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Kootenai River White Sturgeon Investigations

White Sturgeon Spawning and Recruitment Evaluation

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FISHERY RESEARCH

KOOTENAI RIVER WHITE STURGEON SPAWNING AND RECRUITMENT EVALUATION

ANNUAL PROGRESS REPORT
April 1, 2004 to March 31, 2005

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IDFG Report Number 05-37
November 2005

Kootenai River White Sturgeon Spawning and Recruitment Evaluation

Project Progress Report

April 1, 2004 to March 31, 2005

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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 (USACE). Sampling for adult Kootenai River white sturgeon in 2004 began in March and continued into May. One hundred forty-two adult white sturgeon were captured with 4,146 hours of angling and set-lining effort in the Kootenai River. Kootenai River discharge and stage at Bonners Ferry in 2004 peaked in mid December. Discharge remained below 400 cubic meters per second (cms) until June 1; then, because of a systems operations request (SOR), increased and remained between 480 and 540 cms through the end of June. From July through September, discharge ranged from 360 to 420 cms, decreasing to 168 cms by the end of October. Discharge increased again to above 625 cms by November 4 to increase winter storage in Lake Koocanusa and ranged from 310 to 925 cms through the end of December. We monitored the movements of 31 adult sturgeon in Kootenay Lake, British Columbia (BC) and the Kootenai River from mid-March until late August 2004. All telemetered fish were dual tagged with external sonic and radio transmitters, and some of the fish were tagged in previous years. Eighteen of the 31 telemetered adult white sturgeon were released at Hemlock Bar reach (rkm 260.0) as part of a research project to test the feasibility of moving sexually mature adult white sturgeon to areas with habitat types thought to be more suitable for successful egg hatching and early life stage recruitment. Marked fish were monitored from the time of release until they moved downstream of Bonners Ferry. Sampling for white sturgeon eggs with artificial substrate mats began May 3 and ended June 10, 2004. We sampled 650 mat days (a mat day is one 24 h set) during white sturgeon spawning. Most of the sampling occurred in the post-Libby dam spawning reach (rkm 229.0 to 246.0) but some sampling occurred near Crossport (rkm 253.5) and in the Canyon reach above Hemlock Bar (rkm 261.0). We collected eight white sturgeon eggs near Shortys Island in 2004. Sampling for larval white sturgeon began June 8 and continued until July 22, 2004. Sampling occurred primarily at Ambush Rock (rkm 244.0) in an attempt to document any recruitment that might have occurred from the Set and Jet Program. We collected 103 larval fish, but none were white sturgeon larvae or embryos. Juvenile white sturgeon sampling started July 26 and continued through September 27, 2004. A total of 271 hours of gillnetting effort captured 256 juvenile hatchery white sturgeon and two juvenile wild white sturgeon.

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INTRODUCTION

The Kootenai River white sturgeon population is comprised mainly of 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 no larvae and very few wild juveniles have been collected despite years of intensive sampling. Post-release hatchery reared juveniles (as young as 9 months of age at release) consistently exhibit successful growth, and second year survival rates exceed 90% (Ireland et al. 2002). 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.

OBJECTIVE

1. Our study objective was to determine environmental requirements for successful spawning and recruitment of Kootenai River white sturgeon *Acipenser transmontanus*. The main tasks of this program are to monitor the response of all life stages of Kootenai River white sturgeon to mitigative discharge from Libby Dam provided by the United States Army Corps of Engineers (USACE).

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 Kootenai River 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 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 flow regime of the river. Spring discharges were reduced by about a third, and discharge during winter is now three to four times higher (Figure 2). Since 1991, the USACE has increased spring discharge and river stage intended to benefit Kootenai River white sturgeon (hereafter white sturgeon) spawning (Figures 2 and 3).

METHODS

Discharge, Water Levels and Temperature

Kootenai River discharge and water temperature data at Bonners Ferry were obtained from USACE. To coincide with research studies planned in the Canyon Reach upstream of Bonners Ferry (above rkm 262.0) beginning in late May 2004, the U.S. Fish and Wildlife Service (USFWS) (Susan Martin, written communication) submitted a Systems Operation Request (SOR #2004-FWS1). This SOR requested a target discharge of 510 cubic meters per second (cms) measured at the Leonia gage for four consecutive weeks starting with 368 cms the first week and ramping up discharge by 28 cms each week until the target volume was achieved. This SOR was proposed to increase wetted area in the Canyon Reach and to provide water velocities in excess of 1 m/s to reduce any potential predation on spawned white sturgeon eggs (USFWS, SOR #2004-FWS1).

Secchi Disk Measurements

We measured Secchi disk depth in 2004 during egg mat sampling to provide a measure of turbidity during the spawning season. We measured Secchi disk depth at Shortys Island (rkm 229.5), Deep Creek (rkm 240.0), and Ambush Rock (rkm 244.5).

Adult White Sturgeon Sampling

Adult white sturgeon were collected by angling and setlines from March 15 through May 23, 2004 following the methods of Paragamian et al. (1996). Biopsies were performed to determine sex and gonad stage. Those fish expected to spawn in 2004 were tagged with both a depth sensitive radio transmitter (model 2130, Advanced Telemetry Systems brand [ATS], Isanti, Minnesota) and a sonic transmitter (model CT-82-3-AA, Sonotronics brand, Tucson, Arizona) and released. They were then monitored to determine movements during the spawning season. We also angled at the Kootenay River Delta in September and October 2004. Non-ripe male and early vitellogenic female white sturgeon expected to spawn in 2005 or later were tagged with Vemco sonic transmitters (model V16 and V13, Vemco Ltd., Shad Bay, Nova Scotia, Canada) to monitor future movement and behaviors.

Set and Jet Program

White sturgeon are currently spawning over sand substrates (rkm 229.0-246.0) where egg mortality is thought to be high. This may be a leading factor in the well-documented recruitment failure of this population. Substrates at the Hemlock Bar reach (rkm 260.0) more closely resemble spawning and rearing substrates of other successfully recruiting *Acipenser* sp. populations (Parsley and Beckman 1994; Auer and Baker 2002). The Set and Jet Program was designed to determine how sexually mature white sturgeon would respond to being moved long distances (at least 45 km) where habitat conditions were thought to be more favorable for successful egg hatching and early life stage recruitment.

Adult white sturgeon were captured by angling or setlines as previously discussed. We attached radio and sonic transmitters to the dorsal fin and removed a small section of pectoral fin for future genetic analysis or age determination. Sturgeon were either moved upstream to the

Hemlock Bar reach immediately after tagging or held in a holding pen at the Kootenai Tribal hatchery facility (rkm 242.5) and transported upstream at a later date (Rust and Wakkinen 2004). We held fish in the net pen for two reasons. First, at lower river stages, boat travel (jetting) is dangerous and often impossible. Under these conditions, fish were temporarily held in the holding pen, then trucked in 200 liter hatchery tanks to the boat ramp at the mouth of the Moyie River (rkm 259.0) and jetted the remaining distance. Second, individual fish were held at the hatchery facility overnight to facilitate moving several fish upstream in pairs or multiple fish to incorporate any group behavioral response, which may increase the chances that individuals would stay upstream. We tracked all telemetered fish weekly and recorded current velocity, water depth, geographic position, and water temperature at each location.

The 2004 Set and Jet Program included an early and late release group to try to determine the best release timing for increasing the chances of fish staying in the study area and potentially spawning. The early release group included fish released from March 30 through April 29, and the late release group included fish released in May.

Adult White Sturgeon Telemetry

White sturgeon were monitored by boat, fixed station radio receivers, and fixed wing aircraft telemetry throughout the year. This included white sturgeon that were fitted with transmitters as part of the Set and Jet Program that moved out of the Hemlock Bar study area, and white sturgeon with transmitters still active from previous years.

Boat Telemetry

Movements and migration of adult white sturgeon fitted with sonic and radio transmitters (not in the Hemlock Bar reach or a part of the Set and Jet Program) were monitored monthly in 2004 by boat from the Kootenai River at Bonners Ferry (rkm 247.0) to the delta at Kootenay Lake, BC (rkm 120.0). The main objective was to locate late vitellogenic females and reproductive males migrating upstream to staging and spawning areas. Each transmitter location was recorded to the nearest 0.1 rkm, and geographic coordinates (universal transverse mercator; UTM) were recorded. Increased movement of tagged fish during the prespawning and spawning seasons required more frequent monitoring. We monitored reaches above Copeland, Idaho (Figure 1) more intensively during the prespawning and spawning periods when mature sturgeon were moving to spawning areas.

Fixed Receiver Telemetry

Seventeen sonic receivers (model VR2, Vemco Ltd., Shad Bay, Nova Scotia, Canada) were deployed from Port Hill, Idaho (rkm 169.9) upstream to below Ambush Rock (rkm 247.0) in May (Figure 4). This array of sonic receivers extended a previous array established in 2002 by the BC Ministry of Environment (BCME) from below Port Hill, Idaho downstream into Kootenay Lake, BC. Transmitters emitted a distinct pulse, and when tagged fish entered the detection range of a receiver, each receiver recorded the transmitter frequency, time, and date. This provided an opportunity to monitor fish movements continuously throughout the Kootenai River system into Kootenay Lake.

Three fixed-station radio receivers monitored fish movements throughout the spawning season. They were stationed between rkm 170.0 and 251.8. Site 1 was near Boundary Creek Wildlife Management Area (rkm 173.5). This site attempted to monitor rapid downstream movements of transmittered fish that may not have been located by other telemetry techniques. Site 2 was located just upstream of Ambush Rock (rkm 244.5). This site was chosen in 1999 to detect potential fish movements upstream of Ambush Rock where substrates change from primarily sand to gravel and cobble. Site 3 was located in the Crossport area (rkm 251.6) on the north side of the Kootenai River. We established this site in 2004 to detect fish moving downstream of the Set and Jet Program study area (rkm 261.8) and to detect any fish moving upstream into areas with gravel and cobble substrates. Each fixed receiver station consisted of a scanning receiver (model R2100, ATS), data logger (model DCCII, ATS), 3-element Yagi antenna, powered by a 12 volt deep-cycle battery. We mounted the antennas on the riverbank on 1.8 m metal fence posts horizontal to the river, affording a clear 180-degree view of the river. Selected sites were all on straight reaches to maximize reception, and the frequencies of radio-tagged white sturgeon were programmed into the receivers. Data loggers were set to record only those frequencies matching tagged white sturgeon. We upgraded each receiver to count pulse frequency to accommodate the depth sensitive transmitters from previous studies. We used a test radio tag to verify detection range and signal strength at each site.

Fixed Wing Telemetry

We mounted two loop antennas on the wing struts of a Cessna 182 for fixed wing aerial telemetry. Flights followed a route downstream from Bonners Ferry or Leonia to Kootenay Lake at an altitude of 152-305 m and speeds of 60 to 80 knots. The radio frequencies of the transmittered females were cycled through a radio receiver (model R2100, ATS) and deleted after their locations were determined. The frequency-cycling rate was 2-4 seconds to facilitate maximum numbers (13) of fish cycled without sacrificing detection range. We estimated each fish location to the nearest 0.1 rkm.

Artificial Substrate Mat Sampling

We used artificial substrate mats to document white sturgeon spawning in the Kootenai River (McCabe and Beckman 1990). Post-Libby Dam sturgeon spawning locations in the Kootenai River have been well-documented (Paragamian et al. 2002). By sampling near these well-defined areas, we can effectively predict the beginning of the spawning period and use it as an index to document the initiation of spawning.

For the spawning index, 20 substrate mats were placed at the Shortys Island reach (near rkm 231.0) until eggs were collected, marking the beginning of the spawning season. After the spawning period was documented, focus shifted to documenting spawning in the Hemlock Bar reach from females transferred upstream as part of the Set and Jet Program, and up to 20 mats were placed upstream of rkm 261.0 in close proximity to the sexually mature females. We monitored the mats until all females left the study area.

Larval White Sturgeon Sampling

We classified young-of-year white sturgeon as free embryos (hereafter embryos), larva, and juveniles (Kynard and Parker 2004). The embryo stage begins upon hatching and ends

after yolk sac absorption when fish develop into feeding larvae. The larval stage continues until adult-like physical features form (Balon 1999), after which the juvenile stage begins. The duration of each stage is apparently population specific and temperature dependant (Kynard and Parker 2004). All of these three life stages may exhibit a downstream dispersal and may be vulnerable to our sampling gear.

Larval white sturgeon sampling in 2004 focused on documenting recruitment in the Hemlock Bar reach from any potential spawning by females transported upstream as part of the Set and Jet Program. Most of the sampling occurred at Ambush Rock at night. We selected this sampling location and time because it closely modeled the sampling locations of Auer and Baker (2002) who collected larval lake sturgeon in similar habitats at similar times. Limited sampling occurred downstream of rkm 231.0 in an attempt to collect larvae from any recruitment that might have occurred from spawning in the traditional spawning reach. Larval sampling followed that of Rust and Wakkinen (2004).

We sampled for larval white sturgeon using half-meter nets at mid water column and on the water surface and D-ring nets set on the bottom of the Kootenai River. We attached lead weights ranging from 2.7-9.1 kg to mid water column and bottom nets to reach the desired depths. We attached flow meters to the mouth of each net and measured current velocity, which when combined with total sampling time and respective net mouth dimensions gave the total volume of water sampled.

Juvenile White Sturgeon Sampling

We used weighted multifilament gill nets with 2.5, 3.8, 5.1, 7.6, 10.2, and 15.2 cm stretch mesh to sample juvenile and young-of-the-year (YOY) sturgeon from July to September 2004 (Paragamian et al. 1996). We sampled eight different sites between rkm 192.0 and 230.5. Gill nets were set during the day and checked every hour to reduce mortality of sampled fish, and all fish were released alive. We recorded length, weight, PIT tag numbers, condition, and scute removal patterns for each sampled fish. A sample of wild and hatchery juveniles were surgically fitted with internal sonic transmitters (Vemco Ltd., Shad Bay, Nova Scotia, Canada) to monitor movement patterns and habitat preferences.

RESULTS

Discharge, Water Levels and Temperature

Kootenai River discharge and stage at Bonners Ferry during 2004 peaked during mid December (Figures 2 and 3). Discharge remained below 400 cms until June 1; then, because of a systems operations request (SOR), increased and remained between 480 and 540 cms through the end of June. From July through September, discharge ranged from 360 to 420 cms, decreasing to 168 cms by the end of October. Discharge increased again to above 625 cms by November 4 to increase winter storage in Lake Koocanusa and ranged from 310 to 925 cms through the end of December.

Secchi Disk Measurements

We measured Secchi disk depth at Shortys Island (rkm 229.5) and at Deep Creek (rkm 240.0) in 2004. Only one reading was taken at Shortys Island and two readings were taken at Deep Creek. Secchi disk depth was 1.6 meters at Shortys Island and averaged 2 meters at Deep Creek. Secchi disk depth has been recorded while egg mat sampling since 1999. Table 5 lists the range of values from 1999 to 2004.

Adult White Sturgeon Sampling

Between March 2 and September 7, 2004, we captured 24 adult white sturgeon by angling and 118 adult white sturgeon with setlines with 4,135 hours of effort. The catch per unit effort (CPUE) for angling and setline gear was 0.113 and 0.030 fish/rod or setline hour, respectively (Table 1).

One hundred seven (75%) of the 142 adult sturgeon were recaptures from previous years (Table 1). We biopsied 28 adult white sturgeon to determine sex, maturity, and stage.

Set and Jet Program

Eighteen white sturgeon were fitted with radio and sonic transmitters, transported upstream to the Hemlock bar area, and released as part of the Set and Jet Program (Table 2, Figure 5, Appendices 1-3). Twelve males (181, 305, 567, 578, 854, 860, 971, 1583, 1588, 1590, 1591, and 1593) and six females (109, 885, 1584, 1587, 1589, and 1592), were captured downstream at various locations and taken by boat and released at or upstream of Hemlock Bar (rkm 261.0). Fish were either transported and released upstream the day of capture or held in the Kootenai Tribe of Idaho hatchery facility and released upstream later. All fish (except male 578) were expected to spawn in 2004, and 17 were part of the suspected spawner group (Table 3).

Early Release Period

Seven adult white sturgeon (1 female and 6 males) were released during the early release period (Table 2). The first fish were released on March 30 and the last fish were released on April 29. Two of the seven (male 1583, female 1587) fish released upstream during the early release group moved downstream out of the study reach to below Bonners Ferry within one week. Two males (578, 971) stayed in the study reach for between one and two weeks, and three males (860, 854, 305) stayed in the study reach for longer than three weeks. Male 578 was released March 30 and moved downstream out of the study reach by April 6. He was recaptured April 29 at Rock Creek, and because of excessive wear on the dorsal fin, both radio and sonic transmitters were removed. Two males (305, 971), released April 29 and April 14, respectively, moved upstream to below Caboose Creek (near rkm 268.8) within six days after being released. Male 305 spent at least 14 days near rkm 268.8 and 41 days within the study reach before moving downstream to Ambush Rock (rkm 244.5) by June 14. Male 971 spent only three days near rkm 268.8 and by April 26 moved downstream out of the study reach. Male 854 spent 47 days in the study reach and during the period exhibited little movement beyond the release site. Between May 18 and May 24, he moved upstream to rkm 269.2 before dropping back downstream to rkm 261.2 by May 27. By June 7, he moved out of the study reach and was located at rkm 238.0. Male 860 was released on April 29 and spent 60

days in the study reach. Most of the telemetry locations were made near the release site at rkm 261.8. He moved upstream to rkm 265.0 on June 14 and stayed between rkm 265.0 and 266.5 until June 28. He was relocated near the Kootenai River delta on July 8. Female 1587 was the only female released during the early release period. She was released at rkm 261.8 on April 29 and moved downstream to Ambush Rock (rkm 244.5) by May. She spent the next 42 days (through June 10) in the post-Libby dam spawning reach (rkm 228.0–246.0) before dropping downstream to rkm 209.2 by June 10, and eventually to the Kootenai River delta (rkm 120.0) by July 8.

Late Release Period

Eleven adults (five females and six males) were moved upstream and released during the late release period (Table 2). Most of the fish from the late release group were released near Debt Creek (rkm 268.5) (Figure 5) since several fish from the first release group were previously or presently located in this area (Table 2). This area contained water depths over 10 meters, gravel and cobble substrates, and rock outcroppings. Eight of the eleven fish (3 females and 5 males) moved downstream out of the study reach to below Bonners Ferry within one week after being released, and two of the remaining three fish (females 885, 1584) moved downstream out of the study reach within two weeks after being released. Male 1588 spent only four days in the study area (above rkm 262.5), but remained above rkm 259.2 through June 28 (46 days) before moving downstream to the Kootenai River delta by July 8. Two fish from the late release group moved upstream within one day of release. Female 1583 was released on May 17 and moved upstream to rkm 272.0 by May 18, and male 1593 was released on May 26 and moved upstream to rkm 274.0 by May 27. Both fish moved downstream out of the study area within one week.

Adult White Sturgeon Telemetry

Migration of Monitored Sturgeon in 2004

We monitored the movements of 31 adult white sturgeon from September 1, 2003 to August 31, 2004 (Figure 6, Table 3, Appendix 1). These included fish in Kootenay Lake, BC, and the Kootenai River in Idaho and BC. The total included 12 females and 19 males.

Five of the 31 monitored fish are believed to have shed their tags, and 24 of the remaining 26 adult sturgeon were located at least once in the Kootenai River (Table 3). Twenty-one of these fish (6 females and 15 males) moved or were moved into the spawning reach (above rkm 228.0) from various staging or overwintering areas (Table 3). Two fish were located in the spawning reach (rkm 228.0–246.0) on the dates when eggs were collected (Table 4). These two fish (male 664 and female 1587–“Set and Jet” fish Table 2) were located within 2.5 river kilometers of egg collection locations on the days when eggs were retrieved.

Nineteen fish (6 females and 13 males) are thought to have spawned (Table 3, “suspected spawners”) based on their gonadal development stage at capture and/or their movements during the spawning season. Some of these included fish released upstream as part of the Set and Jet Program (Table 2). These included males 181, 305, 504, 567, 664, 854, 860, 971, 1583, 1588, 1590, 1591, and 1593; and females 190, 885, 1584, 1587, 1589, and 1592. Males 664 and 504 were thought to have also spawned in 2003 (Rust and Wakkinen 2004). Male 664 was captured at rkm 217.9 in May 2003 and moved as far upstream as lower

Shortys Island that year before dropping back downstream to just above Rock Creek for the winter. In 2004, he moved upstream to rkm 244.5, where he was recaptured May 20 before moving back downstream to the Rock Creek area (rkm 215.0). Male 504 moved as far upstream as rkm 244.5 in June 2003 and then moved downstream to rkm 173.5 by July 2003 (Rust and Wakkinen 2004). He was located only once in 2004 at rkm 240.1.

Boat Telemetry

Boat telemetry for sturgeon locations occurred from November 25, 2003 through August 4, 2004 (Figure 6). Sixty-nine trips were made for a total of 209.1 tracking hours during which 280 white sturgeon locations were made. From March through June when sturgeon were moving between staging and spawning areas of the river, more than 144 hours were spent tracking and 232 locations were made.

Fixed Receiver Telemetry

Fixed site 1 (rkm 173.5) collected data May 6 through July 7, 2004, site 2 (rkm 244.5) collected data April 29 through July 7, 2004, and site 3 (rkm 251.6) collected data April 29 through July 7, 2004. These dates corresponded to the period of upriver movements of spawning fish as noted by current boat, aerial, and fixed-station telemetry. The only locations discussed in our analysis are those verified by boat or aerial telemetry or those occurring at more than one fixed station. Seven white sturgeon were detected moving past one or more of the three fixed stations. This included five females (fish numbers 109, 1584, 1587, 1589, and 1592) and two males (305 and 567). All seven of the fish were suspected spawners in 2004 (Table 3).

Four female white sturgeon (109, 1584, 1589, and 1592) were detected at site 1 (rkm 173.5) between May 27 and June 17, 2004. Two white sturgeon were located at site 2. These included one female (1587) and one male (305). The fish were located between May 1 and June 14. Three white sturgeon were detected at site 3. This included two females (1587 and 1589, all were suspected spawners) and one male (567, another suspected spawner). These fish were located between May 1 and May 26.

Fixed-wing Telemetry

Fixed-wing airplane flights took place from February 2 through June 28, 2004. Many flights occurred in conjunction with tracking flights for tagged bull trout *Salvelinus confluentus*, rainbow trout *Oncorhynchus mykiss* (Walters 2004), and juvenile white sturgeon released in Montana. Fourteen total flights were made searching for adult sturgeon, of which one flight was made searching for white sturgeon in the lower Kootenai River (rkm 153.0-122.0) and lower Kootenay Lake (rkm 113.0–122.0). Thirteen flights included searches from rkm 245.0 and farther upstream in an effort to detect movements made by fish released as part of the Set and Jet Program. Seventy-six white sturgeon contacts were made in approximately 12.9 hours of telemetry tracking by airplane. This accounted for 65% of the fish locations. Twenty-three different fish were located including 15 suspected spawners (females 885, 1584, 1587, and 1589 and males 305, 504, 567, 664, 854, 860, 971, 1583, 1588, 1591, and 1593) (Table 3). The majority of the flying occurred from Bonners Ferry (rkm 245.0) upstream of the Yaak River (rkm 296.0) and downstream to Rock Creek (rkm 215.0) and the Canadian border (rkm 170.0).

Artificial Substrate Mat Sampling

We deployed substrate mats at five sites within the traditional post-Libby dam spawning reach (rkm 229.0 to rkm 246.0) and sampled 650 mat days. Five eggs were collected at Shortys Island on May 10, and three eggs were collected at Shortys Island on May 13 (Table 4). All eggs were dead at the time of collection and spawning date could not be determined. After eggs were collected at Shortys Island, effort shifted to documenting any spawning from females transported upstream as part of the Set and Jet Program (rkm 253.0–rkm 274.0) (Table 4). No eggs were collected outside of Shortys Island in 2004.

Larval White Sturgeon Sampling

We sampled for white sturgeon embryos and larvae between June 8 and July 22, 2004 (Table 6). We spent a total of 787 hours sampling at five sites (Table 6). Most of the sampling occurred at Ambush Rock to document any recruitment that may have occurred from spawning events occurring upstream of Bonners Ferry from the Set and Jet Program. All sampling at Ambush Rock was conducted at night and all sampling at the other four sites was conducted during daylight hours. One hundred three larval or embryonic fish were captured, but no early life stage white sturgeon were collected (Table 6).

Juvenile White Sturgeon Sampling

We sampled for juvenile white sturgeon with gillnets between July 7 and September 22, 2004. We spent 271 hours of gillnet sampling effort and captured 258 hatchery reared juvenile white sturgeon and two wild juvenile white sturgeon (Tables 7 and 8).

One hundred six hours of sampling effort occurred at Ferry Island and 138 hours of effort were exerted using 5.1 cm gillnets. The 5.1 cm gillnets had the highest catch with 109 individuals, but the highest catch rates were in the 2.5 cm gillnets followed by 10.2 cm gillnets (Table 7). Rock Creek had the highest catch with 38 percent of individuals and had the highest catch rates with 1.7 fish per hour (Table 8).

The average fork and total lengths of 256 juvenile white sturgeon sampled was 40.7 cm and 47.2 cm, and weight averaged 0.50 kg, respectively (Table 9). Appendix 2 lists the details on sizes and numbers of hatchery juvenile white sturgeon stocked in the Kootenai River since 1990. Appendix 3 provides the specific growth parameters of the juvenile white sturgeon captured in 2004. Appendix 4 shows the number of wild juvenile white sturgeon collected annually from 1977 to 2004. Appendix 5 shows the year class assignments from a sample of the wild juvenile white sturgeon collected between 1957 and 2004 that could be aged.

Two wild juvenile white sturgeon were captured at Ferry Island (rkm 205.0) in 2004. One individual was captured in 2.5 cm inch mesh and had a total length, fork length, and weight of 57.4 cm, 50.0 cm, and 0.73 kg, respectively. The other individual was captured in 5.1 cm mesh and had a total length, fork length, and weight of 45.0 cm, 38.5 cm, and 0.32 kg, respectively.

DISCUSSION

White sturgeon spawning events during the years 1994 through 2000 were compared to daily average flow and daily average temperature at Bonners Ferry for each event. White sturgeon often spawned during decreasing seasonal flows and the number of events detected each year ranged from nine to 20, with the number of days during the spawning period ranging from 17 to 31 days (Paragamian and Wakkinen 2002). The most consistent year of Kootenai River white sturgeon spawning was 1996 when spawning was detected from egg mat sampling during 18 of 19 days; flow ranged from 891-1,259 m^3/s and averaged about 1,131 m^3/s for the first 11 events before there was a day of undocumented spawning. Average daily water temperature during spawning ranged from 7.5-14°C. Most of the spawning (48%) occurred when water temperature was 9.5-9.9°C. Average daily flow for spawning events ranged from 141-1,265 m^3/s, but most (63%) spawning took place when flow exceeded 630 m^3/s (Paragamian and Wakkinen 2002). The Kootenai River White Sturgeon Recovery Plan (USFWS 1999) recommends that for optimum white sturgeon spawning in the Kootenai River, flows should be held above 630 m^3/s and water temperature from 9.5-12°C for a duration of 42 d. The most consistent spawning took place at an average of 1,131 m^3/s.

Moving sexually mature white sturgeon relatively long distances in the Kootenai River is feasible and provides some insight into their behavior when introduced into a new environment. Results from the 2004 Set and Jet Program suggest that males tend to stay in the study area longer than females, even when females are not presently in the area. White sturgeon transported upstream earlier in the spring tend to stay upstream longer than those transported later in the spring. Several white sturgeon released as part of the 2003 and 2004 Set and Jet Program moved further upstream several kilometers after being released and many individuals were located between rkm 268.8 and 274.0. These areas have water depths over 10 meters, relatively high (>2m/s) and relatively low (<.5m/s) current velocities with areas of rapidly changing velocities, and rock outcroppings and boulders. All of the females released upstream in 2004 moved out of the study area quickly, and spawning was not documented in the Set and Jet Program study reach in 2004. However, spawning was documented from the 2003 Set and Jet Program as eggs were collected at rkm 261.8 several days after females were released in the area. Even with intensive D-ring and ½ meter net sampling below the egg collection site, no larval white sturgeon were collected in 2003 or 2004. While collecting eggs proves that white sturgeon will spawn in this new habitat, the recruitment potential is very low with relatively few females in the area. This low recruitment potential coupled with the relatively high water volume makes documenting larval recruitment unlikely. Releasing white sturgeon adults in this area may still be a useful tool for “programming” adults to return and possibly spawn, but future studies should focus on testing whether substrate and flow conditions in this area are suitable for egg hatching and larval recruitment. Releasing high numbers of fertilized eggs at specific sites and monitoring hatching and recruitment rates with a variety of larval sampling gears may help answer these questions. If hatching and larval recruitment can be documented at specific sites, these criteria would be useful when planning large-scale white sturgeon spawning habitat restoration projects.

Light penetration or visibility monitoring with Secchi disks during egg mat sampling from 1999 to 2004 was intended to provide an estimate of turbidity rates during the spawning season. Researchers have suggested that the lower post-Libby dam turbidity levels in the Kootenai River may be contributing to the recruitment failure of this population. For Kootenai River and other studies, the relationship between Secchi disk depth and actual turbidity (JTU or NTUs) may provide some insight into pre-Libby Dam conditions and may help to answer questions

about the role of turbidity in fish recruitment in large rivers. Future studies to artificially increase turbidity levels in the Kootenai River during the white sturgeon spawning season have been discussed as a mechanism to increase natural production.

Gillnet sampling for juvenile white sturgeon has been a successful way to measure relative abundance, growth rates, and year class strength of hatchery juveniles and has provided test fish for many other studies (Ireland et al. 2002). In the past, gillnet sampling has also been used to evaluate distribution and movements of hatchery and wild juvenile white sturgeon. Understanding these behavioral differences, habitat preferences, and movements of hatchery and wild juvenile white sturgeon between the Kootenai River in Idaho and British Columbia and Kootenay Lake in British Columbia may help resolve future stocking rate and stocking location issues. Recent advances in sonic telemetry (Vemco) have provided a more efficient, cost-effective method for determining this information.

RECOMMENDATIONS

1. As soon as water temperature reaches 7°C after April 1, provide flows of 425 cms at Bonners Ferry with stable or increasing temperature to initiate and maintain spawning migration of Kootenai River white sturgeon.

2. Provide minimum flows of 630 cms for 42 d (as prescribed for spawning and rearing in the Kootenai River White Sturgeon Recovery Plan) 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 fertilized eggs (embryos) in areas upstream of Bonners Ferry with flow and substrate conditions thought to be more suitable for successful egg hatching and larval recruitment. Monitor hatch success and larval recruitment with standard D-ring and ½ meter nets placed below release sites.

4. Experiment with light traps and other gear types to try to find alternative methods to monitor white sturgeon abundance and recruitment success. Continue to incorporate passive Vemco sonic telemetry techniques into standard adult and juvenile white sturgeon movement and behavioral monitoring to gather seasonal or yearly movement patterns, and phase out standard point location monitoring with current radio and sonic telemetry techniques.

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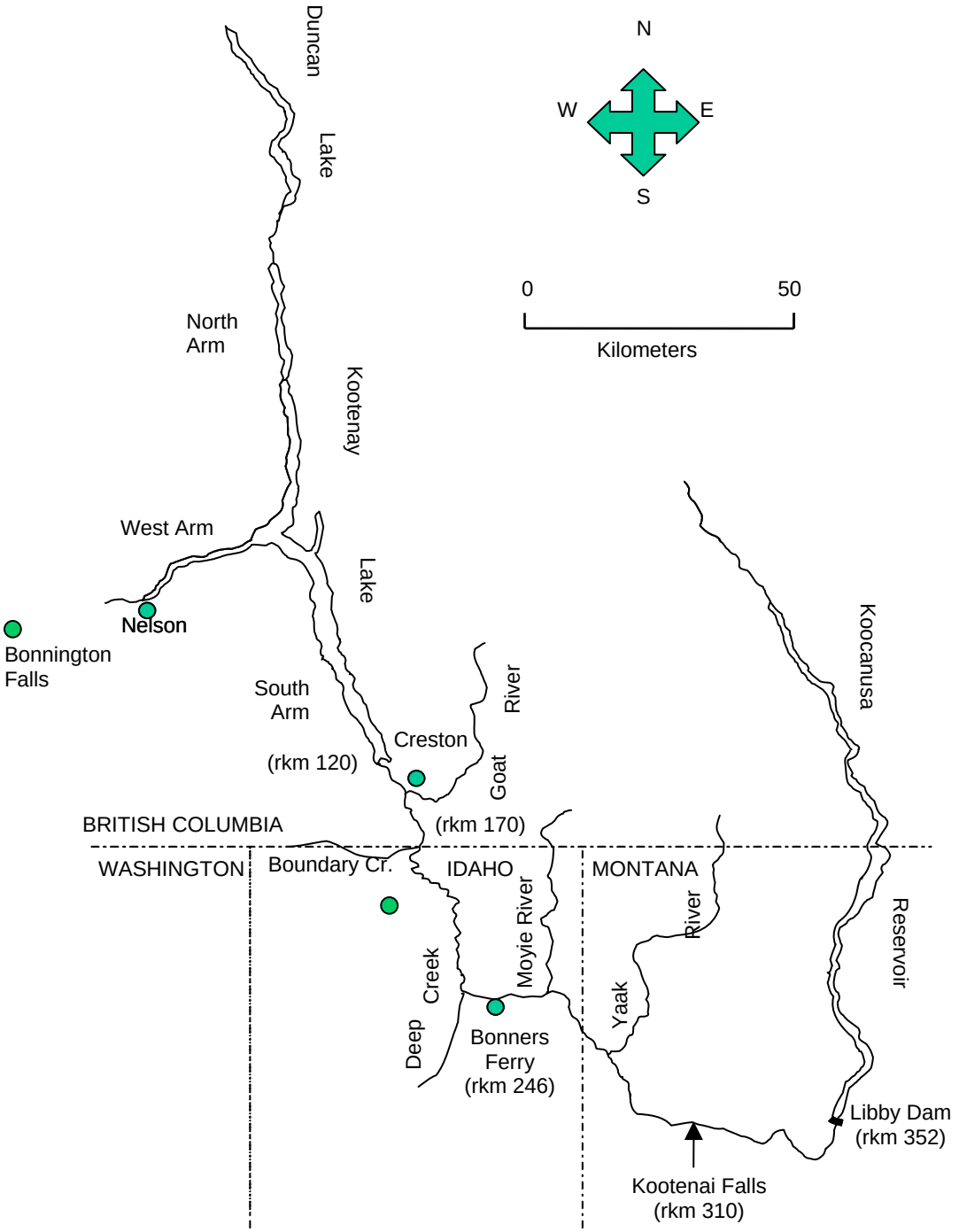

Figure 1. Location of the Kootenai River, Kootenay Lake, Lake Koocanusa, and major tributaries. The river distances from the northernmost reach of Kootenay Lake are in river kilometers (rkm) and are indicated at important access points.

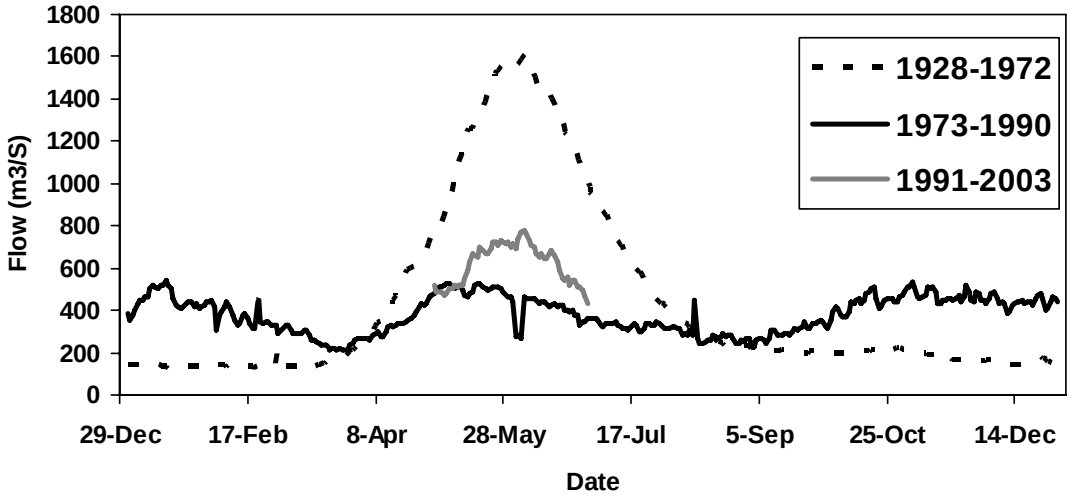

Figure 2. Mean daily flow patterns in the Kootenai River at Bonners Ferry, Idaho from 1928-1972 (pre-Libby Dam), 1973-1990 (post-Libby Dam), and 1991-2003 (post-Libby Dam with augmented flows, May 1 through June 30).

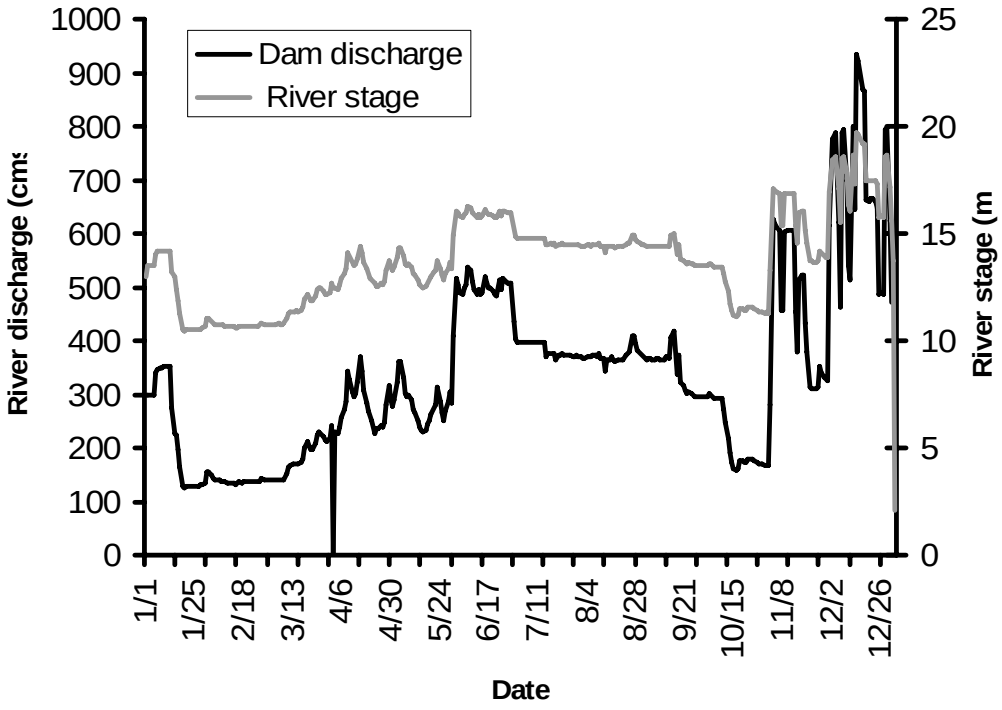

Figure 3. Mean daily discharge (cms) and stage (meters) for Kootenai River at Bonners Ferry, Idaho, 2004.

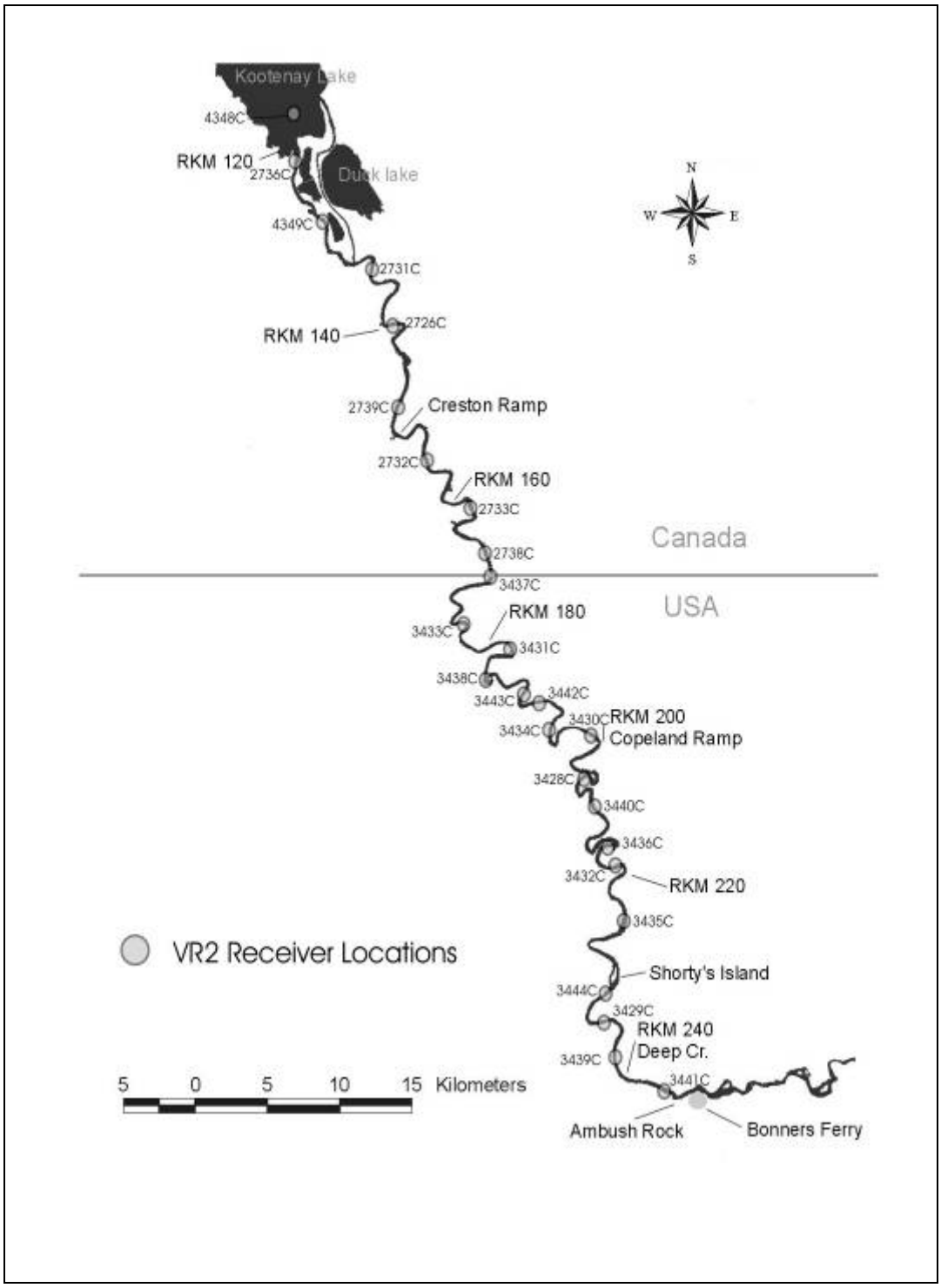

Figure 4. Locations of sonic receivers (Model VR2, Vemco) in Idaho and British Columbia, Kootenai River, 2004.

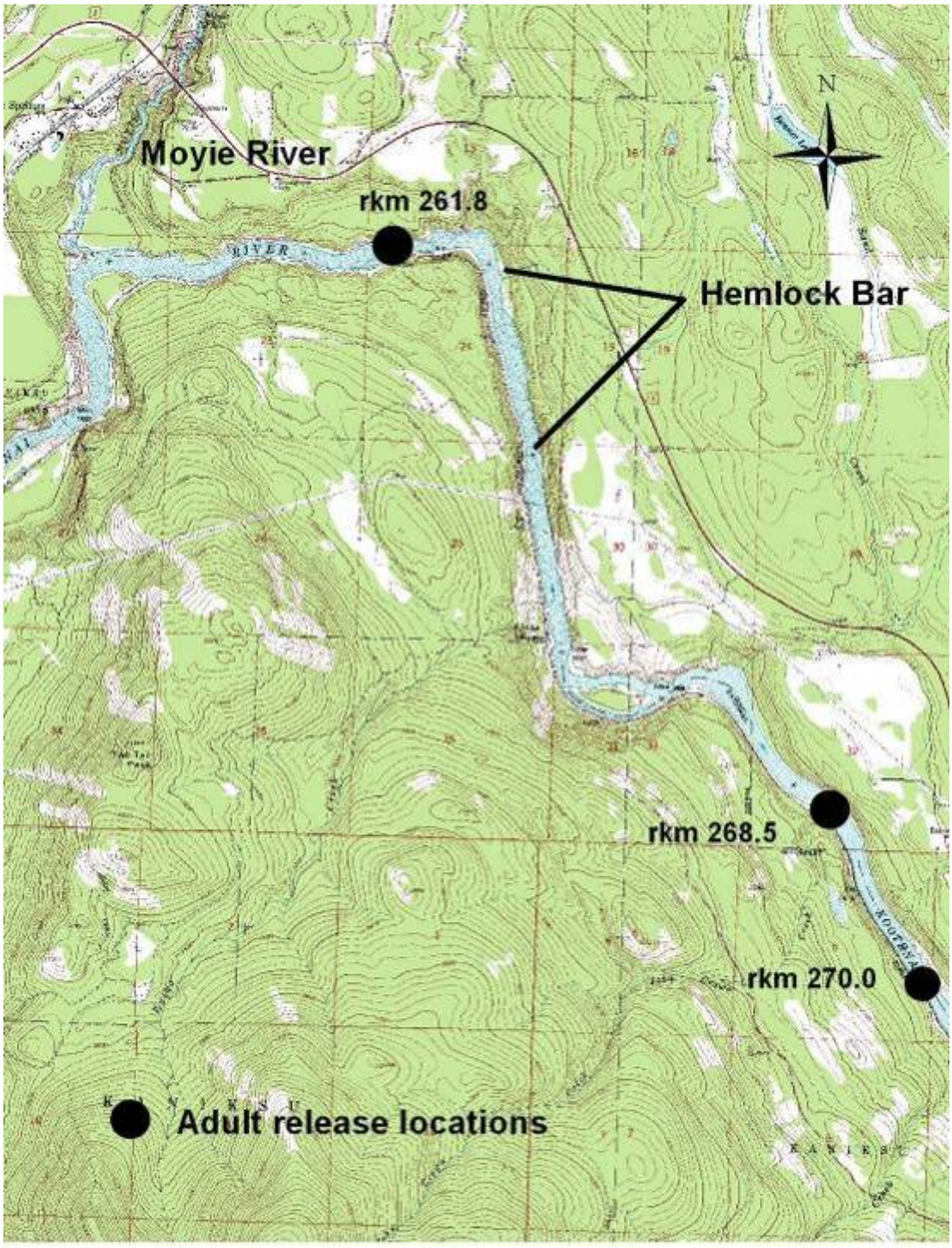

Figure 5. Release locations of adult white sturgeon for Set and Jet Program, Kootenai River, Idaho, 2004 (rkm = river kilometer).

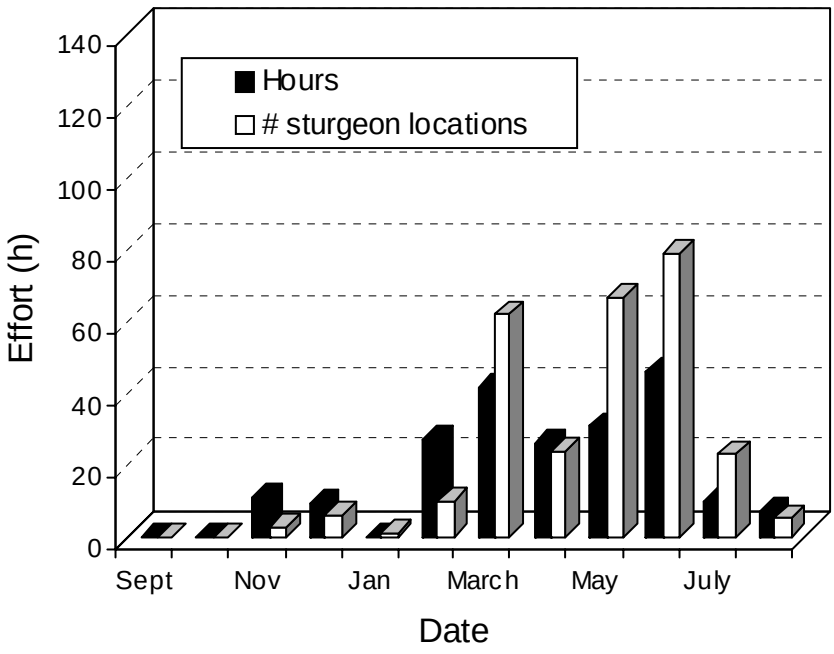

Figure 6. Telemetry effort (hours) and number of times white sturgeon were located monthly from September 1, 2003 to August 31, 2004, Kootenai River, Idaho.

Table 1. Sampling effort and number of adult and juvenile white sturgeon caught by the Idaho Department of Fish and Game alone or with Kootenai Tribe of Idaho personnel in the Kootenai River, Idaho, March 2, 2004 to September 7, 2004.

	Hours of effort	Number of juvenile sturgeon caught	Number of adult sturgeon caught (No. of recaptures)	Juvenile CPUE (fish/h)	Adult CPUE (fish/h)
Gillnet	271.0	258	0	0.952	0
Angling	212.8	0	24(18)	0	0.113
Setline	3,923.0	2	118(89)	0.0005	0.030
Total		260[a]	142(107)[b]		

[a] One additional juvenile was recaptured during burbot hoop net sampling efforts.
[b] An additional 29 adults were captured (28 angling [16 recaptures] and 1 recapture) by setline. No effort data was kept for these fish.

Table 2. Vital statistics from Kootenai River white sturgeon moved upstream as part of Set and Jet Program, Kootenai River, Idaho, 2004.

Year	Sex	Capture date	Release date	Release rkm	Fish Number	Total length (cm)	Weight (kg)	Sonic code	Radio frequency
2004	F	3/24/2004	4/29/2004	261.8	1587	221	72	1234	30.170
2004	M	3/29/2004	3/30/2004	261.8	578	174	29	1234	30.170
2004	M	3/29/2004	3/30/2004	261.8	1583	173	32	1228	30.393
2004	F	3/29/2004	5/17/2004	268.5	1584	202	45	1242	30.140
2004	M	4/13/2004	4/14/2004	268.7	971	192	33	1264	30.010
2004	M	4/13/2004	4/14/2004	268.7	854	194	35	3347	30.200
2004	M	4/28/2004	4/29/2004	261.8	305	199	45	1244	30.190
2004	M	4/28/2004	4/29/2004	261.8	860	183	38	1256	30.402
2004	M	5/13/2004	5/14/2004	270.0	567	179	38	1222	30.261
2004	M	5/13/2004	5/14/2004	270.0	1588	185	35	1266	31.343
2004	F	5/14/2004	5/17/2004	268.5	109	219	59	1224	30.150
2004	F	5/20/2004	5/20/2004	268.5	1589	246	86	1258	30.240
2004	M	5/20/2004	5/20/2004	268.5	181	188	41	1252	30.250
2004	M	5/20/2004	5/20/2004	268.5	1590	186	39	1246	30.300
2004	F	5/26/2004	5/26/2004	268.5	1592	208	59	1262	30.462
2004	M	5/26/2004	5/26/2004	268.5	1593	211	46	1248	30.352
2004	F	5/27/2004	5/27/2004	267.0	885	226	64	1226	30.210
2004	M	5/27/2004	5/27/2004	267.0	1591	175	35	1268	30.332

Table 3. Upriver locations of white sturgeon monitored in the Kootenai River in 2004 (some fish moved out of Kootenay Lake, BC).

Fish #			Tagging location		Highest rkm (date)		Last date above
Male	Unknown	Female	(rkm)	Tag date	>120<225	>225	rkm 225
43[a,e]		—	215.0	3/6/02	[b]	241.0(6/9)	6/19
87[c]		—	205.0	4/19/01	221.5(6/4)[b]	—	—
145[c]		—	215.7	3/21/02	224.6(6/12)[b]	—	—
209[c,d,e,f]		—	205.5[g,i]	4/2/03	—	262.5(4/2)	6/23
262[c]		—	205.0	4/10/01	[b]	—	—
—		284[c]	215.5	3/14/01	218.5(7/8)[b]	—	—
—		292[d,e?]	215.5	3/15/01	[b]	245.6(4/7-7/31)[h]	7/31
—		318[c,d,e]	215.5[i]	4/3/03	—	230.8(5/28)	5/28
504[a,e]		—	204.5	4/15/02	—	244.5(6/23)[b]	6/23
664[d,e,f]		—	217.9[i]	5/7/03	—	266.7(5/12)	6/9
—		715[d,e,f]	227.4[i]	5/29/03	—	261.4(6/2-6/3)	6/9
—		812[a,c,e?]	214.6	4/23/01	[b]	242(4/30,5/12,27,6/9)	8/12
—	859[a,e?]	—	215.0	3/6/02	[b]	242.4(6/9)	6/9
880[a,c,e]		—	215.0	3/13/02	[b]	244.5(3/21-7/8)	8/12
976[d,e,f]		—	217.9[i]	5/5/03	—	261.5(5/6)	8/12[h]
—		990	215.7	3/7/02	[b]	—	—
—		996[c]	215.7	4/9/02	[b]	—	—
—		1453[c,d,e]	215.3	4/3/03	—	231.4(5/27)	[j]
—		1581[c]	215.6	4/12/02	[b,k]	—	—
—		2227[c]	215.8	4/23/02	[b,k]	—	—
—		2247[d,e,f]	229.1	6/8/03	—	262.1(6/9)	6/16
2252[c,d,e?,f]		—	215.5	4/1/03	—	262.5(4/3)[h]	[j]
—		2368[c,d,e]	215.5	4/3/03	—	244.5(5/20-21)	5/27
—		5388[d,e?,f]	215.5	3/11/03	—	270.2(6/27)	7/2
n = 10	n = 1	n = 13	Combined (n = 24)				
n = 7	n = 1	n = 8	Suspected Spawners (n = 16)				
n = 3	n = 0	n = 5	Non-spawners (n = 8)				

[a] Fish thought to have spawned in 2002 (based on movements), but also made movements in 2003, which suggests spawning in 2003.
[b] These fish overwintered in this section.
[c] These fish were tagged with depth tags (n = 14 active, n = 6 male, n = 8 female).
[d] These fish were expected spawners (assessed by their development in 2003).
[e] These fish were suspected spawners (determined by their movements in 2003).
[f] These fish were part of the Set and Jet Program (captured downstream released upriver >rkm 261.0).
[g] This fish was recaptured (first radio tagged 4/18/94 @ rkm 205.0, spawned 1994).
[h] Probably a shed tag.
[i] These fish were recaptured.
[j] These fish never dropped below river kilometer 225.
[k] These fish made no upriver movements out of Kootenay Lake in 2003.

Table 4. Location (rkm), depth (m), effort, and white sturgeon egg catch by artificial substrate mats, Kootenai River, Idaho, 2004.

Geographical description	River location (rkm)	Depth range (m)	Total mat days[a]	Number white sturgeon eggs
Middle Shortys Island	229.6-231.5	7.0-15.9	210	8
US Hwy 95	244.7-246.6	3.1-6.7	303	0
Crossport/Moyie River	253.0-260.9	4.9-13.4	12	0
Hemlock Bar	261.0-268.5	1.8-15.9	110	0
Curley Creek	270.0-274.0	2.4-6.1	15	0
All sections	229.6-274.0	1.8-15.9	650	8

[a] One mat day is one 24-hour set.

Table 5. Secchi disk depth measurements (meters) in the Kootenai River, Idaho during egg mat sampling, 1999–2004.

	1999	2000	2001	2002	2003	2004	Total
Shortys Island (rkm 229.5)							
Average Secchi Depth (m)	1.5	2.5	3.9	1.3	2.8	1.6	2.3
Standard Deviation (sd)	0.7	0.6	0.9	0.3	1.4	n/a	0.8
Upper Range (avg+1sd)	2.2	3.1	4.8	1.6	4.2	n/a	3.2
Lower Range (avg -1sd)	0.8	1.9	3	1	1.4	n/a	1.6
Minimum	0.3	0.9	1.9	0.5	1.4	n/a	1
Maximum	3.1	3.6	5.6	1.7	4.6	n/a	3.7
Number of observations	31	52	40	15	6	1	24.2
Deep Creek (rkm 240)							
Average Secchi Depth (m)	1.6	2.6	3.9	1.2	1.9	2	2.2
Standard Deviation (sd)	0.7	0.7	1	0.4	0.3	0.5	0.6
Upper Range (avg+1sd)	2.3	3.3	4.9	1.6	2.2	2.5	2.8
Lower Range (avg -1sd)	0.6	1.9	2.9	0.8	1.6	1.5	1.6
Minimum	0.3	0.8	1.5	0.5	1.4	1.7	1
Maximum	3.2	4.2	6.1	1.8	2.3	2.3	3.3
Number of observations	29	50	47	16	6	2	25
Ambush Rock (rkm 244.5)							
Average Secchi Depth (m)	1.5	2.5	3.7	1.2	2.3	*	2.2
Standard Deviation (sd)	0.7	0.7	0.8	0.4	1	*	0.7
Upper Range (avg+1sd)	2.2	3.2	4.5	1.6	3.3	*	3
Lower Range (avg -1sd)	0.6	1.8	2.9	0.8	1.3	*	1.5
Minimum	0.3	0.7	1.8	0.5	0.6	*	0.8
Maximum	2.8	4.2	5.2	1.7	4.8	*	3.7
Number of observations	30	50	44	15	19	*	31.6
Total							
Average Secchi Depth (m)	1.5	2.5	3.8	1.2	2.3	1.9	2.2
Standard Deviation (sd)	0.7	0.6	0.9	0.4	1	0.4	0.7
Upper Range (avg+1sd)	2.2	3.1	4.8	1.6	3.3	2.3	2.9
Lower Range (avg -1sd)	0.8	1.9	2.9	0.8	1.3	1.5	1.5
Minimum	0.3	0.7	1.5	0.5	0.6	1.7	0.9
Maximum	3.2	4.2	6.1	1.8	4.8	2.3	3.7
Number of observations	90	152	131	46	31	3	75.5

* no measurements taken

Table 6. Summary of white sturgeon larval sampling effort and volume sampled by gear type and location, Kootenai River, Idaho, 2004.

Gear type	Location (river kilometer)	Sampling dates	Catch	No. sites	Effort (hours) Mean (SD)	Effort (hours) Total	No. sites	Volume (m^3) sampled Mean (SD)	Volume (m^3) sampled Total
Surface and mid-column ½ meter net	224.0	6/25	0	4	2.3 (0.3)	9.0	4	2,098.4 (927.1)	8,393.4
	229.0-229.3	6/22-7/20	1[a]	37	3.4 (1.8)	127.2	37	4,267.3 (2,373.8)	157,888.4
	230.0	6/14-7/13	0	16	3.1 (1.2)	49.1	16	2,954.2 (1,658.6)	47,267.2
	244.5-244.7	6/8-7/22	21[a]	58	3.3 (1.5)	187.6	57	3,337.1 (2,153.9)	190,213.9
	Unknown	6/21	1[a]	4	3.5 (2.5)	13.8	4	2,102.5 (885.6)	8,410.1
	Gear total	6/8-7/22	23	119	3.3 (1.6)	386.8	110	3,493.0 (2,173.2)	412,173.0
Benthic D-ring	224.0	6/25	0	4	2.3 (0.3)	9.0	4	340.6 (386.7)	1,362.6
	229.0-229.3	6/22-7/20	18[b]	35	3.9 (1.7)	135.0	35	1,432.7 (1,949.7)	47,280.7
	230.0	6/14-7/13	1[c]	16	3.0 (1.2)	48.3	16	599.5 (640.4)	9,591.8
	244.5-244.7	6/8-7/22	61	60	3.2 (1.6)	193.4	60	1,773.2 (2,904.7)	106,394.6
	Unknown	6/21	0	4	3.6 (2.4)	14.2	4	74.2 (66.4)	296.9
	Gear total	6/8-7/22	80	119	3.4 (1.6)	400.0	119	1,409.6 (2,378.4)	164,926.7
Combined	All	6/8-7/22	103	238	3.3 (1.6)	786.8	237	2,455.7 (2,501.1)	577,099.7

[a] Unidentifiable species.
[b] 1 catostomidae larvae, 17 unidentifiable individuals.
[c] Catostomidae larvae.

Table 7. Idaho Department of Fish and Game juvenile white sturgeon gillnet sampling effort by mesh size, Kootenai River, Idaho, 2004.

Gillnet Mesh size	Number of sets	Hours of effort	Number of adults captured	Number of juveniles captured	Sturgeon catch per unit of effort
2.5 cm stretch	6	13.0	0	21	1.61
3.8 cm stretch	3	6.0	0	8	1.33
5.1 cm stretch	65	138.0	0	109	0.79
7.6 cm stretch	8	17.0	0	8	0.47
10.2 cm stretch	35	76.0	0	103	1.36
15.2 cm stretch	9	21.0	0	9	0.43

Table 8. Idaho Department of Fish and Game juvenile white sturgeon gillnet sampling effort by sampling location for July through September, Kootenai River, Idaho, 2004.

River Kilometer	Number of sets	Hours of Effort	Number of adults captured	Number of juveniles captured	Sturgeon catch per unit of effort
192.0	15	31.0	0	2	0.06
205.0	36	72.0	0	46	0.64
205.5	15	34.0	0	71	2.09
215.5	27	57.0	0	99	1.74
219.5	6	12.0	0	3	0.25
224.9	12	31.0	0	31	1.00
225.0	9	19.0	0	4	0.21
230.5	6	15.0	0	2	0.13

Table 9. Vital statistics of recaptured juvenile hatchery white sturgeon, Kootenai River, Idaho, 2004.

	Statistic	FL (cm)	TL (cm)	WT (kg)
Recaptures N = 256	Average	40.7	47.2	0.50
	Standard deviation	10.5	12.3	0.55
	Minimum	26.0	29.1	0.10
	Maximum	81.5	94.0	3.60

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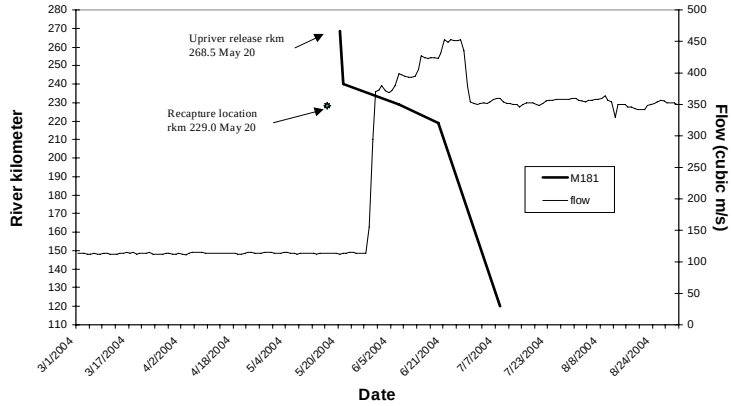
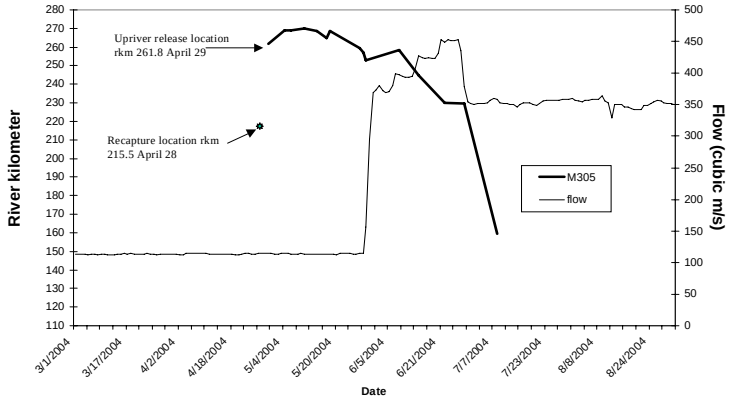
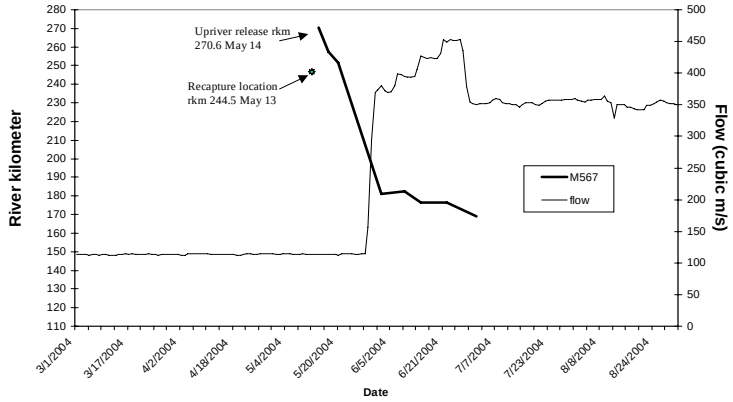
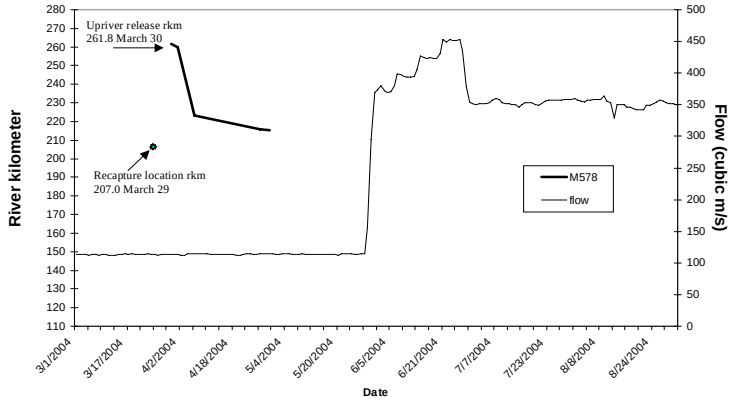
APPENDICES

Appendix 1. Migration and flow (m^3/s) for four male white sturgeon, all of which are believed to have spawned in the Kootenai River, Idaho, 2004.









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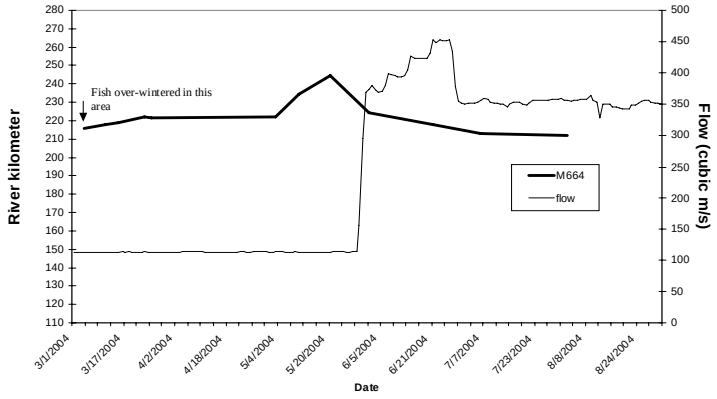
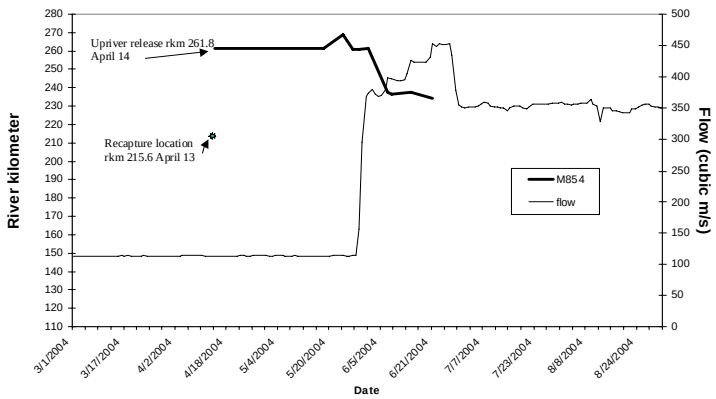
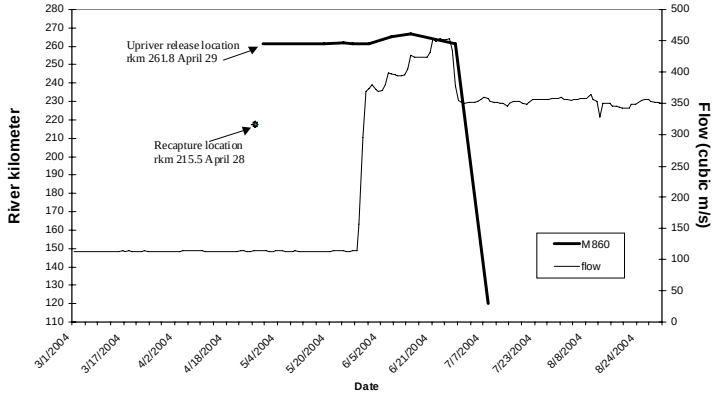
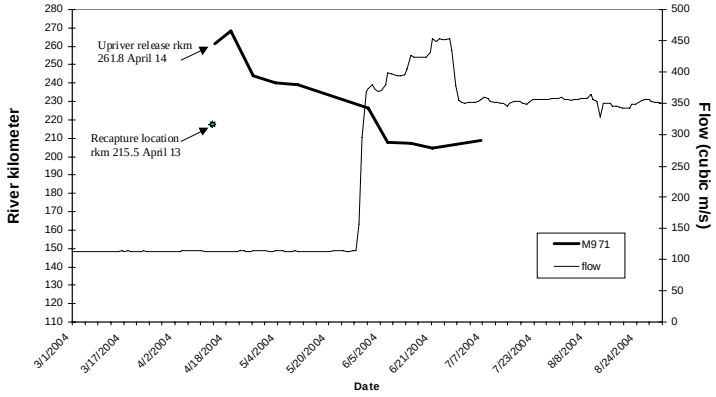
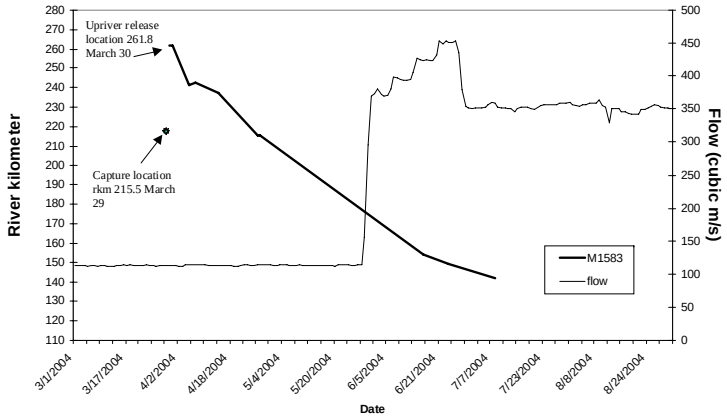


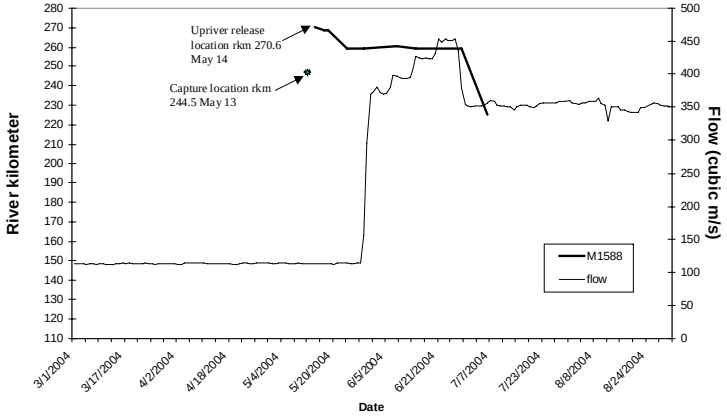


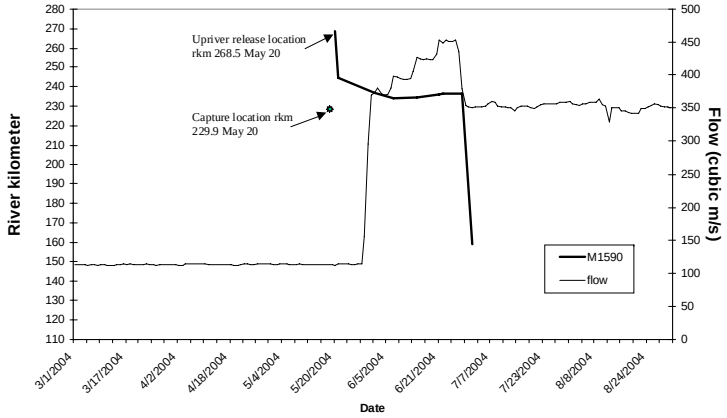


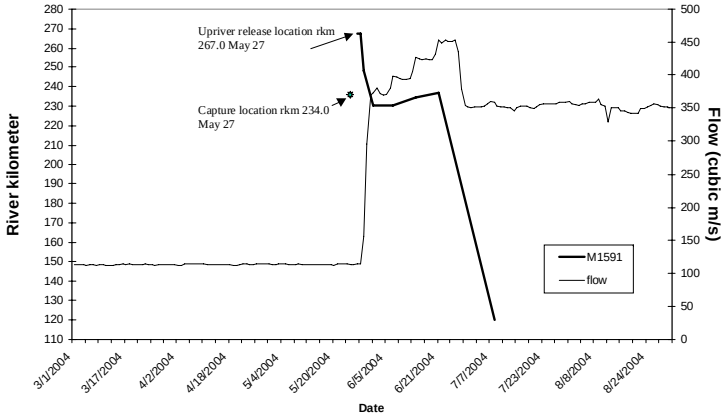


Appendix 1. Continued.









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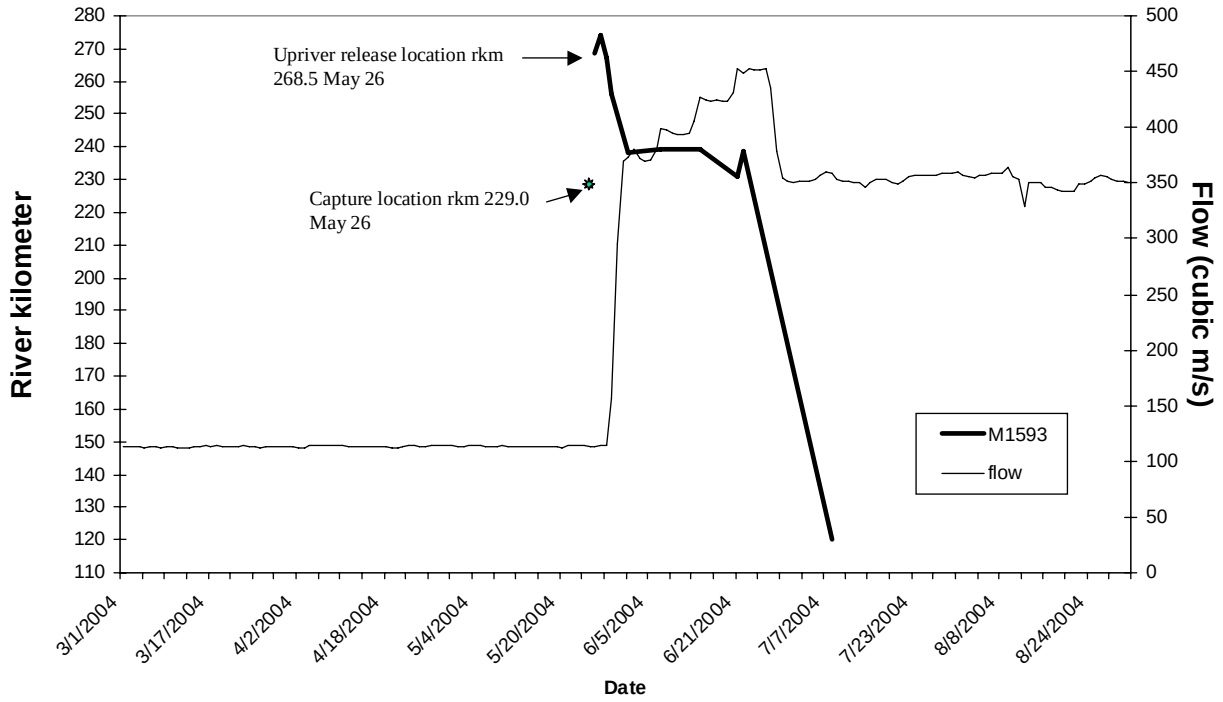

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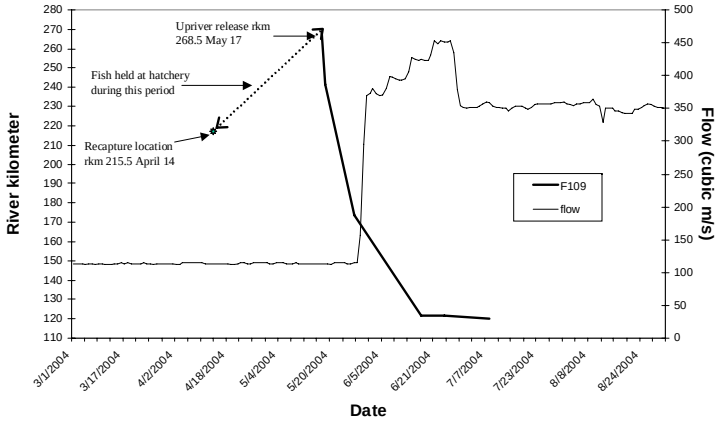
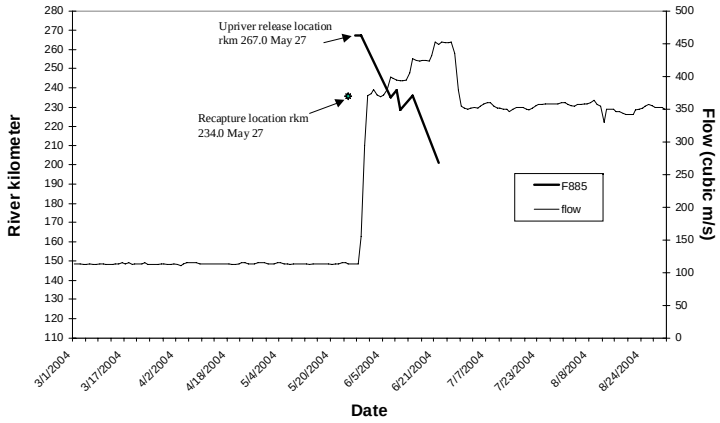
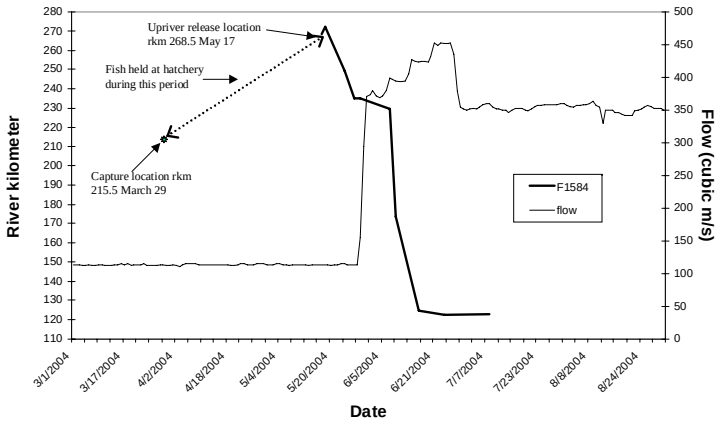
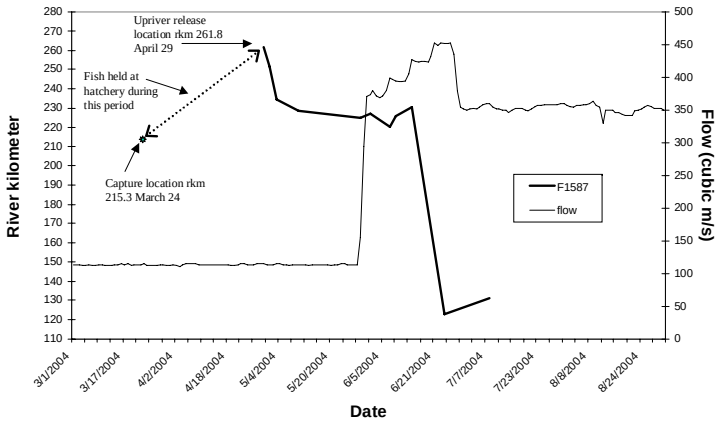
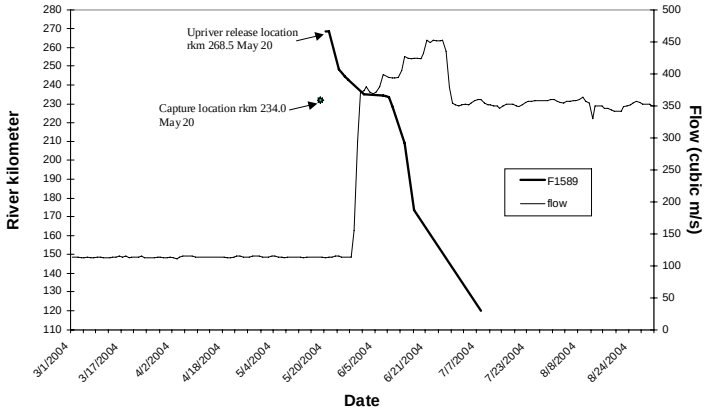


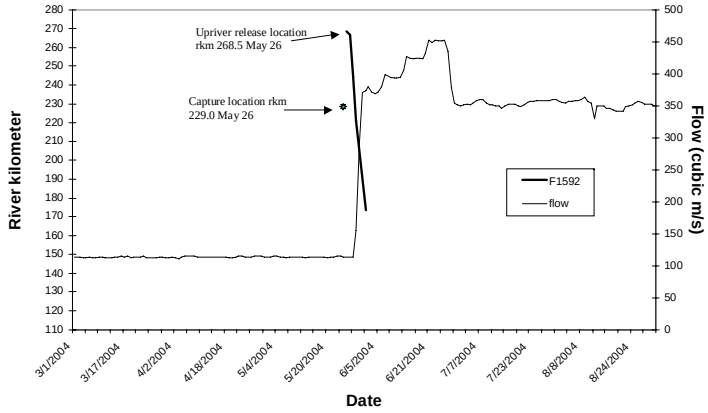






Appendix 1. Continued.





Appendix 2. Numbers and recapture rates of hatchery produced white sturgeon juveniles released into the Kootenai River and Kootenay Lake in Idaho, Montana, and British Columbia between 1990 and 2004 (from Kootenai Tribe of Idaho and Idaho Department of Fish and Game Annual Reports 1992-2004).

Year class	Hatchery facility[a]	Release number	Mean total length (mm) at release (S.D.)	Mean weight (g) at release (S.D.)	Release season and year	Percent (#) of all recaptures
1990	KTOI	14	456.9 (53.0)	320.8 (112.3)	Sum. 1992	0.40%(10)
1991	KTOI	104	254.7 (17.3)	66.1 (13.1)	Sum. 1992	4.41%(111)
1992	KTOI	123	482.6 (113.0)	549.3 (482.9)	Fall 1994	4.17%(105)
1995	KTOI	—	—	—	?[b]	1.31%(33)
1995	KTOI	1,075	228.5 (27.0)	47.3 (16.6)	Sp. 1997	16.42%(413)
1995	KTOI	889	343.6 (43.8)	147.9 (64.0)	Fall 1997	16.06%(404)
1995	KTOI	96	410.7 (68.2)	288.5 (137.8)	Sum. 1998	2.23%(56)
1995	KTOI	25	581.5 (40.5)	863.3 (197.9)	Sum. 1999	0.52%(13)
1998	KTOI	309	260.1 (41.9)	79.0 (44.4)	Fall 1999	1.75%(44)
1999	KTOI	828	256.1 (22.2)	70.6 (18.2)		
1999	KH	1,358	248.1 (32.9)	67.2 (27.6)	Fall 2000	14.35%(361)
1999	—	—	—	—	Fall 2000	0.04%(1)
1999	KTOI	491	284.3 (54.4)	107.6 (60.1)		
1999	KH	1,583	306.5 (40.4)	55.9 (39.5)	Sp. 2001	15.15%(381)
1999	—	—	—	—	?[b]	0.99%(25)
2000	KTOI	2,286	244.0 (38.9)	64.2 (31.0)		
2000	KH	1,654	240.0 (23.2)	57.7 (16.4)	Fall 2001	5.96%(150)
2000	KH	2,209	283.1 (28.7)	99.3 (30.2)	Sp. 2002	0.08%(2)
2000	KH	30	365.4 (14.0)	195.3 (19.9)	Sum. 2002	--(0)
2000	KTOI	214	409.4 (53.5)	294.1 (109.8)	Fall 2002	0.72%(18)
2000	KTOI	908[c]	334.2 (36.9)	192.9 (62.7)	Jan. 2003	1.99%(50)
2000	KTOI	10[d]	557.7 (28.4)	87.6 (18.4)	Feb. 2004	--(0)
2001	KTOI	2,672	200.1 (37.9)	33.0 (15.6)		
2001	KH	4,469	227.4 (24.2)	51.6 (16.6)	Fall 2002	1.39%(35)
2001	KH	1,715	257.1 (26.4)	71.8 (24.2)	April 2003	--(0)
2002	KH	5,864	217.3 (25.2)	41.3 (14.2)	May 2003	0.04%(1)
2002	KTOI	856	214.0 (43.8)	41.9 (22.6)	Oct. 2003	--(0)
2002	KTOI	~550[e]			Nov. 2003	--(0)
2002	KTOI	3,852	215.4 (37.3)	43.4 (20.0)	Late wtr. 2003	0.04(1)
2002	KTOI	3,663	214.2 (54.8)	43.1 (27.2)	Late wtr. '03-early wtr. '04	0.20%(5)
2003	KH	9,020	222.8 (25.7)	48.9 (24.4)	Spring 2004	7.44%(187)
2003	KH	23[f]	229.5 (26.7)	51.9 (18.5)	Sept. 2004	--(0)
2003	KT	3,519	226.9(46.3)	55.4(31.6)	Late wtr. '04	--(0)
?[g]	KT	—	—	—	—	0.08%(2)
?[g]	—	—	—	—	—	4.25%(107)
Total		**50,409**	—	—	—	**4.99%(2515)**

[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 to determine stock year.

[c] Ten fish held-over for later upriver release with transmitters.

[d] These fish were released upriver (rkm 306.5) with sonic and radio tags.

[e] No measurements available for these fish; exact number not known.

[f] These fish were first taken to Kokanee Creek Provincial Park, then released in September 2004

[g] These juvenile white sturgeon had no PIT tag; year class could not be determined by scute removals.

Appendix 3. 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, 2004.

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	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	95.0	--	4.65
	1	140.0	70.4	83.2	--
	1	190.0	70.0	83.0	2.20
	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
	21	205.0	47.0-84.0	55.0-100.0	0.16-3.60
	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
	18	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	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	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
	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

Appendix 3. Continued.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
	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
	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
	5	225.0	31.0-55.0	37.0-65.0	0.35-1.10
	4	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
1995	3	119.0	49.0-58.0	56.5-67.1	0.70-1.27
	5	120.0	59.4-78.5	69.2-92.0	1.30-3.20
	10	121.0	43.9-74.0	50.0-85.5	0.53-2.20
	1	123.0	--	70.1	1.30
	2	130.0	38.0	43.9-55.8	0.46-0.68
	12	134.0	49.0-69.8	57.0-79.5	0.73-2.05
	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
	3	145.0	42.5-59.5	50.0-68.9	0.50-1.25
	1	157.0	54.1	62.6	0.99
	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
	2	174.5	26.3-52.4	30.2-60.7	0.09-0.77
	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
	16	190.0	31.0-51.5	36.0-60.5	0.15-0.78
	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
	1	192.0	34.7	38.2	0.18
	1	192.1	36.1	42.0	0.25
	3	195.7	35.5-50.0	42.0-57.0	0.24-0.65
	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

Appendix 3. Continued.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
	7	203.5	36.5-49.8	42.5-57.5	0.28-0.60
	3	204.0	37.9-47.5	43.5-54.0	0.27-0.72
	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
	4	204.8	46.5-50.3	53.8-58.4	0.54-0.67
	6	204.9	41.9-48.0	48.3-55.2	0.40-0.62
	151	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
	2	213.2	51.4-58.1	60.2-67.0	0.85-1.17
	1	213.5	58.6	67.6	1.13
	2	215.0	33.1-34.3	37.8-39.7	0.10-0.18
	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	25.5-34.4	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
	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
	2	219.0	22.0-25.0	25.3-28.0	0.10
	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
	15	224.8	31.9-48.0	36.2-59.3	0.18-0.65
	24	224.9	30.4-64.0	34.2-74.0	0.15-1.70
	98	225.0	21.0-62.0	24.0-71.8	0.05-1.45
	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	244.4	33.8	43.4	--
	1	244.5	48.2	56.6	0.65
	1	244.6	31.5	36.6	0.13
	6	Unknown	45.5-55.5	52.2-65.3	0.56-1.13
1998	1	204.0	38.4	44.4	0.28
	9	205.0	30.0-41.5	35.0-47.5	0.13-0.42
	1	213.2	35.5	41.5	0.24

Appendix 3. Continued.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
	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
	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
	2	230.9	23.5-25.0	28.0-29.5	0.07-0.08
	1	244.5	40.7	47.4	0.35
	1	Unknown	32.0	40.5	0.23
1999	2	119.0	--	39.0-45.2	0.24-0.38
	5	120.0	33.5-47.5	39.5-55.3	0.24-0.62
	18	121.0	29.5-47.0	34.0-54.0	0.17-0.63
	2	123.0	32.3-39.5	37.5-45.7	0.22-0.32
	7	130.0	27.6-38.5	31.8-44.5	0.12-0.37
	7	134.0	31.3-36.5	36.5-42.6	0.17-0.26
	1	137.0	28.3	33.4	0.14
	29	145.0	26.5-55.3	31.1-64.7	0.11-1.08
	4	150.0	46.0-55.5	53.1-64.3	0.55-1.03
	5	157.0	31.2-35.0	36.9-40.0	0.19-0.27
	13	161.0	27.4-49.5	31.9-56.1	0.13-0.61
	2	163.0	29.0	33.7	0.15
	17	165.0	27.2-53.0	31.0-61.8	0.14-0.93
	2	167.0	32.1-32.7	37.1-38.1	0.16-0.20
	30	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
	28	190.0	23.0-35.9	26.5-41.6	0.06-0.23
	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	28.5-35.5	33.0-41.4	0.15-0.24
	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
	1	203.5	27.5	32.1	0.12
	1	204.0	30.5	35.6	0.15
	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
	189	205.0	19.5-45.4	28.5-52.7	0.05-0.53
	1	205.3	28.0	32.0	0.10
	1	205.4	24.0	29.3	0.05
	48	205.5	25.6-44.0	29.1-49.7	0.11-0.50
	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
	82	215.5	25.5-28.5	30.0-33.5	0.10-0.14

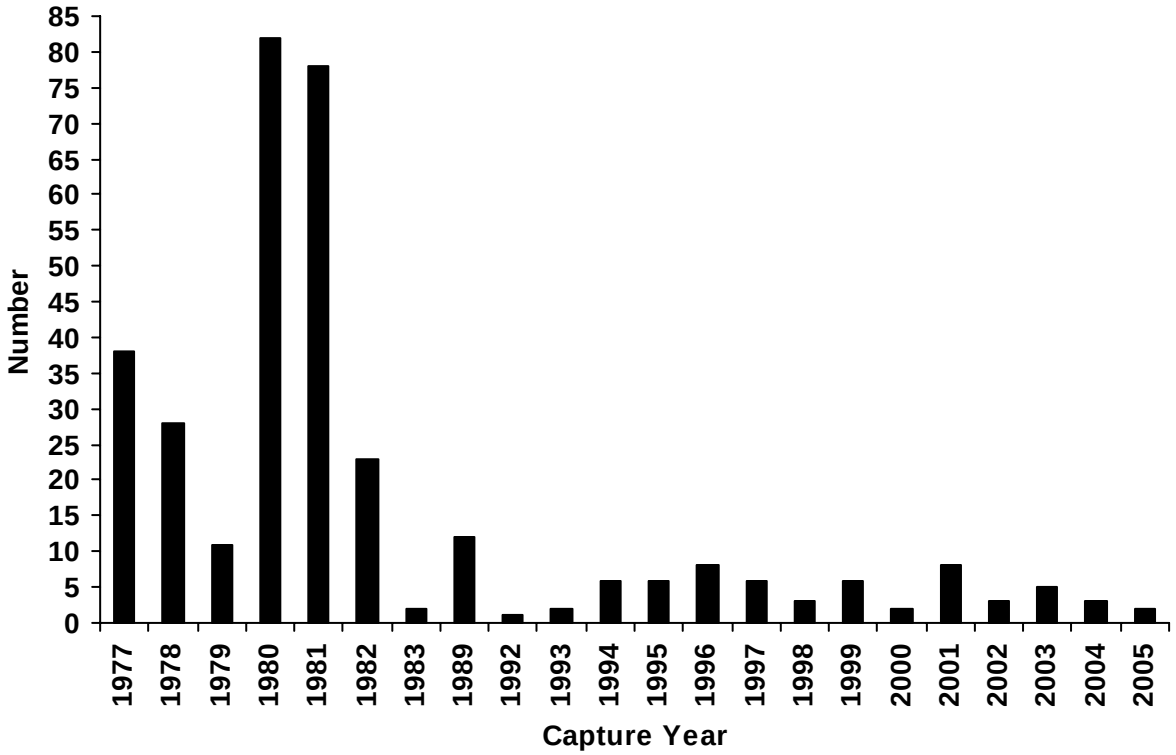
Appendix 3. Continued.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
	1	216.0	28.9	33.6	0.11
	1	219.5	36.0	41.2	0.3
	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
	28	225.0	23.2-42.2	26.1-48.6	0.07-0.55
	1	225.1	26.5	30.7	0.12
	2	230.0	27.0-28.0	32.0-32.5	0.10-0.12
	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
	3	244.5	27.5-33.1	30.5-37.7	0.11-0.20
	92	Unknown	19.0-39.0	22.0-44.2	0.05-0.32
2000	1	76.0	25.6	31.0	0.11
	4	120.0	26.3-32.9	30.9-38.6	0.12-0.21
	2	121.0	26.4-37.0	30.4-42.9	0.12-0.27
	2	130.0	25.1-26.0	29.3-30.0	0.09-0.10
	3	145.0	31.1-39.7	33.2-45.7	0.15-0.38
	25	150.0	27.8-48.5	31.7-56.5	0.10-0.60
	7	157.0	23.5-36.0	27.0-41.1	0.09-0.32
	4	161.0	21.8-29.3	24.5-34.2	0.07-0.17
	2	163.0	25.5-26.5	29.6-31.5	0.13-0.14
	8	165.0	26.0-41.7	29.7-48.5	0.09-0.46
	1	167.0	27.2	31.4	0.10
	2	182.0	29.2-29.4	33.5-34.7	0.13-0.15
	1	190.0	26.1	30.6	0.09
	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
	5	195.8	26.5-34.2	32.3-40.2	0.11-0.27
	49	205.0	21.0-43.1	26.2-50.0	0.05-0.54
	25	205.5	24.1-42.7	28.0-49.2	0.08-0.42
	2	208.0	25.6-32.0	30.0-37.5	0.10-0.19
	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
	24	215.5	25.1-37.7	27.3-44.0	0.09-0.30
	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
	16	225.0	26.1-41.8	30.5-48.5	0.09-0.40
	1	227.8	24.3	27.8	0.09
	1	230.5	32.9	37.5	0.21
2001	1	161.0	18.9	21.9	0.04
	2	195.8	21.9	25.2	0.06
	6	205.0	25.0-32.2	28.2-37.1	0.08-0.17
	3	205.5	23.6-29.1	27.2-33.7	0.08-0.13
	1	213.2	23.0	26.5	0.07
	1	213.5	24.5	28.9	0.09
	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
	7	225.0	18.2-25.8	20.6-30.0	0.04-0.09
	1	228.5	22.7	26.6	0.06
2002	4	121.0	19.0-35.5	22.2-40.9	0.03-0.26
	1	205.0	27.5	31.6	0.11
	2	205.5	27.7	31.4	0.10-0.13
2003	35	120.0	17.8-27.8	20.8-31.9	0.03-0.12
	9	121.0	19.9-33.5	23.1-40.0	0.05-0.24

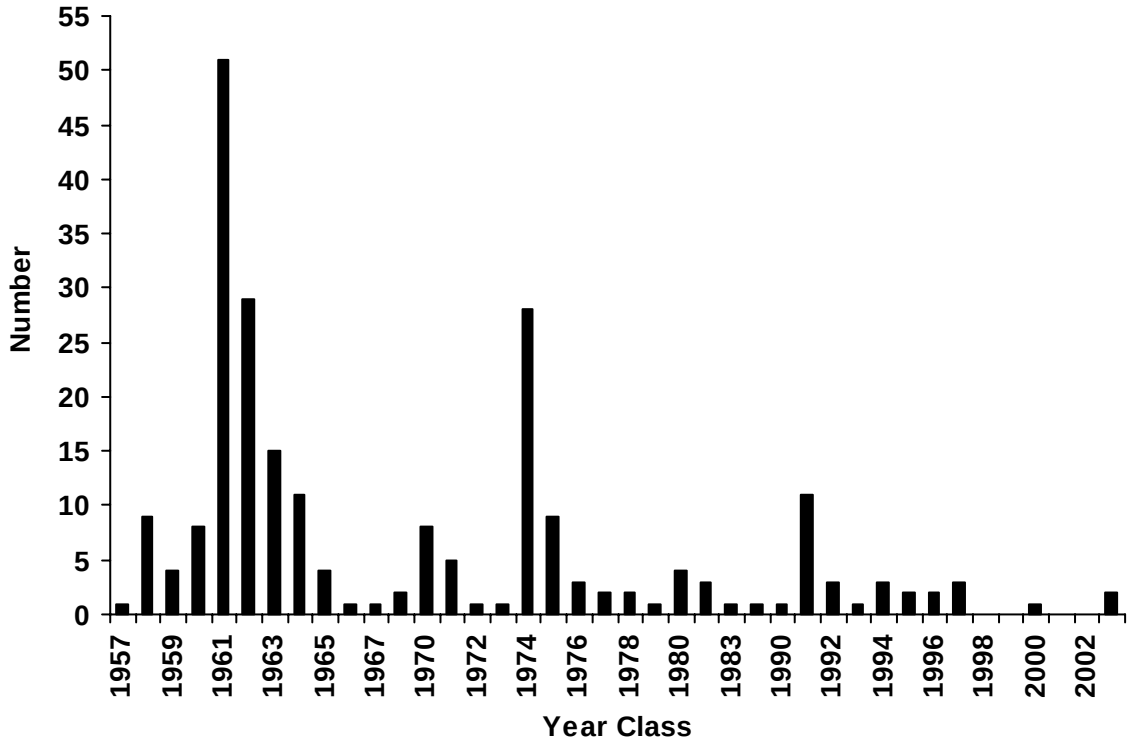
Appendix 3. Continued.

Year class	Number captured	Capture rkm	Fork length (cm)	Total length (cm)	Weight (kg)
	11	123.0	19.4-24.9	22.8-29.2	0.04-0.08
	16	130.0	19.2-25.0	21.9-29.4	0.05-0.08
	1	134.0	22.5	26.5	0.06
	13	137.0	20.1-26.6	23.1-30.8	0.04-0.09
	6	141.0	20.1-24.5	23.4-28.5	0.04-0.09
	29	145.0	19.0-27.8	22.1-32.1	0.04-0.12
	42	161.0	19.8-26.7	23.0-31.9	0.04-0.10
	17	163.0	21.1-28.5	24.8-33.4	0.04-0.11
	3	165.0	23.2-24.5	27.1-28.5	0.07-0.09
	5	167.0	18.7-25.5	21.7-30.4	0.04-0.09
Unknown year class	3	120.0	20.8-41.5	24.1-48.0	0.07-0.42
	15	121.0	21.4-83.5	25.2-96.6	0.05-3.50
	2	130.0	34.0-34.2	39.0-39.8	0.24-0.32
	12	134.0	18.5-70.5	21.0-81.3	0.03-2.40
	3	145.0	28.5-38.3	31.1-44.7	0.13-0.30
	1	150.0	30.1	34.9	0.19
	3	161.0	26.4-29.8	30.6-34.7	0.10-0.17
	3	165.0	32.2-51.5	37.0-59.0	0.25-0.61
	1	167.0	29.2	33.7	0.15
	1	190.0	32.5	37.2	0.20
	1	195.8	34.2	38.0	0.20
	1	204.8	35.4	41.2	0.26
	1	204.9	35.2	41.2	0.20
	23	205.0	26.5-74.0	30.5-87.0	0.05-2.80
	8	205.5	27.7-51.5	31.7-60.0	0.13-0.88
	1	213.5	37.7	43.2	0.28
	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
	1	224.8	50.1	57.9	0.76
	3	224.9	30.0-36.1	34.6-40.7	0.13-0.26
	7	225.0	23.1-59.8	26.7-69.0	0.07-1.22
	1	225.1	53.5	61.5	1.05
	4	Unknown	24.0-32.2	27.2-38.0	0.08-0.18

Appendix 4. Number of wild juvenile white sturgeon captured in the Kootenai River, Idaho, since 1997.



Appendix 5. Number of aged wild juvenile white sturgeon captured by year class in the Kootenai River, Idaho, since 1977.



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