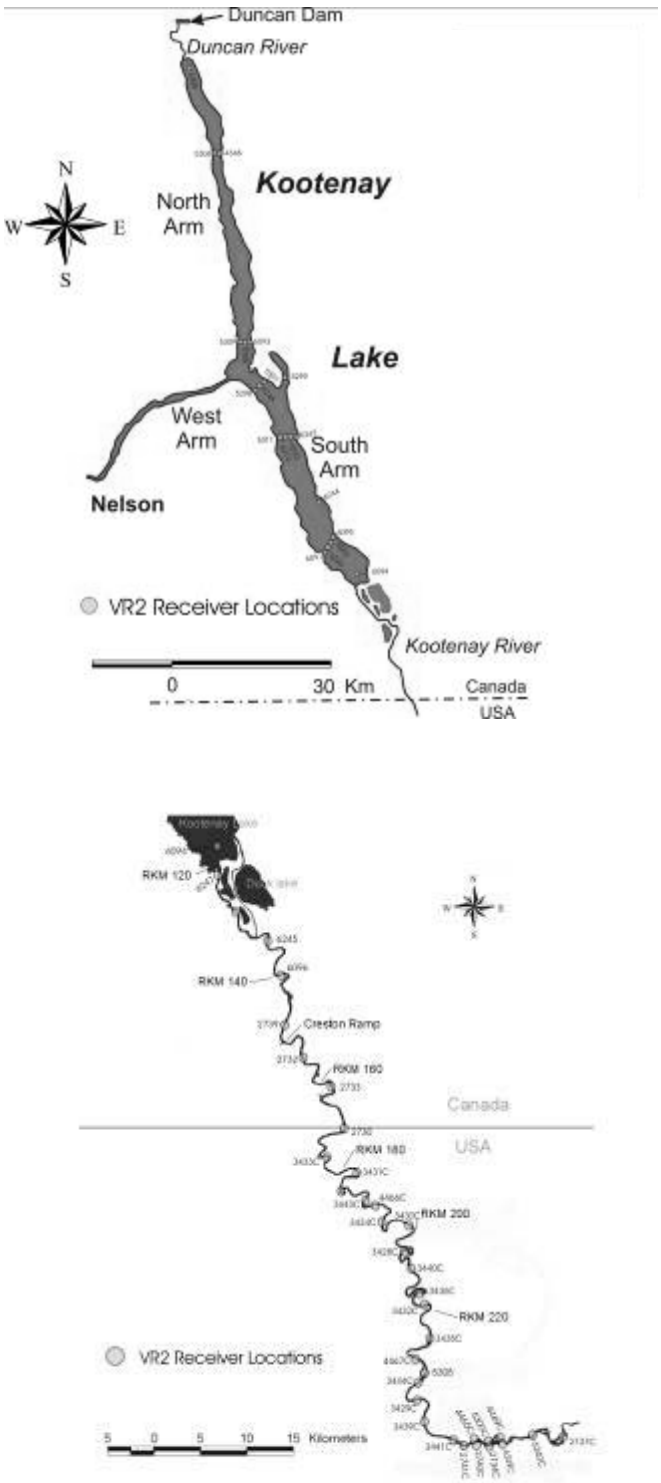

Figure 4. Location of Vemco VR2 receivers in Kootenai River/Lake system, Idaho and British Columbia, Canada, 2007.

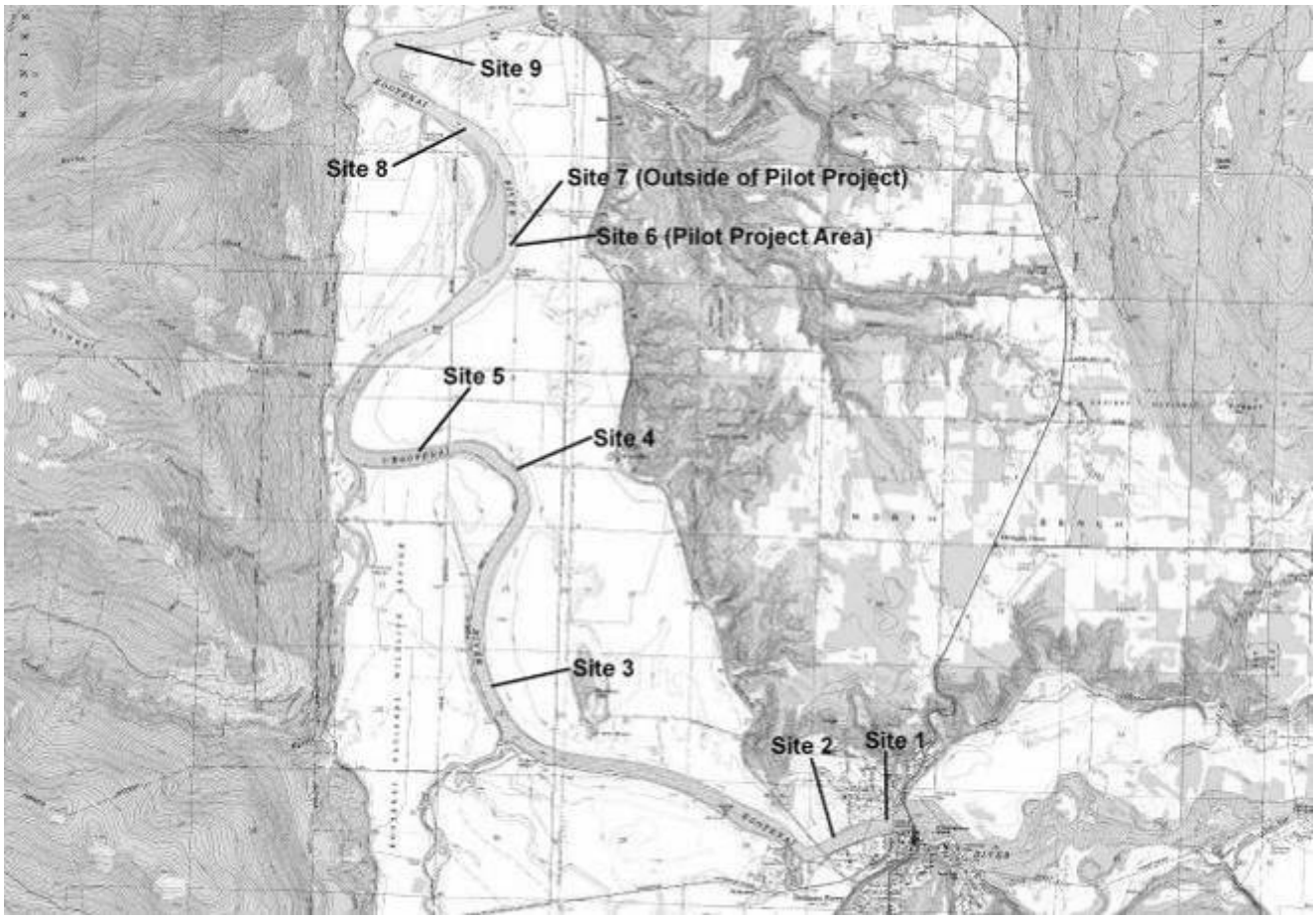

Figure 5. Egg mat placement study site for 2007 Kootenai River white sturgeon egg mat study, Kootenai River, Idaho.

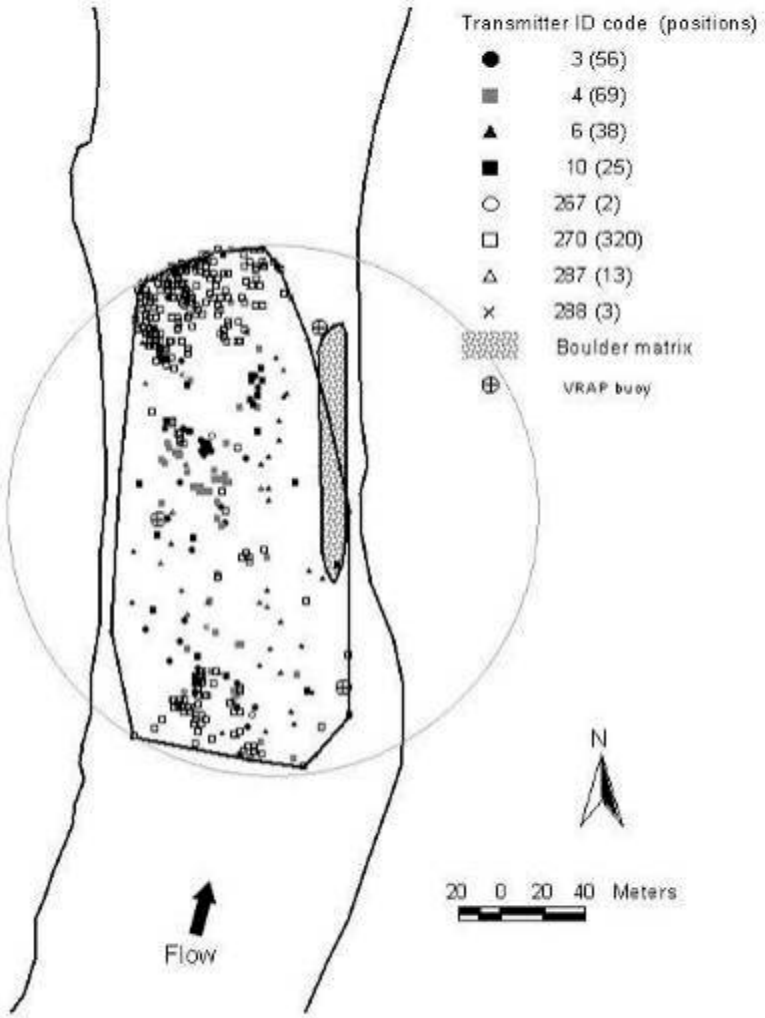

Figure 6. Telemetry locations of eight reproductively mature female white sturgeon in 2006. The boulder matrix area, created in 2007, is noted here since our intent was to investigate use of the unmodified area prior to the habitat improvement project. The polygon surrounding the fish positions shows the area of overlap with the boulder matrix. The light gray circle represents a radius of 125 m from the centroid of the buoy array (From Parsley et al. 2008b).

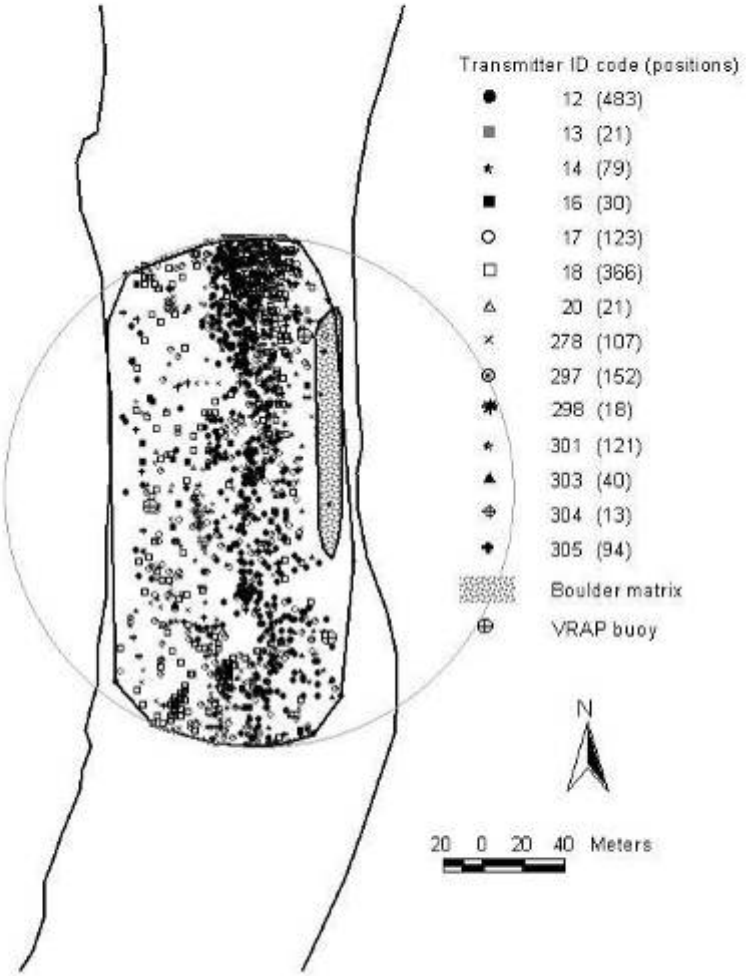

Figure 7. Telemetry locations of 14 reproductively mature female white sturgeon in 2007 and the location of the boulder matrix as constructed. The polygon surrounding the fish locations shows the area of overlap with the boulder matrix. The light gray circle represents a radius of 125 m from the centroid of the buoy array (from Parsley et al. 2008b).

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APPENDICES

Appendix 1. Study site locations for Kootenai River white sturgeon spawning study, Kootenai River, Idaho, 2007.

Site Number	River Kilometer	Latitude	Longitude	Comments
1	245.5	48 41 51.55	116 19 9.86	
2	245.0	48 41 45.98	116 19 28.31	
3	239.5	48 42 51.25	116 23 17.00	
4	236.5	48 44 18.93	116 23 7.11	
5	235.5	48 44 23.40	116 23 53.92	
6	230.6	48 45 52.70	116 23 5.23	Rock Study Area
7	230.6	48 45 52.70	116 23 8.03	Outside of Rock Study Area
8	229.1	48 46 42.48	116 23 41.25	
9	227.0	48 47 15.80	116 24 29.96	

Appendix 2. Random numbers generated table for determining egg mat placement locations for Kootenai River white sturgeon spawning study, Kootenai River, Idaho, 2007.

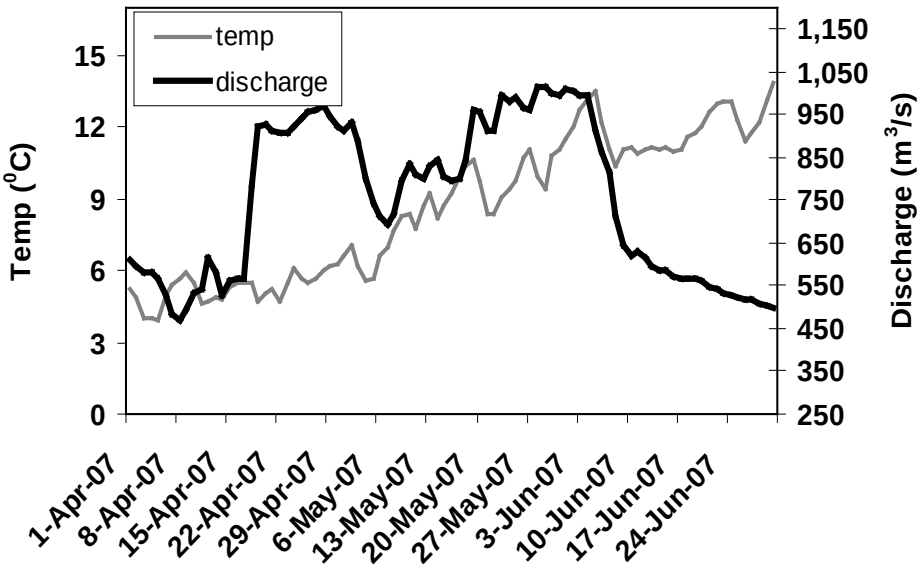
	Mat 1						Mat 2				Mat 3				Mat 4				Mat 5				Mat 6	
Date																								
5/7/2007	3	UP	3	RIGHT	29	DOWN	1	RIGHT	22	UP	1	LEFT	20	DOWN	2	LEFT	3	DOWN	1	LEFT	17	UP	0	LEFT
5/8/2007	2	DOWN	2	RIGHT	2	UP	2	RIGHT	28	DOWN	2	RIGHT	19	UP	2	RIGHT	8	UP	3	RIGHT	10	UP	2	LEFT
5/9/2007	29	DOWN	3	RIGHT	23	DOWN	1	LEFT	4	DOWN	1	LEFT	1	DOWN	2	RIGHT	15	UP	1	RIGHT	19	UP	1	LEFT
5/10/2007	28	UP	0	RIGHT	27	UP	1	RIGHT	32	DOWN	3	LEFT	12	UP	0	LEFT	28	DOWN	0	LEFT	32	UP	1	LEFT
5/11/2007	6	UP	3	LEFT	2	DOWN	0	LEFT	22	UP	1	RIGHT	20	UP	0	LEFT	8	UP	1	RIGHT	24	UP	0	LEFT
5/12/2007	13	DOWN	0	RIGHT	12	UP	2	LEFT	3	DOWN	0	LEFT	19	UP	0	LEFT	14	UP	3	RIGHT	24	UP	3	LEFT
5/13/2007	23	UP	2	LEFT	17	DOWN	1	LEFT	30	UP	3	RIGHT	5	DOWN	2	LEFT	5	UP	1	LEFT	9	UP	1	RIGHT
5/14/2007	19	UP	2	RIGHT	22	UP	0	RIGHT	3	UP	2	RIGHT	7	UP	0	RIGHT	14	DOWN	1	RIGHT	23	DOWN	3	LEFT
5/15/2007	12	DOWN	3	LEFT	9	UP	0	RIGHT	26	UP	1	LEFT	31	DOWN	1	LEFT	19	DOWN	3	RIGHT	25	DOWN	0	LEFT
5/16/2007	2	UP	1	LEFT	7	DOWN	3	LEFT	32	DOWN	2	RIGHT	32	DOWN	1	RIGHT	14	UP	2	RIGHT	32	UP	1	LEFT
5/17/2007	19	DOWN	1	LEFT	16	UP	1	LEFT	10	UP	3	LEFT	7	UP	0	RIGHT	11	UP	3	LEFT	24	DOWN	0	RIGHT
5/18/2007	28	UP	0	RIGHT	16	DOWN	1	RIGHT	2	UP	1	RIGHT	24	DOWN	0	RIGHT	24	DOWN	2	RIGHT	25	UP	1	LEFT
5/19/2007	14	DOWN	2	RIGHT	20	UP	2	LEFT	3	UP	1	LEFT	20	UP	2	RIGHT	24	UP	2	RIGHT	0	DOWN	3	LEFT
5/20/2007	24	UP	1	LEFT	11	DOWN	1	RIGHT	16	UP	2	LEFT	5	DOWN	1	RIGHT	26	DOWN	3	LEFT	9	UP	3	RIGHT
5/21/2007	16	UP	1	LEFT	7	DOWN	1	LEFT	10	UP	3	RIGHT	31	DOWN	1	LEFT	5	UP	1	RIGHT	7	UP	3	LEFT
5/22/2007	28	UP	1	RIGHT	22	DOWN	1	LEFT	10	UP	3	LEFT	9	DOWN	3	RIGHT	31	UP	0	LEFT	28	UP	2	RIGHT
5/23/2007	12	UP	3	LEFT	11	DOWN	1	LEFT	6	UP	1	LEFT	20	DOWN	1	RIGHT	27	DOWN	2	RIGHT	1	UP	2	RIGHT
5/24/2007	23	DOWN	2	LEFT	7	DOWN	0	RIGHT	27	DOWN	2	RIGHT	18	UP	0	LEFT	18	UP	2	RIGHT	32	UP	2	LEFT
5/25/2007	4	DOWN	3	LEFT	19	DOWN	3	RIGHT	11	UP	3	RIGHT	19	DOWN	2	LEFT	11	DOWN	2	LEFT	23	DOWN	1	LEFT
5/26/2007	17	DOWN	2	RIGHT	29	UP	0	LEFT	15	UP	1	LEFT	30	DOWN	2	RIGHT	1	DOWN	3	LEFT	24	UP	1	LEFT
5/27/2007	9	DOWN	2	LEFT	10	UP	1	RIGHT	12	UP	2	LEFT	1	DOWN	3	RIGHT	27	DOWN	2	LEFT	30	DOWN	0	RIGHT
5/28/2007	8	DOWN	2	RIGHT	18	DOWN	0	RIGHT	28	UP	3	RIGHT	3	DOWN	3	RIGHT	13	DOWN	1	RIGHT	28	DOWN	3	LEFT
5/29/2007	19	DOWN	1	RIGHT	8	UP	2	RIGHT	12	DOWN	3	LEFT	2	UP	3	RIGHT	4	UP	3	RIGHT	16	UP	2	RIGHT
5/30/2007	10	UP	0	RIGHT	25	DOWN	3	RIGHT	6	UP	3	LEFT	6	DOWN	0	LEFT	15	DOWN	2	RIGHT	32	UP	2	RIGHT
5/31/2007	31	DOWN	1	RIGHT	3	DOWN	2	RIGHT	14	DOWN	2	LEFT	15	DOWN	3	RIGHT	2	UP	2	RIGHT	11	UP	0	RIGHT
6/1/2007	10	UP	3	RIGHT	26	DOWN	2	LEFT	20	UP	3	RIGHT	13	DOWN	0	RIGHT	4	DOWN	1	LEFT	16	DOWN	2	LEFT
6/2/2007	29	UP	3	RIGHT	2	UP	3	LEFT	9	DOWN	2	RIGHT	3	DOWN	3	RIGHT	13	DOWN	3	LEFT	3	UP	3	LEFT
6/3/2007	5	DOWN	2	RIGHT	31	DOWN	2	RIGHT	1	UP	0	RIGHT	25	DOWN	1	RIGHT	31	UP	0	RIGHT	14	UP	3	LEFT
6/4/2007	4	UP	0	RIGHT	13	UP	0	RIGHT	4	UP	3	LEFT	24	UP	0	LEFT	20	DOWN	0	LEFT	20	DOWN	1	RIGHT
6/5/2007	12	UP	0	LEFT	23	DOWN	3	RIGHT	22	DOWN	2	RIGHT	2	DOWN	1	LEFT	18	DOWN	0	RIGHT	6	UP	0	LEFT
6/6/2007	29	DOWN	0	LEFT	31	DOWN	3	RIGHT	9	UP	2	LEFT	19	DOWN	0	RIGHT	13	UP	0	LEFT	6	DOWN	0	RIGHT
6/7/2007	22	UP	3	LEFT	7	DOWN	3	RIGHT	16	DOWN	3	LEFT	27	UP	1	RIGHT	1	UP	1	RIGHT	31	DOWN	2	RIGHT
6/8/2007	28	UP	0	LEFT	0	UP	3	RIGHT	27	DOWN	0	RIGHT	13	UP	1	RIGHT	29	DOWN	2	RIGHT	22	UP	1	LEFT
6/9/2007	8	UP	0	RIGHT	19	DOWN	0	LEFT	27	UP	2	RIGHT	23	UP	1	RIGHT	8	DOWN	0	LEFT	1	DOWN	2	RIGHT
6/10/2007	15	UP	0	LEFT	11	UP	1	LEFT	23	UP	3	RIGHT	31	UP	3	LEFT	26	UP	2	LEFT	23	DOWN	2	LEFT
6/11/2007	32	DOWN	1	LEFT	18	UP	2	LEFT	14	UP	3	RIGHT	27	UP	2	LEFT	18	DOWN	0	LEFT	21	UP	2	RIGHT
6/12/2007	12	DOWN	2	RIGHT	16	DOWN	1	LEFT	19	DOWN	0	LEFT	8	UP	3	RIGHT	9	DOWN	1	LEFT	27	DOWN	0	RIGHT
6/13/2007	5	UP	3	RIGHT	3	UP	3	LEFT	9	DOWN	0	LEFT	25	DOWN	3	RIGHT	17	DOWN	0	RIGHT	16	DOWN	3	LEFT
6/14/2007	9	DOWN	0	LEFT	28	UP	0	LEFT	22	UP	1	LEFT	10	UP	1	LEFT	22	UP	1	LEFT	15	DOWN	3	RIGHT
6/15/2007	7	DOWN	2	LEFT	29	DOWN	2	RIGHT	22	UP	3	LEFT	25	DOWN	0	LEFT	21	UP	2	LEFT	24	DOWN	0	RIGHT
6/16/2007	27	DOWN	3	RIGHT	26	DOWN	0	LEFT	9	UP	0	LEFT	0	DOWN	1	LEFT	20	DOWN	3	RIGHT	6	DOWN	2	RIGHT
6/17/2007	25	DOWN	1	RIGHT	4	DOWN	3	RIGHT	19	UP	1	RIGHT	2	DOWN	3	RIGHT	10	UP	3	LEFT	12	DOWN	1	LEFT
6/18/2007	15	DOWN	1	LEFT	0	UP	0	RIGHT	7	DOWN	3	LEFT	10	UP	2	LEFT	6	UP	0	RIGHT	6	DOWN	3	RIGHT

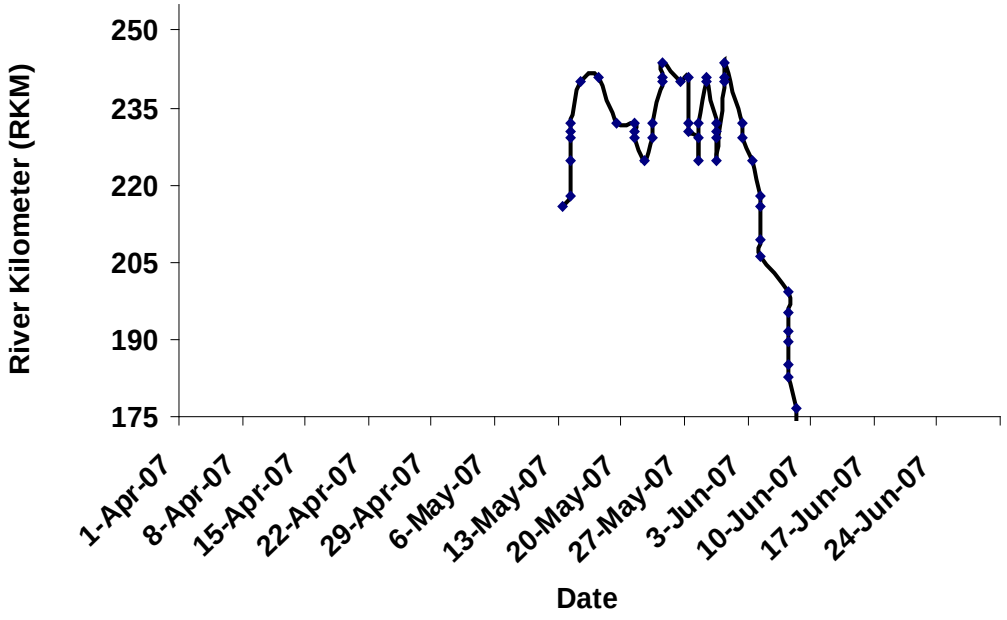
Appendix 2. Continued.

	Mat 1						Mat 2					Mat 3					Mat 4					Mat 5					Mat 6		
Date																												
6/19/2007	3	UP	1	RIGHT	4	UP	0	RIGHT	9	UP	1	RIGHT	20	DOWN	2	LEFT	7	UP	2	LEFT	3	UP	2	LEFT
6/20/2007	15	UP	2	LEFT	2	UP	3	LEFT	28	UP	1	RIGHT	11	DOWN	2	LEFT	0	UP	1	RIGHT	3	DOWN	3	RIGHT
6/21/2007	4	UP	2	RIGHT	1	UP	2	LEFT	11	UP	0	LEFT	28	DOWN	1	RIGHT	14	UP	3	LEFT	14	UP	1	LEFT
6/22/2007	13	DOWN	0	RIGHT	7	DOWN	1	RIGHT	7	UP	2	RIGHT	3	DOWN	3	RIGHT	2	UP	0	RIGHT	31	UP	3	RIGHT
6/23/2007	27	DOWN	2	LEFT	3	DOWN	0	RIGHT	31	DOWN	3	RIGHT	21	UP	3	RIGHT	25	DOWN	2	LEFT	30	UP	1	RIGHT
6/24/2007	14	UP	2	LEFT	9	UP	3	LEFT	30	UP	2	RIGHT	20	UP	3	LEFT	14	UP	1	LEFT	24	DOWN	2	LEFT
6/25/2007	20	UP	1	RIGHT	6	DOWN	2	LEFT	14	UP	1	RIGHT	31	DOWN	2	RIGHT	4	UP	0	LEFT	21	DOWN	0	LEFT
6/26/2007	19	UP	0	RIGHT	17	UP	0	RIGHT	32	UP	1	RIGHT	10	DOWN	3	RIGHT	32	UP	2	RIGHT	31	UP	0	LEFT
6/27/2007	5	DOWN	3	RIGHT	20	DOWN	3	RIGHT	3	UP	2	LEFT	4	UP	1	RIGHT	18	DOWN	2	RIGHT	0	UP	0	RIGHT
6/28/2007	19	UP	0	LEFT	21	DOWN	1	LEFT	2	DOWN	3	LEFT	26	UP	0	RIGHT	26	UP	0	RIGHT	15	UP	2	LEFT
6/29/2007	7	DOWN	3	RIGHT	18	DOWN	0	RIGHT	5	DOWN	2	LEFT	12	DOWN	2	LEFT	27	UP	3	LEFT	20	DOWN	3	RIGHT
6/30/2007	19	UP	2	LEFT	3	UP	0	LEFT	19	UP	2	RIGHT	5	UP	3	RIGHT	25	UP	1	LEFT	14	UP	3	LEFT
7/1/2007	28	UP	1	RIGHT	5	DOWN	1	LEFT	15	DOWN	0	LEFT	9	UP	2	RIGHT	17	UP	0	RIGHT	18	UP	2	LEFT
7/2/2007	30	UP	2	RIGHT	16	UP	2	RIGHT	17	DOWN	3	LEFT	13	DOWN	0	LEFT	17	DOWN	2	RIGHT	27	UP	1	LEFT
7/3/2007	15	DOWN	2	LEFT	23	DOWN	3	RIGHT	32	DOWN	2	LEFT	15	UP	3	RIGHT	14	DOWN	3	LEFT	31	DOWN	2	LEFT
7/4/2007	29	UP	3	RIGHT	6	UP	1	RIGHT	26	UP	2	RIGHT	1	UP	2	RIGHT	28	UP	1	LEFT	24	DOWN	1	LEFT
7/5/2007	15	DOWN	0	LEFT	17	DOWN	0	LEFT	5	DOWN	0	RIGHT	31	UP	2	LEFT	25	UP	2	LEFT	17	UP	3	RIGHT
7/6/2007	28	DOWN	2	LEFT	7	UP	2	RIGHT	20	DOWN	2	LEFT	5	DOWN	3	LEFT	3	DOWN	0	RIGHT	22	UP	0	LEFT
7/7/2007	4	UP	3	RIGHT	9	UP	1	LEFT	12	UP	1	RIGHT	15	DOWN	0	LEFT	12	UP	2	RIGHT	29	DOWN	2	LEFT

Appendix 3. Migration of eight female white sturgeon, all of which are believed to have spawned in the Kootenai River, Idaho, 2007.

Transmitter number 12, stage F-4, tagged 3/29/07 at rkm 215





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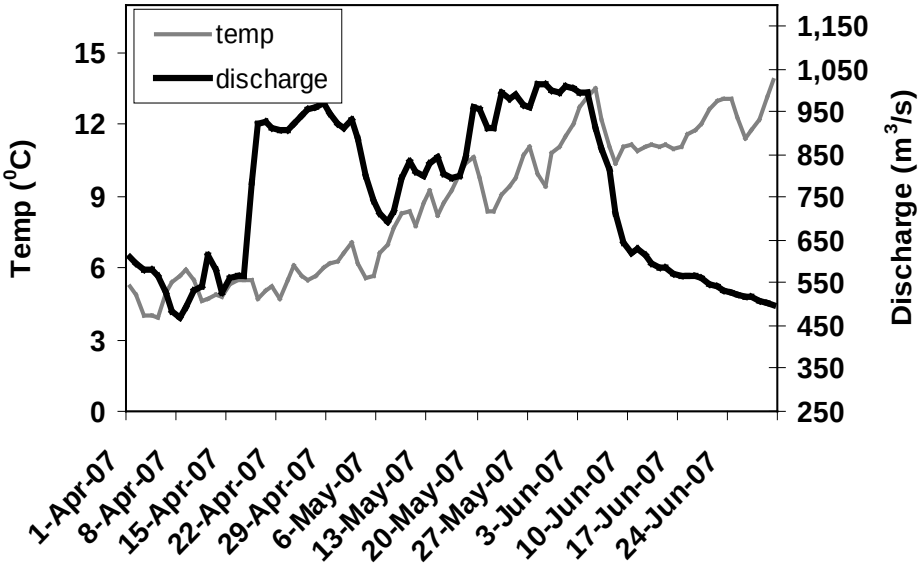

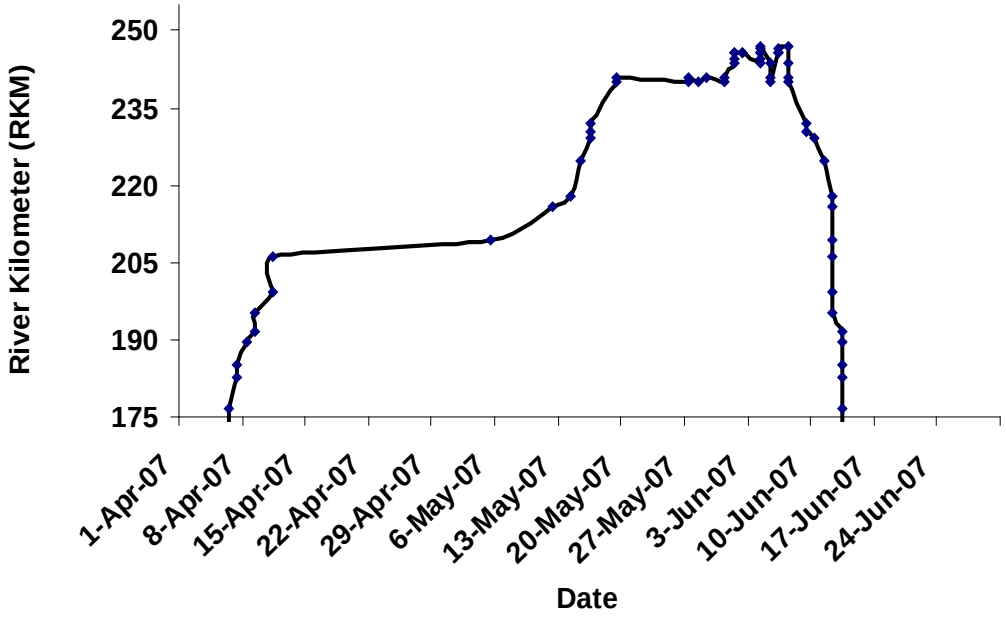

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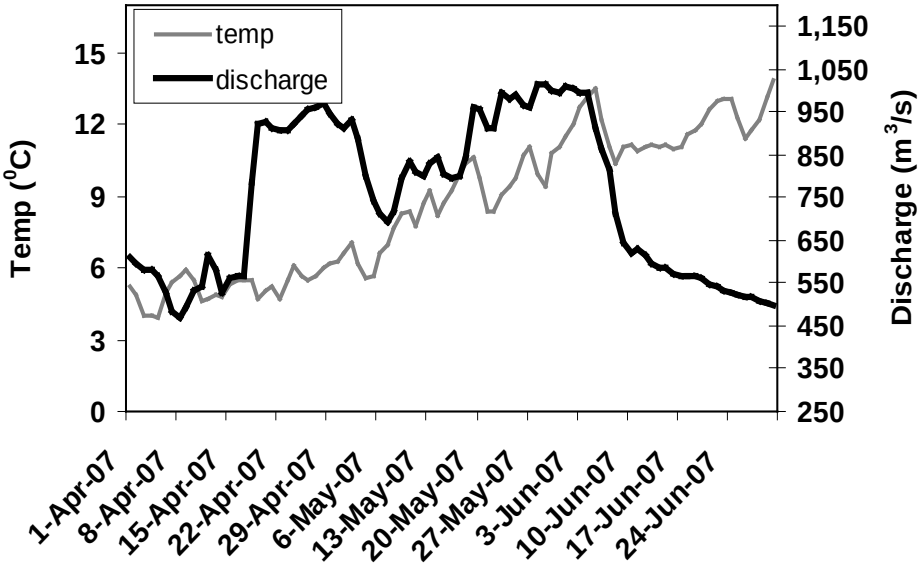
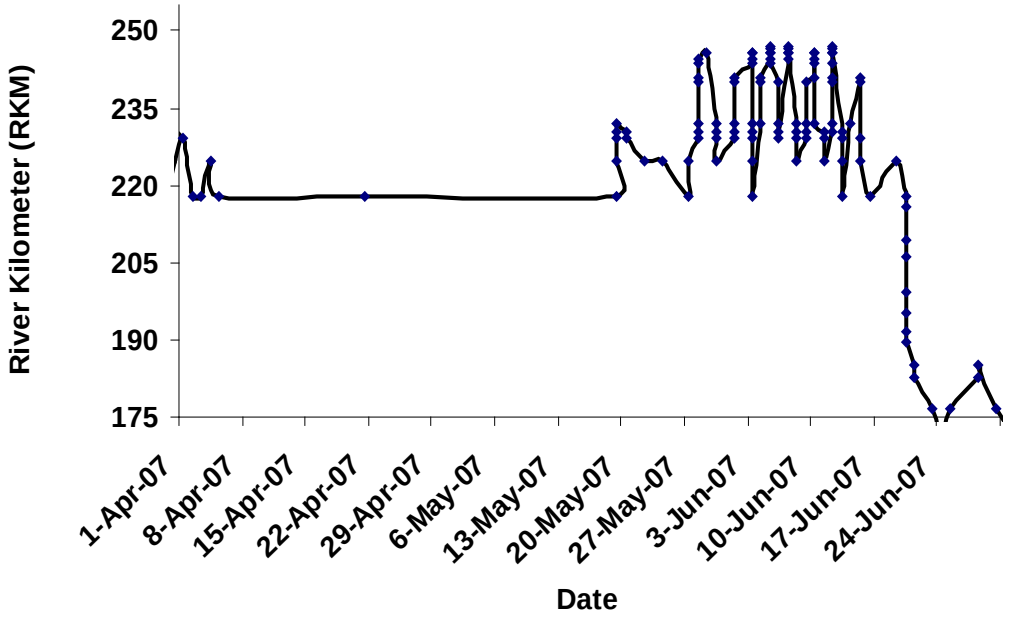
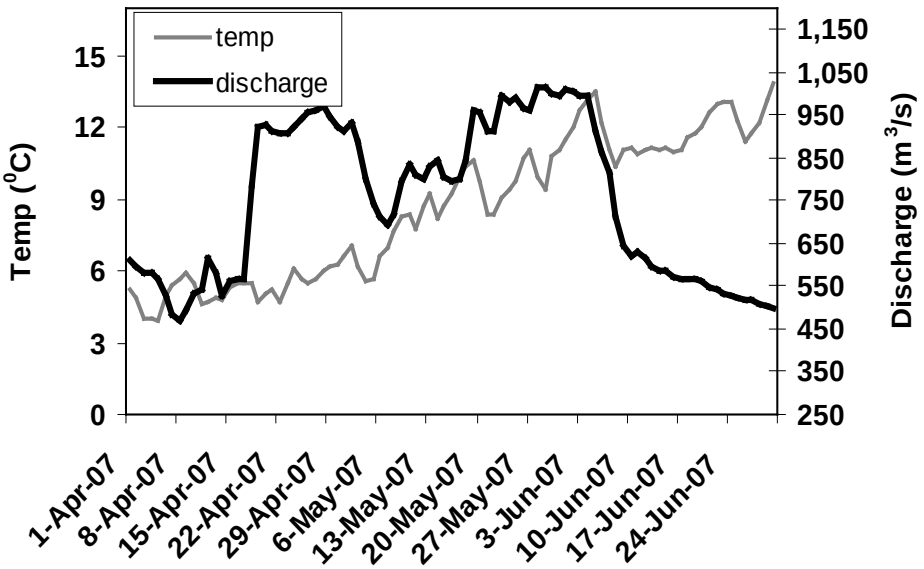
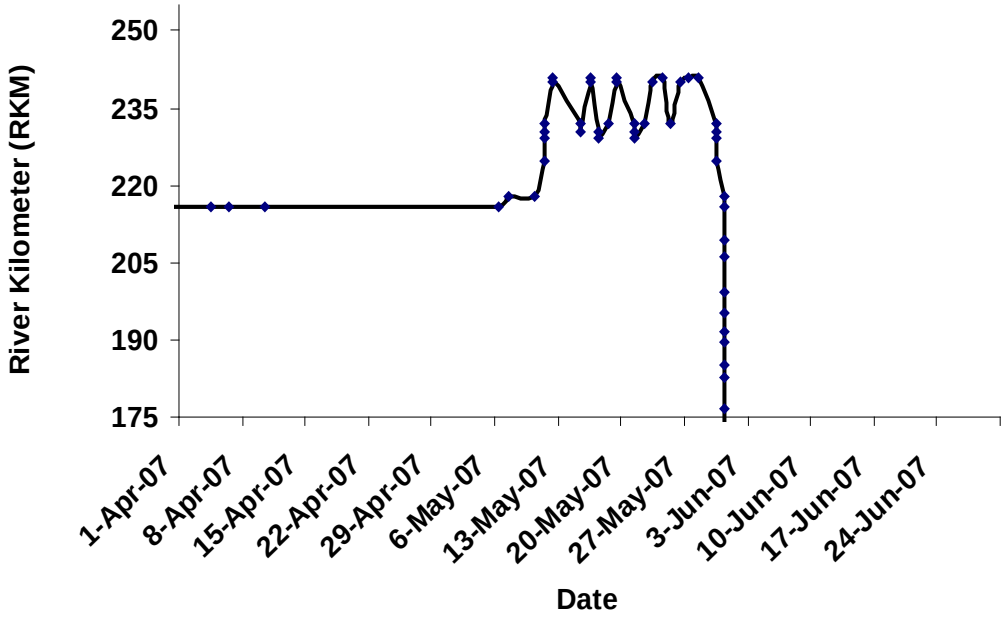




Appendix 3. Continued.

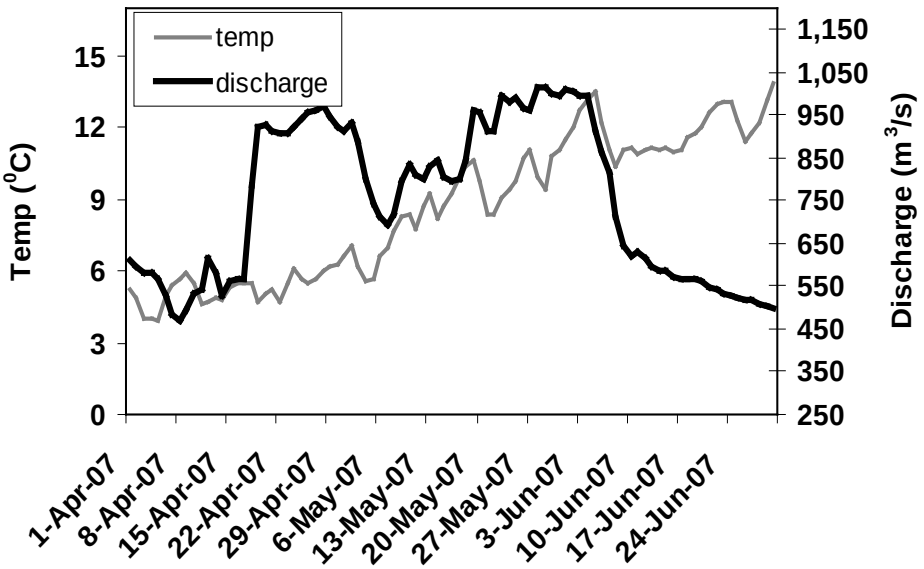
Transmitter number 16, stage F-4, tagged 3/28/07 at rkm 215

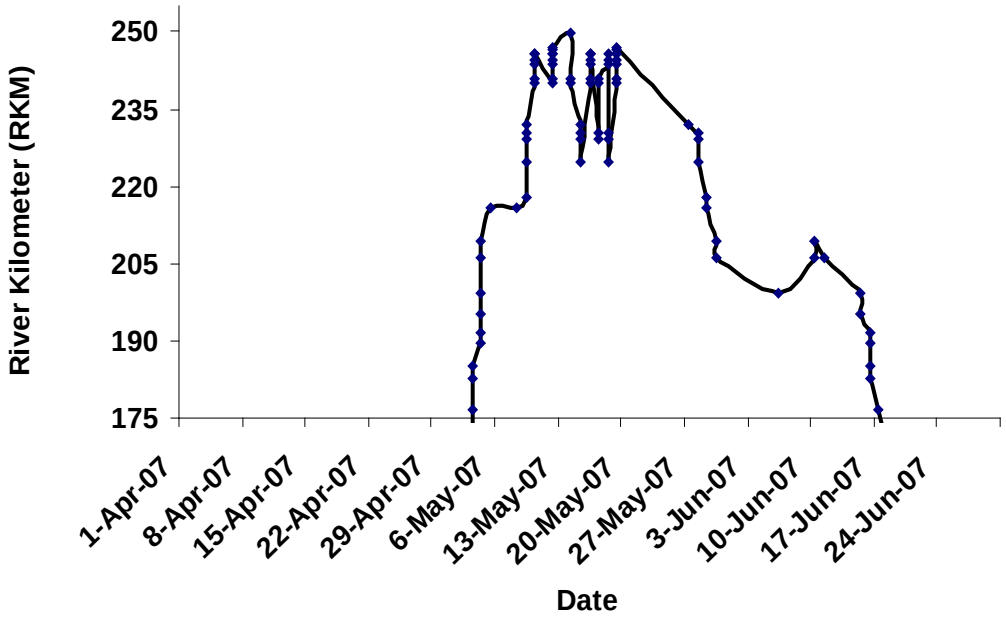




Appendix 3. Continued.

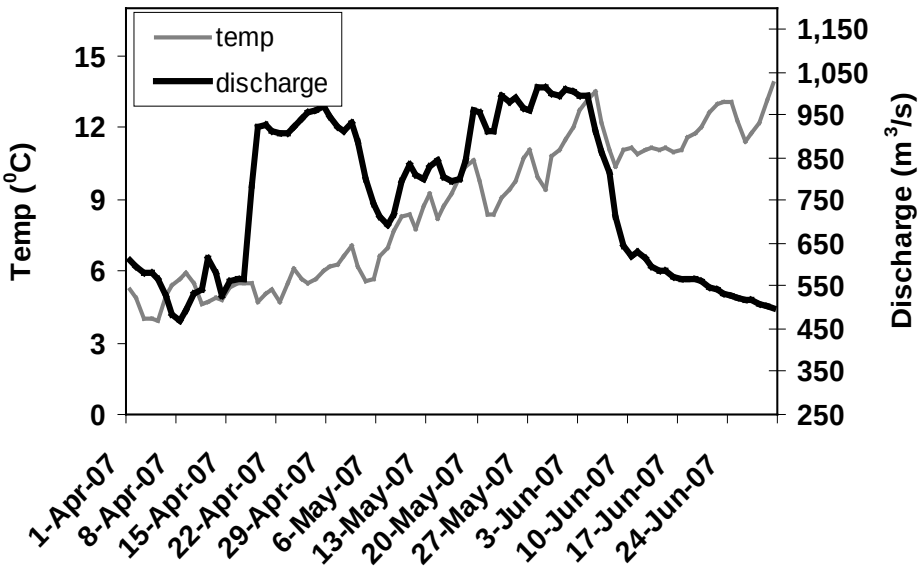
Transmitter number 17, stage F-4, tagged 3/12/07 at rkm 120

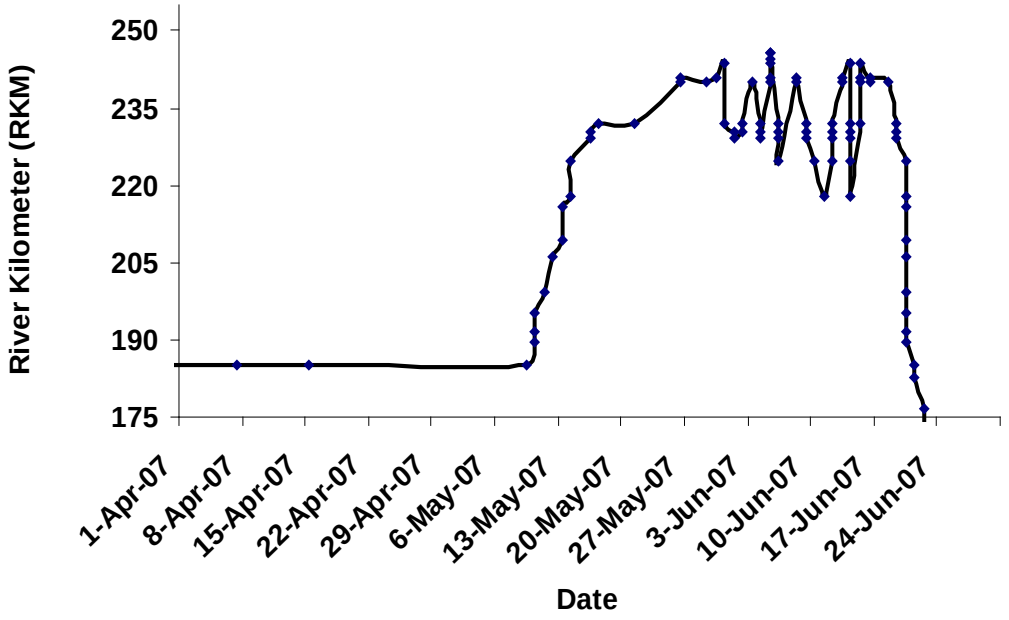




Appendix 3. Continued.

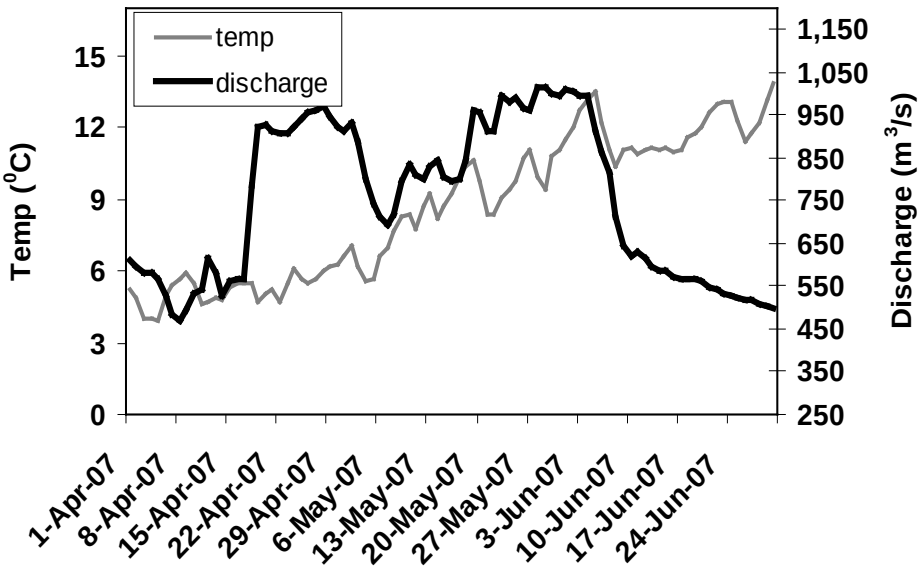
Transmitter number 297, stage F-4, tagged 10/24/06 at rkm 215

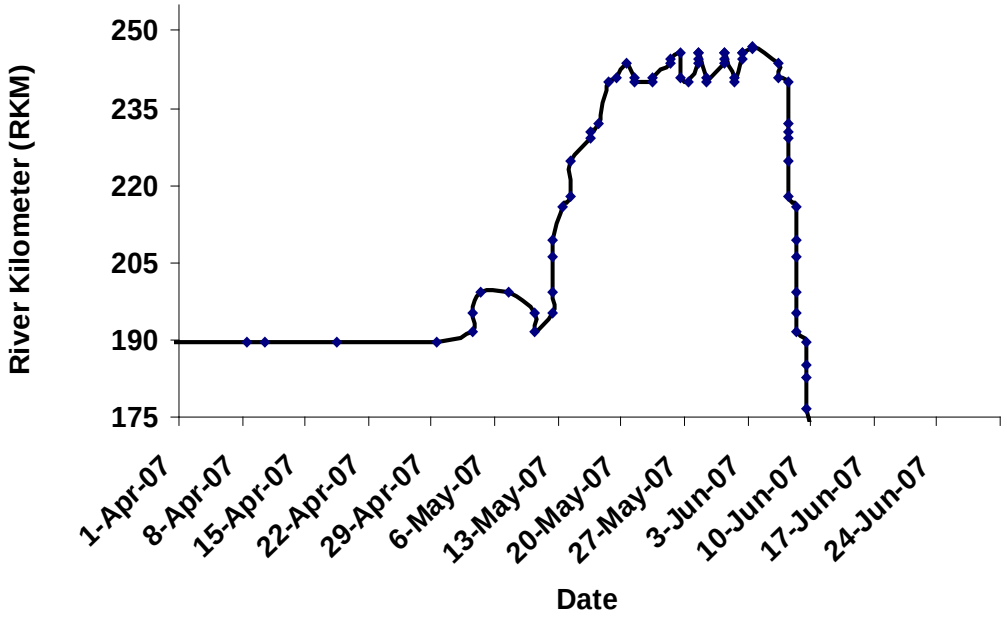




Appendix 3. Continued.

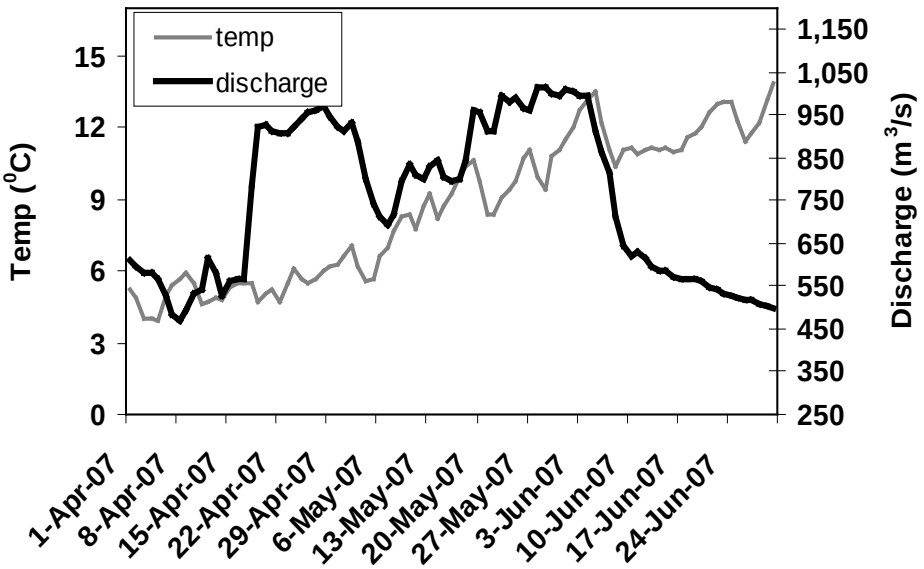
Transmitter number 298, stage F-3, tagged 10/05/06 at rkm 215

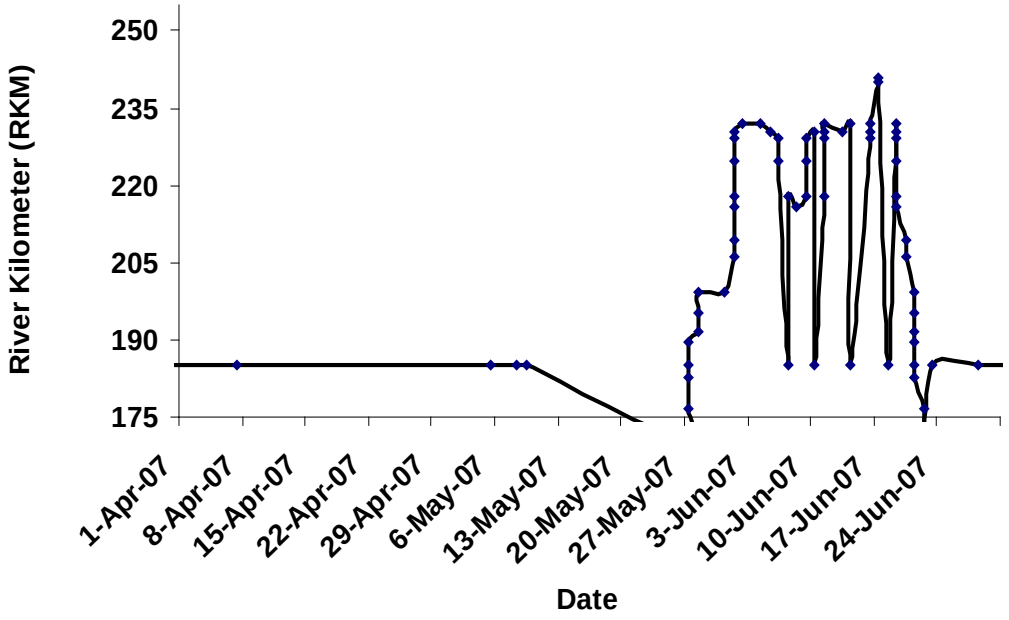




Appendix 3. Continued.

Transmitter number 305, stage F-4, tagged 3/14/07 at rkm 120





Appendix. 4 Numbers and recapture rates of hatchery produced white sturgeon juveniles (progeny of wild brood stock) released into the Kootenai River and Kootenay Lake in Idaho, Montana, and British Columbia between 1990 and December 2007 (from Kootenai Tribe of Idaho and Idaho Department of Fish and Game Annual Reports 1990-2006). This table includes tagged and/or measured fish only.

Year class	Hatchery facility[a]	Release number	Mean total length (mm) at release (S.D.)	Mean weight (g) at release (S.D.)	Release season & year	Number re-captures	Percent of all re-captures
1990	KTOI	14	456.9 (53.0)	320.8 (112.3)	Summer 1992	10	0.25%
1991	KTOI	104	254.7 (17.3)	66.1 (13.1)	Summer 1992	115	2.90%
1992	KTOI	123	482.6 (113.0)	549.3 (482.9)	Fall 1994	111	2.80%
1995	KTOI[b]	0	—	—	?	41	1.03%
1995	KTOI	1,075	228.5 (27.0)	47.3 (16.6)	Spring1997	466	11.74%
1995	KTOI	884	343.6 (43.7)	148.0 (64.0)	Fall 1997	433	10.91%
1995	KTOI	97	410.7 (68.2)	288.5 (137.8)	Summer 1998	60	1.51%
1995	KTOI	25	581.5 (40.5)	863.3 (197.9)	Summer 1999	13	0.33%
1998	KTOI	309	260.1 (41.9)	79.0 (44.4)	Fall 1999	53	1.34%
1999	KTOI	828	256.1 (22.2)	70.6 (18.2)		141	3.55%
1999	KH	1,358	248.1 (32.9)	67.2 (27.6)	Fall 2000	351	8.84%
1999	KTOI	491	284.3 (54.4)	107.6 (60.1)		35	0.88%
1999	KH	1,583	306.5 (40.4)	55.9 (39.5)	Spring 2001	496	12.49%
1999	KT[b]	0	—	—	?	3	0.08%
1999	?[b]	0	—	—	?	45	1.13%
2000	KTOI	2,286	244.0 (38.9)	64.2 (31.0)		92	2.32%
2000	KH	1,654	240.0 (23.2)	57.7 (16.4)	Fall 2001	134	3.38%
2000	KH	2,209	283.1 (28.7)	99.3 (30.2)	Spring 2002	6	0.15%
2000	KH	30	365.4 (14.0)	195.3 (19.9)	Summer 2002	0	0.00%
2000	KTOI	214	409.4 (53.5)	294.1 (109.8)	Fall 2002	26	0.65%
2000	KTOI [c]	907	290.5 (30.8)	190.8 (60.0)	Jan. 2003	84	2.12%
2000	KTOI [d]	10	557.7 (28.4)	87.6 (18.4)	Feb. 2004	0	0.00%
2000	KTOI[l]	3	66.2 (6.01)	425 (66.1)	Summer 2006	0	0.00%
2000	KH	0	—	—	?	4	0.10%
2000	KTOI	0	—	—	?	8	0.20%
2000	?[b]	0	—	—	?	23	0.58%
2001	KTOI	2,672	200.1 (37.9)	33.0 (15.6)		72	1.81%
2001	KH	4,469	227.4 (24.2)	51.6 (16.6)	Fall 2002	2	0.05%
2001	KH	1,715	257.1 (26.4)	71.8 (24.2)	April 2003	5	0.13%
2001	KTOI[l]	1	57.0	750.0	Summer 2006	0	0.00%
2001	KH	0	—	—	?	1	0.03%
2001	?[b]	0	—	—	?	2	0.05%
2002	KH	5,864	217.3 (25.2)	41.3 (14.2)	May 2003	10	0.25%
2002	KTOI	856	214.0 (43.8)	41.9 (22.6)	Oct. 2003	0	0.00%
2002	KTOI [e]	550			Nov. 2003	NRND	0.00%
2002	KTOI	3,852	215.4 (37.3)	43.4 (20.0)	Late wtr. 2003	3	0.08%
2002	KTOI	3,663	214.2 (54.8)	43.1 (27.2)	Late wtr.'03-early wtr. '04	7	0.18%
2002	KTOI[l]	1	55.0	740.0	Summer 2006	0	0.00%
2002	?[b]	0	—	—	?	14	0.35%
2003	KH	9,020	222.8 (25.7)	48.9 (24.4)	Spring 2004	386	9.72%
2003	KH [f]	19	229.5 (26.7)	51.9 (18.5)	Sept. 2004	0	0.00%
2003	KTOI	3,519	226.9(46.3)	55.4(31.6)	Late wtr. 2004	2	0.05%
2003	KTOI[l]	3	43.7 (2.8)	346.7 (49.3)	Summer 2006	0	0.00%
2003	?[b]	0	—	—	?	12	0.30%
2004	KH[g]	2,038	196.2(27.7)[h]	57.4(33.0)	Spring 2005	17	0.43%
2004	KT	1	510	490	Wtr 2007	0	0.00%
2004	?[b]	0			?	52	1.31%
2005	KH [i]	14	298.6(14.1)	174.2(27.8)		0	0.00%
2005	KH[g]	1,765	197.8(24.5)[h]	54.2(22.4)	Spring 2006	17	0.43%
2005	KTOI[j]	510	151.0(39.0)	26.8(19.9)	Fall 2006	3	0.08%
2005	KH[b]	0			?	4	0.10%

Appendix 4. Continued.

Year class	Hatchery facility[a]	Release number	Mean total length (mm) at release (S.D.)	Mean weight (g) at release (S.D.)	Release season & year	Number re-captures	Percent of all re-captures
2005	?[b]	0			?	81	2.04%
2006	KH[g,k]	600	148.8(10.8)[h]	22.9(5.4)	Fall 2006	NRND	0.00%
2006	KH[g]	1,877	182.2(15.0)[h]	43.8(11.7)			
2006	KH[gk]	1,000	184.4(15.9)[h]	45.6(11.5)	Spring 2007	9	0.23%
2006	KT[g]	4,922	170.8(30.2)	21.8(10.8)	Wtr 2007	0	0.00%
2006	KH[b]	0	—	—	?	1	0.03%
2006	?[b]	0	—	—	?	6	0.15%
?	KH[l]	0	—	—	?	2	0.05%
?	KT[l]	0	—	—	?	2	0.05%
?	?[l]	0	—	—	?	510	12.85%
Total marked		**61,985**	—	—	--	**3,970**	**6.40%**

[a] Hatchery facility refers to the rearing hatchery: Kootenai Tribal Hatchery in Idaho (KTOI) or Kootenay Hatchery in British Columbia (KH).
[b] Year class determined by scute removal; fish had shed PIT or PIT was not matched in database.
[c] Eleven fish held-over for later upriver release with transmitters (only 10 released with transmitters).
[d] These fish were released upriver (rkm 306.5) with sonic and radio tags.
[e] No measurements available; exact number not known, approximate is 550; NRND (number recaptured cannot be determined).
[f] These fish were first taken to Kokanee Creek Provincial Park, then released in September 2004
[g] Additional fish were released with no measurements taken or PITs added (see Appendix 3).
[h] Value given is mean fork length (mm).
[i] These fish were released upriver (299.0 and 258.7), 6 of them with Vemco sonic tags.
[j] There were 200 additional fish held over at KTOI hatchery for Biopar study.
[k] These fish did not have a PIT tag added and were all given fish # 999.
[l] These fish were untraceable as to brood year, rearing facility, release date and/or family.

Appendix 5. Juvenile hatchery releases with no tag added or measurements taken through March 31, 2007: combined hatcheries.

Year class	Hatchery facility[a]	Release number	Release season and year
2004	KTOI	3,000	Fall 2004
2004	KTOI	1,275	Late wtr. '04-early wtr. '05
2004	KTOI	17,723	Spring 2005
2004	KH	3,440	Spring 2005
2004	KTOI	8,637	Summer 2005
2005	KTOI	6,200	Fall 2005
2005	KTOI	3,947	Spring 2006
2005	KH	13,665	Spring 2006
2006	KH	6,900	Fall 2006
2006	KTOI	1,425	Spring 2007
Total		66,212	

[a] Hatchery facility refers to the rearing hatchery: Kootenai Tribal Hatchery in Idaho (KTOI) or Kootenay Hatchery in British Columbia (KH).

Appendix 6. Year class, number captured, capture locations, fork length (cm), total length (cm), and weight (kg) of hatchery released juvenile sturgeon captured with gill net from Kootenai River, Idaho, through 2007.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
1990	1	120.0	76.5	88.0	3.00
	3	205.0	61.0-81.4	74.0-95.0	1.75-2.70
	2	215.4	55.4-66.2	66.2-78.1	1.86
	1	215.6	65.2	76.0	2.00
	1	215.7	69.0	82.0	2.25
	1	225.1	65.8	77.0	1.95
	1	Unknown	66.5	76.1	1.95
1991	1	118.0	95.0	110.5	5.65
	3	119.0	73.0-85.0	85.5-98.0	1.10-4.50
	1	119.5	75.0	88.5	--
	4	120.0	63.0-102.5	73.5-118.5	1.60-6.65
	3	121.0	67.0-76.5	77.2-92.0	2.10-3.85
	1	134.0	82.0	94.5	4.1
	1	190.0	70.0	83.0	2.20
	1	192.0	35.1	40.8	0.16
	1	203.4	56.0	64.0	1.05
	4	203.5	52.0-72.0	61.0-83.0	0.95-2.70
	1	204.5	64.0	76.0	--
	1	204.7	60.0	68.8	1.36
	23	205.0	26.5-84.0	30.5-100.0	0.11-3.60
	1	205.4	51.0	60.0	1.10
	4	205.5	47.0-76.0	56.0-89.1	0.69-3.10
	5	215.0	40.0-53.0	47.0-62.0	0.14-0.70
	1	215.3	47.0	56.0	0.70
	1	215.4	64.2	75.4	2.15
	17	215.5	46.0-74.0	54.0-85.1	0.21-2.85
	8	215.6	41.0-57.0	48.0-66.2	0.43-1.80
	4	215.7	39.0-61.0	46.0-72.0	1.05-1.60
	3	216.0	44.0-53.0	51.0-61.0	0.50-0.88
	1	217.1	33.0	42.0	0.49
	1	224.6	48.0	58.0	0.65
	1	224.7	46.0	55.0	0.70
	2	224.9	42.0-73.5	50.0-84.8	0.45-2.80
	10	225.0	38.0-60.5	45.0-70.0	0.40-1.65
	3	225.1	39.0-49.6	46.0-58.0	0.40-0.78
	2	225.5	50.0-52.0	55.0-61.0	1.90-1.95
	1	227.0	36.0	43.0	0.52
1992	3	118.0	80.0-97.5	95.0-110.0	3.4-5.95
	4	119.0	61.0-102.0	69.0-118.0	1.20-5.50
	1	120.0	70.5	80.5	2.20
	1	121.0	77.0	92.0	3.19
	1	123.0	78.0	90.5	3.3
	1	134.0	77.1	90.5	2.95
	1	161.0	67.3	77.5	2.10
	1	174.3	56.0	62.0	1.06
	1	182.5	51.5	59.0	0.78
	1	190.3	61.2	71.0	1.53
	1	190.4	73.0	86.0	4.25
	1	203.4	74.0	85.0	5.20
	4	203.5	52.0-66.0	62.0-75.0	1.55-1.90
	1	204.0	59.0	69.5	1.50
	1	204.3	64.5	75.0	1.77
	1	204.7	65.8	75.6	1.60

Appendix 6. Continued.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
	17	205.0	49.0-68.6	58.0-79.2	2.00
	1	205.3	50.0	90.0	1.80
	2	205.4	62.0-65.3	75.0-75.2	1.83
	6	205.5	49.0-69.0	57.0-79.1	0.20-3.50
	1	205.6	54.0	64.0	--
	1	208.0	70.4	79.4	1.90
	1	210.5	66.3	75.6	1.80
	1	215.0	50.0	59.0	0.70
	2	215.1	59.0-67.90	67.5-81.0	1.11-2.10
	1	215.3	58.0	66.5	1.20
	11	215.5	50.2-72.5	57.9-83.5	0.11-2.13
	8	215.6	45.0-62.0	52.0-75.0	0.48-2.40
1992	6	215.7	42.0-66.0	49.0-77.0	1.05-2.30
	1	215.8	57.0	65.0	1.08
	1	215.9	63.0	75.0	1.35
	2	216.0	49.0-67.5	56.0-78.6	0.70-1.78
	2	217.1	30.0-36.0	35.0-44.0	0.35-0.51
	1	224.5	56.5	66.5	1.16
	2	224.9	50.0-69.5	61.0-80.5	1.30-1.68
	6	225.0	31.0-55.0	37.0-65.0	0.35-1.10
	5	225.1	47.0-62.0	56.0-73.0	0.60-1.30
	1	227.0	66.0	80.0	1.70
	1	227.4	59.1	62.0	1.00
	1	227.8	42.0	49.0	0.90
	1	229.0	46.0	55.0	0.55
	5	118.0	63.1-74.0	72.6-84.6	1.8-3.05
	3	119.0	49.0-58.0	56.5-67.1	0.70-1.27
	11	120.0	56.5-86.9	65.5-99.0	0.83-3.90
	16	121.0	43.9-74.0	50.0-85.5	0.53-2.20
	4	123.0	65.2-75.0	70.1-85.7	1.30-2.60
	3	130.0	38.0-49.5	43.9-57.4	0.46-0.73
	3	134.0	49.0-70.5	57.0-81.3	0.73-2.4
	1	137.0	50.9	59.2	0.76
	1	141.0	53.8	60.4	0.83
	1	144.3	39.8	45.3	0.38
	2	144.5	29.0-45.5	33.5-52.0	0.14-0.56
	4	145.0	42.5-61.0	50.0-70.5	0.50-1.40
	1	157.0	54.1	62.6	0.99
1995	1	157.5	33.2	37.3	0.18
	2	161.0	45.6	51.8	0.44
	1	163.0	49.1	56.9	0.73
	1	174.5	52.4	60.7	0.77
	1	176.0	33.9	40.0	0.20
	4	176.3	24.7-49.3	40.0-58.1	0.15-0.68
	4	176.4	42.5-51.0	50.0-59.0	0.42-0.71
	2	176.5	39.3-44.1	46.2-53.0	0.33-0.48
	2	177.3	37.9-45.0	43.7-52.0	0.28-0.49
	1	184.9	44.2	51.0	0.31
	1	185.0	39.1	43.3	0.33
	1	189.9	51.5	59.5	0.74
	18	190.0	31.0-62.0	36.0-72.3	0.15-1.41
	4	190.1	36.8-54.0	43.9-63.5	0.28-0.87
	2	190.3	27.2-48.5	31.7-56.0	0.15-0.63
	1	190.4	43.0	50.5	0.47
	1	191.9	35.7	41.3	0.20
	2	192.0	34.7-61.4	38.2-71.8	0.18-1.49
	1	192.1	36.1	42.0	0.25
	3	195.7	35.5-50.0	42.0-57.0	0.24-0.65

Appendix 6. Continued.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
	2	195.8	47.5-49.0	55.5-57.0	0.64-1.34
	1	195.9	43.0	50.5	0.42
	1	203.3	39.3	45.5	0.34
	2	203.4	33.2-37.0	38.5-42.9	0.25-0.36
	7	203.5	36.5-49.8	42.5-57.5	0.28-0.60
	6	204.0	37.9-61.0	43.5-70.0	0.27-1.39
	1	204.1	39.0	45.0	0.35
	1	204.3	44.0	51.0	0.35
	3	204.7	43.0-54.3	49.8-63.6	0.43-1.00
	5	204.8	35.4-50.3	41.2-58.4	0.26-0.67
	7	204.9	35.2-48.0	41.2-55.2	0.20-0.62
	160	205.0	30.8-69.1	35.0-81.1	0.13-2.30
	3	205.3	38.0-50.0	44.0-51.0	0.30-0.76
	10	205.4	36.0-50.5	42.2-58.5	0.28-0.78
	33	205.5	26.0-62.1	31.0-71.8	0.08-1.50
	1	207.0	60.0	69.4	1.37
	3	207.5	44.6-59.7	51.3-68.7	0.47-1.18
	2	213.2	51.4-58.1	60.2-67.0	0.85-1.17
	1	213.5	58.6	67.6	1.13
	45	215.0	33.1-70.0	37.8-81.1	0.10-2.14
	9	215.1	36.1-49.5	41.1-58.2	0.25-0.69
	6	215.2	25.0-47.0	30.0-55.5	0.05-0.55
	23	215.4	31.2-49.0	36.5-56.4	0.20-0.75
	149	215.5	25.5-64.8	29.1-74.0	0.06-1.32
	41	215.6	30.0-48.9	34.2-56.8	0.13-0.60
	61	215.7	25.0-54.8	29.0-63.8	0.05-0.93
1995	9	215.8	25.0-50.2	30.0-58.4	0.08-0.68
	2	216.0	40.5-45.6	47.3-52.5	0.39-0.53
	4	219.0	22.0-58.4	25.3-67.4	0.10-1.18
	2	219.8	28.7-33.5	33.5-39.0	0.13-0.25
	1	220.0	32.5	38.0	0.24
	4	222.0	25.9-30.5	30.0-35.0	0.20-0.30
	1	222.7	33.0	38.2	0.20
	1	224.0	61.2	70.9	1.32
	1	224.5	39.0	45.4	0.34
	2	224.6	29.4-35.0	33.0-42.0	0.15-0.19
	12	224.7	31.4-50.9	36.0-58.7	0.18-0.95
	16	224.8	31.9-50.1	36.2-59.3	0.18-0.76
	24	224.9	30.4-64.0	34.2-74.0	0.15-1.70
	105	225.0	21.0-65.9	24.0-75.6	0.05-1.49
	33	225.1	28.0-55.4	32.0-64.2	0.09-1.20
	2	225.2	24.0-27.0	28.0-32.0	0.05
	1	225.4	37.1	43.0	0.20
	1	226.1	45.3	52.3	0.53
	5	227.0	29.5-51.0	33.5-61.0	0.10-1.00
	3	227.2	33.0-35.0	38.0-40.5	0.20
	6	227.3	30.0-34.5	34.5-39.0	0.10-0.20
	11	227.4	22.7-41.4	33.0-48.6	0.10-0.45
	2	227.8	48.3-51.5	54.8-60.2	0.65-0.78
	1	229.7	46.3	53.5	0.55
	2	229.8	39.9-42.3	46.6-50.1	0.35-0.38
	1	230.5	51.5	60.3	0.75
	2	230.8	29.0-36.3	35.0-41.3	0.13-0.25
	3	230.9	27.9-47.5	32.3-55.0	0.13-0.68
	1	234.3	33.2	37.0	--
	2	234.4	25.0-37.0	29.0-42.0	0.09-0.20
	5	234.5	224.0-52.0	27.0-60.2	0.06-0.83
	1	244.0	56.8	66.2	0.98
	1	244.4	33.8	43.4	--

Appendix 6. Continued.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
	1	244.5	48.2	56.6	0.65
1995	1	244.6	31.5	36.6	0.13
	3	245.0	46.4-63.7	67.0-73.6	1.02-1.08
	6	Unknown	45.5-55.5	52.2-65.3	0.56-1.13
	1	145.0	28.5	31.1	0.13
	1	193.5	50.0	57.6	0.71
	1	204.0	38.4	44.4	0.28
	10	205.0	30.0-52.5	35.0-60.5	0.13-0.86
	1	213.2	35.5	41.5	0.24
	1	213.5	37.7	43.2	0.28
	5	215.0	36.1-51.9	52.0-66.7	0.51-1.22
	6	215.5	22.6-46.6	26.7-52.5	0.08-0.34
	1	215.7	33.2	38.7	0.20
	1	224.0	32.5	38.7	0.20
1998	1	224.8	36.0	41.7	0.30
	6	224.9	30.0-51.0	35.1-60.2	0.12-0.83
	6	225.0	27.0-38.5	31.6-44.6	0.06-0.36
	2	225.1	27.7-27.8	32.0-32.4	0.10-0.14
	1	226.1	36.1	41.8	0.28
	1	227.4	25.7	30.5	0.07
	1	227.8	28.4	33.1	0.13
	2	229.8	22.5-25.6	26.4-30.2	0.06-0.10
	1	230.0	54.0	63.7	1.1
	2	230.9	23.5-25.0	28.0-29.5	0.07-0.08
	1	244.5	40.7	47.4	0.35
	55	118.0	42.3-74.0	49.5-86.6	0.47-3.25
	2	119.0	--	39.0-45.2	0.24-0.38
	44	120.0	29.1-62.5	33.9-72.0	0.16-1.54
	33	121.0	29.5-65.0	34.0-75.5	0.17-1.95
	12	123.0	32.1-59.6	37.5-69.5	0.19-1.28
	14	130.0	27.6-48.3	31.8-55.8	0.12-0.62
	9	134.0	31.3-40.5	36.5-47.0	0.17-0.38
	4	137.0	28.3-45.0	33.4-57.0	0.14-.70
	8	145.0	26.5-46.0	31.1-53.1	0.11-0.55
	3	150.0	37.5-41.5	43.6-48.2	0.35-0.45
	5	157.0	31.2-35.0	36.9-40.0	0.19-0.27
	14	161.0	27.4-47.0	31.9-55.2	0.13-0.72
	2	163.0	29.0	33.7	0.15
	7	165.0	27.2-36.5	31.0-42.8	0.14-0.27
	2	167.0	32.1-32.7	37.1-38.1	0.16-0.20
1999	31	174.5	24.1-33.4	28.3-38.9	0.04-0.20
	1	176.1	35.7	42.4	0.25
	1	176.4	26.5	30.5	0.10
	2	176.5	24.5-29.0	28.5-33.6	0.07-0.14
	1	176.9	31.3	36.3	0.17
	5	182.0	30.1-38.5	35.6-44.5	0.15-0.29
	1	189.9	29.0	34.0	0.13
	40	190.0	23.0-47.3	26.5-55.0	0.06-0.63
	2	190.1	27.0-29.0	31.0-33.0	0.10-0.14
	2	190.2	23.5-31.0	28.0-36.0	0.07-0.15
	8	190.3	27.0-41.5	31.1-49.1	0.10-0.36
	5	190.4	27.0-36.0	31.0-41.5	0.10-0.20
	5	192.0	28.5-43.0	33.0-49.9	0.15-0.35
	1	193.0	48.1	55.9	0.62
	2	193.5	48.3-48.7	55.4-56.5	0.48-0.62
	4	195.7	22.3-32.0	25.9-37.0	0.08-0.20
	12	195.8	24.5-36.0	28.6-42.0	0.07-0.31
	14	195.9	22.5-33.5	26.5-39.2	0.04-0.68
	6	196.0	25.5-33.5	30.0-38.5	0.05-0.23

Appendix 6. Continued.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
	8	203.5	27.5-52.5	32.1-60.7	0.12-0.73
	12	204.0	30.5-51.5	35.6-59.7	0.15-86
	3	204.7	26.3-31.7	29.8-38.0	0.11-0.21
	1	204.8	29.0	34.0	0.12
	4	204.9	27.6-32.4	32.0-37.9	0.11-0.19
	228	205.0	19.5-57.5	28.5-68.5	0.05-0.88
	1	205.3	28.0	32.0	0.10
	1	205.4	24.0	29.3	0.05
	49	205.5	25.6-51.5	29.1-60.0	0.11-0.88
	17	207.0	34.4-48.9	40.1-57.0	0.45-0.68
	1	207.5	48.2	55.1	0.74
1999	7	208.0	27.1-35.1	31.4-41.5	0.12-0.23
	4	213.2	29.6-40.6	33.6-47.3	0.15-0.35
	1	213.5	31.0	36.1	0.18
	92	215.0	34.5-55.0	39.6-64.2	0.23-0.91
	83	215.5	20.9-44.5	31.5-52.6	0.14-0.50
	1	216.0	28.9	33.6	0.11
	1	219.0	51.4	59.0	0.70
	1	219.5	36.0	41.2	0.30
	6	224.7	22.6-30.0	24.9-34.9	0.05-0.15
	8	224.8	25.0-27.4	28.5-32.2	0.08-0.12
	14	224.9	26.9-43.5	30.9-50.7	0.10-0.67
	35	225.0	23.2-51.9	26.1-60.4	0.07-0.82
	1	225.1	26.5	30.7	0.12
	3	230.0	27.0-56.9	30.5-62.0	0.11-0.96
	4	230.9	25.0-27.5	29.0-32.0	0.10-0.14
	2	231.0	25.5-285	30.0-33.5	0.10-0.14
	1	244.0	42.3	49.3	0.47
	6	244.5	27.5-37.1	30.5-43.2	0.11-0.28
	1	245.0	47.1	54.0	0.58
	91	Unknown	19.0-39.0	22.0-44.2	0.05-0.90
	1	76.0	25.6	31.0	0.11
	19	118.0	36.9-67.0	42.1-77.7	0.29-1.65
	21	120.0	26.3-60.3	30.9-69.3	0.12-1.44
	19	121.0	26.4-55.9	30.4-64.6	0.12-1.11
	8	123.0	29.5-58.5	34.3-68.5	0.14-1.50
	11	130.0	25.1-42.4	29.3-49.3	0.09-0.39
	2	134.0	36.5-42.5	42.5-49.2	0.25-0.48
	1	137.0	28.2	32.6	0.11
	3	141.0	30.8-39.0	34.8-46.0	0.14-0.31
	4	145.0	31.1-33.0	33.2-38.3	0.15-0.24
	2	150.0	29.3-33.5	34.0-39.0	0.19-0.21
2000	4	157.0	23.5-27.8	27.0-31.9	0.09-0.11
	9	161.0	21.8-33.4	24.5-39.0	0.07-0.24
	3	163.0	25.5-29.0	29.6-33.5	0.13-0.14
	9	165.0	26.0-31.0	29.7-35.6	0.09-0.17
	4	167.0	27.2-35.5	31.4-41.5	0.10-0.26
	2	182.0	29.2-29.4	33.5-34.7	0.13-0.15
	5	190.0	26.1-44.5	30.6-51.7	0.09-0.57
	2	190.3	25.5-29.0	30.9-33.6	0.09-0.14
	2	192.0	30.0	35.0	0.14-0.16
	2	193.0	38.6-40.0	44.4-46.0	0.32-0.39
	6	193.5	37.4-45.8	42.2-52.6	0.14-0.51
	5	195.8	26.5-34.2	32.3-40.2	0.11-0.27
	1	204.0	37.0	43.1	0.03
	81	205.0	21.0-50.0	26.2-59.0	0.05-0.77
	26	205.5	24.1-42.7	28.0-49.2	0.08-0.42
	4	207.0	33.6-40.8	38.5-47.0	0.35-0.37
	2	208.0	25.6-32.0	30.0-37.5	0.10-0.19

Appendix 6. Continued.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
	1	210.0	34.2	40.4	0.25
	10	213.2	26.0-35.3	30.2-41.1	0.10-0.29
	4	213.5	28.0-32.5	32.0-38.6	0.12-0.19
	28	215.0	30.2-48.8	33.8-57.1	0.14-0.76
	25	215.5	25.1-37.7	27.3-44.0	0.09-0.30
2000	1	219.0	38.7	45.4	0.37
	6	224.0	29.6-38.0	34.3-44.0	0.15-0.31
	9	224.9	32.2-39.0	37.7-45.5	0.23-0.44
	25	225.0	26.1-43.0	30.5-50.0	0.09-0.55
	1	227.8	24.3	27.8	0.09
	1	230.5	32.9	37.5	0.21
	1	244.5	50.2	58.7	0.67
	1	245.0	45.3	52.3	0.56
	3	Unknown	28.0-32.2	32.4-38.0	0.12-0.18
	4	118.0	36.6-64.1	43.0-73.4	0.27-1.95
	3	120.0	43.0-54.0	49.6-62.0	0.51-0.89
	2	121.0	51.5-58.0	59.0-66.7	0.61-1.25
	2	123.0	26.2-33.6	31.3-38.8	0.09-0.20
	1	161.0	18.9	21.9	0.04
	2	190.0	31.5-40.8	36.6-47.9	0.19-0.36
	1	192.0	34.9	39.4	0.22
	2	195.8	21.9	25.2	0.06
	2	2023.5	40.9-42.0	47.6-49.1	0.18-0.34
	3	204.0	35.5-38.0	41.8-44.2	0.25-0.30
2001	11	205.0	25.0-39.8	28.2-46.4	0.08-0.39
	3	205.5	23.6-29.1	27.2-33.7	0.08-0.13
	1	207.0	35.3	41.3	--
	1	213.2	23.0	26.5	0.07
	1	213.5	24.5	28.9	0.09
	20	215.0	28.9-40.4	30.9-46.4	0.14-0.35
	7	215.5	21.2-29.3	24.4-33.8	0.05-0.15
	2	224.0	22.9-26.1	26.6-30.4	0.07-0.09
	3	224.9	22.3-29.0	25.8-33.2	0.06-0.20
	9	225.0	18.2-36.0	20.6-42.5	0.04-0.27
	1	228.5	22.7	26.6	0.06
	2	118.0	51.5-53.0	61.0-62.8	0.89-1.10
	2	120.0	26.0-35.5	30.1-40.9	0.10-0.26
	3	121.0	34.3-59.0	39.9-69.6	0.22-1.40
	2	123.0	26.0-53.5	30.1-62.8	0.08-0.88
	3	130.0	22.0-38.0	25.7-44.3	0.07-0.30
	1	134.0	24.0	27.9	0.09
	1	137.0	26.4	30.6	0.10
2002	4	145.0	20.8-23.4	24.1-27.1	0.05-0.08
	4	161.0	24.1-57.2	27.8-67.0	0.07-1.14
	2	163.0	19.0-21.9	22.2-25.2	0.030.06
	3	165.0	22.2-23.6	26.1-27.3	0.05-0.07
	2	167.0	15.0-21.0	17.6-24.0	0.03-0.05
	1	190.0	29.3	33.5	0.14
	1	205.0	27.5	31.6	0.11
	2	205.5	27.7	31.4	0.10-0.13
	1	207.0	35.0	40.2	0.24
	4	118.0	33.8-36.0	39.0-42.0	0.21-0.27
	4	120.0	30.0-39.0	35.0-45.2	0.16-0.45
	10	121.0	21.0-41.0	24.8-48.4	0.08-0.38
2003	5	123.0	22.5-32.7	26.1-37.0	0.06-0.19
	22	130.0	20.2-40.2	23.4-47.2	0.04-0.37
	26	134.0	19.5-41.5	23.0-48.3	0.05-0.38
	13	137.0	21.3-25.0	24.6-29.5	0.04-0.09

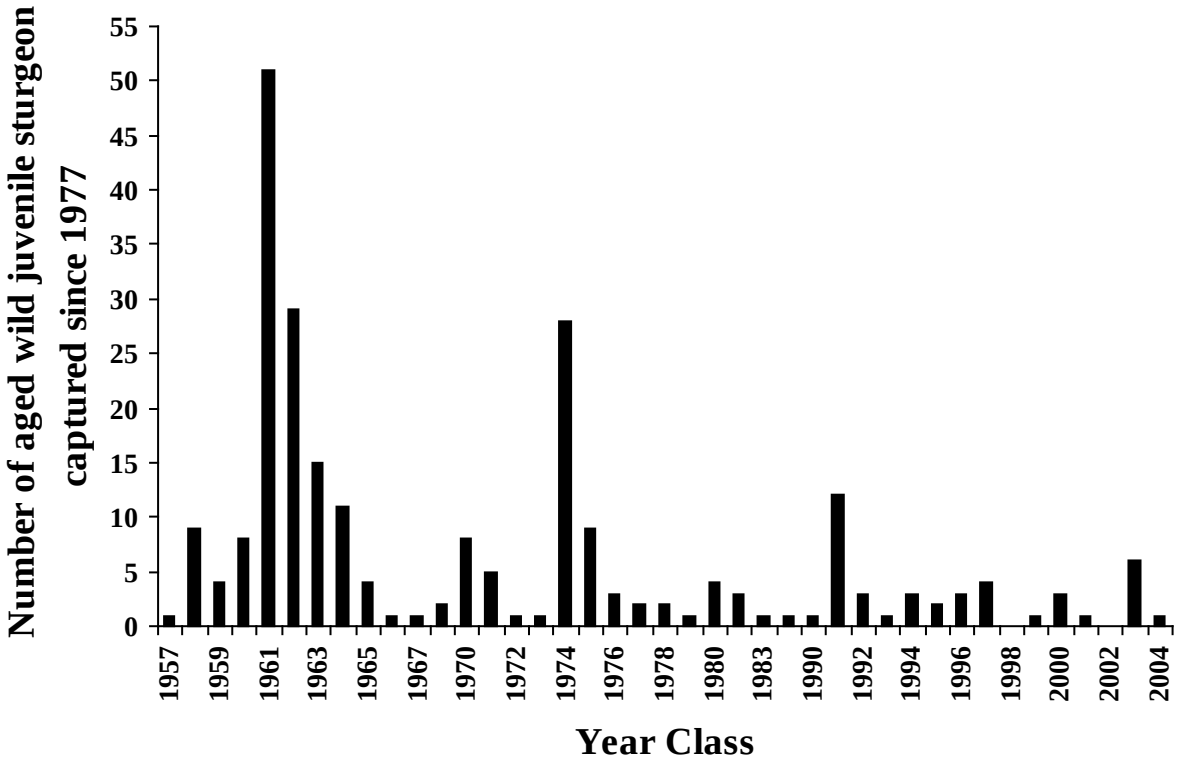
Appendix 6. Continued.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
	15	141.0	18.0-33.0	21.5-39.0	0.03-0.21
	58	145.0	19.0-38.0	22.1-44.0	0.04-0.35
	35	150.0	17.8-30.0	20.8-35.6	0.03-0.18
	4	157.0	20.6-26.0	24.1-29.8	0.07-0.10
	51	161.0	19.5-32.0	22.8-37.5	0.04-0.17
	12	163.0	20.7-33.5	23.8-32.1	0.04-0.11
	18	165.0	20.7-33.5	24.0-40.0	0.05-0.24
	7	167.0	14.9-32.0	17.1-37.8	0.02-0.18
	2	170.0	35.4-36.9	40.7-43.4	0.15-0.19
	3	185.0	33.4-36.4	38.3-41.7	0.13-0.17
2003	1	188.0	32.5	37.7	0.21
	17	190.0	28.0-41.4	32.7-49.0	0.13-0.45
	3	192.0	25.8-27.2	29.6-31.7	0.09-0.11
	1	193.0	32.6	38.1	0.20
	3	193.5	31.9-37.1	37.4-42.5	0.12-0.19
	3	203.5	33.5-44.1	39.3-50.9	0.24-0.43
	4	204	31.0-35.7	36.1-41.5	0.02-0.22
	26	205.0	23.5-38.5	27.2-45.2	0.08-0.34
	3	207.0	34.4-35.9	39.9-42.2	0.23-0.28
	4	207.5	33.2-45.1	39.0-52.9	0.22-0.49
	38	215.0	22.5-46.2	26.5-54.7	0.07-0.47
	5	225.0	25.8-36.0	29.7-42.1	0.11-0.26
	1	230.0	31.2	36.8	0.18
	1	245.0	32.4	37.9	0.17
	1	118.0	27.9	32.1	0.11
	1	123.0	28.0	32.1	0.12
	7	130.0	23.6-36.0	27.5-42.7	0.08-0.26
	1	134.0	23.8	28.4	0.07
	5	141.0	20.5-21.5	23.1-25.3	0.04-0.06
	11	145.0	19.0-29.1	22.0-34.1	0.02-0.14
	4	150.0	17.8-31.0	21.0-35.1	0.04-0.15
	2	157.0	25.5-28.0	29.6-30.5	0.08-0.12
	5	161.0	24.0-29.2	27.9-34.2	0.07-0.14
	2	165.0	28.0-30.0	32.6-35.2	0.11-0.15
2004	1	167.0	29.0	33.4	0.12
	1	190.0	32.1	37.3	0.13
	2	204.0	25.9-30.0	30.0-33.5	0.09-0.12
	5	205.0	23.0-25.6	25.0-39.8	0.07-0.10
	1	207.0	28.0	32.7	0.13
	1	215.0	32.9	37.9	0.22
	1	215.5	35.5	41.9	0.25
	4	225.0	25.6-30.8	26.0-36.4	0.06-0.18
	5	244.0	21.5-24.7	25.3-28.7	0.06-0.09
	4	244.5	25.4-40.1	29.9-47.2	0.09-0.43
	5	245.0	34.2-38.6	40.3-44.9	0.21-0.29
	2	120.0	23.1-25.4	27.3-29.5	0.06-0.08
	4	130.0	23.3-24.8	26.8-29.6	0.06-0.17
	1	134.0	22.6	26.5	0.06
	4	137.0	25.9-28.0	30.0-33.2	0.07-0.12
	10	141.0	20.5-26.5	24.0-30.9	0.04-0.10
	16	145.0	19.5-27.1	23.2-31.8	0.04-0.11
2005	1	157.0	25.5	30.7	0.09
	6	161.0	21.3-26.9	22.9-31.1	0.05-0.10
	2	163.0	20.9-24.1	24.5-28.8	0.04-0.09
	5	165.0	23.0-27.6	27.0-33.0	0.06-0.11
	3	190.0	20.8-27.8	23.2-32.1	0.05-0.09
	3	192.0	22.6-24.3	26.9-27.6	0.06-0.08
	1	193.5	26.2	29.5	0.08
	9	204.0	19.5-25.5	22.6-29.2	0.03-0.08

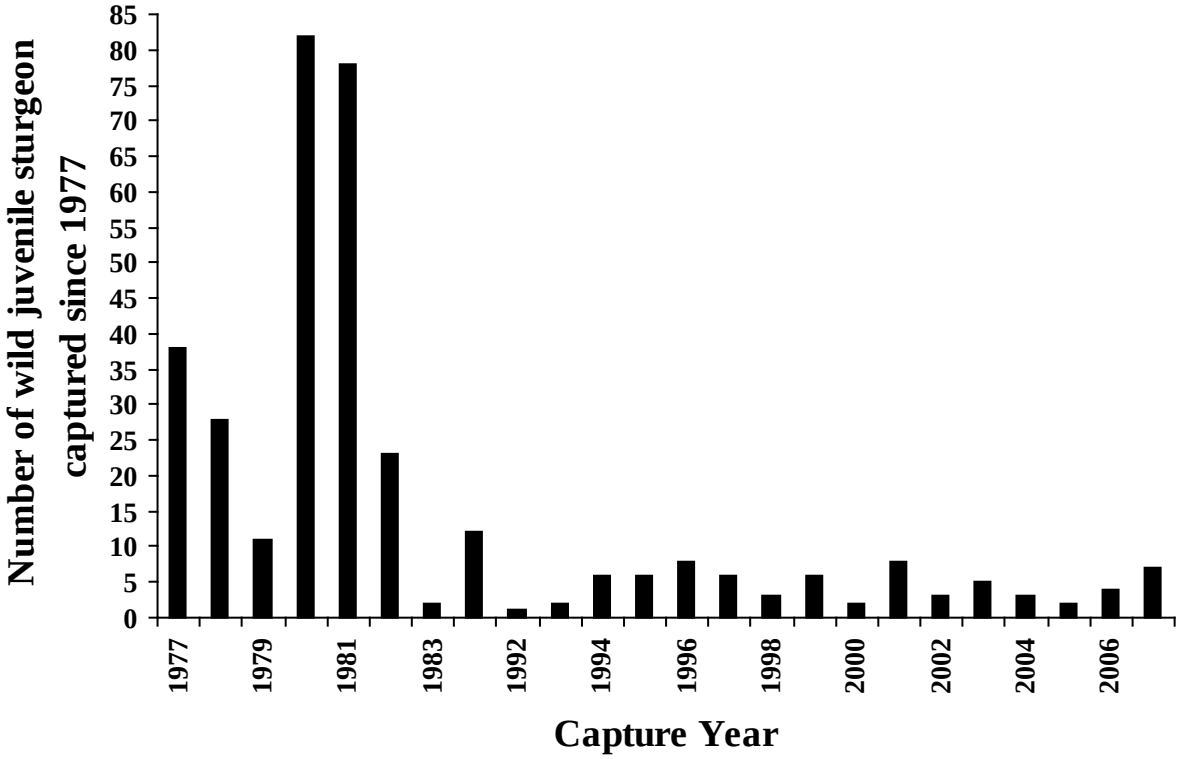
Appendix 6. Continued.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
2005	2	205.0	20.5-29.3	23.7-34.0	0.050.14
	1	207.0	25.0	28.9	0.06
	2	215.0	28.6-31.2	33.2-36.6	0.12-0.19
	3	225.0	20.0-22.7	24.3-26.0	0.06-0.07
	3	229.0	25.1-28.6	29.5-33.0	0.08-0.13
	1	235.0	29.9	35.0	0.13
	22	244.5	18.5-32.3	21.1-40.9	0.03-0.23
	4	245.0	21.6-33.5	25.2-39.3	0.06-0.18
2006	7	193.5	14.9-30.3	17.4-35.1	0.01-0.10
	1	240.5	24.0	27.0	0.08
	1	244.5	19.6	23.6	0.05
	7	245.0	23.8-27.6	27.9-39.6	0.04-0.11
Unknown year class	4	118.0	44.5-60.0	51.5-69.2	0.52-1.80
	34	120.0	32.5-78.3	38.0-89.7	0.21-3.30
	40	121.0	24.5-79.0	28.5-91.0	0.08-3.25
	3	123.0	28.0-88.5	33.0-100.2	0.14-5.35
	24	130.0	18.0-43.2	21.8-55.3	0.03-0.50
	1	134.0	21.4	25.1	0.05
	4	137.0	25.1-27.6	28.9-31.9	0.08-0.10
	26	141.0	19.5-56.0	23.0-65.2	0.04-1.00
	15	145.0	19.5-38.3	22.8-44.7	0.04-0.30
	16	150.0	20.3-30.1	23.4-34.9	0.05-0.19
	6	157.0	21.6-50.0	24.1-58.7	0.06-0.80
	16	161.0	22.1-46.3	25.9-53.8	0.07-0.55
	4	163.0	18.5-30.2	21.0-34.6	0.03-0.17
	13	165.0	16.8-36.5	19.0-41.5	0.03-0.30
	6	167.0	15.4-31.0	17.8-36.0	0.02-0.16
	4	170.0	24.8-32.0	29.2-37.7	0.05-0.11
	5	182.0	26.2-33.5	30.5-38.8	0.10-0.21
	2	185.0	30.5-35.7	35.0-41.1	0.04-0.24
	4	188.0	26.3-34.0	30.2-39.3	0.06-0.19
	8	190.0	20.5-48.5	24.7-56.2	0.06-0.59
	11	192.0	21.4-33.0	24.6-38.8	0.03-0.20
	20	193.0	22.5-35.1	26.2-41.2	0.07-0.24
	30	193.5	13.6-45.7	16.0-52.9	0.01-0.42
	1	195.8	34.2	38.0	0.20
	7	203.5	25.0-65.9	30.0-75.7	0.07-1.42
	4	204.0	21.2-72.5	25.0-84.8	0.05-0.56
	41	205.0	15.4-74.0	17.2-87.0	0.01-2.80
	6	205.5	33.4-35.0	38.1-40.7	0.16-0.33
	26	207.0	26.8-56.3	26.2-65.1	0.05-0.68
	10	207.5	25.6-43.0	30.0-49.5	0.05-0.47
	36	215.0	24.0-61.9	28.5-71.1	0.06-1.22
	1	215.4	61.0	72.0	1.10
	10	215.5	21.8-51.0	24.7-58.3	0.07-0.90
	2	219.5	30.9-33.0	35.5-36.7	0.20-0.23
	3	224.9	30.0-36.1	34.6-40.7	0.13-0.26
	11	225.0	23.1-37.2	26.7-43.1	0.07-0.41
	1	230.0	30.0	35.0	0.13
	1	241.0	24.7	29.0	0.05
	14	244.5	19.1-43.1	22.0-50.4	0.04-0.52
	40	245.0	20.8-62.4	22.3-72.5	0.03-1.40
	1	Unknown	24.0	27.2	0.08
Total	3,880				

Appendix 7. Number of aged wild juvenile white sturgeon captured by year class in the Kootenai River, Idaho, since 1977.



Appendix 8. Number of wild juvenile white sturgeon captured annually in the Kootenai River, Idaho, since 1977.



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