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Evaluate Potential Means of Rebuilding Sturgeon Populations in the Snake River between Lower Granite and Hells Canyon Dams

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EVALUATE POTENTIAL MEANS OF REBUILDING STURGEON POPULATIONS IN THE SNAKE RIVER BETWEEN LOWER GRANITE AND HELLS CANYON DAMS

2000 Annual Report

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ABSTRACT

The specific research goal of this project is to identify means to restore and rebuild the Snake River white sturgeon (*Acipenser transmontanus*) population to support a sustainable annual subsistence harvest equivalent to 5 kg/ha/yr (CBFWA 1997). Based on data collected, a white sturgeon adaptive management plan will be developed. This 2000 annual report covers the fourth year of sampling of this multi-year study.

In 2000 white sturgeon were captured, marked, and population data were collected in the Snake and Salmon rivers. The Snake River was sampled between Lower Granite Dam (rkm 174) and the mouth of the Salmon River (rkm 303), and the Salmon River was sampled from its mouth upstream to Hammer Creek (rkm 84). A total of 53,277 hours of setline effort and 630 hours of hook-and-line effort was employed in 2000. A total of 538 white sturgeon were captured and tagged in the Snake River and 25 in the Salmon River. Since 1997, 32.8 percent of the tagged white sturgeon have been recaptured. In the Snake River, white sturgeon ranged in total length from 48 cm to 271 cm and averaged 107 cm. In the Salmon River, white sturgeon ranged in total length from 103 cm to 227 cm and averaged 163 cm. Using the Jolly-Seber open population estimator, the abundance of white sturgeon <60 cm, between Lower Granite Dam and the mouth of the Salmon River, was estimated at 2,725 fish, with a 95% confidence interval of 1,668-5,783.

A total of 10 white sturgeon were fitted with radio-tags. The movement of these fish ranged from 54.7 km (34 miles) downstream to 78.8 km (49 miles) upstream; however, 43.6 percent of the detected movement was less than 0.8 km (0.5 mile). Both radio-tagged fish and recaptured white sturgeon in Lower Granite Reservoir appear to move more than fish in the free-flowing segment of the Snake River. No seasonal movement pattern was detected, and no movement pattern was detected for different size fish.

Differences were detected in the length frequency distributions of white sturgeon in Lower Granite Reservoir and the free-flowing Snake River (Chi-Square test, $P<0.05$). The proportion of white sturgeon greater than 92 cm (total length) in the free-flowing Snake River has shown an increase of 31 percent since the 1970's.

Analysis of the length-weight relationship indicated that white sturgeon in Lower Granite Reservoir had a higher relative weight factor than white sturgeon in the free-flowing Snake River. A von Bertalanffy growth curve was fitted to 138 aged white sturgeon. The results suggests fish are currently growing faster than fish historically inhabiting the study area, as well as other Columbia River basin white sturgeon populations.

Artificial substrate mats were used to document white sturgeon spawning. A total of 34 white sturgeon eggs were recovered: 27 in the Snake River, and seven in the Salmon River.

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The Bonneville Power Administration provided funding for this project. Nelson Allen, Charles Axtell, David Cunningham, Sean McConville, Joseph McCormack, Russell McCormack, Bradley Mitchell, James Paddlety, and Charles Taylor conducted the field sampling. Jay Hesse contributed valuable report reviews and edits. Dr. Dennis Scarnecchia of the University of Idaho, Department of Fish and Wildlife provided generous use of his laboratory for pectoral fin ray analysis. We also appreciate the Nez Perce Tribe for administration of this project.

INTRODUCTION

Traditionally, the Nez Perce people harvested Snake River white sturgeon (*Acipenser transmontanus*) for subsistence purposes. However, subsistence fishing has been severely limited as a result of low white sturgeon numbers between Hells Canyon and Lower Granite dams. Development of the Columbia River Basin hydroelectric system has created impoundments that have altered the habitat and movement of white sturgeon and their principal food resources in the Lower Snake River between Hells Canyon and Lower Granite dams. The goal of this project is to identify means to restore and rebuild the Snake River white sturgeon population between Hells Canyon and Lower Granite dams capable of supporting a sustainable annual subsistence harvest of white sturgeon equivalent to 5 kg/ha/yr (CBFWA 1997). If the population has not changed dramatically over the last 25-29 years since the completion of Lower Granite Dam in 1975, and the closure of catch-and-keep fishing in 1970, then implementation of scientifically sound mitigative strategies would be needed to realize the harvest objective.

It is hypothesized that: 1) natural production of white sturgeon is less than what it was before construction and operation of the hydropower system, 2) white sturgeon rearing habitat in many areas is under seeded because of the reduction in spawning habitat caused by the hydropower system construction and operations, 3) white sturgeon production can be significantly enhanced by some combination of spawning and rearing habitat restoration, and/or supplementation, and 4) naturally spawning white sturgeon populations can be preserved and optimum rates of production can be restored while concurrently maintaining tribal and recreational fishing opportunities (CBFWA 1997). However, additional data are needed to fully assess these hypotheses and develop a strategy to restore the Snake River white sturgeon population between Hells Canyon and Lower Granite dams.

The 1994 Northwest Power Planning Council Fish and Wildlife Program (NPPC -FWP) section 7.3B.1 called for fisheries managers to complete a biological risk assessment that addressed the informational needs pertaining to the Hells Canyon white sturgeon population. In 1996, the Biological Risk Assessment Team (BRAT), consisting of regional fisheries managers and researchers, was convened. The highly coordinated Phase I assessment was completed during 1997. This assessment identified: 1) potential mitigative actions to meet the project goal, and 2) data needs to fully assess the risks associated with applied actions. In addition, a multi-year study plan (Hoefs 1997) was developed to collect information identified by the BRAT. The 1994 NPPC -FWP (sections 10.4A.1 and 10.4A.4) called for the Bonneville Power Administration (BPA) to fund the Nez Perce Tribe to prepare an evaluation of potential means of rebuilding white sturgeon populations between Lower Granite Dam and Hells Canyon Dam (NPPC 1994). Phase II, the data collection phase of the project, was initiated in 1997 and will continue through 2002. Research conducted in 1997, 1998 and 1999 is reported in Hoefs (1998), Tuell and Everett (2000) and Tuell and Everett (2003), respectively.

Based on data collected during Phase II an adaptative management plan will be developed. The adaptative management plan will: 1) fully assess the risks and uncertainties associated with potential mitigative actions identified by the BRAT (Carmichael et al. 1997), 2) make recommendations to implement alternative mitigative actions designed to restore and rebuild the white sturgeon population to obtain a sustainable annual tribal subsistence harvest of 5 kg/ha/yr (CBFWA 1997), and 3) develop an adaptive management plan for the implementation, evaluation and monitoring of effects of applied mitigation action on the Snake River white sturgeon population between Hells Canyon and Lower Granite dams. Table 1 outlines specific tasks for data collection during Phase II as identified by Hoefs (1997).

The primary objective of sampling in 2000 was to capture and mark white sturgeon in the Snake and Salmon rivers in order to estimate population abundance, distribution and growth. Data were also collected on white sturgeon movement, spawning and rearing. This report presents results from 2000 Phase II data collection. In addition, during 2000 the Nez Perce Tribe hosted the regional white sturgeon research coordination meeting. The meeting’s agenda and a summary letter sent to Dr. Brian Allee, director of CBFWA, are contained in Appendix A.

Table 1. Phase II research tasks designed to collect information to fully assess the risk and effectiveness associated with potential management actions (modified from Hoefs 1997).

Goal: Collect biological and environmental data identified by the *Upper Snake River White Sturgeon Biological Risk Assessment* that will allow identification and assessment of mitigative actions designed to restore, protect and enhance the sturgeon population between Hells Canyon and Lower Granite dams and will establish a baseline on which to assess effectiveness of applied mitigative actions.

Objective 1. Assess the health and status of the Snake River white sturgeon population between Hells Canyon and Lower Granite Dams.

Task 1.1 Estimate white sturgeon abundance throughout entire reach and determine if there has been any marked change in abundance or age structure of the population over the last 25 years.

Task 1.2 Determine distribution/movements of fish, abundance of various age classes of white sturgeon per reach throughout the system and determine what environmental factors (velocity, flow, temperature, substrate) may affect distribution.

Task 1.2 Collect life history data for subadult and adult white sturgeon to model population dynamics.

Objective 2. Define habitat used for spawning and rearing of white sturgeon in the Snake River between Lower Granite and Hells Canyon Dams.

Task 2.1 Define habitat used for spawning. Identify environmental conditions associated with spawning: document timing, duration, location and environmental conditions.

Task 2.2 Identify distributions of larvae and young of the year throughout the area and identify associated environmental factors that define 'nursery' habitat.

Task 2.3 Identify rearing habitat for juvenile and adult white sturgeon.

Objective 3. Develop plans to address other informational needs identified by the BRAT not covered by tasks listed above.

METHODS

Study Area

The study area included 314 river kilometers (Rkms; 195 river miles) in the Snake and Salmon rivers (Figure 1). Sampling occurred in the Snake River between Lower Granite Dam (Rkm 174) and the mouth of the Salmon River (Rkm 303) and in the Salmon River from its mouth to Vinegar Creek (Rkm 185). The Snake River was divided into eight sampling reaches, while the Salmon River was divided into four sampling reaches. Reaches ranged from 16 km to 33 km in length in the Snake River and 42 km to 53 km in length in the Salmon River. The habitat encountered in these 314 Rkm was diverse, ranging from deep (>30 m) slack water pools in Lower Granite Reservoir to class III and IV rapids in the free-flowing Snake and Salmon rivers. Furthermore, one-third of the study area was accessible by boat only. In addition to sampling the Snake and Salmon rivers, select areas of the Clearwater River were sampled from its mouth upstream to near Orofino, Idaho (Rkm 74).

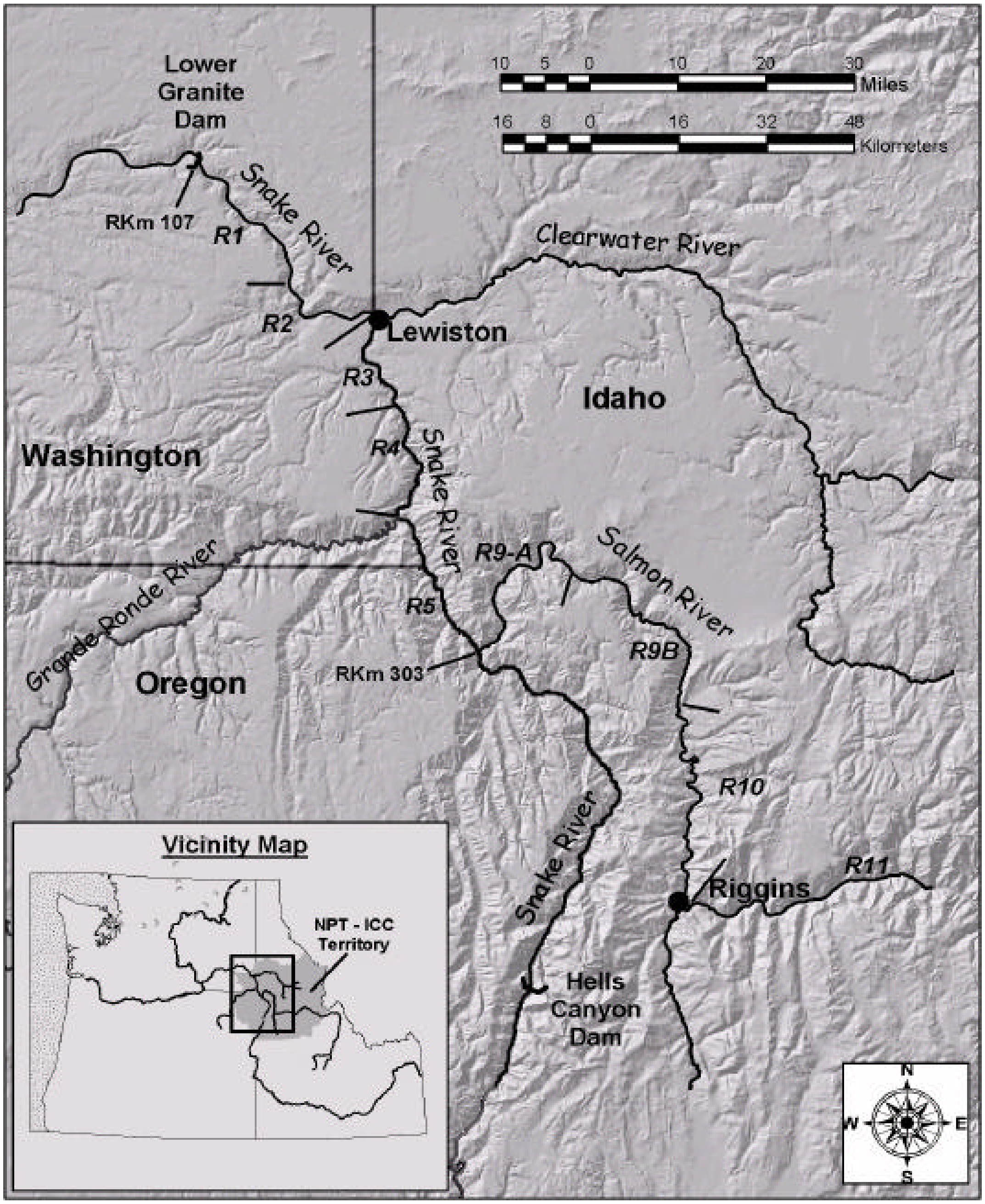

Figure 1. Map of study area. Sampling are reaches identified as R1 through R11.

Fish Sampling

The research study design (Hoefs 1997) called for stratified random sampling of reaches at weekly intervals from January through December (Table 2). Sampling sites were randomized within each reach. Reaches were divided into 0.8 km (0.5 mile) sampling segments, each segment was considered a potential sampling site, and 20 sampling sites were randomly chosen within a reach. Setlines and hook-and-line sampling were used to capture white sturgeon, depending on flow characteristics. Sampling sites were not stratified by habitat characteristics (depth, velocity or substrate type), thus catches were unbiased by habitat conditions to which white sturgeon may or may not be responding. Habitat data were collected at each sampling site. These data will be used to test correlations between white sturgeon presence and habitat characteristics.

Table 2. Location and calendar week for white sturgeon sampling in the Snake, Salmon and Clearwater rivers, 2000.

Study Reach	Location Description	Lower Rkm	Upper Rkm	Weeks Sampled
1	Lower Segment Lower Granite Reservoir	174	206.5	4, 14, 25, 35, 37, 44
2	Upper Segment Lower Granite Reservoir	207	223.5	1, 12, 26, 34, 38, 43
3	Clearwater River - Tenmile Rapids	224	239.5	2, 15, 27, 33, 40, 45
4	Tenmile Rapids - Grand Ronde River	240	270.5	5, 13, 28, 31, 41, 46
5	Grande Ronde River - Salmon River	271	302.5	6, 11, 16, 30, 42, 48
6	Salmon River - West Creek[1]	303	343.5	
7	West Creek – Sheep Creek[1]	344	368.5	
8	Sheep Creek – Hells Canyon Dam[1]	369	398	
9a	Lower Salmon River Gorge	0	41.5	9, 10, 29
9b	Upper Salmon River Gorge	42	83.5	7
10	Middle Salmon River[2]	84	131.5	
11	Upper Salmon River[2]	132	185	
12	Clearwater River	0	74	36

[1]Sampled by Idaho Power Company
[2]No sampling conducted in 2000

Setlines consisted of 30 m of anchored bottom-line with ten gangen lines attached by snaps approximately every 3 m (Apperson and Anders 1990, Lepla 1994, Thomas and Haas 1999). Gangen were rigged with galvanized circle hooks to reduce potential hooking injury. A combination of ten 8/0, 10/0, 12/0, 14/0 and 16/0 hooks were used on each line. Pickled squid and lamprey were used as bait. Setlines were checked twice a day and empty hooks rebaited. Set hours were recorded and the catch-per-unit-effort (CPUE) was calculated based on the hours a line with ten hooks was fished. White sturgeon size selectivity was evaluated by examining total length frequency distributions of catch among hook sizes (Elliott and Beamesderfer 1990). In 1999 and 2000, the addition of 8/0 hooks was evaluated to see if the total length frequency distribution of captured white sturgeon shifted toward smaller fish. Comparisons were made using a Chi-squared analysis on the proportion of fish sampled in each 20 cm (total length) size class.

Hook-and-line sampling was used primarily in the upper reaches of the Salmon River where water conditions prevented the use of setlines. Hook-and-line sampling was used throughout the remaining study area to supplement setline sampling. Sixty-pound test or greater Dacron line with either barbless 'J' hooks or barbless circle hooks of varying size (8/0 to 16/0) were used. A variety of bait types (e.g., lamprey, pickled squid) were used also. Hours fished were recorded, and the CPUE was calculated based on man-hours spent fishing.

Concurrent with the work being done by the Nez Perce Tribe, Idaho Power Company (IPC) is assessing the status of white sturgeon in the Hells Canyon Reach of the Snake River (Rkm 303 to Rkm 462; IPC 1997). Because of the similarity in objectives and tasks, the Nez Perce Tribe and IPC have a formal agreement for data sharing. Thus, our 2000 random stratified sampling conducted for population abundance did not include the Snake River above the mouth of the Salmon River. The Clearwater River was sampled using both setlines and hook-and-line. Because the number of white sturgeon reported in the Clearwater River is historically low, areas where white sturgeon have been reported in the Clearwater River were targeted instead of applying a randomized sampling design. The objective of sampling in the Clearwater River was to document the current distribution of white sturgeon, not to estimate the population abundance.

All white sturgeon captured were processed aboard the collection boat, or at the site of collection near the shore. White sturgeon brought aboard the boat were placed in a vinyl stretcher or large PVC trough, and their gills flushed with river water while being processed. After the fish were processed they were released at their location of capture.

Fish captured were checked for previous marks and tags (tag scars, fin marks, scute marks, and missing barbels and tags). New captures were tagged using a 15 mm, 134 Khz, Passive Integrated Transponder (PIT) tag injected near the armor of the head on the left side (North et al. 1996). Total and fork length (cm), girth (cm), and weight (0.1 kg) of the fish were measured and recorded.

Abundance

A mark-recapture study design was used to investigate the abundance of white sturgeon between Lower Granite Dam and the mouth of the Salmon River. Using a multiple sampling-pass model, white sturgeon have been captured, marked and released in the study area since 1997 (Hoefs 1999, Tuell and Everett 2000, Tuell and Everett 2003). Sampling passes were arranged as complete surveys of the entire study area and combined to consist of similar sampling effort. White sturgeon recaptured within the same pass were not regarded as recaptures for use in the population estimate.

In order to better evaluate changes in the abundance, both a closed population and an open population model, was selected to calculate the current population abundance (Tuell and Everett 2003). The first was a modified Schnabel estimate (Schnabel 1938) given by the following:

$$\hat{N} = \frac{\text{###} (C_t M_t)}{\text{###} (R_t)+1}$$

where $\hat{N}$ is the population abundance estimate, C_t is the total number of fish caught in sampling pass t, R_t is the number of fish already marked when captured during sampling pass t, and M_t is the number of marked fish in the population before sample pass t. The Schnabel model has the following assumptions:

1. The population is closed;

2. All fish are equally likely to be captured in each sample;

3. Capture and marking do not affect catchability;

4. Each sample is random; and,

5. Marks are not lost between sampling.

The 95% confidence interval for the Schnabel model's population abundance estimate was calculated using the method described in Zar (1996).

The second method estimates population abundance according to the method of Jolly (1965) and Seber (1982). This estimator assumes an open population structure and was calculated using computer software (Krebs 1998). The model equation is given by:

$$\hat{N} = \frac{\hat{M}_t n_t}{m_t}$$

where $\hat{N}$ is the population abundance estimate for sampling pass t, m_t is the number of fish marked prior to sampling pass t, n_t is the number of fish captured at sampling pass t, and $\hat{M}_t$ is calculated by the following:

$$\hat{M}_t = \frac{Z_t R_t}{r_t}$$

where Z_t is the number of marked fish that were not recaptured during sampling pass t, R_t is the number of fish released with marks at sampling pass t, and r_t is the number of fish captured during sampling pass t that were recaptured after sampling pass t. The Jolly-Seber model has the following assumptions:

1. The population need not be closed;

2. All fish are equally likely to be captured in each sample;

3. Capture and marking do not affect catchability;

4. Marks are not lost between sampling; and,

5. Sampling time is negligible in relation to intervals between samples.

The 95% confidence interval for the Jolly-Seber model's population abundance estimate was calculated using the method described in Manly (1984).

Specific size groups, based on the previous harvestable slot limit, were compared for fish captured in Lower Granite Reservoir (reaches 1-3), the free-flowing Snake River (reaches 4-5) and the Salmon River (reaches 9a and 9b). White sturgeon were separated into three size groups: less than 92 cm, 92-183 cm and greater than 183 cm (Coon et al. 1977). Comparisons were made using a Chi-squared analysis on the proportion of fish sampled in each size group.

Age and Growth

Pectoral fin rays were collected for age determination from a sub-sample of fish in three river segments: Lower Granite Reservoir, the free-flowing Snake River and the Salmon River. The lead ray of the left pectoral fin was clipped near the point of attachment and distally about 2.5 cm from this point (Wilson 1987, Devore et al. 1995, Beamesderfer et al. 1995). Each ray was cleaned and cut using a procedure similar to that outlined by Brennan and Cailliet (1989). This method has been validated for both lake sturgeon (Rossiter et al. 1995) and white sturgeon (Brennan and Cailliet 1991, Tracy and Wall 1994). Each fin ray was analyzed using the procedure described in Everett et al. (2003). All work was done without specific knowledge of the length, weight, origin or gender of the fish. Two technicians interpreted each fin ray independently. If there was a discrepancy between the two annuli counts, then the fin ray was re-read by each technician. If the discrepancy was not resolved after the second reading, then the fin ray was re-read with both technicians present. If the discrepancy was not resolved after the third reading, then the fin ray was considered unreadable and removed from the sample.

Lengths-at-age were used to create a von Bertalanffy growth curve (Misra 1980; Moreau 1987). Fish from the reservoir, and the free-flowing segment of the Snake River, as well as the Salmon River were combined to create the growth curve. The von Bertalanffy growth function is given by:

$$L(t)=L_{\infty}\{1-e^{-K(t-t_0)}\}$$

where L_{∞} represents the length of an infinitely old fish, K represents a curvature parameter or how fast the fish reach L_{∞}, and t_0 is an initial condition parameter. The data were fitted to the von Bertalanffy growth curve using nonlinear regression computer software (Sherrod 1992). No statistical comparisons were made with historical data or white sturgeon populations in other Columbia River Basin reaches. However, graphical displays were included for visual comparison. Differences in growth rate between males and females were not examined due to small sample size.

Paired samples of total length and weight were fitted to the allometric weight equation:

$$W = aL^b$$

where W represents the weight of the fish in kg, and L represents its total length in cm. Relative weights (W_r) were calculated for the reservoir and free-flowing segments of the Snake River and the Salmon River using the standard weight equation given by:

$$W_s = 2.735\ E\text{-}6 * L^{3.232}$$

developed by Beamesderfer (1993). Relative weight was determined by dividing the actual weight of the fish by the standard weight (W_s) for a fish of that length and then multiplying by 100. Only white sturgeon 60 cm and larger were included in the calculation of W_r. Using W_r, Snake River white sturgeon condition factor was compared between the reservoir and free-flowing segments using a two-sample t-test. No statistical comparisons were made with Salmon River white sturgeon using W_r. However, graphical comparisons were included in the analysis. The allometric growth curves reported for several Columbia River Basin white sturgeon populations were plotted with the growth curves from the Lower Granite Reservoir, the free-flowing Snake River and the Salmon River. In addition, historical growth curves reported for the Snake River population were also graphically displayed for visual comparison.

Spawning

Artificial substrate mats (McCabe and Beckman 1990) were used to document white sturgeon spawning. The substrate mats were modified by Parley and Kappenman (2000), and were deployed and checked using the method outlined in Tuell and Everett (2003). Eggs and larvae were preserved in formalin for later identification. Temperature, near substrate velocity and substrate were recorded at sampling sites.

Movement

Movement and migration patterns of white sturgeon were investigated using telemetry and mark-recapture data. Fish were selected based on three criteria. First, large maturing fish were targeted in order to identify spawning migrations and spawning habitat. Second, fish were selected based on location in order to get a representative sample throughout the study area. Finally, juvenile fish were selected to identify rearing locations and general movement patterns. White sturgeon were fitted with telemetry tags using a method similar to Haynes et al. (1978), Apperson and Anders (1990) and modified by Tuell and Everett (2003). Because of the diverse habitat encountered throughout the study area, a Combined Acoustic and Radio Tag (CART; Deary et al. 1998) was utilized. The CART's dual capability of transmitting both acoustic and radio frequencies allowed for tag detection in a variety of habitats. Acoustic frequencies can be detected in deep water; whereas, radio frequencies can be detected in shallow, more turbulent water. Tags were outfitted with three-year batteries.

Radio tracking was conducted by boat, vehicle and plane/helicopter. Habitat data were recorded at sites where fish were detected by boat. Fish locations were tracked every two weeks. A tracking period covered several days, i.e. crews were given several days to locate a fish. A directional hydrophone deployed from a boat was used to receive acoustic signals. Four or six-element antennas were used to receive radio signals. Recaptured PIT tagged white sturgeon were used to supplement movement analysis.

RESULTS

Sampling Effort

A total of 53,277 hours of setline effort and 630 hours of hook-and-line effort was employed in 2000 (Table 3). In Lower Granite Reservoir (reaches 1-3), 19,762 hours of setline sampling was conducted with 22 hours of hook-and-line effort. In the free-flowing Snake River (reaches 4-5), 27,875 hours of setline sampling was conducted with 502 hours of hook-and-line effort. In the Salmon River (reaches 9-12), 5,160 hours of setline sampling was conducted with 90 hours of hook-and-line effort. A total of 166 white sturgeon were sampled from Lower Granite Reservoir, 372 from the free-flowing Snake River and 25 from the Salmon River (Appendix B). Although similar effort was employed in each Snake River reach, the overall catch and CPUE was greater in the reach 5. Moreover, the overall CPUE in the free-flowing Snake River reaches was greater than the CPUE in Lower Granite Reservoir.

Approximately 480 hours of setline sampling and 16 hours of hook-and-line sampling were conducted in the Clearwater River during 2000. No fish were captured. Sampling was concentrated around Slaughter House Hole near Orofino (Rkm 67), the mouth of the North Fork near Orofino (Rkm 65), Pink House Hole near Orofino (Rkm 63), the mouth of Big Canyon Creek near Peck (Rkm 56), Big Eddy near Lenore (Rkm 45), the bridge near Cherry Lane (Rkm 34), the beach at Myrtle (Rkm 29), and Lapwai Creek near Spalding (Rkm 19).

Table 3. Sampling effort, catch and catch per unit effort (CPUE) per reach using setlines and hook-and-line sampling in the Snake, Salmon and Clearwater rivers in 2000.

Study	Setline			Hook-and-Line		
Reach	Effort (hrs)	Catch	CPUE	Effort (hrs)	Catch	CPUE
1	9,813	84	**0.009**	19	0	**0**
2	9,949	61	**0.006**	3	0	**0**
3	9,396	21	**0.002**	0	0	**0**
4	9,032	76	**0.008**	245	69	**0.282**
5	9,447	160	**0.017**	257	67	**0.261**
9a	3,576	24	**0.007**	4	0	**0**
9b	1,584	1	**0.001**	86	0	**0**
10	0	0	**0**	0	0	**0**
11	0	0	**0**	0	0	**0**
12	480	0	**0**	16	0	**0**
Total	53,277	427	**.008**	630	136	**0.216**

Abundance

During 2000, 538 white sturgeon were captured in the Snake River and 25 in the Salmon River (Appendix B). Of these, 317 were unmarked and 246 were previously marked fish. These 317 fish plus the 768 from 1997-99 bring the total number of marked fish in the study area to 1,085. No mortalities occurred during collection or processing. In Lower Granite Reservoir white sturgeon ranged from 48 cm to 252 cm total length and averaged 116 cm (Figure 2). White sturgeon captured in the free-flowing segment of the Snake River ranged from 54 cm to 271 cm total length and averaged 103 cm (Figure 3). White sturgeon captured in the Salmon

River ranged from 103 cm to 227 cm total length and averaged 163 cm (Figure 4). In 2000, incidental captures consisted of 10 channel catfish (*Ictalurus punctatus*), 8 largescale suckers (*Catostomus macrocheilus*) and 4 smallmouth bass (*Macropterus dolomieui*).

The proportion of white sturgeon within each size class significantly differed (Chi-Square test, $P<0.05$) between fish captured in Lower Granite Reservoir and the free-flowing segment of the Snake River in 2000. Similarly, these proportions differed significantly (Chi-Square test, $P<0.05$) between these two river segments in 1997 (Hoefs 1998), 1998 (Tuell and Everett 2000) and 1999 (Tuell and Everett 2001). However, within each river segment, no significant differences (Chi-Square test, $P>0.05$) were detected in the proportions of different size classes between 1997-2000. Due to small sample size no comparisons were made with Salmon River fish.

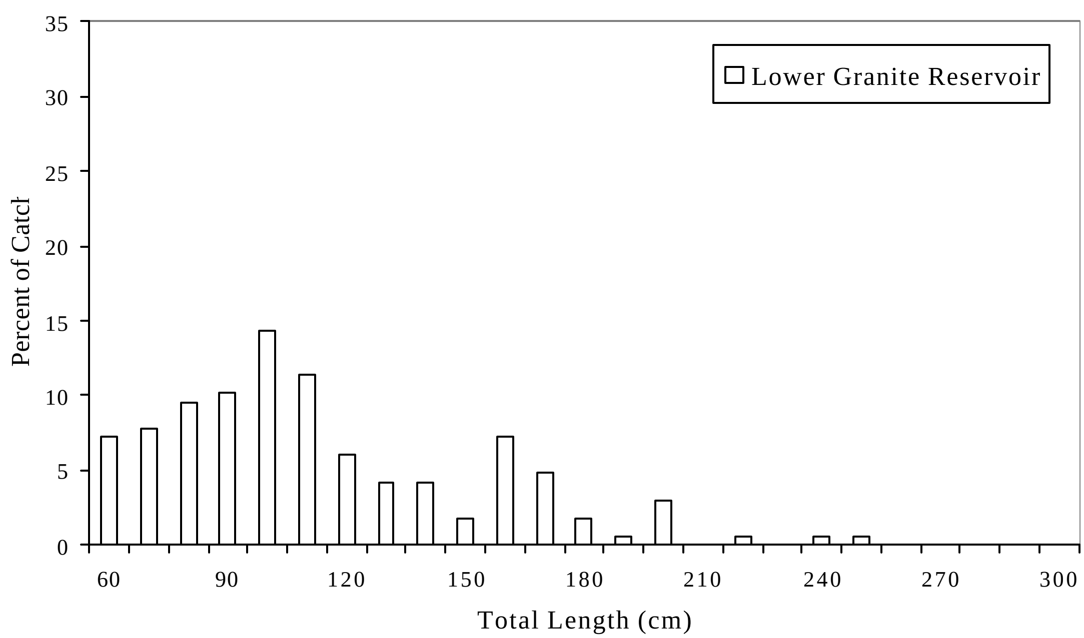

Figure 2. Length frequency distribution of white sturgeon captured in Lower Granite Reservoir in 2000.

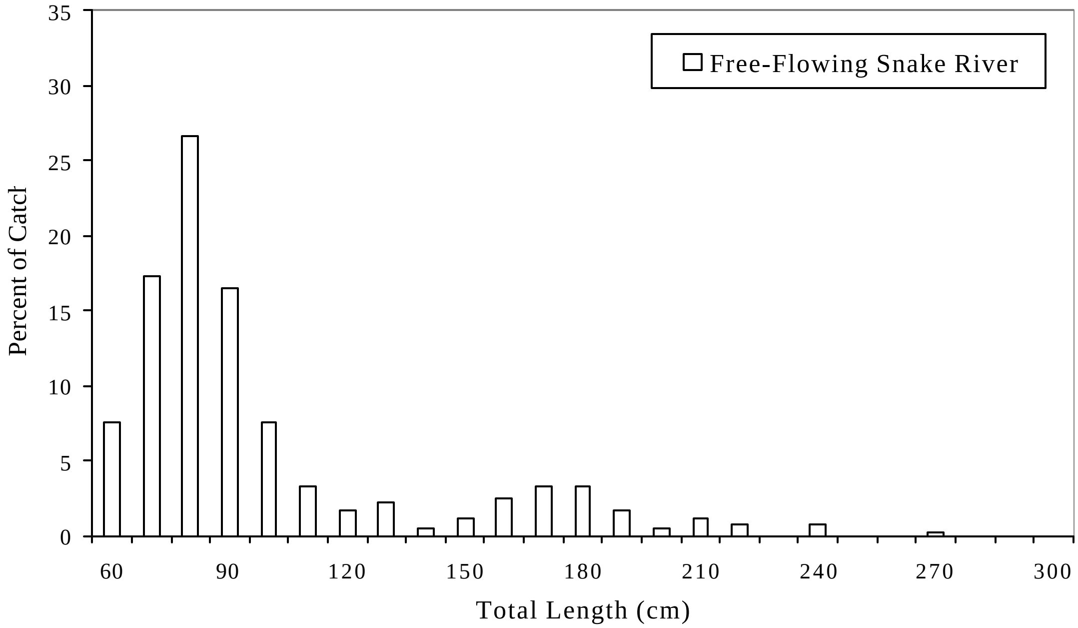

Figure 3. Length frequency distribution of white sturgeon captured in the free-flowing Snake River in 2000.

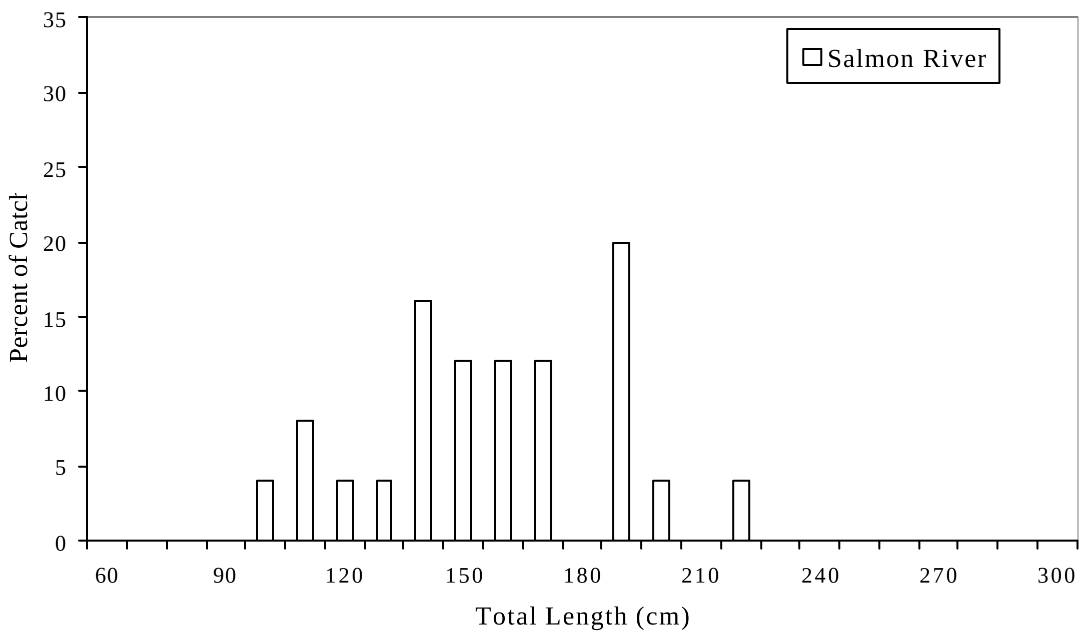

Figure 4. Length frequency distribution of white sturgeon captured in the Salmon River in 2000.

Comparisons of length frequency distributions indicate different hook sizes select for different fish size (Figure 5). The proportion of white sturgeon captured within the 20 cm length intervals was significantly different across the various hook sizes ($\div^2$=77.0; d.f.=44; P<0.05). A larger proportion of small fish were captured with small hooks and a larger proportion of large fish were captured with large hooks. However, no significant difference ($\div^2$=5.5; d.f.=9; P>0.05) was detected in the length frequency distributions between 1997-98 and 1999-2000 with the addition of 8/0 hooks during setline sampling (Figure 6). Furthermore, white sturgeon 60 cm and larger appear fully recruited to the range of hook sizes (8/0 to 16/0) employed during this study.

Since 1997, 18 complete sampling passes have been conducted in the Snake River study area. Due to the low numbers of recaptured white sturgeon within individual passes, several complete passes were combined. Both the closed and open model abundance estimators were based on a nine-pass model. In the Salmon River, the number of recaptures was too low to calculate an abundance estimate. The abundance of white sturgeon >60 cm FL was estimated by the modified Schnabel estimator to be 2,754 with a 95 percent confidence interval of 2,336-3,354. Using the open model, Jolly-Seber estimate, the abundance was estimated to be 2,725 with a 95 percent confidence interval of 1,668-5,783. The surface area of the Snake River from Lower Granite Dam to the mouth of the Salmon River is estimated at 4,450 ha (Les Cunningham, U.S. Army Corps of Engineers, personal communication). Therefore, the density of white sturgeon in that segment of the Snake River is estimated between 0.52 and 0.75 fish/ha using the Schnabel estimate, or 0.37 and 1.30 fish/ha using the Jolly-Seber estimate.

Age and Growth

In 2000, an additional 100 white sturgeon were examined for age from three river segments: 43 fish from the reservoir segment, 45 fish from the free-flowing segment, and 12 from the Salmon River. The age assignment procedure resulted in 11 fish being removed from all samples due to age discrepancies (Table 4). The 89 white sturgeon assigned ages ranged from 3 to 42 years old. The largest sturgeon aged was a 21-year-old, 252 cm TL, and the smallest an age-3 fish, 55 cm TL. The von Bertalanffy growth curve (Figure 7) generated from length-at-capture data from fish sampled in both 1999 and 2000 (n=138) is given by $L(t)=276(1-e^{-0.06(t+0.3)})$ where L(t) is total length in cm.

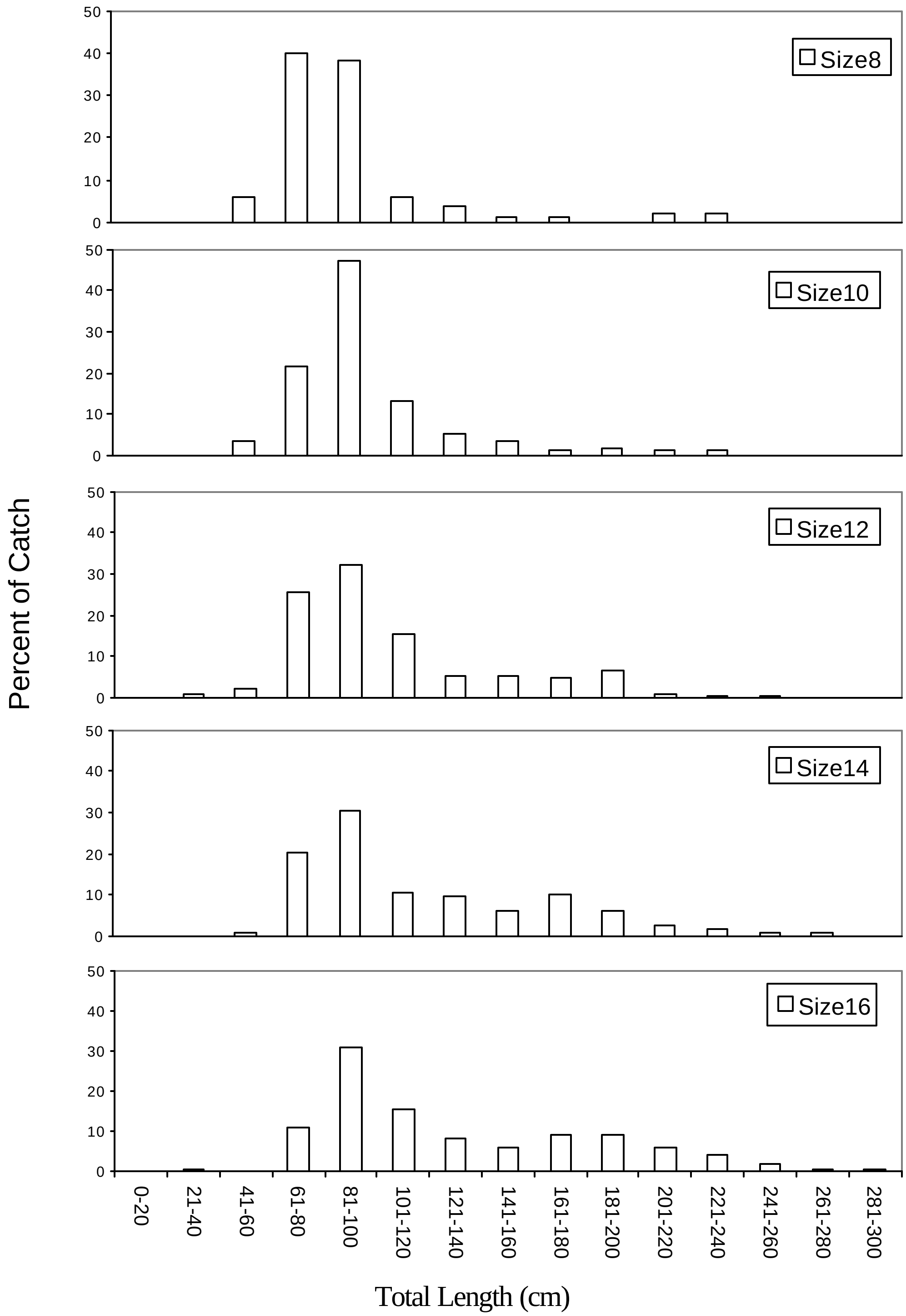

Figure 5. Length frequency distribution of white sturgeon captured in the Snake and Salmon rivers by hook size, 1997-2000.

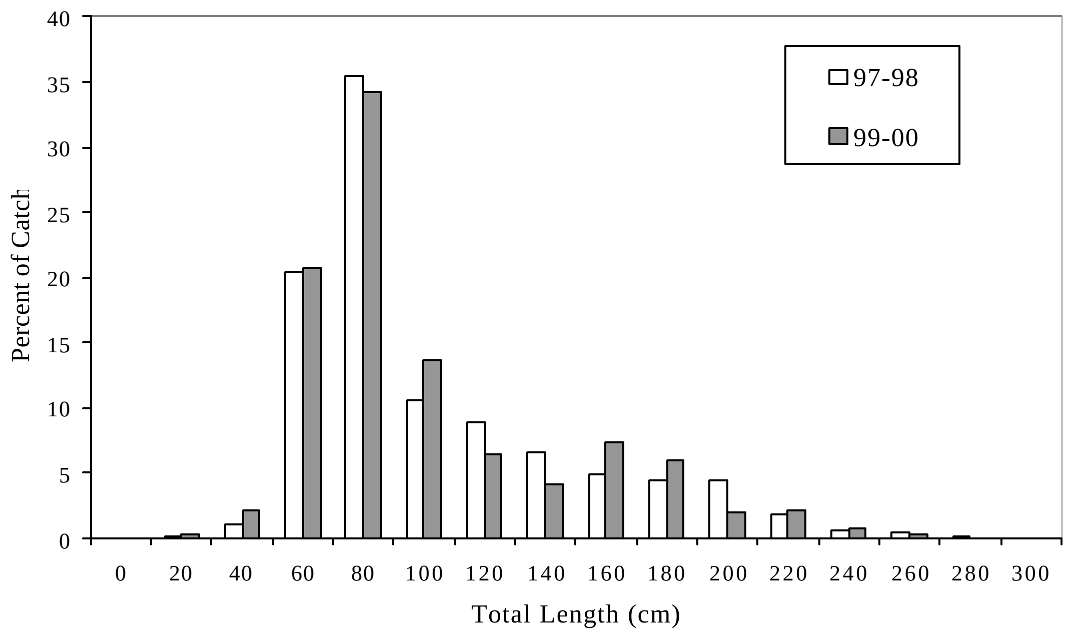

Figure 6. Comparison of the total length frequency distributions of white sturgeon catch between 1997-98 and 1999-2000.

Table 4. Summary of pectoral fin rays collected by river segment, aged, and removed from analysis because of age discrepancies in 1999 and 2000.

	Number of Samples		
Location	**Collected**	**Removed**	**Aged**
Lower Granite Reservoir	58	9	49
Free-Flowing Snake River	73	8	65
Salmon River	25	1	24
Total	156	18	138

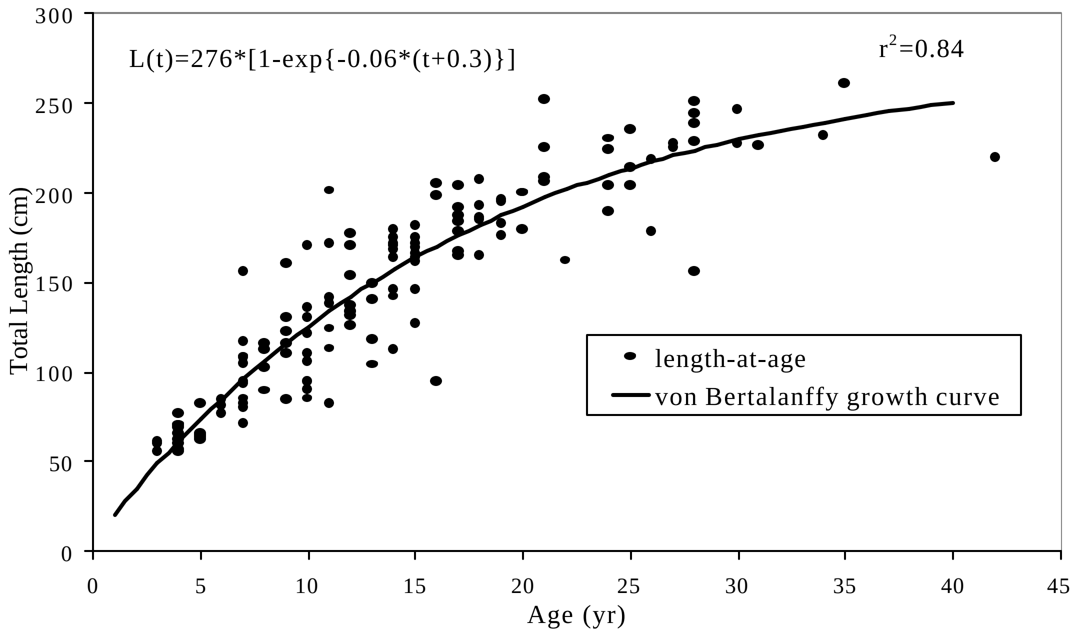

Figure 7. The von Bertalanffy growth curve fitted to 138 aged white sturgeon in the Snake and Salmon Rivers, 1999 and 2000.

A total of 562 white sturgeon from the Snake and Salmon rivers was measured for weight (kg). These fish ranged in weight between 0.6 and 136 kg. The allometric relationship between weight (kg) and total length (cm) derived for white sturgeon collected in Lower Granite Reservoir, the free-flowing Snake River and the Salmon River was $W = (1.83\ E\text{-}06)L^{3.22}$ (Figure 8), $W = (1.60\ E\text{-}06)L^{3.24}$ (Figure 9), and $W =(1.54\ E\text{-}06)L^{3.25}$ (Figure 10), respectively. The overall mean W_r for white sturgeon 60 cm and larger captured in Lower Granite Reservoir, the free-flowing Snake River and the Salmon River was 91.4, 85.0 and 86.3, respectively. The W_r differed significantly between the reservoir and free-flowing segments (t-test; $P<0.05$). Due to small sample size no comparisons were made with Salmon River fish.

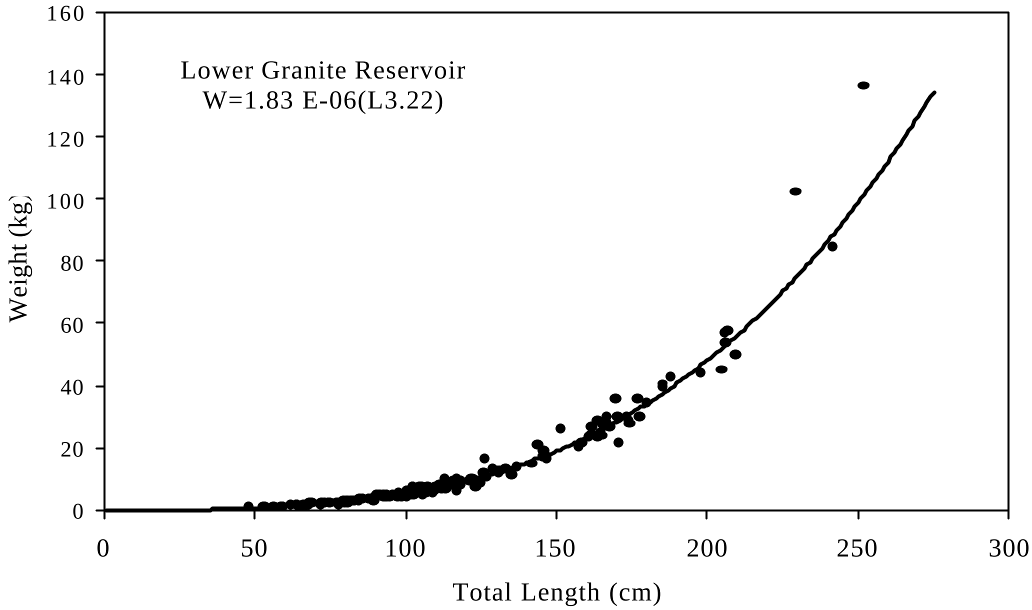

Figure 8. Allometric relationship between weight (kg) and total length (cm) for white sturgeon collected in Lower Granite Reservoir during 2000.

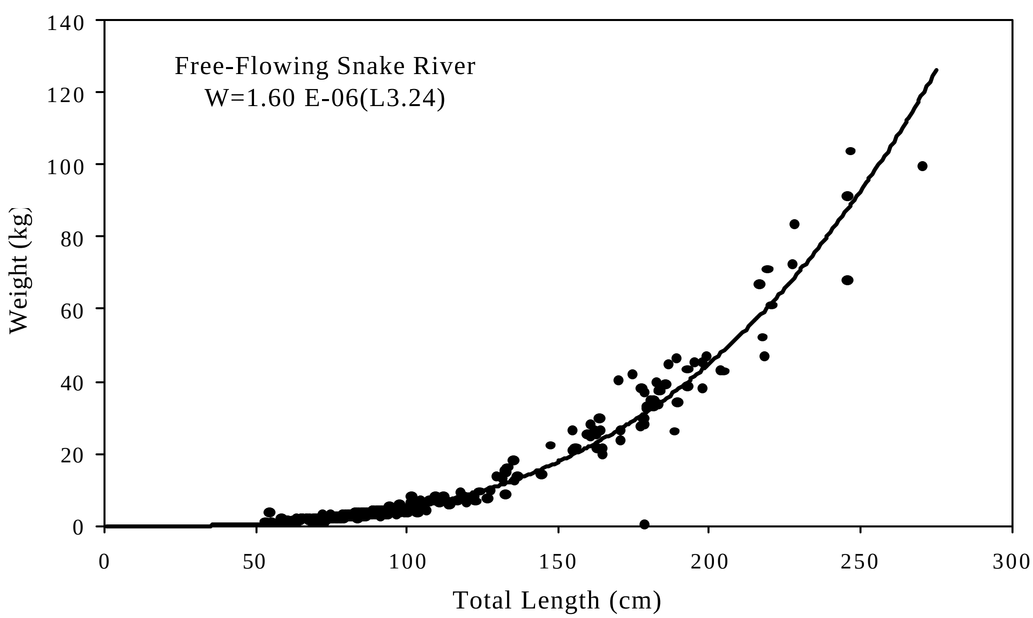

Figure 9. Allometric relationship between weight (kg) and total length (cm) for white sturgeon collected in the free-flowing Snake River during 2000.

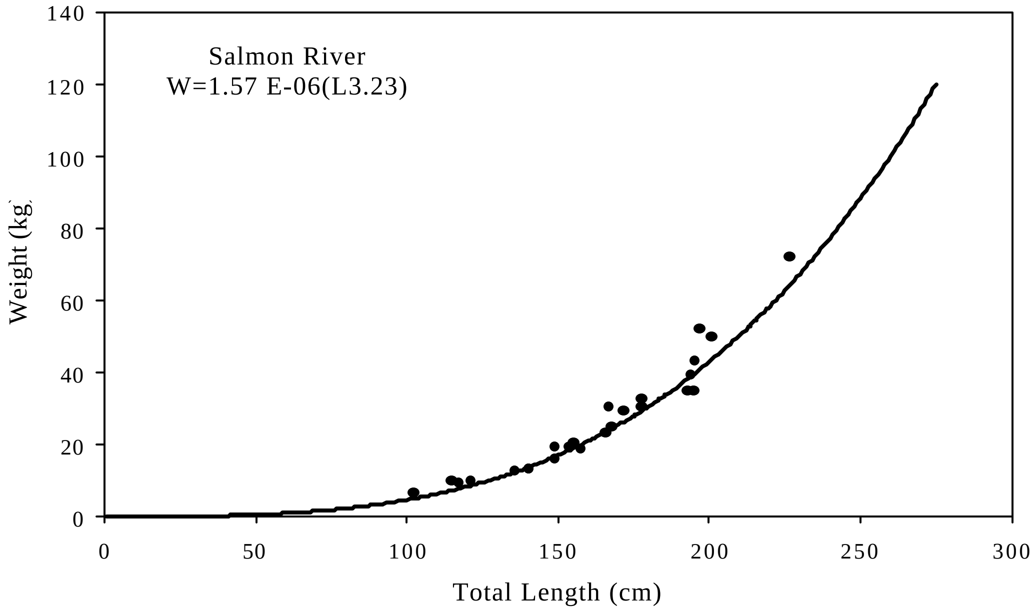

Figure 10. Allometric relationship between weight (kg) and total length (cm) for white sturgeon collected in the Salmon River during 2000.

Spawning

Select fish over 150 cm total length were examined for gender. Gender was determined for 78 of the 87 white sturgeon examined. A total of 35 fish were determined to be female, and 43 fish were determined to be male.

In 2000, 24 artificial egg mats were deployed in the Snake River and 12 in the Salmon. A total of 28,752 hours of artificial egg mat effort was conducted in the Snake River and 8,928 hours in the Salmon River. Thirty-four white sturgeon eggs were recovered, 27 from the Snake River and 7 from the Salmon River (Appendix C). During the time the eggs were found, the daily mean discharge at the Snake River gage at Anatone (Rkm 269) ranged from 696 to 1,768 m^3/s (24,567 to 62,436 cfs) and 476 to 1,178 m^3/s (16,800 to 41,600 cfs) at the Salmon River gage at White Bird (Rkm 84; Figures 11 and 12). At sites where eggs were found in the Snake River, the mean substrate velocity was 0.9 m^3/s, mean water temperature was 15.8E C and mean depth was 18.3 m. At sites where eggs were found in the Salmon River, the mean substrate velocity was 1.2 m/s, mean water temperature was 13.7E C and mean depth was 2.9 m. At each egg location, the primary substrate type was sand or small gravel. Most eggs were recovered between 200 and 300 meters below a major rapid.

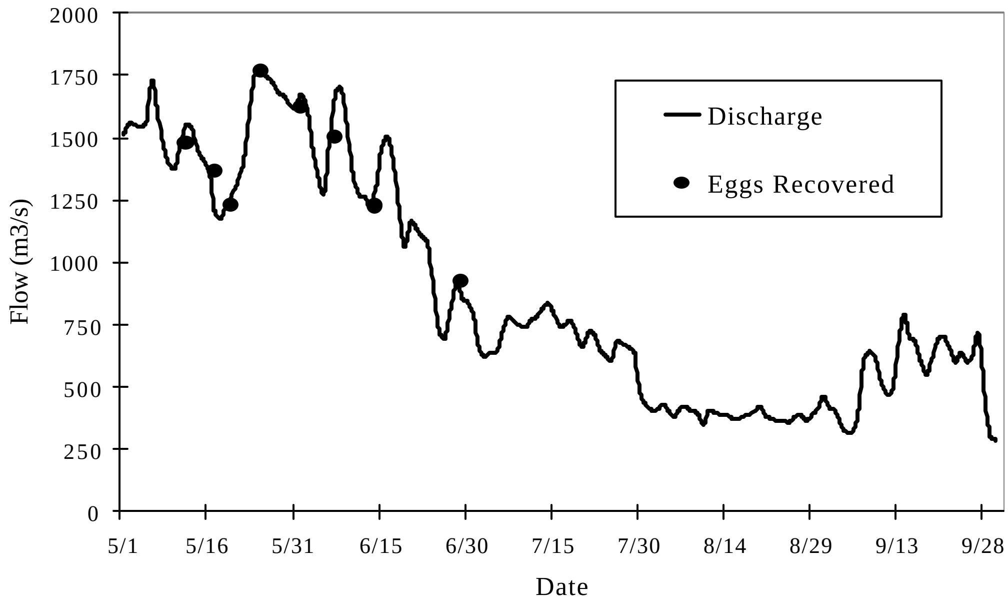

Figure 11. Daily average discharge at the Snake River, Anatone gauge when white sturgeon eggs were collected in the Snake River, 2000 (USGS gauge number 13334300).

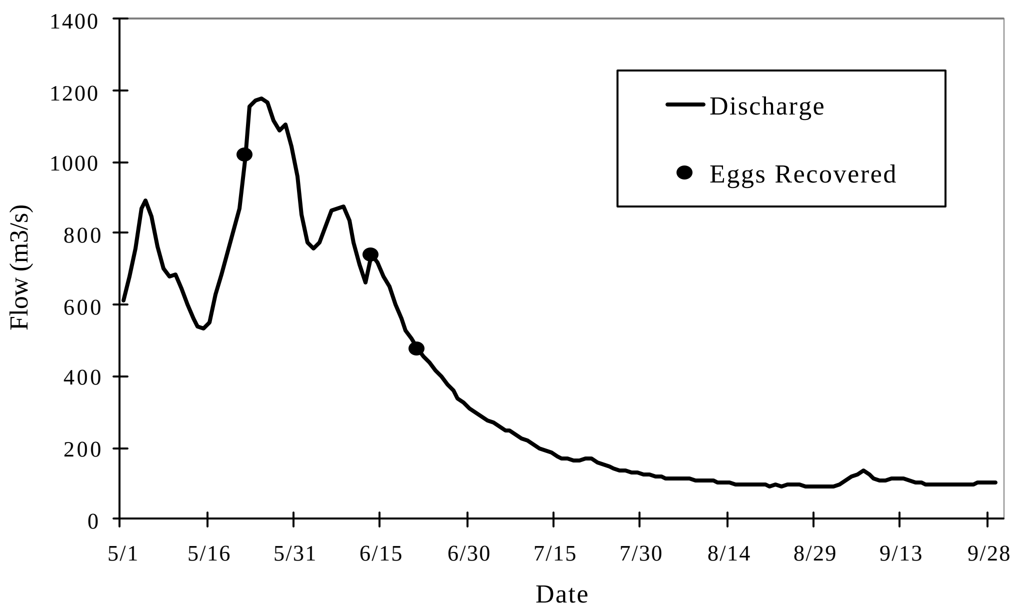

Figure 12. Daily discharge at the Salmon River, White Bird gauge when white sturgeon eggs were collected in the Salmon River, 2000. (USGS gauge number 13317000).

Movement

An additional 10 white sturgeon were fitted with radio tags in 2000 (Appendix D). Radio-tagged fish ranged in total length from 133 to 229.5 cm. Radio tagged white sturgeon were tracked throughout the year approximately every two-weeks. The interval between detections ranged from one to 89 days. Movements of radio-tagged fish were both upstream and downstream (Figures 13 and 14). Radio-tagged white sturgeon originating in Lower Granite Reservoir moved an average of 5.2 km (3.2 miles) between detections, whereas white sturgeon originating from the free-flowing Snake River and the Salmon River moved an average of only 0.9 km (0.6 miles) between detections. The distance of individual fish movement ranged from 0 km to 79 km (49 miles) and averaged 0.3 km (.2 miles). Due to small sample size, no seasonal movement pattern was detected for radio-tagged fish, and no movement pattern was detected among radio-tagged fish of different size-classes.

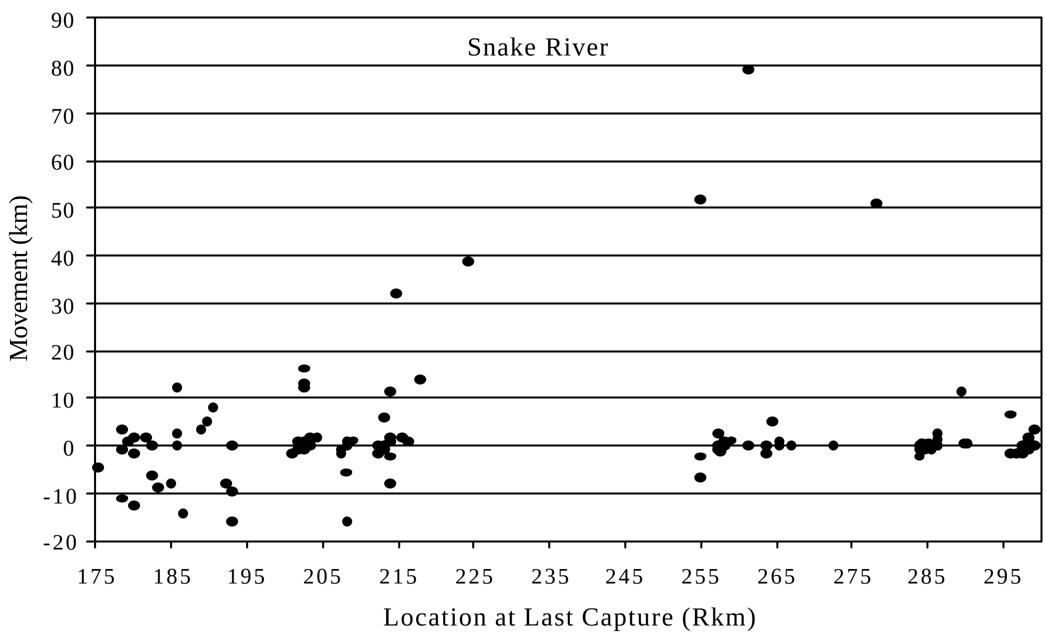

Figure 13. Total movement of 16 radio-tagged white sturgeon fitted with Combined Acoustic Radio Tags in the Snake River during 2000. Points represent distance from previous detection. Negative values indicate movement downstream and positive values indicate movement upstream.

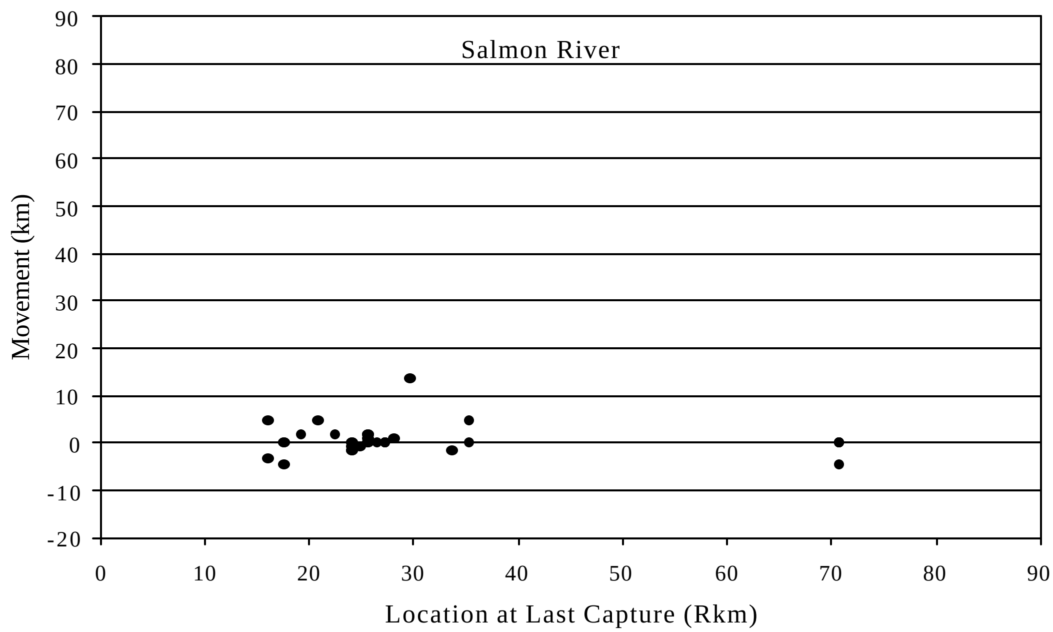

Figure 14. Total movement of 6 radio-tagged white sturgeon fitted with Combined Acoustic Radio Tags in the Salmon River during 2000. Points represent distance from previous detection. Negative values indicate movement downstream and positive values indicate movement upstream.

In 2000, a total of 205 distinct PIT/Floy tagged white sturgeon were recaptured. Of these, 131 were fish that had been previously tagged in 1997-99 (Hoefs 1998, Tuell and Everett 2000, Tuell and Everett 2003). During 2000, 18.9 percent (205 of 1,085) of the marked white sturgeon were detected at least once. One white sturgeon was captured four times. From 1997 to 2000 a total of 356 white sturgeon have been recaptured. These fish ranged from 64 cm to 252 cm in total length. In the Snake River, movements of 124 recaptured fish were less than or equal to 0.8 km (0.5 mile) or had no discernable movement. Sixty-six fish moved more than 0.8 km up to 16 km (10 miles) while 27 others moved more than 16 km up to 94.1 km (58.5 miles). Several fish were recaptured from previous sampling performed by other agencies. Duration between captures ranged from 0 to 1,267 days. Movements were both upstream and downstream, with five moving from Lower Granite Reservoir into the free-flowing Snake River and three fish moving from the free-flowing Snake River into Lower Granite Reservoir. White sturgeon originating in Lower Granite Reservoir moved an average of 17.2 km (10.7 miles) between recaptures (Figure 15); whereas, white sturgeon originating from the free-flowing Snake River moved an average of only 3.5 km (2.2 miles; Figure 16). In 2000, five PIT/Floy tagged white sturgeon were recaptured within the Salmon River, they moved an average of 0.8 km (1 mile). For PIT/Floy tagged fish, no clear seasonal movement pattern was detected (Figure 17), and no distinct movement pattern was detected among fish of different size-classes (Figure 18).

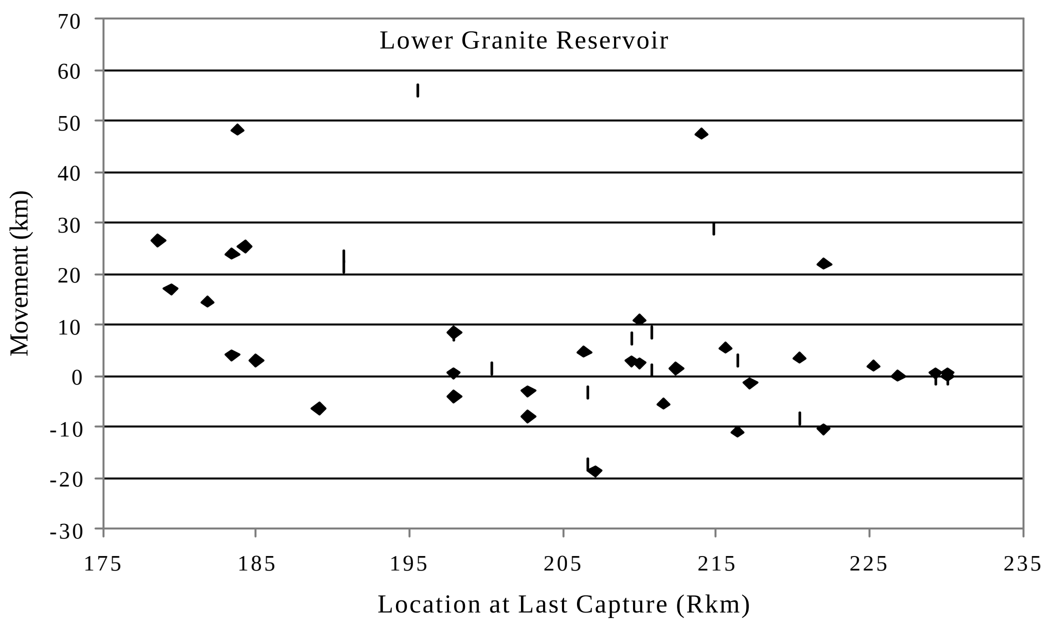

Figure 15. Total movement of 50 recaptured PIT/Floy tagged white sturgeon initially captured in Lower Granite Reservoir. Negative values indicate movement downstream and positive values indicate movement upstream.

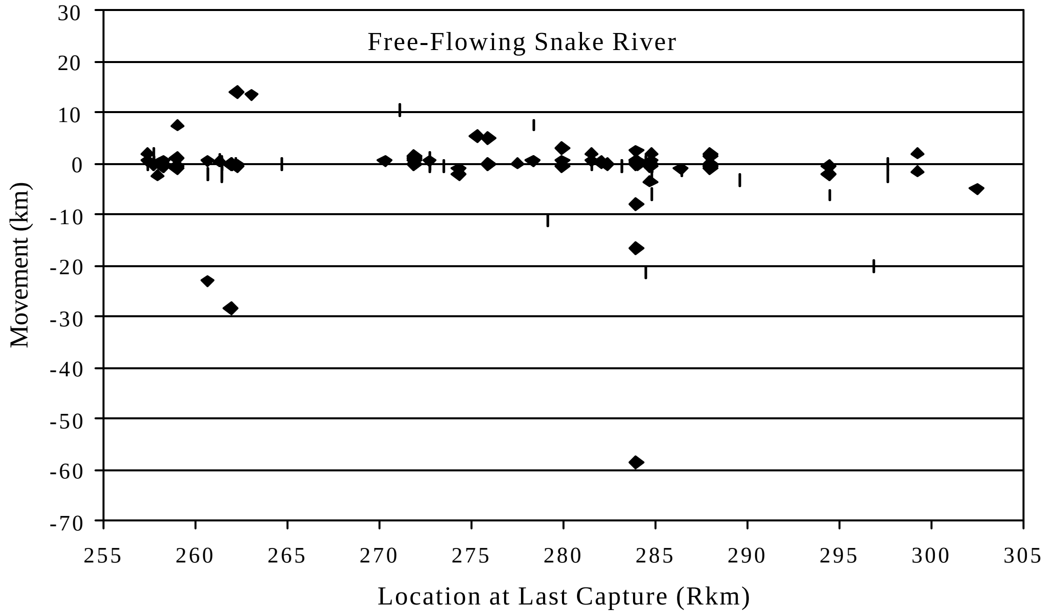

Figure 16. Total movement of 165 recaptured PIT/Floy tagged white sturgeon initially captured in the free-flowing Snake River. Negative values indicate movement downstream and positive values indicate movement upstream.

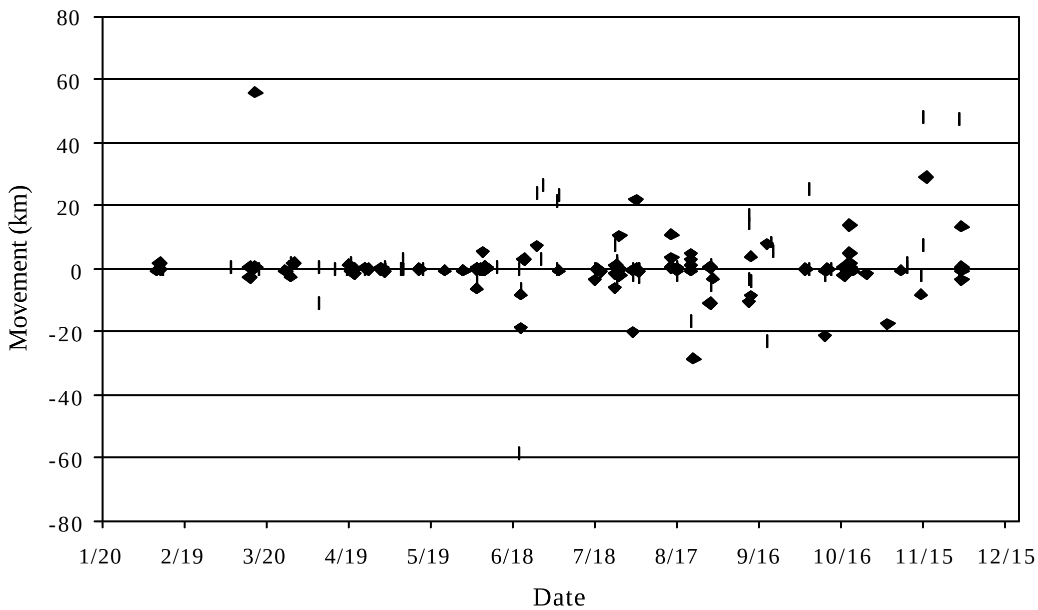

Figure 17. Seasonal movement of 220 recaptured PIT/Floy tagged white sturgeon. Negative values indicate movement downstream and positive values indicate movement upstream.

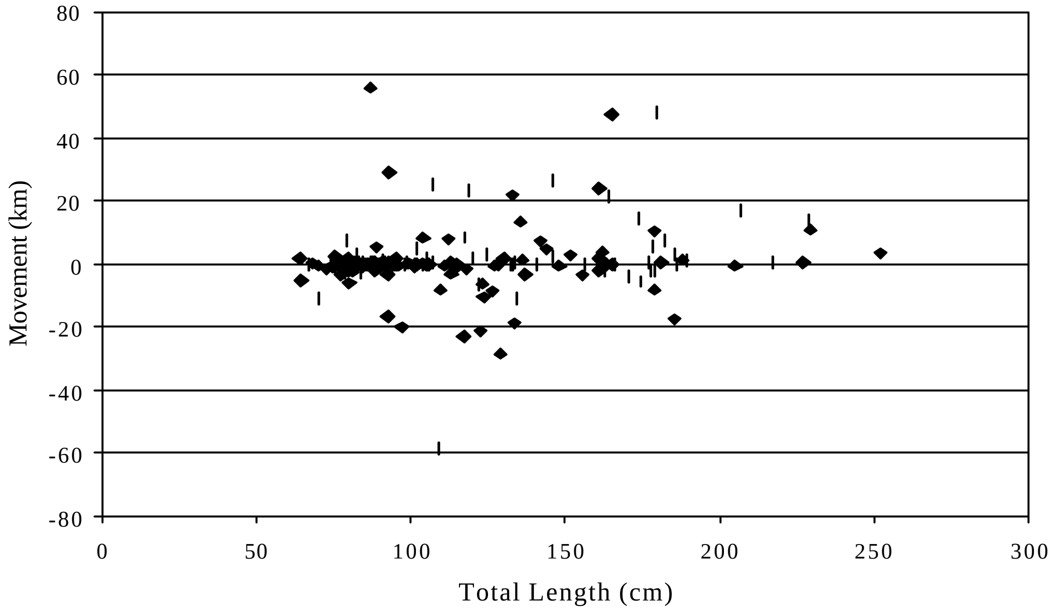

Figure 18. Size and movement of 220 recaptured PIT/Floy tagged white sturgeon. Negative values indicate movement downstream and positive values indicate movement upstream.

DISCUSSION

White sturgeon were not evenly distributed throughout the study area. In the transition zone between Lower Granite Reservoir and the free-flowing Snake River, an approximate 15 km segment, we have documented a lack of catch since 1997. Relatively shallow water depths (<5m) distinguish this segment. The catch rate for white sturgeon was generally lower in Lower Granite Reservoir than the free-flowing Snake River. Two exceptions were noted in 2000, one near Rkm 188 and another near Rkm 206. As suggested by Lepla (1994), this may be associated with food availability from tributaries nearby (Knoxway Bay, Rkm 188; Steptoe Canyon, Rkm 206). Furthermore, the catch rate was more consistent in the free-flowing Snake River, with the exception of the five km below the mouth of the Salmon River.

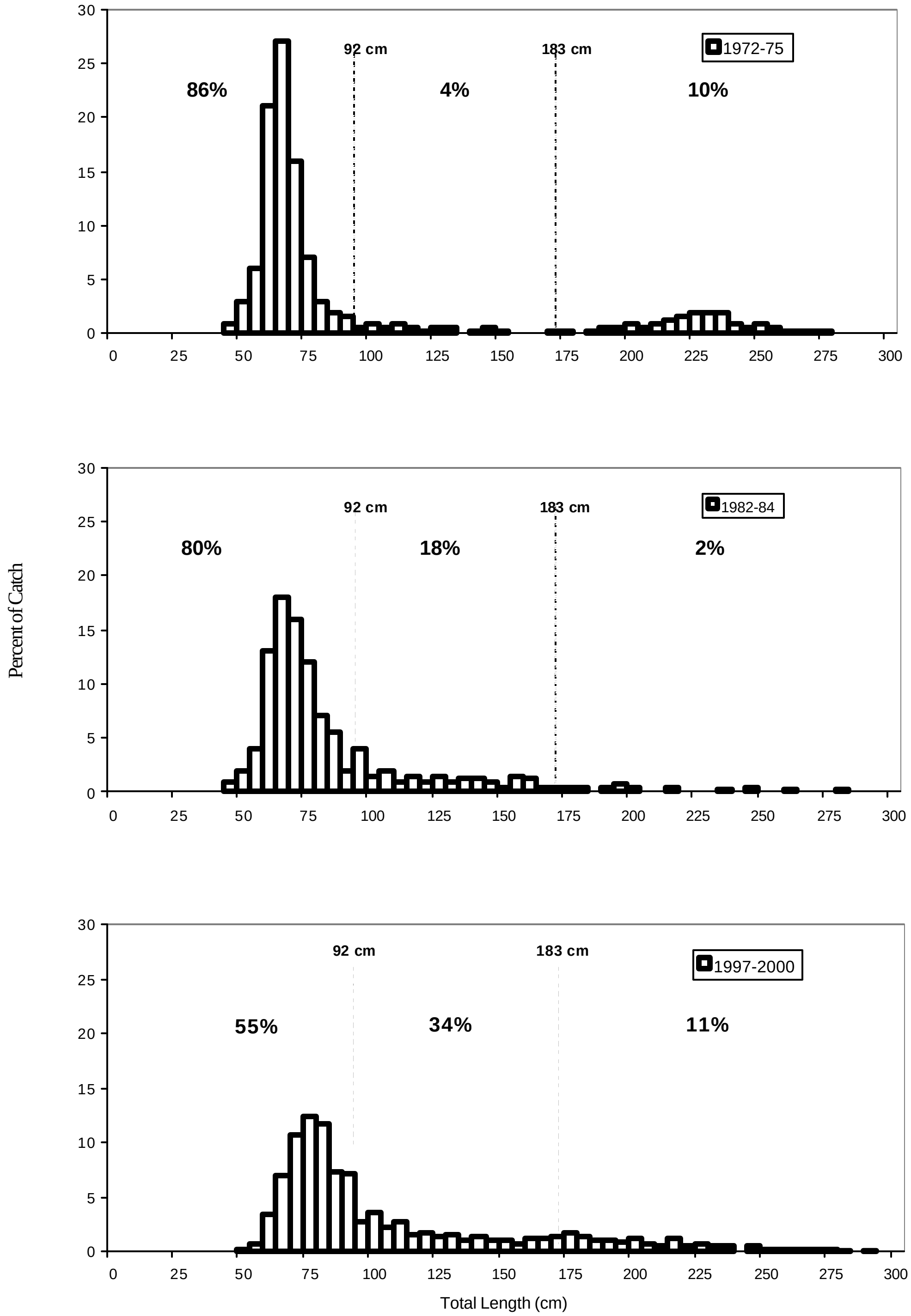

Figure 19. The length (total length) frequency distributions of white sturgeon sampled from the Hells Canyon reaches of the Snake River, 1997-2000, 1982-84 (Lukens 1985), and 1972-75 (Coon et al. 1977) and the percent of the populations < 92 cm, between 92 and 183 cm, and >183 cm.

The analysis of the length frequency distributions of white sturgeon within each river segment has revealed no difference in the size class composition between 1997 and 2000. Due to this similarity, the data were pooled across years to analyze trends in the available historic data. Examining the free-flowing segment of the Snake River, we observe a trend in the change of the length frequency distribution of white sturgeon (Figure 19). Earlier studies found that a large proportion of the white sturgeon population was comprised of fish with total lengths less than 92 cm (Coon et al. 1977; Lukens 1985). In 1972-75, 86 percent and in 1982-84, 80 percent of the population was comprised of white sturgeon less than 92 cm. In addition, the proportion of white sturgeon between 92 and 183 cm, which were heavily harvested until 1970, comprised 4 and 18 percent of the populations sampled in the 1970's and 1980's, respectively. In contrast, of the white sturgeon collected during 1997-2000, only 55 percent were less than 92 cm, while 34 percent ranged between 92 and 183 cm. Before these findings can be attributed to changes in the population, or the recovery of a size class that was over harvested, further population abundance sampling is needed.

The mean total length of the fish collected in Lower Granite Reservoir was larger than fish collected in the free-flowing Snake River. The length frequency distributions indicate that the white sturgeon population in Lower Granite Reservoir is dominated by white sturgeon measuring between 92 and 183 cm, with few large white sturgeon (>183 cm). In contrast, white sturgeon in the small (< 92 cm) size class dominated the population in the free-flowing Snake River. Coon et al. (1977) observed differences in the percent of the population between 92 and 183 cm long between these two segments. According to Coon et al. (1977), 29 percent of the white sturgeon collected between the Lower Granite Dam site and 20 km upstream was between 92 and 183 cm, but only 3 percent of the population in the upper river was comprised of fish in this length class. This study was conducted from 1972-75, which was just after the closure of the recreational white sturgeon harvest, but prior to the closure of Lower Granite Dam. Considering each river segment separately, we observe a shift in the length frequency distribution of white sturgeon since the 1970's. The proportion of white sturgeon in the middle size class sampled from Lower Granite Reservoir and the free-flowing Snake River has increased 27 percent and 22 percent, respectively.

The majority of the sampling in 1997 (Hoefs 1998) and 1998 (Tuell and Everett 2000) was done with setlines rigged with 12/0, 14/0 and 16/0 hooks. In earlier studies, smaller hooks were used and white sturgeon appeared to be recruited to the gear at smaller sizes (Coon et al. 1977, Lukens 1985, Lepla 1994). In 1999 and 2000 the addition of a smaller hook size did not significantly change the length frequency distribution of white sturgeon captured throughout the study area. Our results suggest that white sturgeon are fully recruited to our setline methods at size 60 cm. The smaller hooks (size 8/0 and 10/0) will continue to be used for setlines.

In 2000, an additional 317 white sturgeon were sampled in the study area bringing the total number of marked fish to 1,085. Since 1997, 32.8 percent of the tagged fish have been recaptured. North et al. (1993) reported a tag recovery rate of 7.3 percent (79 of 1,081) of PIT tagged white sturgeon in 1994 in two Lower Columbia River reservoirs using both setlines and gillnets. Recapture data from these marked fish in 2001 and beyond will allow us to estimate the current population and more accurately assess the movement dynamics of white sturgeon in the study area.

Comparing the historic estimates of Snake River white sturgeon abundance indicates a changing population (Table 5). Differences in methodology may account for some of the differences observed. Historically, the Schnabel estimate has been used to report white sturgeon abundance in the middle Snake River. However, the model assumes a closed population. We have observed movement from the free-flowing segment to reservoir and visa versa. In addition, the Washington Department of Fish and Wildlife has recovered 18 PIT tagged white sturgeon that originated in Lower Granite Reservoir (John Devore, Washington Department of Fish and Wildlife, pers. comm.). These fish were tagged by the University of Idaho and recaptured in Little Goose or Lower Monumental reservoirs. Therefore, the assumptions for the Jolly-Seber model are more practical for this population's data. This model assumes an open but geographically closed population. Further difficulties are encountered with comparing historical data due to the specific area where surveys were conducted. Several previous surveys started and ended at varying locations.

In 1975, the population from Rkm 174 (lower Granite Dam site) to Rkm 398 (Hells Canyon Dam) was estimated at between 8,000 and 12,000 fish (Coon et al. 1975). Combining the 2000 abundance estimates for white sturgeon between Lower Granite Dam to the mouth of the Salmon River with the estimated abundance above the Salmon River to Hells Canyon Dam (Lepla et al. 2001) result in a total population of 4,066 (Schnabel) or 4,325 (Jolly-Seber). The Multi-year Study Plan (Hoefs 1997) calls for five years of data collection in order to adequately develop an estimate of the population of white sturgeon in the Snake River between Lower Granite Dam and the mouth of the Salmon River. The findings reported here constitute the results of the fourth year of data collection. Although we did not find any white sturgeon in the Clearwater River from 1997 to 2000 this does not mean that white sturgeon do not utilize the Clearwater River. Use may be seasonal or numbers may be low enough that they were undetected.

Based on the plotted length-weight relationships from historical data for the Hells Canyon population, the condition factor appears to have fluctuated since the 1970's (Figure 20). For 1997-2000, the condition of white sturgeon captured in the free-flowing Snake River segment is similar to the condition observed for white sturgeon in 1973-75 (Coon et al. 1977) and lower than in 1982-84 (Lukens 1985). For the reservoir fish, the condition factor appears similar to that observed in 1990-91 (Lepla 1994; Figure 21). Lepla (1994) showed that the relative weight of white sturgeon collected after impoundment was higher than white sturgeon sampled prior to impoundment. For 1997-2000, the mean W_r was significantly higher for fish from Lower Granite Reservoir than for fish from the free-flowing Snake River. However, comparing the plotted length-weight relationship between white sturgeon in Lower Granite Reservoir and the free-flowing Snake River shows little difference for fish less than 250 cm total length (Figure 22). Comparing the parameters of the length-weight equations fitted for several Columbia River Basin white sturgeon populations shows an intermediate condition factor for the Hells Canyon population (Figure 23, Table 6).

Table 5. Population abundance estimates reported for white sturgeon between Lower Granite Dam (Rkm 108) and Hells Canyon Dam (Rkm 398).

Location	Abundance (estimator)	Sample Year(s)	Report
Lower Granite Dam site to Hells Canyon Dam (Rkm 174-398)	8,000-12,000 (Schnabel)	1972-75	Coon et al. 1977
Clearwater River to Hells Canyon Dam (Rkm 224-398)	3,955 (Schnabel)	1982-84	Lukens 1985
Lower Granite Reservoir (Rkm 174-240)	1,524 (Schnabel) 1,372 (Jolly-Seber)	1990-91	Lepla 1994
Lower Granite Reservoir (Rkm 174-240)	1,804 (Schnabel)	1992	Bennett el al. 1993
Salmon River to below Hells Canyon Dam (Rkm 303-383)	1,312 (Schnabel) 1,600 (Jolly-Seber)	1997-2000	Lepla et al. 2001
Lower Granite Dam to Salmon River (Rkm 174-303)	2,754 (Schnabel) 2,725 (Jolly-Seber)	1997-2000	this report

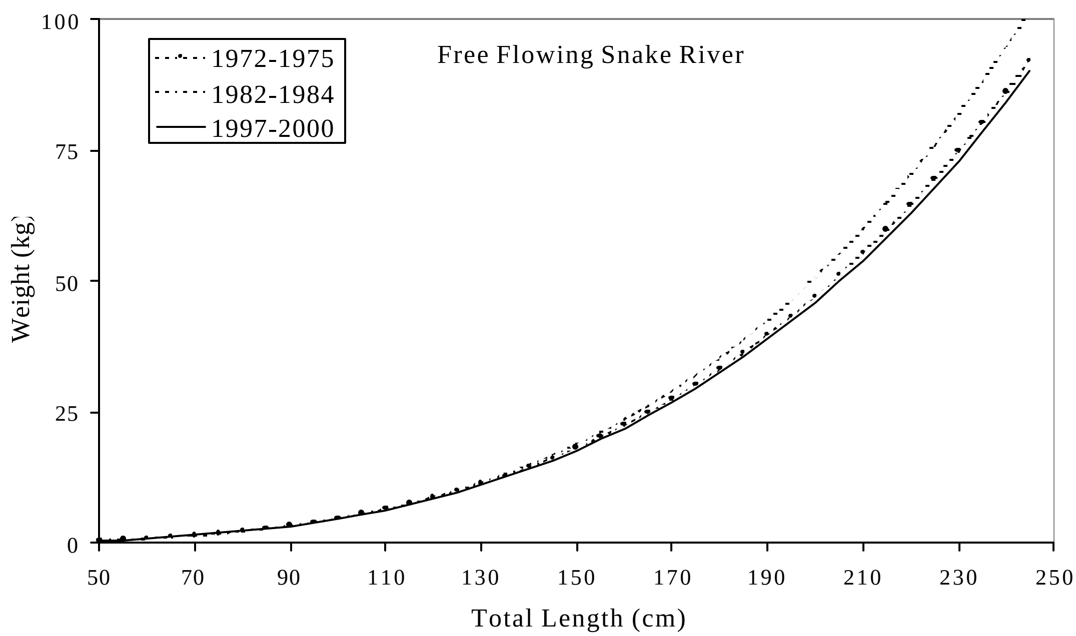

Figure 20. Comparison of the length-weight relationship for white sturgeon sampled from the free-flowing segment of the Snake River during 1997-2000, 1982-84 (Lukens 1985), and 1972-75 (Coon et al. 1977).

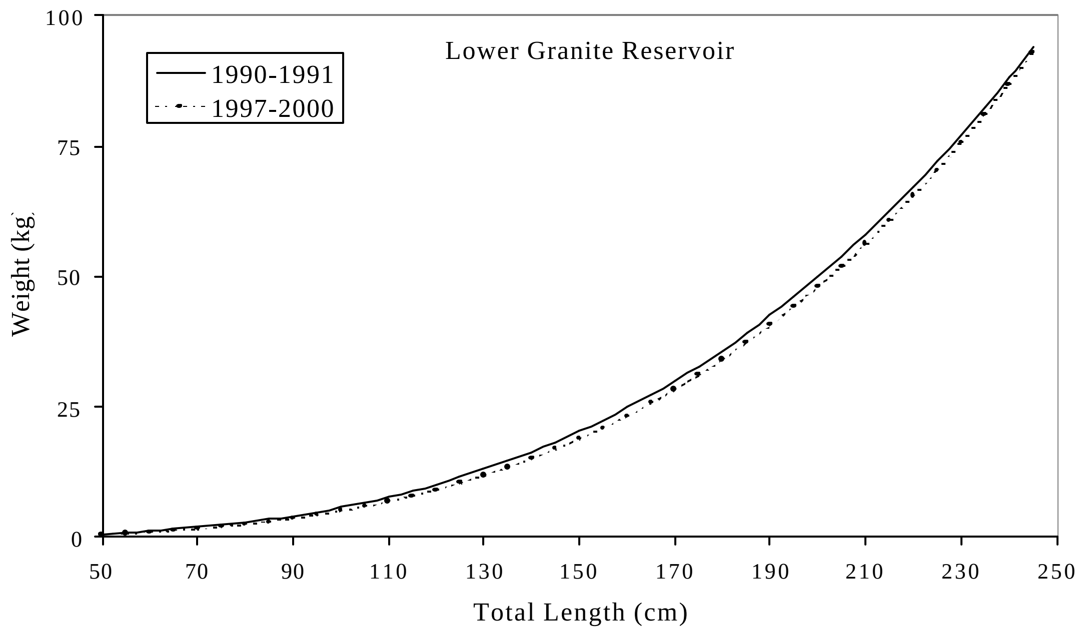

Figure 21. Comparison of the length-weight relationship for white sturgeon sampled from Lower Granite Reservoir during 1997-2000, and 1990-91 (Lepla 1994).

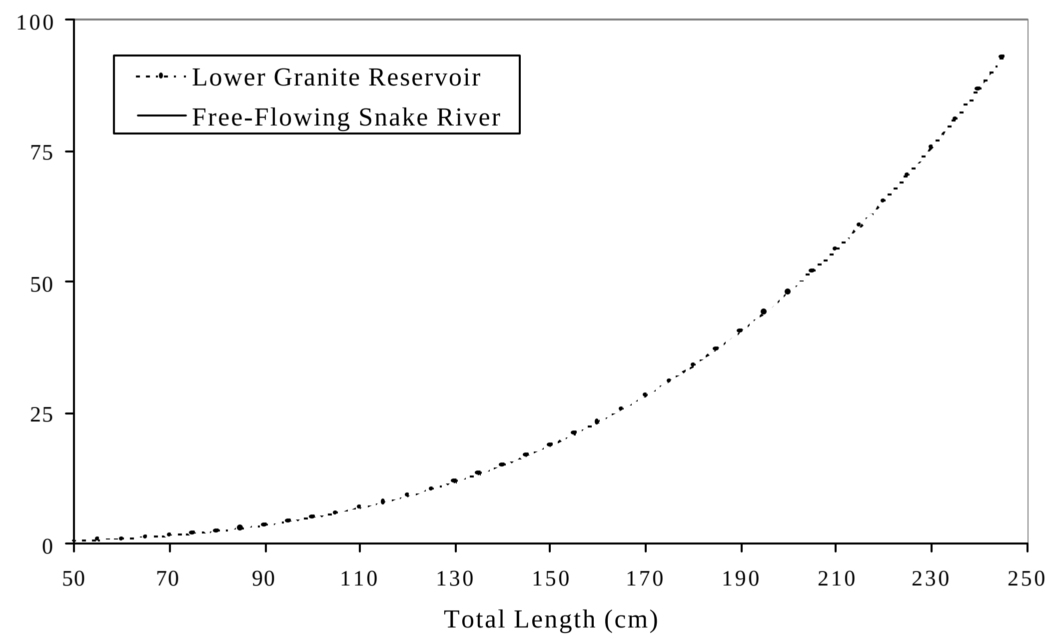

Figure 22. Comparison of the length-weight relationship for white sturgeon sampled from Lower Granite Reservoir and the free-flowing segment of the Snake River during 1997-2000.

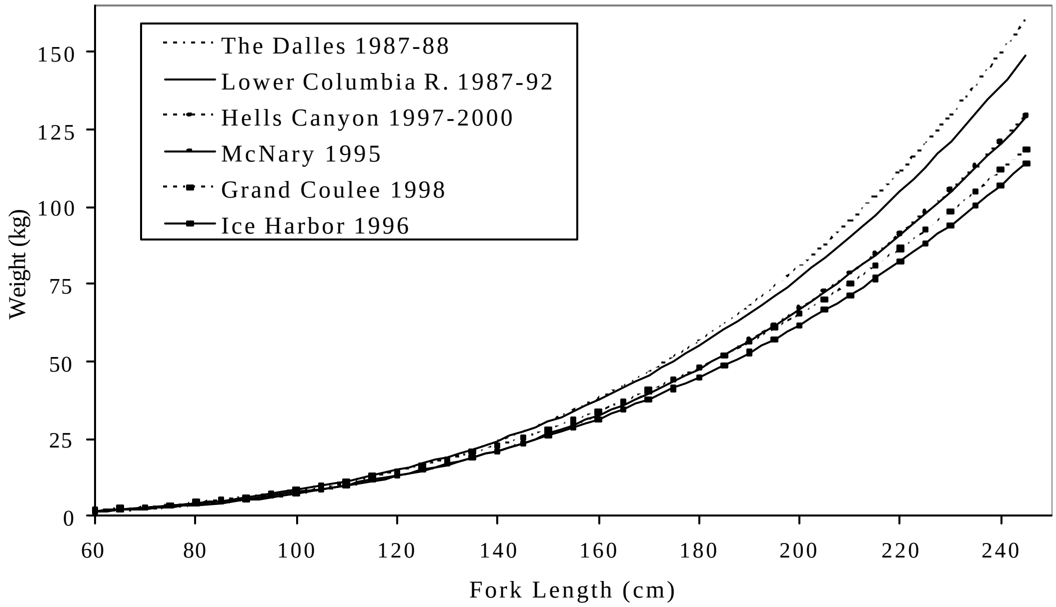

Figure 23. Comparison of the length-weight relationship for white sturgeon sampled from several Columbia River Basin populations. The Hells Canyon curve includes combined data for the Snake River from Lower Granite Dam to Hells Canyon Dam (Lepla et al. 2001).

Table 6. Parameters for the fork length (cm) and weight (kg) equation* and relative weights (W_r) for 12 Columbia River basin white sturgeon populations.

Location	a	b	W_r	Reference
Lower Columbia River 1987-92	2.85E-06	3.23	112	Devore et al. 1995
Bonneville Reservoir 1989	3.11E-06	3.19	97	Beamesderfer et al. 1995
The Dalles Reservoir 1987-88	1.35E-06	3.38	97	Beamesderfer et al. 1995
John Day Reservoir 1990	2.40E-06	3.26	100	Beamesderfer et al. 1995
McNary Reservoir 1993 & 1995	2.47E-06	3.23	97	Rien and Beiningen 1997
Grand Coulee Reservoir 1998	1.11E-05	2.94	91	Ward 2000
Ice Harbor Reservoir 1996	6.85E-06	3.02	92	Ward 1998
Lower Monumental Reservoir 1997	7.61E-06	3.01	99	Ward 1999
Little Goose Reservoir 1997	1.31E-05	2.91	97	Ward 1999
Lower Granite Reservoir 1990-91	4.00E-06	3.14	103	Lepla 1994
Lower Granite Dam to Salmon River 1997-2000	1.16E-06	3.31	85	this report
Salmon River to Hells Canyon Dam 1997-2000	2.89E-06	3.19	88	Lepla et al. 2001

$^*W = aL^b$

White sturgeon captured in 2000 from Hells Canyon appear to be growing faster based on age and growth comparisons with historical data (Figure 24). Based on the von Bertalanffy growth equations, white sturgeon age 1 to 20 that were captured from 1972-75 and 1982-84 grew approximately 6.3 cm/year and 5.8 cm/year, respectively. In contrast, white sturgeon captured from 1999-2000 exhibited a growth rate of 9.3 cm/year. The von Bertalanffy growth equations also suggest that the Hells Canyon white sturgeon population grows faster than several other Columbia River Basin populations (Figure 25). Table 7 compares the parameters of the von Bertalanffy growth equation for several Columbia River Basin white sturgeon populations. The growth rate reported for the 1999-2000 white sturgeon population is based on a sample size of 138 pectoral fin clips; whereas, other studies analyzed several hundred fin rays (e.g. n=605, Coon et al. 1977; n=409, Lukens 1985).

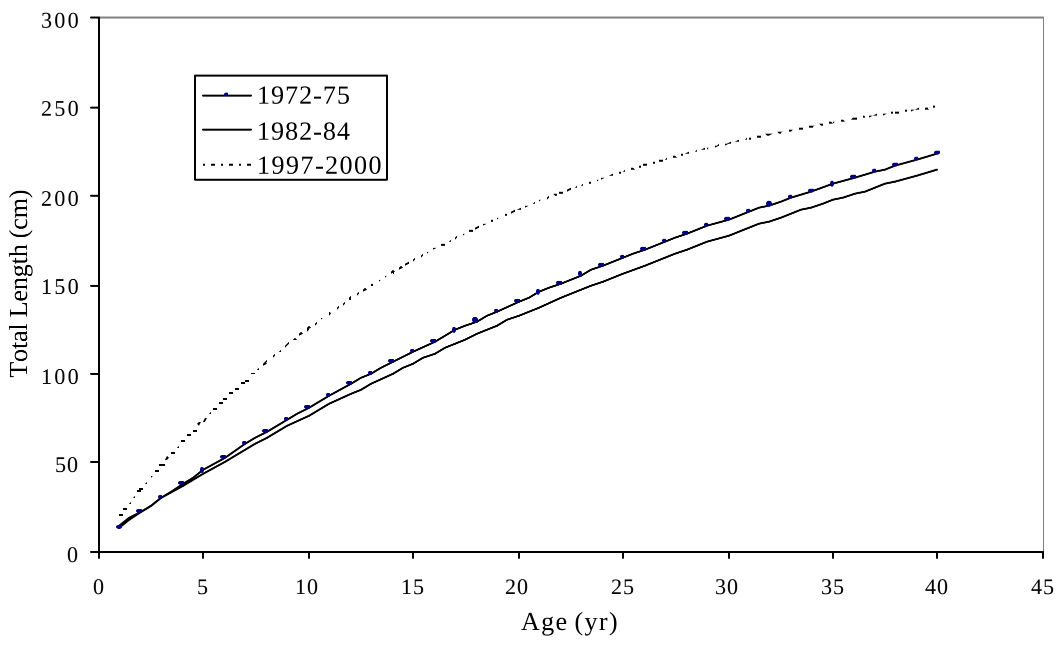

Figure 24. Comparison of the von Bertalanffy growth curves for white sturgeon sampled from the free-flowing segment of the Snake River during 1997-2000, 1982-84 (Lukens 1985), and 1972-75 (Coon et al. 1977).

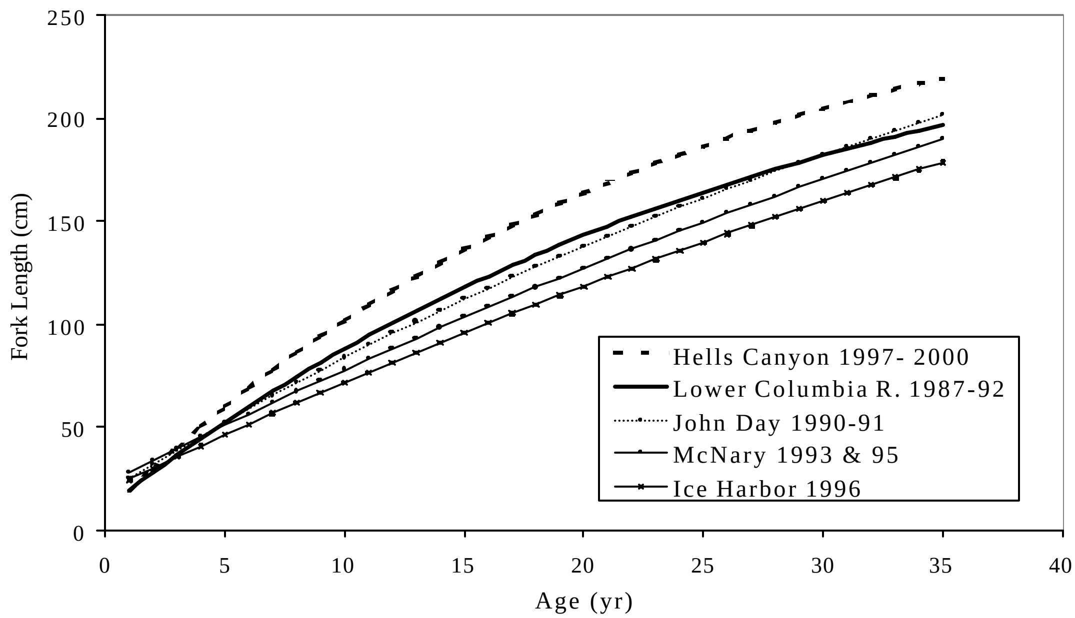

Figure 25. Comparison of the von Bertalanffy growth curves for white sturgeon sampled from several Columbia River Basin populations. The Hells Canyon curve includes combined data for the Snake River from Lower Granite Dam to Hells Canyon Dam (Lepla et al. 2001).

Table 7. Parameters for the von Bertalanffy growth equation* for 12 Columbia River Basin white sturgeon populations.

Location	**L4**	**K**	**t_0**	**Reference**
Lower Columbia River 1987-92	276	0.035	-1.13	Devore et al. 1995
Bonneville Reservoir 1989	311	0.022	-2.40	Beamesderfer et al. 1995
The Dalles Reservoir 1987-88	340	0.023	-2.40	Beamesderfer et al. 1995
John Day Reservoir 1990	382	0.020	-2.40	Beamesderfer et al. 1995
McNary Reservoir 1993 & 1995	496	0.013	-3.69	Rien et al. 1997
Grand Coulee Reservoir 1998	255	0.035	-3.45	Devore et al. 2000
Ice Harbor Reservoir 1996	478	0.012	-3.37	Devore et al. 1998
Lower Monumental Reservoir 1997	596	0.010	-5.69	Devore et al. 1999
Little Goose Reservoir 1997	278	0.034	-1.16	Devore et al. 1999
Lower Granite Reservoir 1990-91	225	0.049	-2.31	calculated from Lepla 1994
Lower Granite Dam to Salmon River 1997-2000	265	0.050	-0.32	this report
Salmon River to Hells Canyon Dam 1997-2000	331	0.305	-1.54	Lepla et al. 2001

*$L(t)=L_{\equiv}\{1-e^{-K(t-t_0)}\}$

Based on the presence of eggs, white sturgeon appear to have spawned in 2000. The temperatures, depths and near substrate velocities where white sturgeon eggs were recovered in the Snake River are within the range reported for other Columbia River Basin white sturgeon populations (Parsley et al. 1993; McCabe and Tracy 1994; Parsley and Kappenman 2000). In contrast, the primary substrate type where eggs were found differed between the Snake River and Columbia River. The actual spawning location could not be identified due to the nature of the dispersal eggs; thus, the actual habitat characteristics at the spawning locations could not be measured. Paragamian et al. (1999) reported tracking the spawning migrations of 14 white sturgeon in the Kootenai River of Idaho to locations where eggs were eventually recovered. Therefore, the continued radio tracking of mature fish may allow for greater precision in identifying actual spawning locations and habitat preference for white sturgeon in the Hells Canyon reach of the Snake River.

Movement data from recaptured PIT/Floy tagged fish from 1997-2000 indicate white sturgeon make migrations between Lower Granite Reservoir and the free-flowing Snake River. A total of 3.9 percent (8 of 205) of the recaptured white sturgeon moved between the two segments. North et al. (1993) reported 4 percent (27 of 636) of the recaptured white sturgeon from three reservoirs in the Columbia River moved between reservoirs or out of the study area.

The movement of white sturgeon in Lower Granite Reservoir was more pronounced than those tagged in the free-flowing segment. Data from both radio-tagged and recaptured PIT/Floy tagged fish suggest a tendency for white sturgeon in Lower Granite Reservoir to move more than fish in the free-flowing segment. However, in 2000 a majority of our recaptured PIT/Floy tagged fish (154 of 223) spent over 90 days at-large (between captures). This 90 days would encompass any potential spawning migrations made by white sturgeon, thus the degree of movement may be larger. Other authors have reported seasonal and directional movement patterns with a distinct sedentary period during winter (Devore and Grimes 1994, Haynes et al. 1978). However, because of the large time intervals between recaptures, seasonal and directional movement patterns were difficult to assess. Further sampling is needed in order to accurately quantify the degree of seasonal migrations.

No discernable movement pattern was detected for white sturgeon of varying length. In contrast, Coon et al. (1977) observed a downstream movement trend in smaller white sturgeon.

Coon et al. (1977) found that white sturgeon less than 92 cm in length generally tended to move downstream, while larger white sturgeon, although movements were localized, moved both upstream and downstream. However, both Lepla (1994) and North et al. (1993) found no relationship between white sturgeon length and direction or distance traveled. Continued tracking of the movement of white sturgeon of different sizes throughout the Snake and Salmon rivers using radio-telemetry will help to clarify habitat use throughout the system, as well as reduce the time marked white sturgeon are at-large.

PLANS FOR 2001

Specific sampling plans and objectives for 2001 are outlined in the Multi-year Study Plan (Hoefs 1997). In 2001, we will continue to capture white sturgeon using a randomized sampling design between Lower Granite Dam and the mouth of the Salmon River. Recapture data and new capture data will be used to estimate population size and collect additional population data as outlined by Task 1 (Table 2). To complete Task 1 we intend to expand our sampling to include the Salmon River and begin measuring environmental conditions at locations where white sturgeon are sampled. Furthermore, we plan to increase our effort at collecting and analyzing white sturgeon age and growth data (Task 1.2).

We intend to continue our assessment of habitat used by white sturgeon for spawning and rearing (Task 2). This will be accomplished by increasing the number of radio tagged white sturgeon and investigating habitat use and movement of juvenile, adult and spawning white sturgeon using radio tracking techniques developed and used in the Columbia River Basin by other white sturgeon researchers (see Hoefs 1997). In addition, during the spring, substrate mats will be deployed throughout the study area to collect white sturgeon eggs in order to verify spawning locations and timing. Furthermore, we intend to initiate young-of-the-year (YOY) sampling (Task 2.2). During late fall and early winter YOY white sturgeon will be collected to identify movement and rearing habitat.

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APPENDIX A

2000 White Sturgeon Research Coordination Conference

May 9, 2000

Brian Allee
Columbia Basin Fish and Wildlife Authority
2501 SW First Avenue, Suite 200
Portland, OR

Dr. Allee,

Historically, the white sturgeon research and management agencies have meet on an annual or bi-annual basis to coordinate research efforts. On February 28 and 29, 2000 the white sturgeon research coordination conference was held in Clarkston, Washington. This conference was a continuation of this coordination process. The goals of this conference were to: 1) continue update and inform area white sturgeon researchers on current projects and 2) document coordination efforts among area researchers. In addition, this conference specifically addresses the concerns of the Northwest Power Planning Council's Independent Science Review Panel on regional white sturgeon research coordination efforts. This letter serves to summarize the results of the conference as well as document the high-level of coordination among white sturgeon researchers.

The conference was two days. The first day consisted of presentations by the attending agencies to provide a review and update to their projects (Attachment A). The second day consisted of seven work sessions designed to focus attention on specific issues to allow for productive dialogue (Attachment B). The participants of each work session first developed a topic goal. This was followed by a round table discussion of issues specific to their topic. The seven work sessions were: Snake River stock assessment and management, Mid-Columbia River stock assessment and management, Upper-Columbia River/Lake Roosevelt investigations, consumptive fisheries, supplementation and hatchery practices, genetics, and YOY/juvenile collection techniques.

Micheal A. Tuell
White Sturgeon Research Project Leader
Nez Perce Tribe

cc: John Skidmore, BPA
Charlie Craig, BPA
Bob Lohn, NPPC
Brian Marotz, Chairman Resident Fish Caucus
Conference Attendants- Project Leaders

Attachment A

CONFERENCE PRESENTATIONS

Title	Speaker/Agency
An overview of mitochondrial DNA diversity of white sturgeon from the Columbia River Basin.	Paul Anders Univ of Idaho
Oxbow/Hells Canyon consumptive sturgeon fishery.	Rick Orme Nez Perce Tribe
Survey update of white sturgeon associated with the Hells Canyon Complex.	Ken Lepla Idaho Power Co.
Stock assessment update of white sturgeon in the Snake and Salmon rivers.	Scott Everett Nez Perce Tribe
White Sturgeon Ecology and Biology U.S. Geological Survey Activities.	Mike Parsley USGS
Sturgeon stock assessment in the upper Columbia River.	John Devore WDFW
Status of white sturgeon research and population stabilization efforts in the lower Columbia River in British Columbia.	Larry Hildebrand RL&L Environmental Service Ltd.
Kootenai River white sturgeon research update.	Vaughn Paragamian IDFG
Restoring productivity of reproductively-challenged reservoir populations of white sturgeon using supportive breeding techniques.	Blaine Parker CRITFC
Development of a blood test for determining sex and maturity of white sturgeon.	Marty Fitzpatrick Oregon State Univ

CONFERENCE PARTICIPANTS/OBSERVERS

John Skidmore	Bonneville Power Administration
Neil Ward	Columbia Basin Fish and Wildlife Authority
Blaine Parker	Columbia River Inter-Tribal Fish Commission
Larry Barrett	Idaho Department of Fish and Game
Vaughn Paragamian	Idaho Department of Fish and Game
Phil Bates	Idaho Power Company
Ken Lepla	Idaho Power Company
Sue Ireland	Kootenai Tribe of Idaho
Jack Siple	Kootenai Tribe of Idaho
Carl East	Nez Perce Tribe
Scott Everett	Nez Perce Tribe
Jay Hesse	Nez Perce Tribe
Rick Orme	Nez Perce Tribe
Dave Statler	Nez Perce Tribe
Mike Tuell	Nez Perce Tribe
Silas Whitman	Nez Perce Tribe
Tom Rien	Oregon Department of Fish and Wildlife
Dave Ward	Oregon Department of Fish and Wildlife
Molly Webb	Oregon State University
Grant Feist	Oregon State University
Larry Hildebrand	Rivers, Lakes & Lands Environmental Service Limited
Paul Anders	University of Idaho
Jon Firehammer	University of Idaho
Joe Kozfkay	University of Idaho
Peter McHugh	University of Idaho
Dennis Scarnecchia	University of Idaho
Will Young	University of Idaho
John Holmes	U.S. Fish and Wildlife Service
Dena Gadomski	U.S. Geological Survey
Darren Gallion	U.S. Geological Survey
Kevin Kappenman	U.S. Geological Survey
Mike Parsley	U.S. Geological Survey
John Devore	Washington Department of Fish and Wildlife

Attachment B

WORK SESSIONS

Snake River stock assessment and management

Discussion points

- Review stock assessment activities in the Hell's Canyon Reach
  Goals of each agency's research.
- Sampling strategies.
- The necessity to prioritize research needs. Examples include: identifying carrying capacity and potential food limitations, identifying spawning areas, reviewing Biological Risk Assessment Team (BRAT) process.
- Goals for radio telemetry, eggmats and YOY collections.
- Impacts of catch and release regulations.

Work Session Participants

Larry Barrett	Idaho Department of Fish and Game
Ken Lepla	Idaho Power Company
Scott Everett*	Nez Perce Tribe
Mike Tuell	Nez Perce Tribe
Tom Rien	Oregon Department of Fish and Wildlife
Dena Gadomski	U.S. Geological Survey
Darren Gallion	U.S. Geological Survey
Mike Parsley	U.S. Geological Survey

Mid-Columbia River stock assessment and management

Discussion points

- Coordinate further data gathering.
- Importance of documenting coordination of white sturgeon research projects to maximize information flow and collaboration on long term management goals.
- Concerns over lack of recruitment and lack of protected spawning habitat.
- Strategy for scheduled stock releases.
- Need to gather information on white sturgeon early life history.
- Potential effects of contaminants on sturgeon eggs.

Work Session Participants

Blaine Parker	Columbia River Inter-Tribal Fish Commission
Vaughn Paragamian	Idaho Department of Fish and Game
Tom Rien*	Oregon Department of Fish and Wildlife
Grant Feist	Oregon State University
Molly Webb	Oregon State University
Larry Hildebrand	Rivers, Lakes & Land Environmental Service Limited
John Holmes	U.S. Fish and Wildlife Service
Dena Gadomski	U.S. Geological Survey
John Devore	Washington Department of Fish and Wildlife

Upper-Columbia River/Lake Roosevelt investigations

Discussion points

- Recovery plan: broodstock source, flow/ecosystem changes.
- Supplemention: genetics and aquaculture basis, strategy and goals.
- Identified some problems: egg predation, egg location, spawn timing, discharge.
- Habitat: limited productivity, improvement potential, similarity with kokanee issues.
- Spawning challenges in hatchery situation.
- Ongoing tasks: spawning surveys, YOY indexing.
- Entrainment issues.

Work Session Participants

Vaughn Paragamian	Idaho Department of Fish and Game
Mike Tuell	Nez Perce Tribe
Darren Gallion	U.S. Geological Survey
Kevin Kappenman	U.S. Geological Survey
John Devore*	Washington Department of Fish and Wildlife

Consumptive fisheries

Discussion points

- Perceived need for consumptive fisheries.
- Appropriate stock sources for consumptive fisheries.
- Disease risk/potential of stocking.
- Logistic and economical feasibility of consumptive fisheries.
- Potential Benefits of a consumptive fishery.
- NPT proposed consumptive fishery in Oxbow/Hells Canyon Reservoirs.

Work Session Participants

Larry Barrett	Idaho Department of Fish and Game
Ken Lepla	Idaho Power Company
Jack Siple	Kootenai Tribe of Idaho
Sue Ireland	Kootenai Tribe of Idaho
Carl East	Nez Perce Tribe
Scott Everett	Nez Perce Tribe
Rick Orme*	Nez Perce Tribe
Mike Tuell	Nez Perce Tribe
Dave Ward	Oregon Department of Fish and Wildlife
Paul Anders	University of Idaho
Darren Gallion	U.S. Geological Survey
Kevin Kappenman	U.S. Geological Survey
Mike Parsley	U.S. Geological Survey

Supplementation and hatchery practices

Discussion points

- Overview of CRITFC's supplementation objectives and current efforts.
- CRITFC's spawning strategies.
- CRITFC's release locations and monitoring activities.
- KTOI white sturgeon hatchery update.
- KTOI specific spawning and incubation techniques.

Work Session Participants

Blaine Parker*	Columbia River Inter-Tribal Fish Commission
Larry Barrett	Idaho Department of Fish and Game
Ken Lepla	Idaho Power Company
Sue Ireland*	Kootenai Tribe of Idaho
Jack Siple	Kootenai Tribe of Idaho
Carl East	Nez Perce Tribe
Scott Everett	Nez Perce Tribe
Tom Rien	Oregon Department of Fish and Wildlife
Dave Ward	Oregon Department of Fish and Wildlife
John Holmes	U.S. Fish and Wildlife Service
Dena Gadomski	U.S. Geological Survey

Genetics

Discussion points

- Life history and genetic characteristics of white sturgeon.
- Reviewed ongoing genetic analyses (UI) and their implications for basin-wide research and management.
- Discussion of specific ongoing white sturgeon research and management programs as they relate to genetics.
- Discussion of aspects of genetic sample collection protocol, DNA isolation, PCR techniques and DNA amplification, DNA digestion (RFLP's, AFLP's), allozyme, nuclear and mtDNA analyses, electrophoretic techniques, microsatellite markers.
- Inference and recommendations from DNA data and analyses.
- Uniqueness of sturgeon: polyploidy in sturgeon and resulting complications for nuclear genetic analysis, genetic diversity, variation and population structure of white, pallid, shovelnose and Alabama sturgeon, genetic distance, speciation and taxonomy in sturgeon.
- Direct sequencing and genotyping, isolation by distance model for Columbia Basin white sturgeon.

Work Session Participants

Blaine Parker	Columbia River Inter-Tribal Fish Commission
Vaughn Paragamian	Idaho Department of Fish and Game
Sue Ireland	Kootenai Tribe of Idaho
Jack Siple	Kootenai Tribe of Idaho
Carl East	Nez Perce Tribe

Rick Orme	Nez Perce Tribe
Dave Ward	Oregon Department of Fish and Wildlife
Larry Hildebrand	Rivers, Lakes & Land Environmental Service Limited
Paul Anders*	University of Idaho
John Holmes	U.S. Fish and Wildlife Service
Kevin Kappenman	U.S. Geological Survey

YOY/juvenile collection techniques

Discussion points

- Importance of identifying goal of sampling. Examples include: documenting the presence of a particular life stage, evaluating habitat use, indexing recruitment, investigating cause-and-effect relations.
- Efficiency and selectivity of gear. Overview of gears used to sample different life stages.
- Spatial and temporal distribution of sampling effort.
- Statistical considerations and sampling strategies in view of ultimate sampling goal.

Work Session Participants

Larry Barrett	Idaho Department of Fish and Game
Ken Lepla	Idaho Power Company
Vaughn Paragamian	Idaho Department of Fish and Game
Sue Ireland	Kootenai Tribe of Idaho
Jack Siple	Kootenai Tribe of Idaho
Scott Everett	Nez Perce Tribe
Mike Tuell	Nez Perce Tribe
Tom Rien	Oregon Department of Fish and Wildlife
Dave Ward	Oregon Department of Fish and Wildlife
John Holmes	U.S. Fish and Wildlife Service
Dena Gadomski	U.S. Geological Survey
Darren Gallion	U.S. Geological Survey
Kevin Kappenman	U.S. Geological Survey
Mike Parsley*	U.S. Geological Survey

*indicates work session moderator

APPENDIX B

2000 White Sturgeon Capture and Marking Data

Table B. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
26-Jan-00	1510102806		177.8	171	198	79	43.9
27-Jan-00	1510102466		179.4	174	205	82	44.9
1-Feb-00	1510082E34		264.7	78	92	31	3.3
1-Feb-00	1510083611		264.7	96.5	110.5	40	6.8
1-Feb-00	151010026D		264.7	85	98	29	3.2
1-Feb-00	151010092C		264.7	73	86	25	2.4
1-Feb-00	151010C0C		264.7	81	94	31	3.4
2-Feb-00	1510101108		264.7	77.5	87.5	28.5	2.9
9-Feb-00	1510106178		272.7	93	105	39	6.8
9-Feb-00	1510080A0A		285.6	69	83	29	3.0
9-Feb-00	1510083276		285.6	57.5	64.5	19	1.0
9-Feb-00	151010616E		285.6	73.5	84	26.5	2.5
9-Feb-00	151010793A		285.6	70	81	25.5	2.6
9-Feb-00	1510107A14		285.6	96.5	108	38.5	6.9
9-Feb-00	1510102270		288.0	238	271	97.5	99.1
9-Feb-00	1510103071		288.0	77.5	84	23.5	2.2
9-Feb-00	151010183A		299.3	217	246	85.5	67.9
9-Feb-00	1510104921		299.3	86	100.5	29.5	3.5
10-Feb-00	151010286E		272.7	121	137	49	13.6
10-Feb-00	1510100472		273.5	101	113	39	6.8
10-Feb-00	1510102861		285.6	75	91	26	3.2
10-Feb-00	1510082E74		288.0	119	130	52	13.6
10-Feb-00	1510083201		288.0	118	128	41	9.5
10-Feb-00	1510081238		298.5	84	98	31	5.0
11-Feb-00	151008341E		272.7	152	163	64	24.9
11-Feb-00	1510082004		288.0	174	187	72	44.5
16-Feb-00	7F7D042B28		74.0	150	167	54	30.2
29-Feb-00	1510083A11		29.8	110.5	121.5	43	9.5
29-Feb-00			34.6	174.5	195.5	74.5	42.9
29-Feb-00	1510081249		37.0	157.5	178	61	30.4
7-Mar-00	1510107A54		16.1	203	227	32	71.7
7-Mar-00	1510103659		32.2	129	149	51	15.9
8-Mar-00	1510100451		22.5	173	195	66	34.5
8-Mar-00	1510084A62		27.4	172	197	82	51.8
9-Mar-00	1510103C6E		30.6	137	149	56	19.1
14-Mar-00	1510101A26		273.5	78	89	30	2.7
14-Mar-00	1510100929		280.8	68	73	26	0.9

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
14-Mar-00	1510101C7A		280.8	75	87	30	2.7
14-Mar-00	1510081E04		290.4	150	171	63.5	26.0
14-Mar-00	1510103239		290.4	64.5	75	25.5	2.0
14-Mar-00	1510101259		292.8	78.5	89.5	35	3.9
14-Mar-00	1510103E09		293.6	68	78.5	22	1.9
15-Mar-00	1510103006		289.6	82	94.5	29.5	3.6
15-Mar-00	1510103174		289.6	59	69	21.5	1.1
15-Mar-00	151010224C		290.4	53.5	73.5	22	1.4
16-Mar-00	1510101A62		273.5	85	93	33	3.6
16-Mar-00	1510083458		285.6	75	87	27.5	2.7
16-Mar-00	151010383E		291.2	67	76	24	1.6
17-Mar-00	151010294C		278.4	55	72	22	0.9
17-Mar-00	1510102034		281.6	75	84	25	1.6
17-Mar-00	1510105844		281.6	149	165	60	21.3
17-Mar-00	1510104C69		291.2	59	69	23	0.9
27-Mar-00	151008291E		261.5	62	70	23	1.8
28-Mar-00	1510085C26		262.3	78.5	91.5	26	2.3
29-Mar-00	1510107036		254.2	70.5	81	26	2.3
29-Mar-00	151008313C		260.7	105.5	120	35.5	6.4
29-Mar-00	1510107A2A	436	260.7	147	189	66.5	25.9
29-Mar-00	001544608		271.1	100	109.5	37.5	6.8
29-Mar-00	1510083622		271.1	92	107	33.5	3.9
29-Mar-00	1510100974		271.1	81.5	92	31.5	3.4
30-Mar-00	1510083936		260.7	98.5	111	38	6.6
30-Mar-00	1510102408		260.7	82	95	32	3.8
31-Mar-00	1510101962		264.7	98	110	41	7.9
31-Mar-00	1510101E49		271.1	85	93	32	3.2
5-Apr-00	1510103634		204.3	146	165.5	59.5	23.6
6-Apr-00	151010543A		206.8	85.5	99	36	4.3
7-Apr-00	151010105E		206.8	138	158.5	61	21.4
8-Apr-00	1510083640	955	261.5	62	70	22	1.6
8-Apr-00	1510103209	956	261.5	61	66	23.5	1.6
8-Apr-00	1510104C2C	957	261.5	73	82.5	26	2.3
10-Apr-00	151010445E	953	258.2	75	83.5	30.5	2.3
13-Apr-00	1510104E6A		230.1	71.5	83	26.5	2.7
14-Apr-00	1510081204	954	230.1	101	115	43	8.2
18-Apr-00	151010286C		273.5	81	91	29	2.9
18-Apr-00	151010405A		284.0	81	91	29	3.4
18-Apr-00	1510105939		284.0	75	87	37.5	3.2
18-Apr-00	1510105006		293.6	60.5	70	22	1.4

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
19-Apr-00	1510082E74		290.4	120	136	50	12.3
19-Apr-00	1510107C39		302.5	54	63.5	19.5	1.0
20-Apr-00	1510104A04		273.5	70	77	26	2.3
20-Apr-00	1510101A4A		280.8	72	78	30	2.5
20-Apr-00	1510083218		282.4	71	79	25	2.0
20-Apr-00	1510104966		282.4	68.5	78	28.5	2.3
20-Apr-00	1510101079		284.0	76.5	84.5	30.5	3.2
20-Apr-00	1510107628	174	284.0	100.5	111	43	6.6
20-Apr-00	1510105A70		302.5	56	64	19	1.6
21-Apr-00	1510107918		282.4	75	84	26.5	2.9
21-Apr-00	7F7D042D54		282.4	75	85.5	26.5	2.7
21-Apr-00	1510081436		284.0	69	78	28	2.0
21-Apr-00	1510085679		284.0	80	89.5	33.5	3.6
21-Apr-00	1510100221		284.0	74	85	27	2.5
21-Apr-00	1510100E46		284.0	62.5	69	22	1.4
21-Apr-00	1510103260		284.0	69.5	78.5	27	2.5
21-Apr-00	1510104021		284.0	80	89	29.5	3.2
21-Apr-00	1F4D071E6F	414	284.0	76.5	86.5	28	2.7
21-Apr-00	1510101640	121	284.8	81.5	92	30	3.4
25-Apr-00	1510081A66		261.9	83	96	35	4.4
25-Apr-00	1510083264		261.9	73	84.5	28	2.5
25-Apr-00	151008340A	473	261.9	95.5	106	37	5.6
25-Apr-00	1510083636		261.9	65.5	75.5	27	2.2
25-Apr-00	1510102E5E		261.9	75	85.5	30.5	2.6
25-Apr-00	1510105A11		261.9	89	103	33.5	4.5
25-Apr-00	1510105C31		261.9	67.5	78.5	21	2.0
25-Apr-00	1510106231		261.9	92.5	105	32	4.7
25-Apr-00	1510106E19		261.9	82	94	30	3.4
26-Apr-00	151008242E		261.9	83	94	31	3.9
26-Apr-00	1510104E40		261.9	111	124.5	44	9.3
26-Apr-00	1510107908	284	284.8	77	85.5	21	2.5
1-May-00	1510081868		261.9	74.5	86	29.5	3.4
1-May-00	151008291E		261.9	61	68	23	1.6
1-May-00	151008340A		261.9	91	105	36.5	5.2
1-May-00	151008484A		261.9	80.5	91	33.5	4.1
1-May-00	1510100A60		261.9	74.5	85	30.5	2.9
1-May-00	1510102E10		261.9	80	91.5	31	3.6
1-May-00	1510104061		261.9	86.5	101	32	4.3
1-May-00	151010583A		261.9	53	59	19	0.9
1-May-00	151010593E		261.9	79	89	31	3.2

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
1-May-00	1510105C31		261.9	61.5	67	21.5	1.6
2-May-00	1510081A66		261.9	82	91	32.5	3.9
2-May-00	1510105C31		261.9	61.5	67	21.5	1.6
2-May-00	1510106231		261.9	93.5	105.5	34.5	5.1
2-May-00	1510082471		284.8	85	99.5	33.5	3.8
2-May-00	1510083A2C		284.8	72.5	85	27	2.4
2-May-00	1510084A68		284.8	83	94.5	30.4	3.7
2-May-00	1510085679		284.8	74.5	87.5	32	3.5
2-May-00	1510103E59		284.8	72	84	28	2.3
2-May-00	1510104451		284.8	65.5	73.5	24	2.0
2-May-00	1510106250		284.8	78.5	90	31	3.7
3-May-00	1510105C6C		292.8	159.5	182	71.3	32.8
4-May-00	1510102664		284.8	149	171	60	23.6
4-May-00	1510107066		284.8	83	92.5	21.5	3.5
8-May-00	1510083A2C		284.8	72	82	27	2.3
8-May-00	1510083E51		284.8	82	94	31	2.9
8-May-00	151010116A		284.8	76	88	27	2.9
9-May-00	151008093C	88	284.8	116	132	48	12.7
9-May-00	1510081916	1047	284.8	137.5	156	59	21.5
9-May-00	1510083912		284.8	71	82.5	27	2.4
9-May-00	151010561A		284.8	72	81.5	25	2.2
15-May-00	1510101606		284.0	78	85	28.5	2.3
16-May-00	1510084158	1046	284.8	71	81	31.5	2.7
16-May-00	1510101902		284.8	72.5	84	25.5	2.1
16-May-00	1510102178		284.8	82	94	28	3.0
23-May-00	1510080154	958	282.1	76	86	28.5	2.9
24-May-00	1F4D122959	959	282.4	72	82	23.5	2.5
31-May-00	1510085679		284.0	82	92.5	30	3.6
31-May-00	1510101C11		284.0	71	79	29	2.7
31-May-00	1510105972		284.0	83.5	92	29.5	3.9
5-Jun-00	1510081868	1039	261.5	72	82.5	28	2.8
5-Jun-00	1510085914	1040	261.5	78	88.5	29.5	3.0
5-Jun-00	1510100E0C	1041	261.5	75.5	86.5	27	2.3
5-Jun-00	7F7D0F373D	1042	261.5	72	82.5	28	2.7
5-Jun-00	1510082019	1044	284.5	80	93.5	26.5	3.0
5-Jun-00	1510082842	1045	284.5	110	123	33.5	6.5
5-Jun-00	1510084A68	963	284.5	83	89	33	3.9
5-Jun-00	1510085679	960	284.5	81	91	32	3.4
5-Jun-00	1510103006	964	284.5	82	92.5	31	3.6
6-Jun-00	1510083911	1034	258.2	92	104	36	4.8

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
6-Jun-00	1510083264	1036	261.5	72	84	28	2.6
6-Jun-00	151008340A	473	261.5	89	102	34	5.4
6-Jun-00	1510100A60	1035	261.5	76	90	31	2.8
6-Jun-00	1510102E10	1038	261.5	80	92	30	3.0
6-Jun-00	1510106231	1037	261.5	91	101.5	33	4.9
6-Jun-00	1510083912	965	284.0	72	81	28.5	2.0
6-Jun-00	1510101640	121	284.0	80	87	30.5	3.4
6-Jun-00	1510106129	966	284.0	185.5	204	75	42.6
7-Jun-00	1510104039	1033	0.0	85.5	96	34	5.4
7-Jun-00	1510104250	159	0.0	80	93	33	3.6
7-Jun-00	1510084E4E	967	284.0	81.5	89	33.5	3.9
7-Jun-00	1510100249	969	284.0	73	83	30	2.7
7-Jun-00	1510100464	973	284.0	72	79	26.5	2.3
7-Jun-00	1510101C11	962	284.0	70.5	82	29.5	2.5
7-Jun-00	151010491E	968	284.0	63	71	23	1.6
7-Jun-00	151010493A	971	284.0	86.5	95	32.5	3.6
7-Jun-00	1510107908	284	284.0	77.5	84	29	2.9
7-Jun-00	1510107C2A	165	284.0	73	83	31.5	2.7
7-Jun-00	7F7D0E2E51	970	284.0	75.5	85.5	28.5	2.9
7-Jun-00	7F7D0E3423	972	284.0	77.5	89.5	30.5	3.4
8-Jun-00	1510082471	1030	284.8	83.5	93	32	4.1
8-Jun-00	1510083A79	970	284.8	77	87.5	27	3.2
8-Jun-00	1510100249	969	284.8	74	84.5	29.5	3.0
8-Jun-00	1510103006	964	284.8	81.5	91	29.5	4.0
8-Jun-00	1510105939	1032	284.8	77	88.5	30.5	3.5
8-Jun-00	151010705E	1031	284.8	71	81	27.5	2.3
8-Jun-00	7F7D0E3423	972	284.8	79	91.5	30.5	3.2
12-Jun-00	1510100464	1028	284.8	71	78	24	2.5
12-Jun-00	151010092A	1029	284.8	76.5	85.5	32	3.5
12-Jun-00	1510106E72	1027	284.8	65	74	25	2.3
14-Jun-00	1510085E6A	1026	284.8	146	163.5	56.5	21.4
20-Jun-00	1510100C2A	978	189.9	151.5	170	70	35.4
20-Jun-00	1510102C12	976	189.9	115.5	131.5	50.5	12.2
20-Jun-00	151010493A	975	189.9	92	109	39.5	6.4
20-Jun-00	1510105E2E	977	189.9	106	116	47.5	9.3
20-Jun-00	1510104E6C	979	191.5	76.5	86	34.5	3.6
20-Jun-00	151008361E	980	202.7	99.5	110	43	7.3
20-Jun-00	1510082822	981	272.7	65.5	76	24	2.0
20-Jun-00	1510083A62	982	272.7	48	55.5	19	0.7
21-Jun-00	151008563E	359	177.0	116.5	133.5	48	12.9

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
21-Jun-00	1510080151	983	178.6	105.5	122	46.5	10.2
21-Jun-00	1510080000	986	189.9	97	109.5	35.5	5.9
21-Jun-00	1510102030	985	189.9	94.5	107.5	40.5	7.0
21-Jun-00	151010367C	984	189.9	94.5	105.5	40.5	7.3
21-Jun-00	151008441A		198.7	80	90	35.5	3.8
22-Jun-00	1510082A76	987	189.9	161	185.5	73	40.4
22-Jun-00	7F7F5A3728	988	189.9	146	164	64.5	28.4
22-Jun-00	7F7F5D3047	990	189.9	157.5	180	71	34.0
22-Jun-00	1510084A34	1074	202.7	101	113	45.5	8.7
22-Jun-00	1510081209	1025	257.4	161.5	178.5	64	29.5
27-Jun-00	1510105454	1073	209.2	154	171	59.5	21.3
27-Jun-00	1510103C20	1071	210.8	83	94	34	4.0
27-Jun-00	151010424E	1072	210.8	67.5	78	26.5	1.9
27-Jun-00	1510107A68	1070	211.6	154.5	174.5	63.5	27.5
27-Jun-00	1510102A6E	1069	218.0	102.5	113.5	38.5	6.6
27-Jun-00	4158650C6F	5	221.2	126.5	142	52	14.7
27-Jun-00	1510085044	399	222.0	143	161	62.5	23.3
27-Jun-00	1510107A4A	1068	222.0	90	103	34	4.5
28-Jun-00	1510103072	1067	212.4	54	62	22	1.2
28-Jun-00	1510105921	992	218.0	100	112	42	7.7
28-Jun-00	1510107C04	991	218.0	129	147	56	17.2
28-Jun-00	151010045C	910	221.2	111.5	124.5	49	9.5
29-Jun-00	1510103934	993	217.2	188.5	206	88.5	56.7
29-Jun-00	1510106E41	995	221.2	134	146	55	19.1
29-Jun-00	1510085222	1066	257.4	66	77	24.5	2.3
4-Jul-00	1510102E5C	371	225.3	143.5	164	58.5	23.1
4-Jul-00	1510081220	996	226.1	110.5	127	45.5	10.4
4-Jul-00	1510082E6E	998	226.9	91.5	105.5	37	5.9
4-Jul-00	151010587C	700	228.5	56.5	65.5	22	0.9
5-Jul-00	151010541E	328	228.5	104	118.5	42	7.9
5-Jul-00	1510104E6A	699	229.3	71	81	25	2.3
9-Jul-00	151008285E	1053	29.8	184	201	78	49.7
11-Jul-00	151010294A	1065	267.1	156	175	81	41.5
12-Jul-00	1510103C28	1064	259.9	182	198	72.6	38.0
12-Jul-00	1510104930	1063	259.9	105	119	40.5	7.9
12-Jul-00	1510101672	1061	265.5	104	117	38	6.9
12-Jul-00	151010524C	1062	265.5	171	193	76.5	43.1
12-Jul-00	1510105436	1060	266.3	84	94.5	31	3.9
18-Jul-00	1510081A79	698	23.3	107.5	117.5	43.5	9.1
18-Jul-00	151010242A	697	24.1	156.5	172	58.5	29.3

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
18-Jul-00	1510100200	695	26.5	162	178	61.5	32.2
18-Jul-00	1510101668	694	26.5	141	155.5	55.5	20.4
18-Jul-00	7F7D053160	696	26.5	124	140.5	45.5	12.9
18-Jul-00	1510100404	1058	29.0	139	154	58	19.3
18-Jul-00	1510101970		29.0	154	168	60	24.7
18-Jul-00	1510106831		29.0	120	136	48.5	12.5
18-Jul-00	1510082454	1057	29.8	95	102.5	38	6.3
18-Jul-00	151008290C	1055	33.0	140.5	157.8	54.5	18.7
18-Jul-00	1510103041	1056	33.0	151	166	60	23.0
19-Jul-00	7F7D053160	696	26.5	124	140.5	45.5	12.9
19-Jul-00	151010520A	1054	28.2	172	193	65	34.5
19-Jul-00	1510083C4E	1052	29.8	170.5	194	74	38.9
20-Jul-00	1510083A11	1051	28.2	107	115	43	9.8
21-Jul-00	1510103022	693	261.5	53	61	20.5	0.7
25-Jul-00	1510101674	1010	174.6	103.5	116	46	8.9
25-Jul-00	1510103221	1001	271.9	90	102	32	4.8
25-Jul-00	1510103C0E	1059	271.9	82	92	27	2.9
25-Jul-00	1510105438	1002	271.9	93.5	94.5	35.5	5.1
25-Jul-00	1510082E70	1004	274.3	38	77	23.5	1.9
25-Jul-00	1510103102	1003	274.3	142.5	160	66	25.3
25-Jul-00	151010347E	1005	274.3	71.5	81.5	25	2.1
25-Jul-00	151010705E	1031	275.1	70	80	23.5	2.1
25-Jul-00	151010296A	1006	288.0	57	65	20	1.2
25-Jul-00	1510082470	1009	290.4	69	79	24.5	2.0
25-Jul-00	1510083616	1011	290.4	163	182	64	34.7
25-Jul-00	1510084210	1008	290.4	49	55	19	3.5
25-Jul-00	1510100656	1007	290.4	68	75.5	22	2.0
25-Jul-00	1510080600	1012	291.2	106	118	47	9.0
25-Jul-00	151008290E	1013	292.0	68.5	77	27	2.1
25-Jul-00	1510080660	1014	296.9	64	72.5	22	1.6
26-Jul-00	1510082848	484	274.3	83	94.5	30.5	4.1
26-Jul-00	1510105178	692	274.3	72.5	84	26.5	2.7
26-Jul-00	1F4D071F6E	691	274.3	135.5	155	60	26.1
26-Jul-00	151008561A	690	288.0	66	75.5	24	2.3
26-Jul-00	151010112E	689	288.0	84.5	95	33	4.3
26-Jul-00	151008220C	686	291.2	69	78	23	2.3
26-Jul-00	1510102211	688	291.2	54	62.5	18	0.9
26-Jul-00	1510102C74	685	291.2	69	79.5	23	2.3
26-Jul-00	1510103820	684	291.2	68.5	79	24.5	2.3
26-Jul-00	1510103A7C	687	291.2	70.5	79.5	22.5	1.8

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
26-Jul-00	1510105A70	1015	294.4	56	64.5	19	1.0
26-Jul-00	1510082A68	1016	296.1	63	64.5	19.5	1.5
27-Jul-00	1510104420	683	274.3	172.5	189.5	76	46.0
27-Jul-00	1510102401	682	275.9	66	75.5	24	1.8
27-Jul-00	1510104016	681	275.9	66.5	74.5	24.5	1.8
27-Jul-00	1510085132	677	281.6	198.5	219.5	86	70.8
27-Jul-00	1510101061	678	281.6	62	72	23	1.1
27-Jul-00	1510105208	680	281.6	64.5	74.5	24.5	1.6
27-Jul-00	1510106131	679	281.6	55	63.5	20.5	0.7
27-Jul-00	1510083201	676	288.0	117.5	133	37.5	8.6
27-Jul-00	1510083A22	675	288.0	162	179	69.5	36.7
27-Jul-00	1510080149	674	291.2	155	179	65	0.0
27-Jul-00	1510103010	673	291.2	90	97	29	3.9
27-Jul-00	1510100A52	1019	296.9	67.5	59	20	1.7
1-Aug-00	1510083152	1078	257.4	55	61	20	1.1
1-Aug-00	1510100240	1076	257.4	72.5	85	27	2.6
1-Aug-00	1510102426	1077	257.4	60	70	23.5	1.4
1-Aug-00	1510104218	453	257.4	77	83	29.5	3.2
1-Aug-00	1510107A2A	436	257.4	146	162.5	64	26.4
1-Aug-00	1510080109	1024	259.9	166	184	73.4	37.0
1-Aug-00	151008217C	1022	261.5	68	77.5	23	2.2
1-Aug-00	1510082446	1021	261.5	60	68	22	1.4
1-Aug-00	1510105C31	1020	261.5	57	75	24	1.7
1-Aug-00	1510106E19	1023	261.5	77	84.5	27	3.1
1-Aug-00	1510100260	1019	264.7	85.5	97	26	3.1
1-Aug-00	1510082822	672	271.9	67	75.5	24	2.0
2-Aug-00	151008061C	1086	257.4	152	164	70	29.3
2-Aug-00	1510102631	1087	257.4	121.5	133	55	15.3
2-Aug-00	1510106E61	1085	259.9	160.5	180	70.5	32.6
2-Aug-00	1510081122	1081	261.5	83	95	33.5	4.4
2-Aug-00	1510081868	1039	261.5	72.5	81	27	2.9
2-Aug-00	1510102C18	1084	261.5	57	65.5	22.5	1.7
2-Aug-00	1510102E10	1038	261.5	79.5	87.5	29	2.8
2-Aug-00	1510103678	1083	261.5	46	53.5	17	1.0
2-Aug-00	1510084A64	1080	263.9	225	247	97	103.4
2-Aug-00	1510102E14	1079	263.9	70	79.5	26.5	2.3
3-Aug-00	1510082440	1090	257.4	55	63	21	1.0
3-Aug-00	151008391E	1091	257.4	76.5	87.5	28	2.8
3-Aug-00	1510085C7E	1089	257.4	69	78.5	26	2.0
3-Aug-00	1510100E0C	1041	257.4	74	83.5	27	2.4

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
3-Aug-00	1510101014	117	257.4	90	101	34	4.4
3-Aug-00	1510103166	1092	257.4	86	95.5	28.5	3.8
3-Aug-00	151010364C	24	257.4	74	83	29	3.1
3-Aug-00	1510081258	1088	258.1	78.5	88	31	3.5
3-Aug-00	1510083911	1034	258.1	92.5	102	31.5	4.8
3-Aug-00	1510105266	1093	261.5	51.5	58	19	0.7
3-Aug-00	1510101108	1096	264.7	78	86	29	2.9
3-Aug-00	1510104430	1094	264.7	89	99	33	4.5
3-Aug-00	1510107644	1095	264.7	82.5	92	32	3.5
3-Aug-00	1510103151	1097	271.1	139	155	55	20.7
15-Aug-00	1510082411	1100	225.3	83.5	93.5	34	3.9
15-Aug-00	1510102610	1099	225.3	73.5	80.5	29	2.6
15-Aug-00	1510083A69	1017	226.1	231	252	106.5	136.1
15-Aug-00	1510084440	1075	227.7	205	229.5	103	102.1
15-Aug-00	1510104E6A	699	230.1	72.5	81	25	2.8
17-Aug-00	1510083264	1036	258.2	73	80	27	2.5
17-Aug-00	1510083911	1034	258.2	90.5	101	33.5	4.5
17-Aug-00	1510101014	117	258.2	90	98.5	32.5	4.5
17-Aug-00	1510101658	669	258.2	91.5	101.5	40	4.8
17-Aug-00	1510104173	667	258.2	95	104	28	3.2
17-Aug-00	1510105018	670	258.2	89.5	99.5	33.5	3.6
17-Aug-00	1510185820	666	258.2	127.5	145	51	13.8
17-Aug-00	1F2E340A75	668	258.2	103	114	36	5.4
17-Aug-00	4159042321	671	258.2	92	102	32.5	4.3
22-Aug-00	151010424E	1072	212.4	68	78	27	2.0
22-Aug-00	1510080008	664	214.0	135	146	53.5	17.2
22-Aug-00	151010312E	665	214.0	62.5	72	25	1.6
22-Aug-00	4158596E01	662	214.0	132	144	62	20.9
22-Aug-00	4158602432	663	214.0	144	151.5	62.5	26.1
22-Aug-00	1510083620	661	214.8	44	48	17	0.7
22-Aug-00	1510084A11	361	214.8	81.5	90.5	32.5	3.9
22-Aug-00	1510081A78	660	215.6	147	166	70	27.2
22-Aug-00	1510082262	556	221.2	95	109	38	5.9
22-Aug-00	1510101466	555	221.2	100	111.5	41	7.8
22-Aug-00	1510103E1E	553	221.2	83.5	94	33	4.4
22-Aug-00	151008283C	552	222.0	56	64	23.5	1.5
22-Aug-00	1510083122	551	222.8	66.5	74.5	25.5	2.4
22-Aug-00	1510081209	1025	257.4	167	186	66	38.8
22-Aug-00	1510101640	121	257.4	82	92.5	29	3.4
22-Aug-00	1510102C16	557	257.4	97	111	37	6.3

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
22-Aug-00	151010423A	261	257.4	77.5	89	30	3.7
22-Aug-00	1510105018	290	257.4	88	96	31	3.9
22-Aug-00	1F2E340A75	668	257.4	103	114.5	34.5	5.9
22-Aug-00	1510083264	1036	259.0	72.5	82	28	2.7
23-Aug-00	1510083914	659	213.2	68	77.5	28.5	2.5
23-Aug-00	1510102A62	658	214.0	90	100.5	40	5.9
23-Aug-00	1510102420	657	214.8	58	67	24	1.4
23-Aug-00	1510106426	656	214.8	91	94	34.5	4.8
23-Aug-00	1510104E40		216.4	117	129	52.5	13.2
29-Aug-00	1510105E36	650	183.4	145.5	162	61	26.5
29-Aug-00	1510102E28	558	189.9	73.5	88	30	3.2
29-Aug-00	1510084824	559	195.5	96	112	41	6.8
29-Aug-00	1510085856	560	195.5	64.5	74.5	28	2.4
29-Aug-00	1510082220	98	198.7	99	113	43	7.5
29-Aug-00	1510082E42	563	198.7	118	134	49.5	12.8
29-Aug-00	1510082E59	564	198.7	161.5	177	75	35.6
29-Aug-00	1510100272	561	198.7	82.5	95	33	4.0
29-Aug-00	1510102A60	562	198.7	104	118.5	44.5	9.4
29-Aug-00	1510080146	566	202.7	186	209.5	85	49.6
29-Aug-00	151010524E	565	202.7	168	188	78	42.5
29-Aug-00	1510107A68	1070	202.7	154	174	65	28.8
29-Aug-00	151008014A	568	203.5	58	67.5	22.5	1.1
29-Aug-00	1510085A32	571	203.5	212.5	242	99.5	84.3
29-Aug-00	1510100A46	570	203.5	85.5	93	36	4.6
29-Aug-00	1510102C10	569	203.5	82	97.5	34	3.9
29-Aug-00	1510103C3C	567	203.5	51	59	20	0.9
30-Aug-00	1510100E76	649	189.1	76	83	32	2.7
30-Aug-00	1510084A34	1074	197.9	102	113	47.5	9.7
30-Aug-00	1510082270	574	202.7	73	82	28.5	2.8
30-Aug-00	1510102910	572	202.7	97.5	109.5	41	6.6
30-Aug-00	1510104874	575	202.7	60	68	24	1.5
31-Aug-00	4SJBNLP68C945AK	648	177.8	152	167	70	29.7
31-Aug-00	151010165C	576	202.7	105.5	121.5	44.5	9.3
31-Aug-00		577	202.7	118.5	135.5	49.5	11.1
12-Sep-00	1510101110	646	184.2	83	90.5	33.5	3.9
12-Sep-00	1510101679	647	184.2	95.5	106	35	5.0
12-Sep-00	1510083C50	645	191.5	86.5	98	36.5	5.2
12-Sep-00	AVID*021*299*374	578	200.3	79.5	90.5	33	5.1
12-Sep-00	1510082E5E	579	201.1	120.5	137	52	13.9
12-Sep-00	1510083C66	582	201.1	93.5	109	36	5.4

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
12-Sep-00	1510084400	580	201.1	76	89	30	3.3
12-Sep-00	1510105966	583	201.1	56.5	64	24	1.4
12-Sep-00	1510100218	587	202.7	68	78	26	1.4
12-Sep-00	1510100474	586	202.7	46.5	53	17.5	1.0
12-Sep-00	1510105C42	584	202.7	107	125	44	8.7
12-Sep-00	1510107950	585	202.7	61	69	24.5	2.2
12-Sep-00	1510101416	127	205.1	107	123.5	39	7.6
12-Sep-00	1F2E490B5F		205.1	104	118	41	8.1
12-Sep-00	AVID*002*036*537	589	205.1	153.5	173.5	68	29.5
12-Sep-00	1510080E2A	643	206.0	72.5	82.5	30	2.9
12-Sep-00	1510102600	644	206.0	71	80	26	2.4
12-Sep-00	1510102C79	642	206.0	55.5	64	22	1.3
12-Sep-00	1510102466	641	206.8	185	206.5	83	53.5
13-Sep-00	1510081630	640	185.0	113	126	52.5	12.0
13-Sep-00	1510085C6C	639	189.9	148	162	59.5	23.8
13-Sep-00	1510104974	396	191.5	151	170.5	68	29.5
13-Sep-00	1510106430	637	191.5	182.5	207	83.5	57.4
13-Sep-00	1510107638	638	191.5	115	126.5	46.5	10.9
13-Sep-00	1510102274	636	195.5	102.5	117	42.5	7.9
13-Sep-00	151010262A	590	201.1	75.5	85	31.5	3.4
13-Sep-00	1510102979	591	202.7	51.5	59.5	23	0.6
13-Sep-00	1510105E12	592	206.0	113	130.5	51	12.8
13-Sep-00	1510082C0C	593	206.8	122	126.5	55.5	16.0
13-Sep-00	1510140303A	594	206.8	81.5	93	33	4.0
14-Sep-00	1510080072	633	189.9	70	79.5	30	2.9
14-Sep-00	151010160A	632	189.9	89	98.5	34.5	4.8
14-Sep-00	151010392E	634	189.9	88	96	39	4.5
14-Sep-00	1510106E28	631	189.9	148	165	61	24.9
14-Sep-00	1510084622	595	197.9	61.5	89.5	28.5	2.7
14-Sep-00	1510083E09	597	202.7	87.5	100.5	35.5	5.0
14-Sep-00	1510100E54	596	202.7	100.5	116	41.5	8.4
19-Sep-00	151008216A	629	210.8	60.5	68.5	26	2.0
19-Sep-00	1510083150	630	210.8	99	112	46.5	7.0
19-Sep-00	1510100C76	628	211.6	47.5	53.5	19	1.1
19-Sep-00	1510107646	627	211.6	85.5	110	42	6.8
19-Sep-00	1510107642	626	215.6	63	73.5	26.5	2.0
19-Sep-00	1510101826	625	216.4	58.5	75	26.5	2.0
19-Sep-00	1510102976	598	218.0	71	82.5	31	2.9
19-Sep-00	151008313C	599	223.7	105	117	31	5.9
19-Sep-00	AVID *002*036*537	600	224.5	151	167	67	28.0

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
20-Sep-00	1510101A04	624	210.8	63	72.5	25.5	2.3
20-Sep-00	1510106431	623	210.8	139	157.5	60.5	20.2
20-Sep-00	1510084A34	1074	211.6	104	117	46	9.8
20-Sep-00	151010246C	621	211.6	97	105.5	39	6.6
20-Sep-00	1510104031	622	211.6	57	64	21	1.4
20-Sep-00	151008125A	620	215.6	51	59	19.5	1.1
20-Sep-00	1510082940	752	220.4	58	66.5	22.5	1.3
20-Sep-00	1510083C41	751	220.4	86	98.5	36	4.6
20-Sep-00	1510100910	753	224.5	82.5	104	34	5.3
20-Sep-00	1510102648	756	224.5	146.5	168	64	26.3
20-Sep-00	1510103136	755	224.5	86	100.5	24.5	4.8
20-Sep-00	1510105A7A	754	224.5	115	131	46	11.7
21-Sep-00	1510082E1C	619	211.6	86	100.5	34	3.9
21-Sep-00	1510100024	618	215.6	63.5	72	25	1.8
21-Sep-00	1510102438	617	215.6	85.5	102.5	44.5	7.5
21-Sep-00	1510083E6C	757	218.0	130	145.5	55.5	16.9
21-Sep-00	1510081A78	660	224.5	155	178	66	29.7
3-Oct-00	151008213A	764	226.1	82.5	91.5	36	5.1
3-Oct-00	1510082E3A	765	226.9	91.5	101	38	5.7
3-Oct-00	1510084419	766	261.5	163	184	70.5	37.4
3-Oct-00	1510101828	767	261.5	73	81	27	2.7
3-Oct-00	1510102C08	769	261.5	90	102	36	6.1
3-Oct-00	151010305A	768	261.5	68.5	78.5	25	2.3
4-Oct-00	1510101679	647	225.3	94	107	33	5.2
4-Oct-00	1510103169	770	226.1	49	56.5	18	1.0
4-Oct-00	1510104E6A	771	230.1	74	84.5	25	2.8
10-Oct-00	1510082842	1045	250.2	109.5	122.5	38	7.7
10-Oct-00	1510082A32	772	257.4	79	88.5	29	3.5
10-Oct-00	1510083911	774	257.4	91.5	103.5	33	5.1
10-Oct-00	1510083C12	773	257.4	83.5	95	30	4.2
11-Oct-00	151008221A	779	257.4	81	93	30	3.5
11-Oct-00	1510084818	780	257.4	80.5	92	30.5	3.7
11-Oct-00	151008217C	1022	261.5	70	78	27	2.4
11-Oct-00	1510082908	777	261.5	52.5	60	19.5	0.9
11-Oct-00	151008484A	776	261.5	84	95	32	4.1
11-Oct-00	1510102151	778	261.5	72	80.5	27	2.5
11-Oct-00	1510082644	775	265.5	178	198	76	44.8
12-Oct-00	151008320E	784	261.5	172.5	193	75	38.1
12-Oct-00	1510106231	783	261.5	91	102	35	6.0
12-Oct-00	1510084636	782	263.1	167.5	190	69	33.7

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
12-Oct-00	7F7D0D742C	781	267.1	225.5	246	99	90.7
17-Oct-00	1510084959	801	272.7	77.5	87.5	27	3.6
17-Oct-00	1510101C7E	802	272.7	64	72	21.5	1.8
17-Oct-00	1510082171	804	275.9	164	183	74	39.5
17-Oct-00	1510101C52	805	275.9	196.5	221	79	60.8
17-Oct-00	1510103418	803	275.9	72.5	81.5	27	2.7
17-Oct-00	1510105001		275.9	71	83	23	2.5
17-Oct-00	1510101E10	807	280.0	70.5	81	26.5	3.2
17-Oct-00	1510102424	809	280.0	77	84.5	26	3.6
17-Oct-00	1510102428	808	280.0	63	70.5	22	1.8
17-Oct-00	1510104E71	816	280.0	76	84	24.5	2.7
17-Oct-00	1510105A3C	810	280.0	145.5	164.5	60	26.3
17-Oct-00	1510103149	811	281.6	161	177.5	62.5	27.2
17-Oct-00	1510101A0E	812	282.4	75	84.5	25.5	3.2
17-Oct-00	1510082240	785	299.9	64.5	73.5	23.5	1.9
18-Oct-00	1510103221	1001	271.9	90	98	34.5	5.7
18-Oct-00	1510082E70	813	272.7	66.5	74.5	25	2.5
18-Oct-00	1510082466	794	275.9	201	228	89.5	72.3
18-Oct-00	1510084E50	815	275.9	59.5	66	22.5	1.8
18-Oct-00	1510102C28	814	275.9	66	74	23.5	2.3
18-Oct-00	1510083A68	816	279.2	75	83.5	25	3.4
18-Oct-00	1510101E56	817	279.2	122	133.5	54.5	15.9
18-Oct-00	1510085132	677	282.4	195.5	217	85	66.7
18-Oct-00	1510102440	819	282.4	60	69.5	21.5	1.8
18-Oct-00	1510107918	818	282.4	75	83.5	26.5	2.9
18-Oct-00	1510085679	820	284.8	81	92	30	4.1
18-Oct-00	1510102178	821	284.8	78.5	89.5	26	3.4
18-Oct-00	1510103611	822	284.8	75	85	26.5	2.9
18-Oct-00	1510082A21	788	285.6	77	88.5	30	3.7
18-Oct-00	1510102A32	787	285.6	69	78	26	2.6
18-Oct-00	1510104039	786	285.6	96	104.5	33	5.4
18-Oct-00	151008142E	790	286.4	62	71.5	21.5	1.6
18-Oct-00	1510101448	789	286.4	67	75	23	3.0
18-Oct-00	1510105422	791	292.8	156.5	183.5	69	33.3
18-Oct-00	1510082276	792	294.4	64	72.5	23	1.6
18-Oct-00	151010766C	793	295.3	61	69	19	1.4
19-Oct-00	1510101622	833	275.9	59	65.5	22.5	1.6
19-Oct-00	1510105821	832	275.9	73	83.5	28	3.6
19-Oct-00	1510101C6A	829	279.2	68.5	76	27	2.5
19-Oct-00	1510081164	828	280.0	161	178	70.5	37.6

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
19-Oct-00	1510106E02	827	280.0	153	170.5	64.5	39.9
19-Oct-00	1510080154	958	282.4	76	85	26.5	2.9
19-Oct-00	151010162A	831	284.0	95.5	102	47.5	7.7
19-Oct-00	1510101849	830	284.0	64.5	72.5	22.5	2.7
19-Oct-00	1510082019	823	284.8	79	88.5	24	2.9
19-Oct-00	1510084E41	967	284.8	81	90.5	31.5	4.1
19-Oct-00	1510103E42	825	284.8	203	228.5	85	83.0
19-Oct-00	1510105844	824	284.8	144.5	161	60	24.5
19-Oct-00	1510080144	796	285.6	68.5	78	24	2.3
19-Oct-00	151008240A	795	285.6	71.5	81	24	2.4
19-Oct-00	1510102954	798	288.8	179	199.5	76	46.6
19-Oct-00	1510102C78	797	288.8	172	195.5	74	45.1
19-Oct-00	151010340C	799	297.7	71	80	26.5	2.6
19-Oct-00	1510082826	826	300.1	69	77	22	1.8
20-Oct-00	1510106250	800	285.6	79	88	27	3.0
20-Oct-00	1510083201	676	287.2	115	127	38	7.3
20-Oct-00	1510104C49	298	287.2	187	205	77	42.5
24-Oct-00	1510103458	501	224.5	93	102.5	42	7.4
25-Oct-00	1510101E06	835	214.8	107.5	118	41.5	9.1
25-Oct-00	7F7B035743	834	214.8	129	147	58	16.3
2-Nov-00	1F4D4C7157	74	178.6	165	185.5	74.5	39.5
7-Nov-00	151010105A	502	228.5	98.5	102	34.5	5.0
9-Nov-00	1510085A11		228.5	98	105	39	7.0
9-Nov-00	1510104E6A	771	230.9	74	83	28.5	2.4
14-Nov-00	1510101648		257.4	94.5	105	34	5.0
14-Nov-00	151010480E	503	271.1	160	179	64.5	27.9
14-Nov-00	1F4D071F6E	691	271.1	144.5	161	67.5	27.6
15-Nov-00	151010567C	504	261.5	157	179.5	67	32.2
15-Nov-00	1510102259	272	271.1	68	79	26.5	2.5
16-Nov-00	1510084A11	361	261.5	83	93	30	3.1
16-Nov-00	1510106E16	505	271.1	115	133	54	14.6
28-Nov-00	1510102401	682	275.9	67.5	76.5	25	2.2
28-Nov-00	1510085C5A	506	277.6	81.5	91	32	3.7
28-Nov-00	1510082124	837	284.8	71	82	26.5	2.5
28-Nov-00	151010061A	115	284.8	194	218.5	77.5	46.5
28-Nov-00	1510103051	838	284.8	194.5	218	79	51.9
28-Nov-00	4158602432	836	290.4	147	165	58.5	19.7
29-Nov-00	1510085C1C	507	272.7	98.5	112.5	41.5	8.0
29-Nov-00	1F4D2F075E	508	279.2	67	77.5	22.5	1.5
29-Nov-00	1510103120	509	280.0	76.5	86	30	3.3

Table B-1 cont. White sturgeon capture data collected in 2000.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
29-Nov-00	1510085A29	351	284.8	122	135.5	59	17.9
29-Nov-00	1510100222	413	284.8	160.5	181	68.5	34.2
29-Nov-00	1510103831	842	284.8	75	84	26	3.2
29-Nov-00	151010561A	841	284.8	71	80	25	2.7
29-Nov-00	1510103E2A	840	292.8	65	72.5	24.5	2.0
29-Nov-00	1510101442	839	293.6	135.5	148	60.5	22.0

APPENDIX C

2000 White Sturgeon Egg Recovery and Habitat Data

Table C-1. White sturgeon artificial substrate spawning data.

Date	River	Location (Rkm)	Depth (m)	Substrate	Near Substrate Velocity (m/s)	Temp. (° C)	Number of Eggs
5/10	Snake	288.0	6	sand	0.79	12	1
5/15	Snake	286.4	21	sand	1.1	14	2
5/15	Snake	291.2	23	sand	1.1	14	1
5/18	Snake	286.4	21	sand	0.95	14.5	1
5/23	Snake	282.4	31	sand	2.07	14.5	1
5/23	Snake	286.4	20	sand	0.97	14.5	1
5/23	Snake	264.7	17	sand	0.87	14.5	1
5/30	Snake	291.2	22	gravel	0.82	13	1
5/30	Snake	291.2	24	sand	0.65	13	1
5/30	Snake	265.2	15	sand	1.4	13	1
6/5	Snake	275.1	12	sand	0.95	16.5	1
6/5	Snake	277.6	10	sand	1	16.5	2
6/5	Snake	277.6	10	sand	0.75	16.5	2
6/5	Snake	282.4	23	sand	0.6	16.5	1
6/5	Snake	291.2	27	sand	0.9	16.5	3
6/12	Snake	291.2	33	sand	1.3	14.5	1
6/27	Snake	276.7	13	sand	0.5	19.5	1
6/27	Snake	276.7	16	gravel	0.5	19.5	1
6/27	Snake	277.6	9	sand	0.65	19.5	2
6/27	Snake	282.4	21	sand	0.75	19.5	1
6/27	Snake	286.4	11	sand	0.55	19.5	1
5/22	Salmon	65.5	3.4	sand	2.1	12.6	4
6/13	Salmon	65.5	4.0	sand	0.9	12.4	1
6/21	Salmon	65.2	1.5	sand	0.5	16.1	2

APPENDIX D

2000 White Sturgeon Radio Tag Data

Table D-1. White sturgeon fitted with Combined Acoustic/Radio Tags (CART) in the Snake and Salmon Rivers, 2000.

Tag Date	Code*	River	Location (Rkm)	Gender	Total Length (cm)	Weight (kg)
07-Mar-00	73	Salmon	11.3	Female	227	71.7
22-Jun-00	143	Snake	189.9	Male	185.5	40.4
27-Jun-00	61	Snake	209.2	Male	171	21.3
11-Jul-00	71	Snake	267.1	Female	175	41.5
12-Jul-00	62	Snake	259.9	Female	198	38.0
12-Jul-00	115	Snake	222.0	Female	164	23.1
26-Jul-00	98	Snake	26.5	Undetermined	140.5	12.9
15-Aug-00	137	Snake	227.7	Female	229.5	102.1
16-Nov-00	154	Snake	271.1	Undetermined	133	14.6
29-Nov-00	74	Snake	293.6	Undetermined	148	27.4

*radio frequency: 149.880 Mhz, acoustic frequency: 150.077 Mhz (with 150 Mhz up-converter)