B O N N E V I L L E   P O W E R   A D M I N I S T R A T I O N

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

Annual Report 2001 | March 2003 | DOE/BP-00004046-1

This Document should be cited as follows:

Everett, Scott, Michael Tuell, "Evaluate Potential Means of Rebuilding Sturgeon Populations in the Snake River between Lower Granite and Hells Canyon Dams", 2001 Annual Report, Project No. 199700900 (et al.), 68 electronic pages, (BPA Report DOE/BP-00004046-1)

Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

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

2001 Annual Report

Prepared by:

Scott R. Everett
and
Michael A. Tuell

Nez Perce Tribe
Department of Fisheries Resources Management
P.O. Box 365
Lapwai, ID 83540

March 2003

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

2001 Annual Report

Prepared by:

Scott R. Everett
and
Michael A. Tuell

Nez Perce Tribe
Department of Fisheries Resources Management
P.O. Box 365
Lapwai, ID 83540

Prepared for:

U.S. Department of Energy
Bonneville Power Administration
Environmental, Fish and Wildlife
P.O. Box 3621
Portland, OR 98208-3621

Project Number 199700900
Contract Number 00004046

March 2003

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 2001 annual report covers the fifth year of sampling of this multi-year study.

In 2001 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 45,907 hours of setline effort and 186 hours of hook-and-line effort was employed in 2001. A total of 390 white sturgeon were captured and tagged in the Snake River and 12 in the Salmon River. Since 1997, 36.1 percent of the tagged white sturgeon have been recaptured. In the Snake River, white sturgeon ranged in total length from 42 cm to 307 cm and averaged 107 cm. In the Salmon River, white sturgeon ranged in total length from 66 cm to 235 cm and averaged 160 cm. Using the Jolly-Seber model, the abundance of white sturgeon <60 cm, between Lower Granite Dam and the mouth of the Salmon River, was estimated at 2,483 fish, with a 95% confidence interval of 1,208-7,477.

An additional 10 white sturgeon were fitted with radio-tags during 2001. The locations of 17 radio-tagged white sturgeon were monitored in 2001. The movement of these fish ranged from 38.6 km (24 miles) downstream to 54.7 km (34 miles) upstream; however, 62.6 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 30 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 309 aged white sturgeon. The results suggest 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 14 white sturgeon eggs were recovered in the Snake River in 2001.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX TABLES

ACKNOWLEDGEMENTS

The Bonneville Power Administration provided funding for this project. Charles Axtell, Clint Chandler, David Cunningham, David Kane, Joseph McCormack, Bradley Mitchell, James Paddlety, Winfred Perez 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 population. In 1996, a 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, 1999 and 2000 is reported in Hoefs (1998), Tuell and Everett (2000), Tuell and Everett (2003) and Everett and Tuell (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 2001 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 2001 Phase II data collection.

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 white 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.

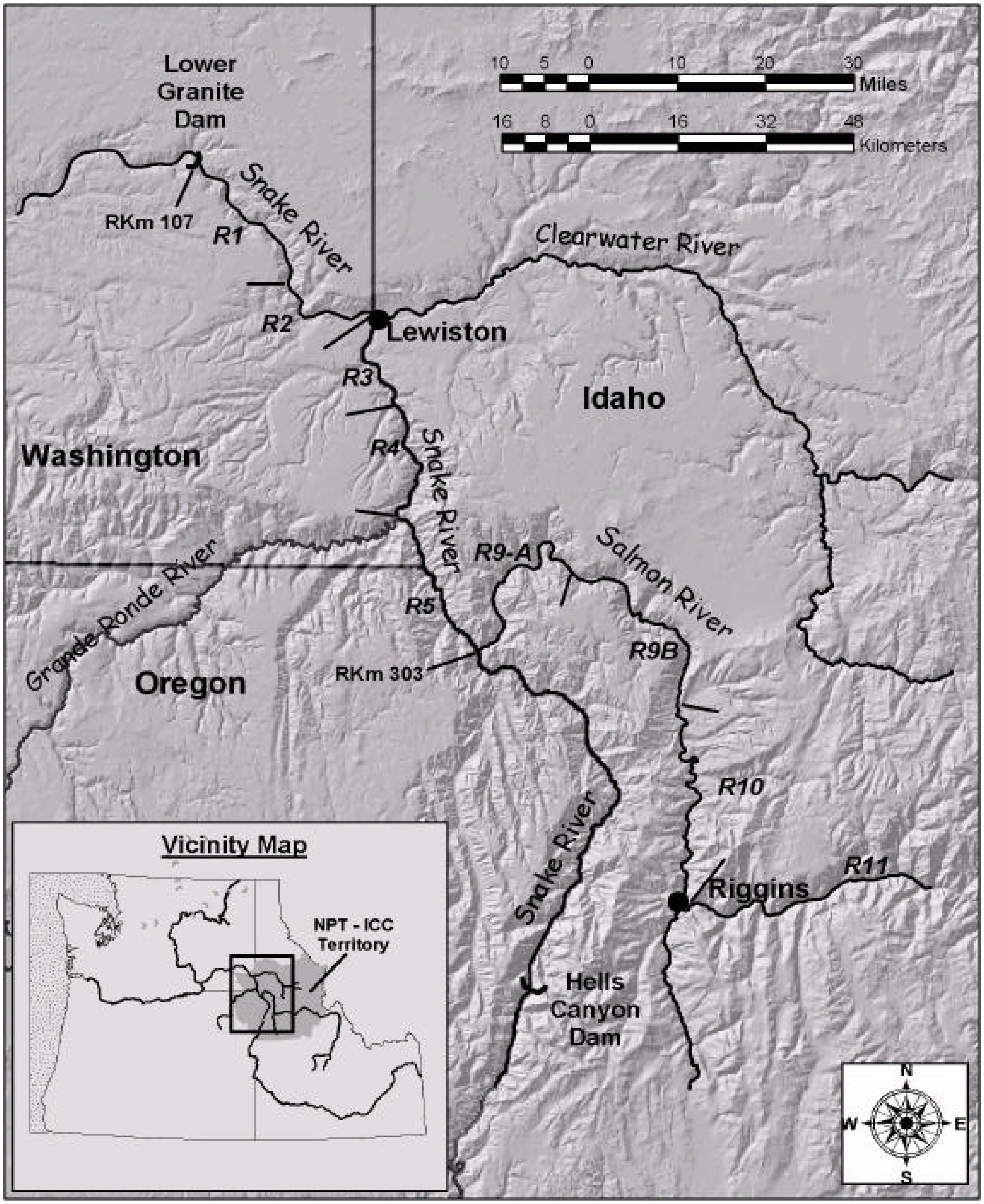

Figure 1. Map of study area. Sampling reaches are identified as R1 through R11.

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, 2001.

Study Reach	Location Description	Lower Rkm	Upper Rkm	Weeks Sampled
1	Lower Segment Lower Granite Reservoir	174	206.5	2, 15, 20, 30, 34
2	Upper Segment Lower Granite Reservoir	207	223.5	3, 16, 21, 28, 35
3	Clearwater River - Tenmile Rapids	224	239.5	4, 17, 23, 29, 37
4	Tenmile Rapids - Grand Ronde River	240	270.5	5, 18, 24, 31, 38
5	Grande Ronde River - Salmon River	271	302.5	6, 19, 25, 33, 43
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	26, 40
9b	Upper Salmon River Gorge[2]	42	83.5	40
10	Middle Salmon River[3]	84	131.5	
11	Upper Salmon River[3]	132	185	
12	Clearwater River[3]	0	74	

[1]Sampled by Idaho Power Company
[2]Hook-and-line sampling only
[3]No sampling conducted in 2001

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. Each setline used a combination of ten 8/0, 10/0, 12/0, 14/0 and 16/0 hooks. 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.

In 2001, white sturgeon young-of-the-year (YOY; < 25 cm TL) sampling was initiated. Setlines rigged with 50 'J' hooks were used to sample for YOY white sturgeon. Hooks ranged in size from 6 to 16 and were baited with worms, salmon eggs, pickled squid, herring and/or shad. Setlines were deployed and checked as described above. YOY sampling was conducted in areas adjacent to where white sturgeon abundance sampling was conducted. Sampling sites were randomized within each reach and selected as described above (Table 3). Sampling effort consisted of six setlines per reach.

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 angler-hours.

Table 3. Location and calendar week for white sturgeon young-of-the-year sampling in the Snake River, 2001.

Study Reach	Location Description	Lower Rkm	Upper Rkm	Weeks Sampled
1	Lower Segment Lower Granite Reservoir	174	206.5	17, 30, 34
2	Upper Segment Lower Granite Reservoir	207	223.5	18, 20, 28
3	Clearwater River - Tenmile Rapids	224	239.5	18, 21, 29
4	Tenmile Rapids - Grand Ronde River	240	270.5	19, 22, 31
5	Grande Ronde River - Salmon River	271	302.5	23, 33

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 2001 random stratified sampling conducted for population abundance did not include the Snake River above the mouth of the Salmon River.

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, Everett and Tuell 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. Also, white sturgeon captured during the YOY sampling were not included in the abundance calculations due to differences in sampling effort and gear type.

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

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

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 45,907 hours of setline effort and 186 hours of hook-and-line effort was employed in 2001 (Table 4). In Lower Granite Reservoir (reaches 1-3), 26,709 hours of setline sampling was conducted with 126 hours of hook-and-line effort. In the free-flowing Snake River (reaches 4-5), 17,260 hours of setline sampling was conducted with 38 hours of hook-and-line effort. In the Salmon River (reaches 9-12), 1,938 hours of setline sampling was conducted with 22 hours of hook-and-line effort. A total of 402 white sturgeon were sampled during 2001; 86 from Lower Granite Reservoir, 304 from the free-flowing Snake River and 12 from the Salmon River (Appendix A). Although similar effort was employed in each Snake River reach, the overall catch and CPUE was greater in the reach 5. Moreover, the combined CPUE in the free-flowing Snake River was over five times greater than the CPUE in Lower Granite Reservoir (Figure 2).

In 2001, 6,644 hours of white sturgeon YOY setline sampling effort was employed. Sampling was conducted in the Snake River reaches 1-5. No white sturgeon YOY setline sampling was conducted in the Salmon River. A total of 48 white sturgeon were captured. Fish ranged from 52 cm to 94 cm total length and averaged 75.5 cm (Appendix B). However, no YOY (<25 cm TL) white sturgeon were collected. Incidental captures consisted of 34 channel catfish (*Ictalurus punctatus*), 17 largescale suckers (*Catostomus macrocheilus*), 12 smallmouth bass (*Macropterus dolomieui*) and 4 carp (*Cyprinus carpio*).

Table 4. 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 2001.

Study	**Setline**			**Hook-and-Line**		
Reach	**Effort (hrs)**	**Catch**	**CPUE**	**Effort (hrs)**	**Catch**	**CPUE**
1	8,442	22	**0.003**	6	0	**0**
2	8,855	19	**0.002**	10	0	**0**
3	9,412	18	**0.002**	110	27	**0.245**
4	8,770	74	**0.008**	0	0	**0**
5	8,490	227	**0.027**	38	3	**0.079**
9a	1,938	12	**0.006**	15	0	**0**
9b	0	0	**0**	7	0	**0**
10	0	0	**0**	0	0	**0**
11	0	0	**0**	0	0	**0**
12	0	0	**0**	0	0	**0**
Total	45,907	372	**.008**	186	30	**0.161**

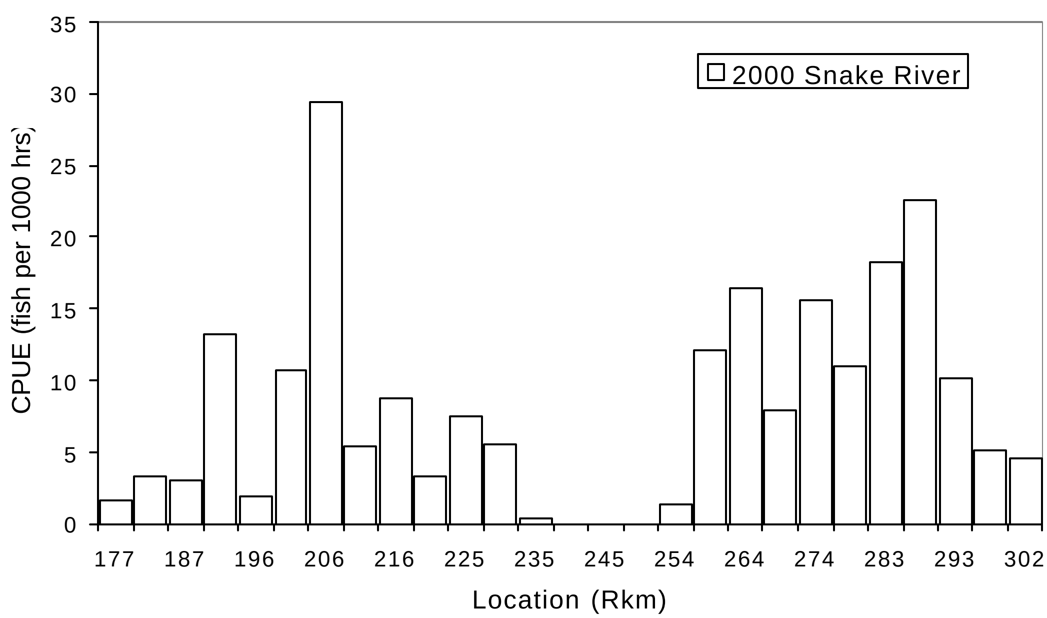

Figure 2. Distribution of CPUE (fish/1000 hours) per five km segments in the Snake River, 2001.

Abundance

Of the 402 white sturgeon captured during 2001, 250 were unmarked and 152 were previously marked fish. These 250 fish plus the 1,085 from 1997-2000 bring the total number of marked fish in the study area to 1,335. No mortalities occurred during collection or processing. In Lower Granite Reservoir white sturgeon ranged from 51 cm to 187 cm total length with a median of 118 cm (Figure 3; mean 120 cm). White sturgeon captured in the free-flowing segment of the Snake River ranged from 42 cm to 307 cm total length with a median of 86 cm (Figure 4; mean 105 cm). White sturgeon captured in the Salmon River ranged from 66 cm to 235 cm total length with a median of 164 cm (Figure 5; mean 160 cm). In 2001, incidental captures consisted of 14 channel catfish, 6 smallmouth bass and 2 largescale suckers.

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 2001. 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), 1999 (Tuell and Everett 2001) and 2000 (Everett and Tuell 2003). Within each river segment, no significant differences (Chi-Square test, $P>0.05$) were detected in the proportions of different size classes between 1997-2001. Furthermore, differences in these proportions were detected between Salmon River white sturgeon and fish captured in both Lower Granite Reservoir and the free-flowing Snake River (Chi-Square test, $P>0.05$).

Since 1997, 22 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 13-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 2,621 with a 95 percent confidence interval of 2,250-3,138. Using the open model, Jolly-Seber estimate, the abundance was estimated to be 2,483 with a 95 percent confidence interval of 1,208-7,477. 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 0.51 and 0.71 fish/ha using the Schnabel estimate, or 0.27 and 1.68 fish/ha using the Jolly-Seber estimate.

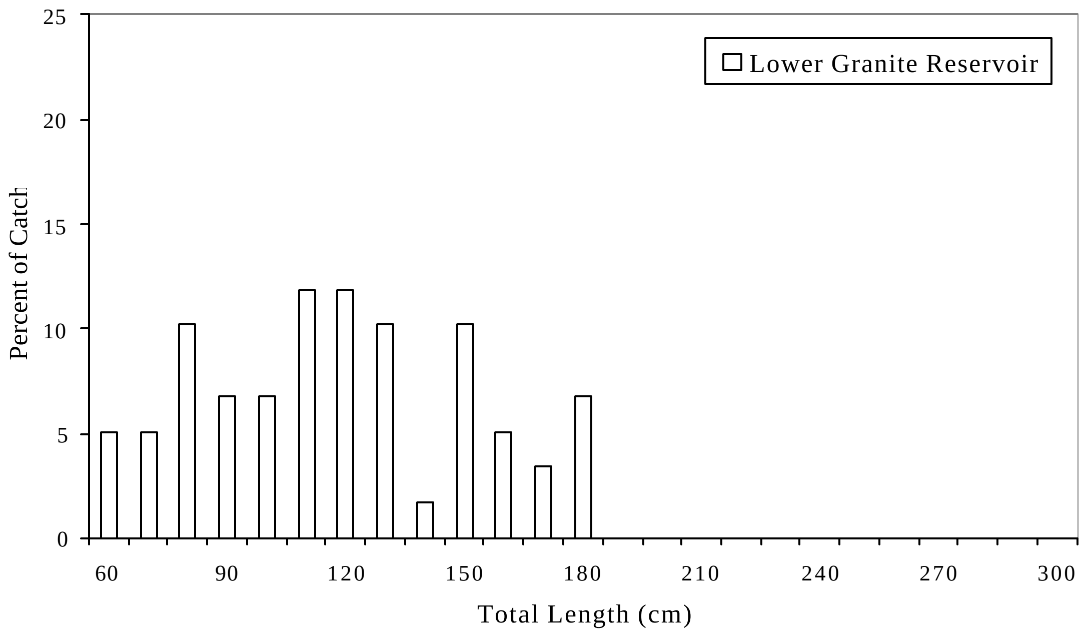

Figure 3. Length frequency distribution of white sturgeon captured in Lower Granite Reservoir in 2001.

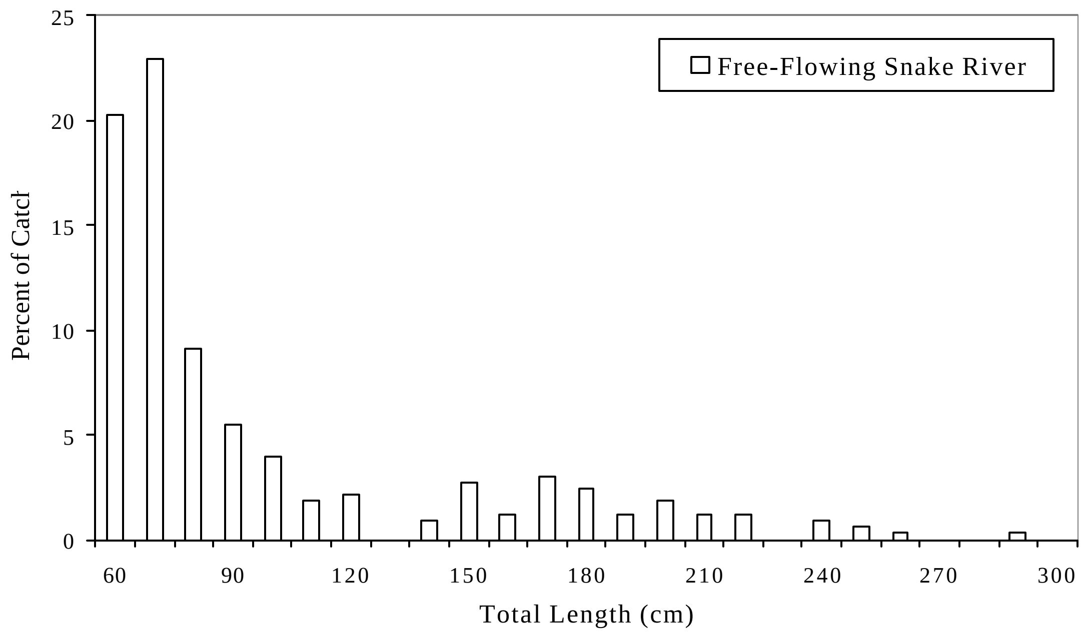

Figure 4. Length frequency distribution of white sturgeon captured in the free-flowing Snake River in 2001.

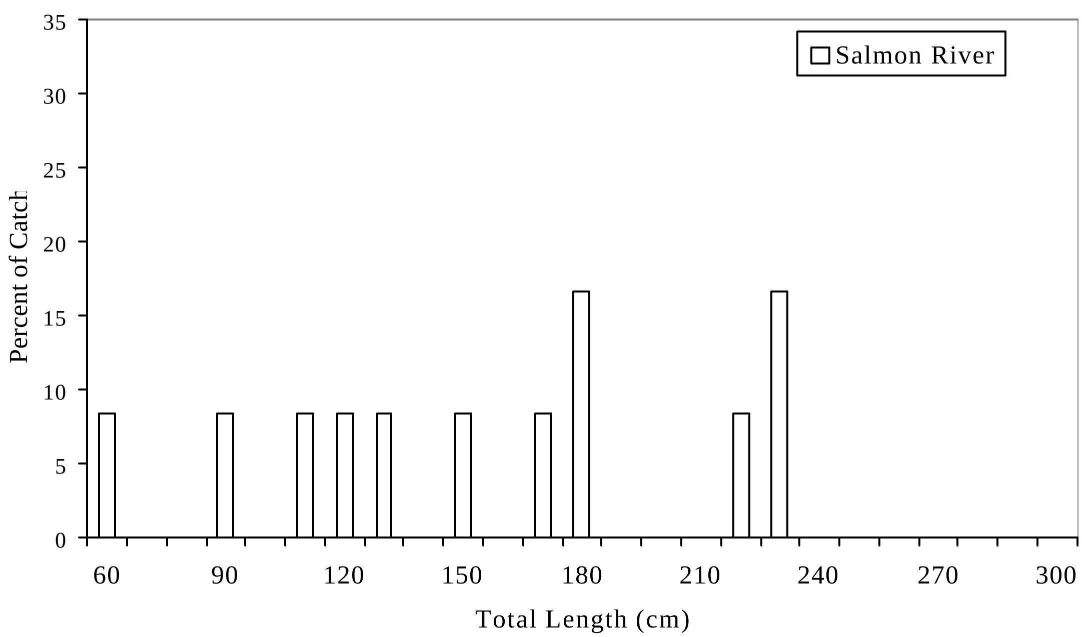

Figure 5. Length frequency distribution of white sturgeon captured in the Salmon River in 2001.

Age and Growth

In 2001, an additional 179 white sturgeon were examined for age from three river segments: 34 fish from the reservoir segment, 135 fish from the free-flowing segment, and 10 from the Salmon River. The age assignment procedure resulted in 8 fish being removed from all samples due to age discrepancies (Table 5). The 171 white sturgeon assigned ages ranged from 2 to 63 years old. The largest white sturgeon aged was a 63-year-old, 307 cm TL, and the smallest an age-2 fish, 52 cm TL. The von Bertalanffy growth curve (Figure 6) generated from length-at-capture data from fish sampled in 1999, 2000 and 2001 (n=309) is given by $L(t)=311(1-e^{-0.045(t+1.34)})$ where L(t) is total length in cm.

In 2001, a total of 387 white sturgeon from the Snake and Salmon rivers was measured for weight (kg). These fish ranged in weight between 0.6 and 106 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 $W = (3.35\ E\text{-}06)L^{3.11}$ (Figure 7), $W = (1.75\ E\text{-}06)L^{3.21}$ (Figure 8), and $W =(3.83\ E\text{-}06)L^{3.07}$ (Figure 9), 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 95.6, 83.2 and 90.6, 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.

Table 5. Summary of pectoral fin rays collected by river segment, aged, and removed from analysis because of age discrepancies in 1999, 2000, and 2001.

	Number of Samples		
Location	**Collected**	**Removed**	**Aged**
Lower Granite Reservoir	92	11	81
Free-Flowing Snake River	208	14	194
Salmon River	35	1	34
Total	335	26	309

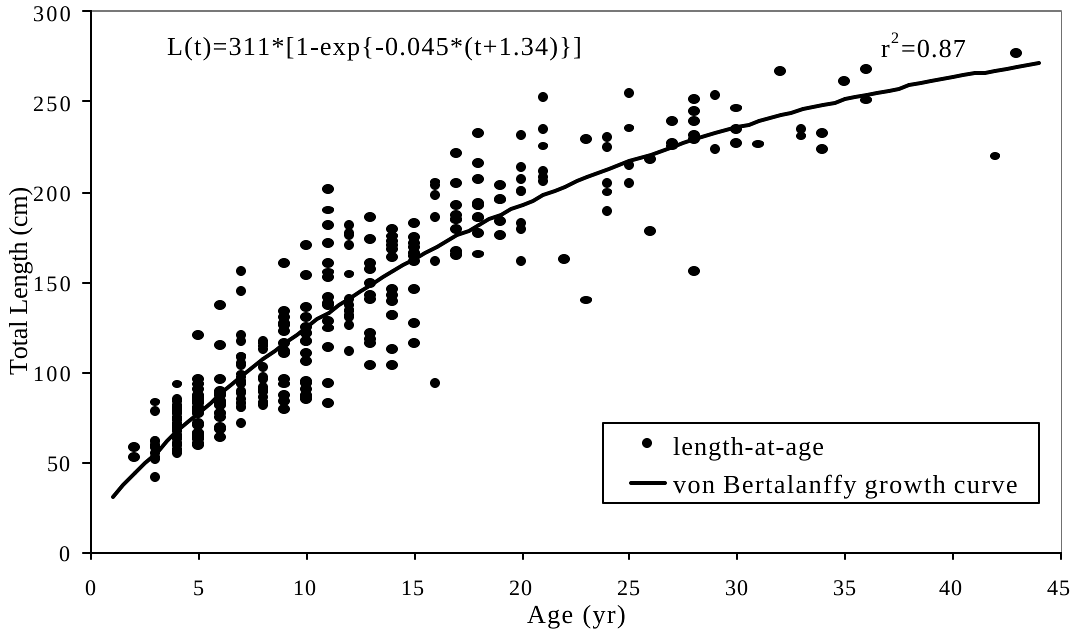

Figure 6. The von Bertalanffy growth curve fitted to 309 aged white sturgeon in the Snake and Salmon Rivers, 1999, 2000, and 2001.

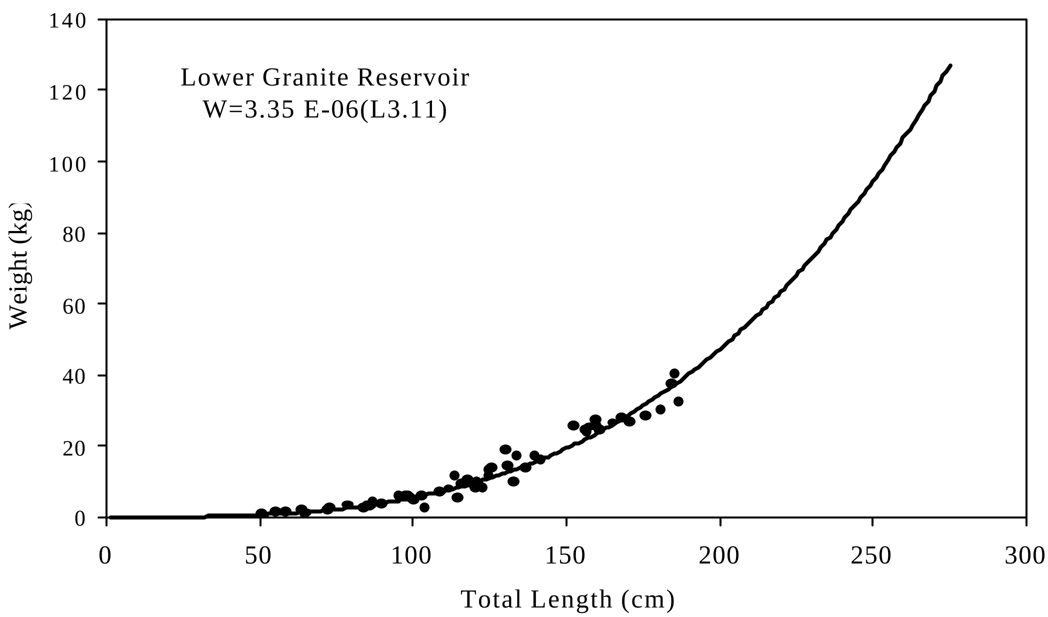

Figure 7. Allometric relationship between weight (kg) and total length (cm) for white sturgeon collected in Lower Granite Reservoir during 2001.

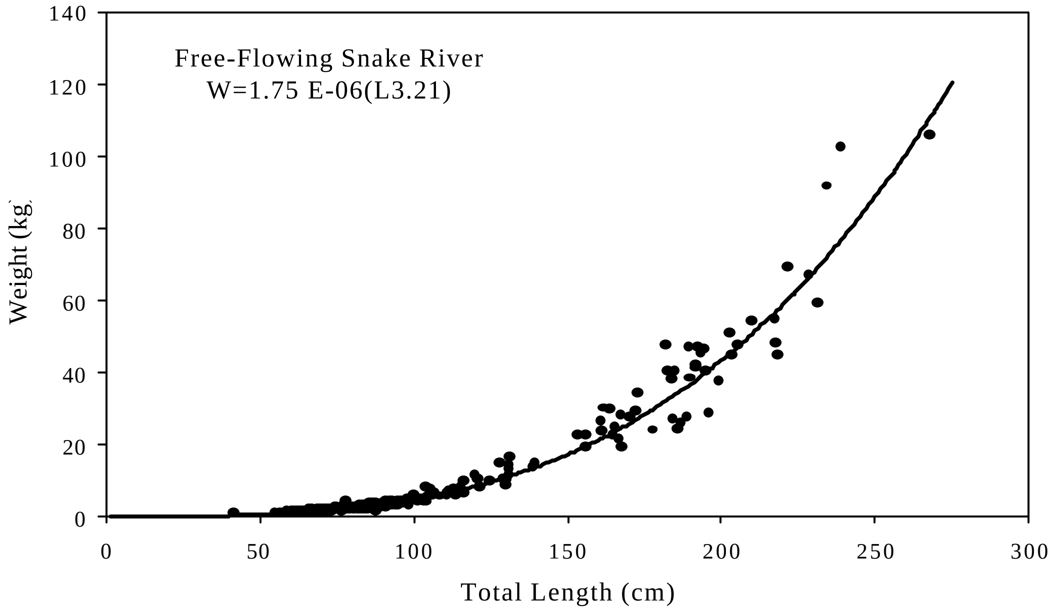

Figure 8. Allometric relationship between weight (kg) and total length (cm) for white sturgeon collected in the free-flowing Snake River during 2001.

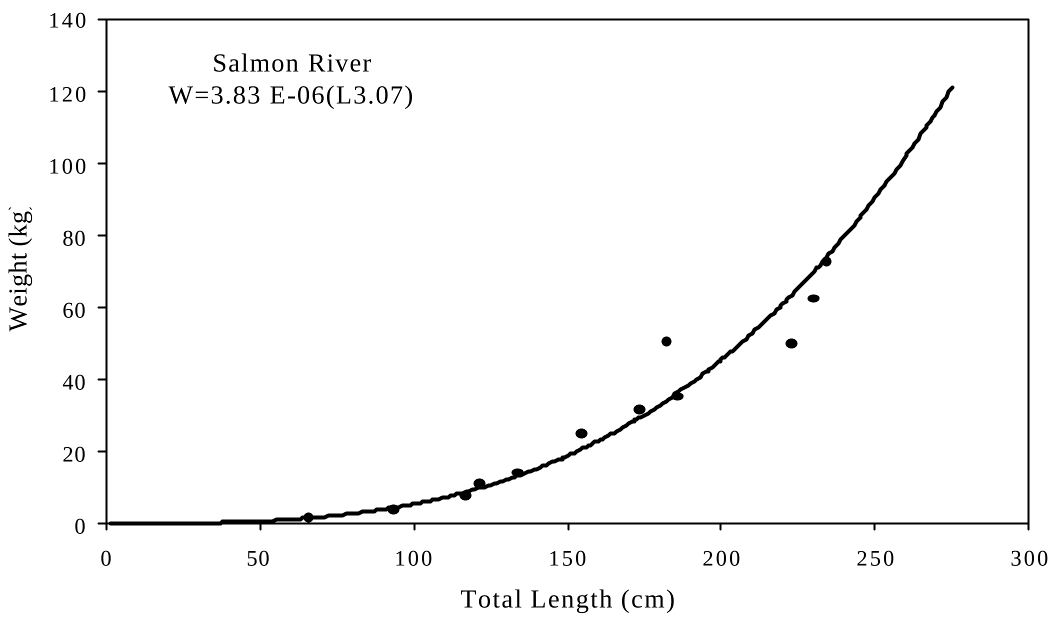

Figure 9. Allometric relationship between weight (kg) and total length (cm) for white sturgeon collected in the Salmon River during 2001.

Spawning

In 2001, 88.1% of the white sturgeon over 150 cm TL were examined by surgical biopsy to determine gender. Gender was assigned to 73 of the 91 white sturgeon examined. A total of 41 fish were determined to be female, and 32 fish were determined to be male.

In 2001, 22 artificial egg mats were distributed throughout the free-flowing Snake River. A total of 40,848 hours of egg mat effort was conducted, and fourteen white sturgeon eggs were recovered (Appendix C). During the time the eggs were found, the daily mean discharge at the Snake River gauge at Anatone (Rkm 269) ranged from 428 to 1,8,55 m^3/s (15,113 to 65,501 cfs; Figure 10). At sites where eggs were found, the mean near substrate velocity was 1.1 m/s, mean water temperature was 16.1EC and mean depth was 15.9 m. At each egg location, the primary substrate type was sand. No artificial egg mat sampling was conducted in the Salmon River in 2001.

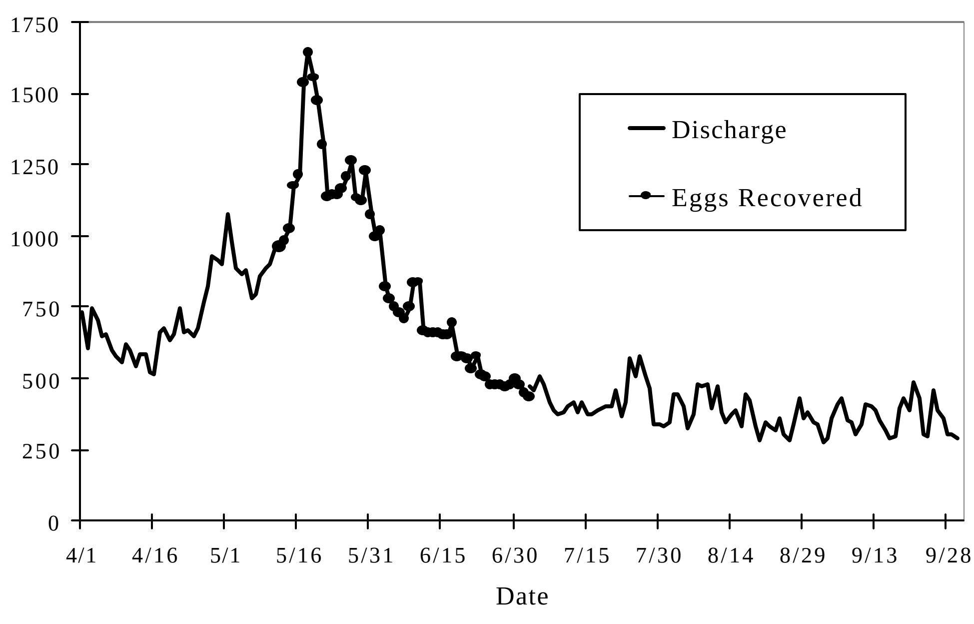

Figure 10. Daily mean discharge at the Snake River, Anatone gauge when white sturgeon eggs were collected in the Snake River, 2001 (USGS gauge number 13334300).

Movement

An additional 10 white sturgeon were fitted with radio/acoustic tags in 2001 (Appendix D). Radio/acoustic-tagged fish ranged in total length from 89.0 to 276.5 cm. White sturgeon were tracked throughout the year approximately every two-weeks. The interval between detections ranged from one to 160 days. Movements of radio/acoustic-tagged fish were both upstream and downstream (Figure 11). White sturgeon originating in Lower Granite Reservoir moved an average of 8.0 km (4.9 miles) between detections, whereas white sturgeon originating from the free-flowing Snake River moved an average of 4.4 km (2.7 miles) between detections. The distance of individual fish movement ranged from 0 km to 53 km (33 miles) and averaged 5.3 km (3.3 miles). One white sturgeon was tracked in the Salmon River during 2001. Over a 49-day period, this fish was observed to move less than one km (0.6 miles). No seasonal movement pattern was detected for radio-tagged fish, and no movement pattern was detected among radio/acoustic-tagged fish of different size-classes.

In 2001, a total of 152 PIT/Floy tagged white sturgeon were recaptured. Of these, 126 were distinct recaptures and 26 were multiple recaptures. Of the 126 distinct white sturgeon recaptured, 118 were fish that had been previously tagged in 1997-2000 (Hoefs 1998, Tuell and Everett 2000, Tuell and Everett 2003, Everett and Tuell 2003) and the remaining eight fish were first captured during 2001. During 2001, 9.4 percent (126 of 1,335) of the marked white sturgeon were detected at least once. From 1997 to 2001 a total of 482 white sturgeon have been recaptured. In the Snake River, movements of 79 recaptured fish were less than or equal to 0.8 km (0.5 miles) or had no discernable movement. Fifty-one fish moved more than 0.8 km up to 16 km (10 miles) while 22 others moved more than 16 km up to 90.1 km (56 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 three fish 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 19.4 km (12.1 miles) between recaptures (Figure 12); whereas, white sturgeon originating from the free-flowing Snake River moved an average of only 4.8 km (3.0 miles; Figure 13). In 2001, no PIT/Floy tagged white sturgeon were recaptured within the Salmon River. For PIT/Floy tagged fish, no clear seasonal movement pattern was detected (Figure 14), and no movement pattern was detected among fish of different size-classes (Figure 15).

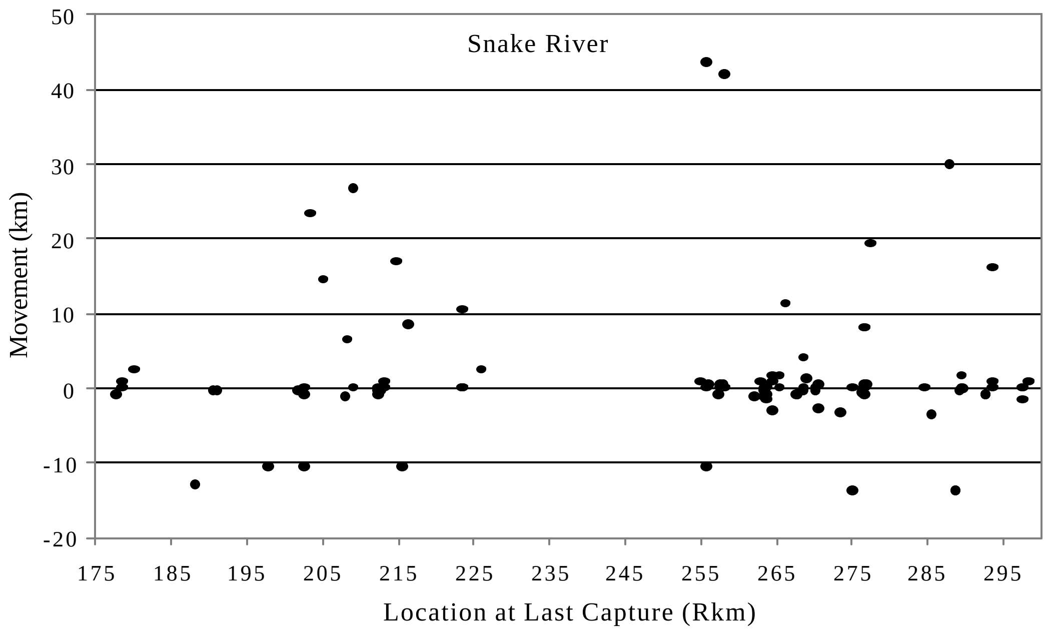

Figure 11. Total movement of the 17 radio-tagged white sturgeon tracked in the Snake River during 2001. Points represent distance from previous detection. Negative values indicate movement downstream and positive values indicate movement upstream.

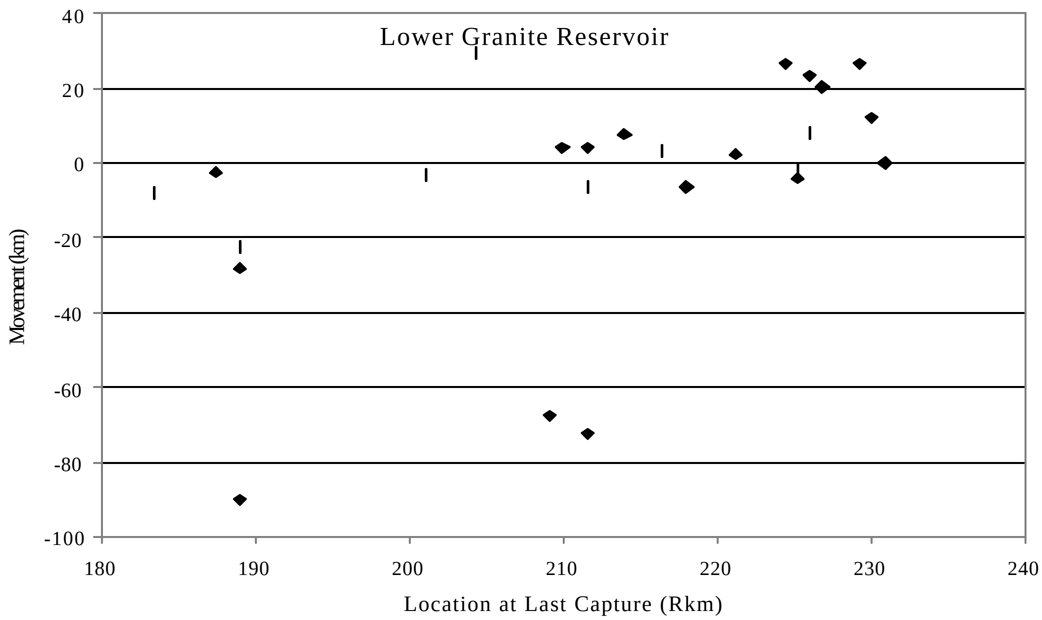

Figure 12. Total movement of 26 recaptured PIT/Floy tagged white sturgeon initially captured in Lower Granite Reservoir. Negative values indicate movement downstream and positive values indicate movement upstream.

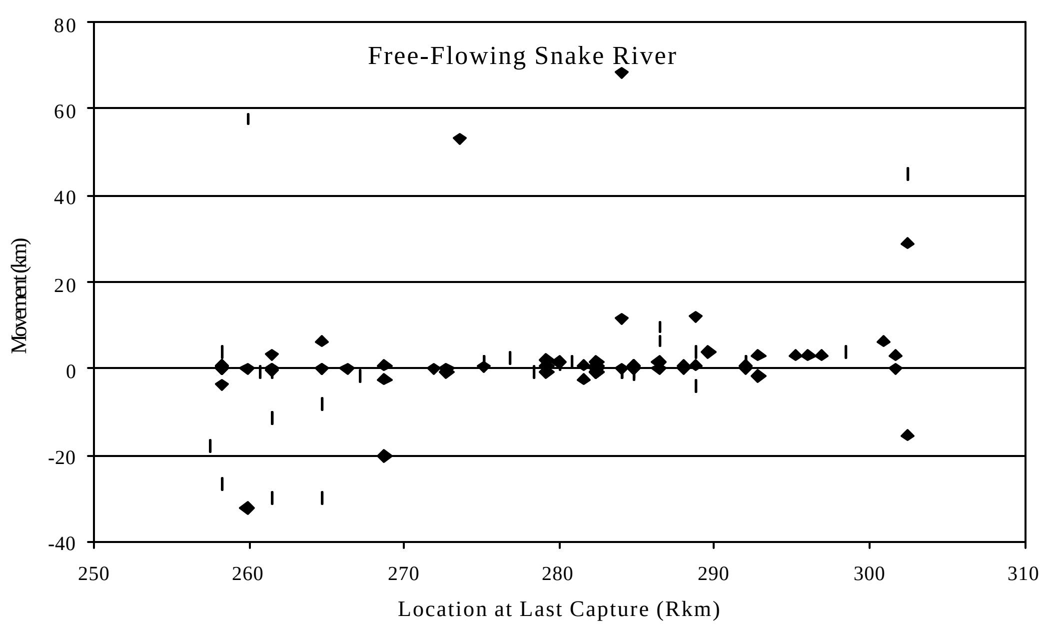

Figure 13. Total movement of 126 recaptured PIT/Floy tagged white sturgeon initially captured in the free-flowing Snake River. Negative values indicate movement downstream and positive values indicate movement upstream.

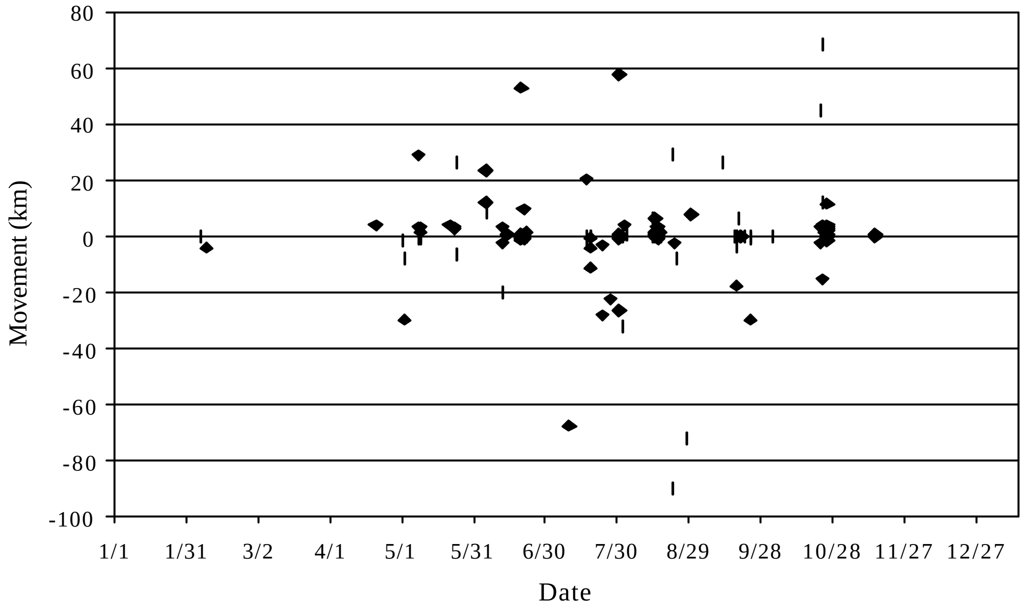

Figure 14. Seasonal movement of 152 recaptured PIT/Floy tagged white sturgeon. Negative values indicate movement downstream and positive values indicate movement upstream.

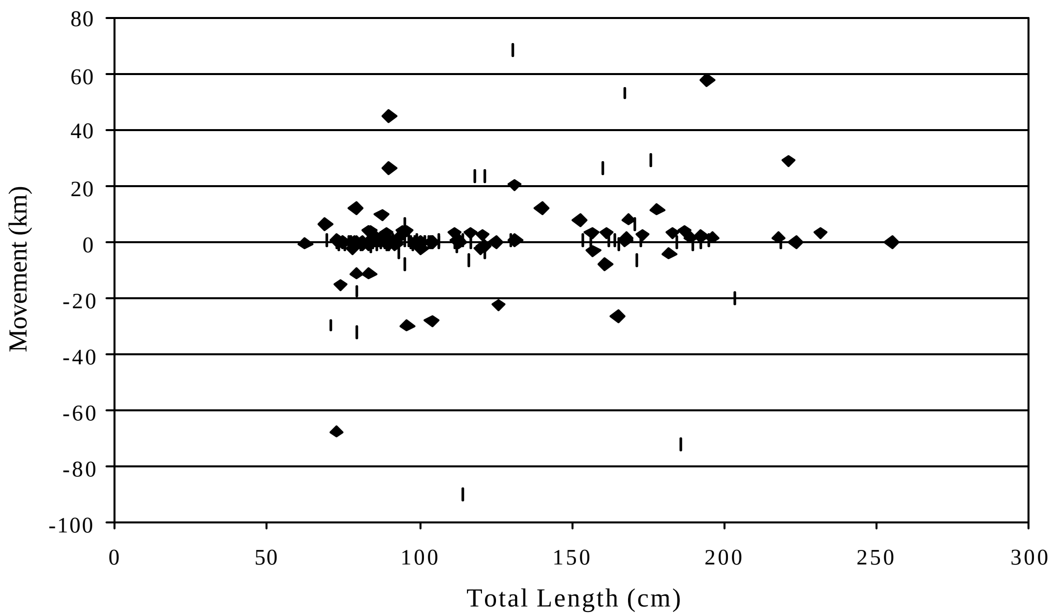

Figure 15. Size and movement of 152 recaptured PIT/Floy tagged white sturgeon. Negative values indicate movement downstream and positive values indicate movement upstream.

DISCUSSION

White sturgeon were not evenly distributed throughout the study area. The catch rate for white sturgeon was lower in Lower Granite Reservoir than the free-flowing Snake River. In Lower Granite Reservoir the highest catch rates were noted in three areas, one near Rkm 188, one near Rkm 206 and one near Rkm 225. As suggested by Lepla (1994), this may be associated with food availability from tributaries nearby (Knoxway Bay, Rkm 188; Steptoe Canyon, Rkm 206; Clearwater River, Rkm 225). In contrast, above Rkm 254 the lowest catch rate calculated for any five km segment was at least double the highest catch rate in Lower Granite Reservoir. 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 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 2001. 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 16). 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 1997-2001, only 56 percent were less than 92 cm, while 34 percent ranged between 92 and 183 cm.

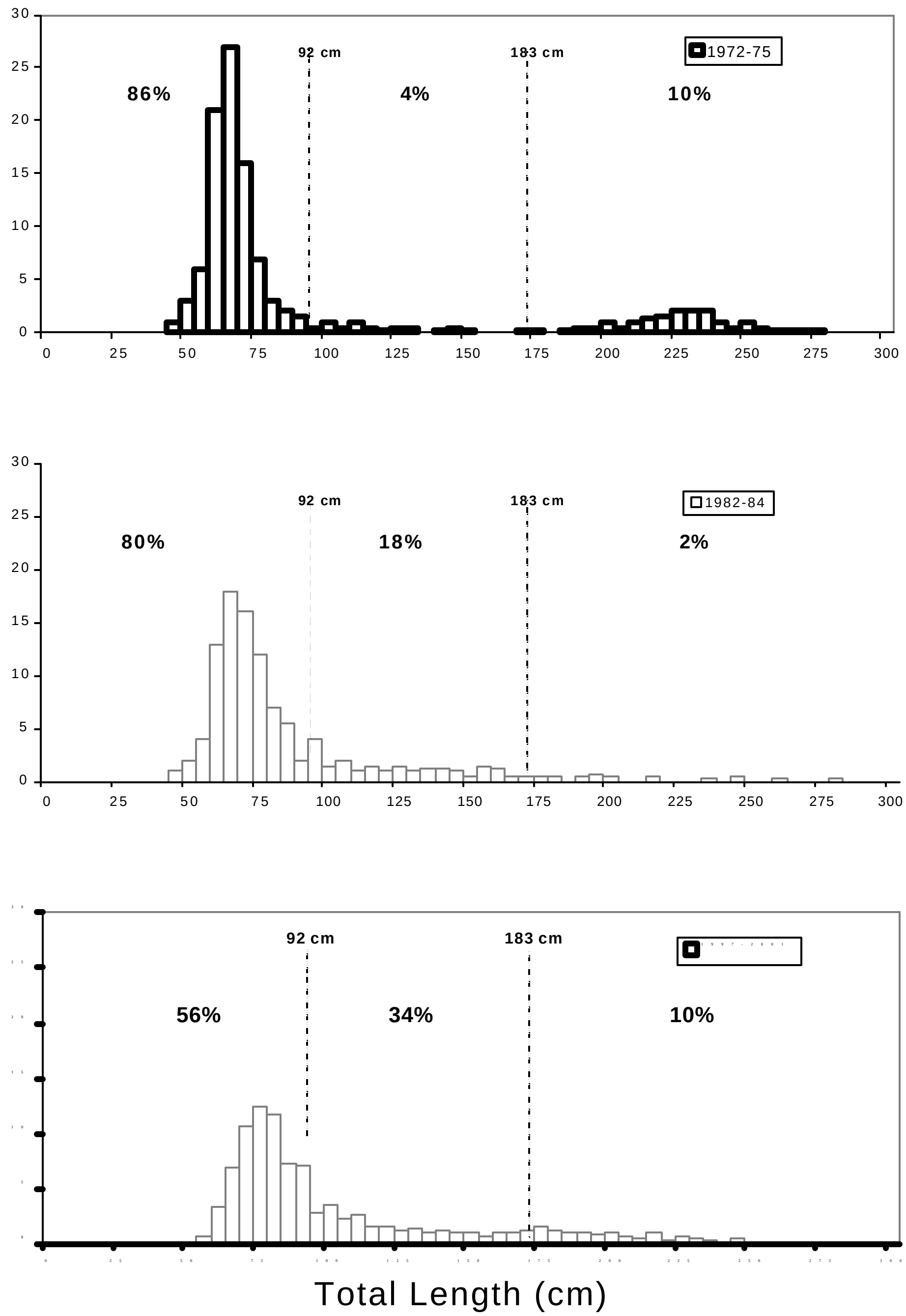

Figure 16. The length (total length) frequency distributions of white sturgeon sampled from the Hells Canyon reaches of the Snake River, 1997-2001, 1982-84 (Lukens 1985), and 1972-75 (Coon et al. 1977) and the percent of the populations < 92 cm, between 92 and 183 cm, and >183 cm.

The 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 31 percent and 23 percent, respectively.

Comparing the historic estimates of Snake River white sturgeon abundance indicates a changing population (Table 6). 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. In addition, Morrill et al. (2001) has observed entrained white sturgeon at the smolt monitoring facility at Lower Granite Dam. 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.

Table 6. 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)	2,621 (Schnabel) 2,483 (Jolly-Seber)	1997-2001	this report

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 2001 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 3,933 (Schnabel) or 4,083 (Jolly-Seber). Further modifications to this estimate may be necessary based on the forthcoming white sturgeon movement and migration analysis. If the degree of emigration is found to be significant, then losses need to be accounted for in the model.

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 17). For 1997-2001, 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 18). Lepla (1994) showed that the relative weight of white sturgeon collected after impoundment was higher than white sturgeon sampled prior to impoundment. For 1997-

2001, 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 19). 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 20, Table 7).

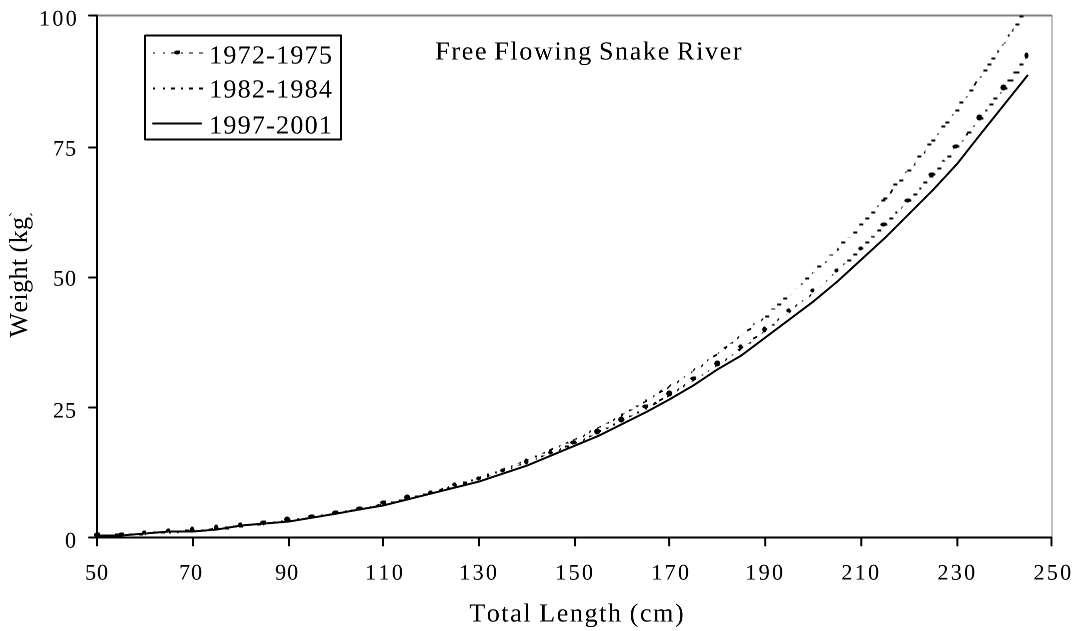

Figure 17. Comparison of the length-weight relationship for white sturgeon sampled from the free-flowing segment of the Snake River during 1997-2001, 1982-84 (Lukens 1985), and 1972-75 (Coon et al. 1977).

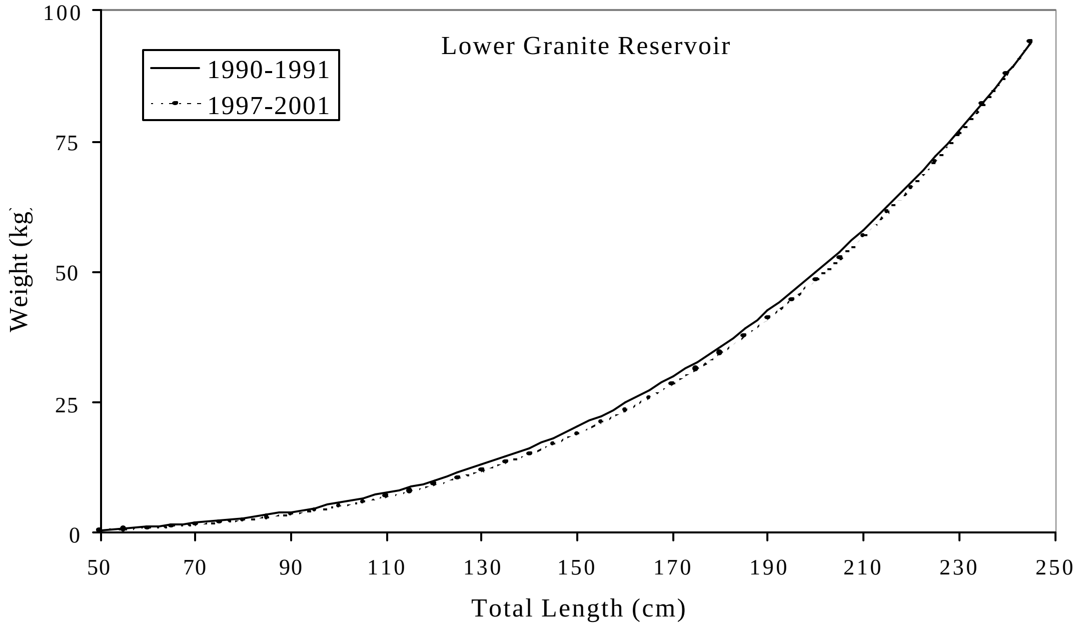

Figure 18. Comparison of the length-weight relationship for white sturgeon sampled from Lower Granite Reservoir during 1997-2001, and 1990-91 (Lepla 1994).

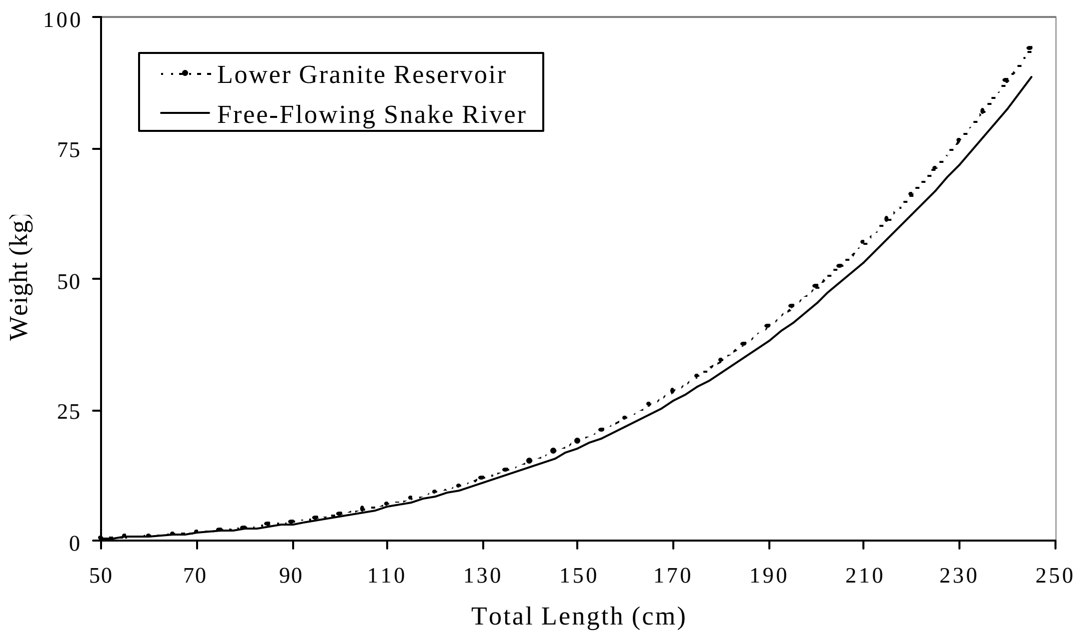

Figure 19. Comparison of the length-weight relationship for white sturgeon sampled from Lower Granite Reservoir and the free-flowing segment of the Snake River during 1997-2001.

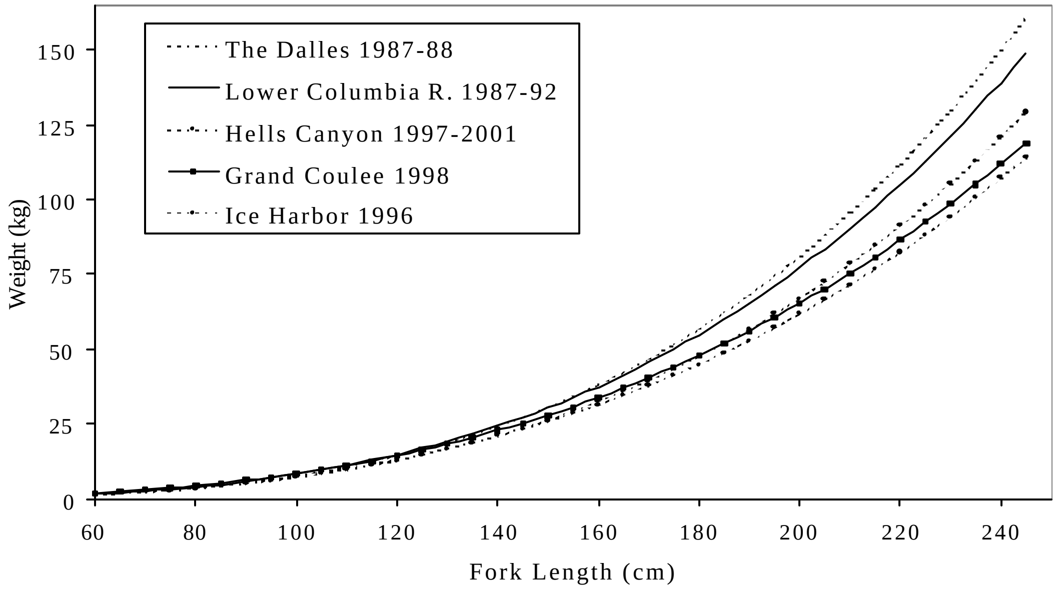

Figure 20. Comparison of the length-weight relationship for white sturgeon sampled from several Columbia River Basin populations. The Hells Canyon curve includes combined data for the Snake River from Lower Granite Dam to Hells Canyon Dam (Lepla et al. 2001).

Table 7. 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 1997-2001	2.39E-06	3.24	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 from 1999 to 2001 from Hells Canyon appear to be growing faster based on age and growth comparisons with historical data (Figure 21). Based on the von Bertalanffy growth equations, white sturgeon age 1 to 20 that were captured from 1972-75 and 1982-84 grew approximately 7.0 cm/year and 6.6 cm/year, respectively. In contrast, white sturgeon captured from 1999-2001 exhibited a growth rate of 9.6 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 22). Table 8 compares the parameters of the von Bertalanffy growth equation for several Columbia River Basin white sturgeon populations.

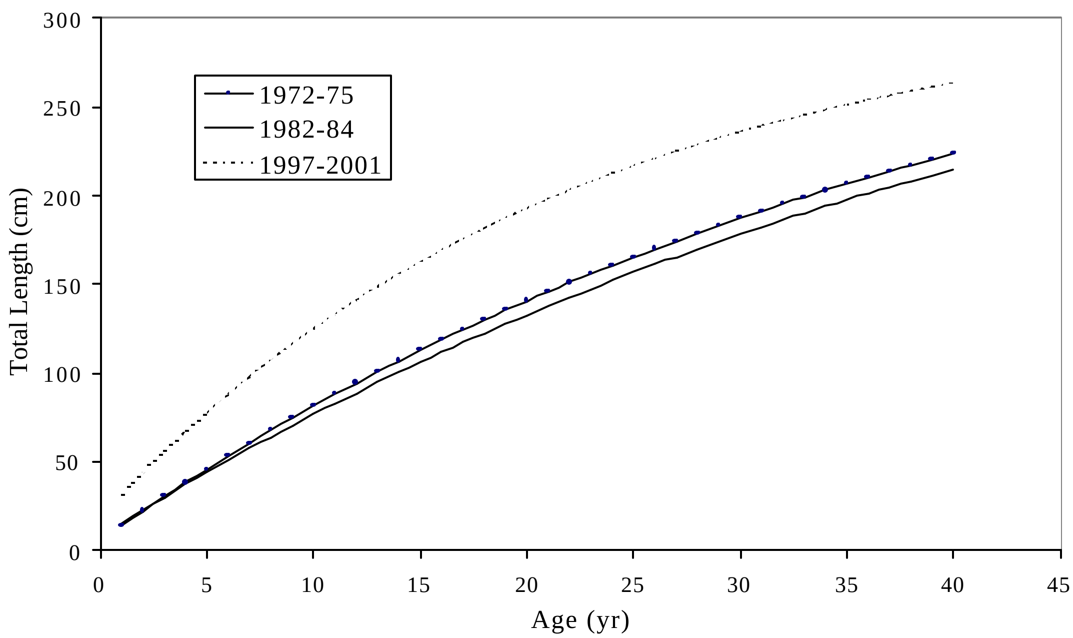

Figure 21. Comparison of the von Bertalanffy growth curves for white sturgeon sampled from the free-flowing segment of the Snake River during 1997-2001, 1982-84 (Lukens 1985), and 1972-75 (Coon et al. 1977).

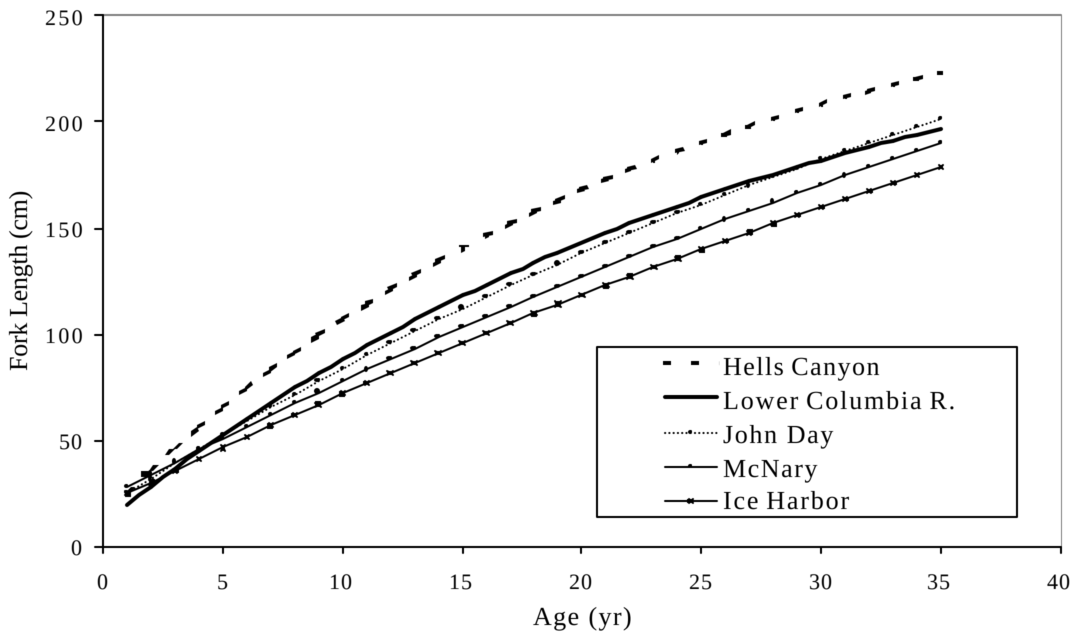

Figure 22. Comparison of the von Bertalanffy growth curves for white sturgeon sampled from several Columbia River Basin populations. The Hells Canyon curve includes combined data for the Snake River from Lower Granite Dam to Hells Canyon Dam (Lepla et al. 2001).

Table 8. Parameters for the von Bertalanffy growth equation* for 12 Columbia River Basin white sturgeon populations.

Location	L_4	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 1997-2001	278	0.046	-1.12	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 spawned in 2001. 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 1997-2001 indicate white sturgeon make migrations between Lower Granite Reservoir and the free-flowing Snake River. A total of 4.7 percent (6 of 126) 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 2001 a majority of our recaptured PIT/Floy tagged fish (130 of 152) 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.

Collecting YOY white sturgeon proved more difficult than anticipated. Using the sampling gear available, the intensity of effort most likely needed to collect appreciable numbers of YOY white sturgeon would be substantial. Therefore, sampling for YOY white sturgeon using setlines will be suspended in 2002. Current Endangered Species Act (ESA) section 10 permits have been applied for and are pending to allow small-mesh (5 cm) diver gillnets to sample for YOY white sturgeon in the Snake and Salmon rivers in 2002.

PLANS FOR 2002

Specific sampling plans and objectives for 2001 are outlined in the Multi-year Study Plan (Hoefs 1997). In 2002, we will 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.

LITERATURE CITED

Apperson, K., and P.J. Anders. 1990. Kootenai River white sturgeon investigations and experimental culture. Annual Progress Report FY 1989. Idaho Department of Fish and Game and Bonneville Power Administration. Contract Number DE-A179-88BP93497, Project 88-65. Portland, OR.

Beamesderfer, R.C. 1993. A standard weight (W_s) equation for White Sturgeon. California Fish and Game. 79(2):63-69.

Beamesderfer, R.C.P., T.A. Rien, and A.A. Nigro. 1995. Differences in the dynamics and potential production of impounded and unimpounded White Sturgeon populations in the Lower Columbia River. Transactions of the American Fisheries Society. 124:857-872.

Bennett, D.L., T.L. Dresser, T.S. Curet, K.B. Lepla, and M.A. Madsen. 1993. Lower Granite Reservoir in-water disposal test: Results of the fishery, benthic and habitat monitoring program-year 4 (1991). Completion report. U.S. Army Corps of Engineers, Walla Walla, WA.

Brennan, J.S., and G.M. Cailliet. 1989. Comparative age-determination techniques for white sturgeon in California. Transactions of the American Fisheries Society. 118:296-310.

Brennan, J.S., and G.M. Cailliet. 1991. Age-determination and validation studies of white sturgeon, *Acipenser transmontanus*, in California. Pages 209-234 in P. Williott, editor. Acipenser. Centre National du Machinisme Agricole du Genie Rural des Eaux et des Forets, Bordeaux, France.

Carmichael, R., L. Lestelle, L. Mobrand, D. Statler, R. Carter, D. Bennett, J. Chandler, K. Lepla, T. Cochnauer, J. Devore, T. Rien, R. McMullin, M. J. Parsley, and A. Seamans. 1997. Upper Snake River White Sturgeon Biological Risk Assessment. Prepared for Nez Perce Tribe by Mobrand Biometrics Inc. Vashon Island, WA.

CBFWA (Columbia Basin Fish and Wildlife Authority). 1997. Draft Multi-year implementation plan for resident fish protection, enhancement and mitigation in the Columbia River Basin. CBFWA Tech. Planning Document. Portland, OR.

Collins, M.R., and T.I.J. Smith. 1996. Sturgeon fin ray removal is nondeleterious. North American Journal of Fisheries Management. 16:939-941.

Coon, J.C. , R.R. Ringe, and T.C. Bjornn. 1977. Abundance, growth and movements of white sturgeon in the mid-snake river. Research Technical Completion Report Project B-026-IDA. Idaho Water Resources Research Institute. University of Idaho. Moscow, ID.

Deary, C., D.A. Scruton, G.H. Niezgoda, S. McKinley, D. Cote, K.D. Clarke, D. Perry, T. Lindstrom, and D. White. 1998. A dynamically switched combined acoustic and radio transmitting (CART) tag: An improved tool for the study of diadromous fishes. Marine Technology Society. 32:63-69.

Devore, J.D., and J.G. Grimes. 1994. Migration and distribution of White Sturgeon in the Columbia River downstream from Bonneville Dam. Pages 83-100 *in* R.C. Beamesderfer and A.A. Nigro, editors. Status and habitat requirements of the White Sturgeon populations in the Columbia river downstream of Mc Nary Dam, Final Report of Research, Volume I. Project Number 86-50, Contract Number DE-AI79-86BP63584 to Bonneville Power Administration, Portland OR.

Devore, J.D., B.W. James, C.A. Tracy, and D.A. Hale. 1995. Dynamics and potential production of White Sturgeon in the unimpounded Lower Columbia River. Transactions of the American Fisheries Society. 124:845-856.

Devore, J.D., B.W. James, D.R. Gilliland, and B.J. Cady. 1998. Report B. Evaluate the success of developing and implementing a management plan for white sturgeon in reservoirs between Bonneville and McNary dams in enhancing production and Describe the life history and population dynamics of subadult and adult white sturgeon upstream of McNary Dam and downstream from Bonneville Dam. Pages 34 to 69 *in* D.L. Ward editor. White Sturgeon mitigation and restoration in the Columbia and Snake Rivers upstream from Bonneville Dam, and Effects of mitigative measures on productivity of white sturgeon populations in the Columbia River downstream of McNary Dam. Annual Progress Report. Project Number 86-50, Contract Number DE-AI79-86BP63584 to Bonneville Power Administration, Portland, OR.

Devore, J.D., B.W. James, and D.R. Gilliland. 1999. Report B. Evaluate the success of developing and implementing a management plan for white sturgeon in reservoirs between Bonneville and McNary dams in enhancing production and Describe the life history and population dynamics of subadult and adult white sturgeon upstream of McNary Dam and downstream from Bonneville Dam. Pages 55 to 93 *in* D.L. Ward editor. White Sturgeon mitigation and restoration in the Columbia and Snake Rivers upstream from Bonneville Dam, and Effects of mitigative measures on productivity of white sturgeon populations in the Columbia River downstream of McNary Dam. Annual Progress Report. Project Number 86-50, Contract Number DE-AI79-86BP63584 to Bonneville Power Administration, Portland, OR.

Devore, J.D., B.W. James, D.R. Gilliland, and B.J. Cady. 2000. Report B. Evaluate the success of developing and implementing a management plan for white sturgeon in reservoirs between Bonneville and McNary dams in enhancing production and Describe the life history and population dynamics of subadult and adult white sturgeon upstream of McNary Dam and downstream from Bonneville Dam, and

Effects of mitigative measures on productivity of white sturgeon populations in the Columbia River downstream of McNary Dam. Pages 41 to 74 *in* D.L. Ward editor. White Sturgeon mitigation and restoration in the Columbia and Snake Rivers upstream from Bonneville Dam. Annual Progress Report. Project Number 86-50, Contract Number DE-AI79-86BP63584 to Bonneville Power Administration, Portland, OR.

Elliott, J.C., and R.C. Beamesderfer. 1990. Comparison of efficiency and selectivity of three gears used to sample white sturgeon in a Columbia River Reservoir. Calif. Fish and Game. 76:174-190.

Everett, S.R., D.L. Scarnecchia, G.J. Power, and C.J. Williams. 2003. Comparison of age and growth of shovelnose sturgeon in the Missouri and Yellowstone Rivers. North American Journal of Fisheries Management.

Everett, S.R., and M.A. Tuell. 2003. Evaluation of potential means of rebuilding sturgeon populations in the Snake River between Lower Granite and Hells Canyon dams. 2000 Annual Report. Report to Bonneville Power Administration. Contract Number 00000333-00023, Project 199700900. Portland, OR.

Haynes, J.M., R.H. Gray, and J.C. Montgomery. 1978. Transactions of the American Fisheries Society. 107(2):275-280.

Hoefs, N.J. 1997. Phase Two: Multi-year study plan to evaluate potential means of rebuilding sturgeon populations in the Snake River between Lower Granite and Hells Canyon Dams. Nez Perce Tribe Department of Fisheries Resource Management and Bonneville Power Administration. Contract Number 97AM30423, Project 199700900. Portland, OR.

Hoefs, N.J. 1998. Evaluation of potential means of rebuilding sturgeon populations in the Snake River between Lower Granite and Hells Canyon dams. 1997 Annual Report. Report to Bonneville Power Administration. Contract Number 97AM30423, Project 199700900. Portland, OR.

IPC (Idaho Power Company). 1997. Status and habitat use of white sturgeon in the Hells Canyon Complex. Formal Consultation Package for Relicensing. Hells Canyon Project, FERC no. 1971. Volume 1. Idaho Power Company. Boise, ID.

Jolly, G. M. 1965. Explicit estimates from capture-recapture data with both death and immigration-Stochastic Model. Biometrika 52:225-247.

Krebs, C.J. 1998. Krebs ecological methodology for windows. Version 0.94. University of Alberta, Edmonton.

Lepla, K.B. 1994. White sturgeon abundance and associated habitat in Lower Granite Reservoir, Washington. Thesis. University of Idaho. Moscow, ID.

Lepla, K.B., J. A. Chandler, and P. Bates. 2001. Status and habitat use by white sturgeon associated with the Hells Canyon Complex. In progress. Idaho Power Company, Boise, ID.

Lukens, J.R. 1985. Hells Canyon White Sturgeon Investigations. Idaho Department of Fish and Game, River and Stream investigations, Job Performance Report, Project No. F-73-R-7. Idaho Fish and Game, Boise, ID.

Manly, B.F.J. 1984. Obtaining confidence limits on parameters of the Jolly-Seber model for capture-recapture. Biometrics 40:749-758.

Marchant, S.R., and M.K. Shutters. 1996. Artificial substrates collect Gulf Sturgeon eggs. North American Journal of Fisheries Management. 16:445-447.

McCabe, T.C., Jr., and L.G. Beckman. 1990. Use of artificial substrate to collect White Sturgeon eggs. California Fish and Game. 76(4):248-250.

McCabe, T.C., Jr. and C.A. Tracy. 1994. Spawning and early life history of White Sturgeon, *Acipenser transmontanus*, in the lower Columbia River. Fisheries Bulletin. 92:760-772.

Misra, R. K. 1980. Statistical comparisons of several growth curves of the von Bertalanffy type. Canadian Journal of Fisheries and Aquatic Sciences. 37:920-926.

Moreau, J. 1987. Mathematical and biological expression of growth in fishes: Recent trend and further developments. Pages 81-113 *in* R.C. Summerfelt and G. E. Hall, editors. The age and growth of fish. The Iowa State University Press, Ames.

Morrill, C., F. Mensik, and D. Ross. 2001. Lower Granite Dam smolt monitoring program. Annual Report. Project Number 198712700, Contract Number 1998GR02117 to Bonneville Power Administration, Portland, OR.

North, J.A., R.C. Beamesderfer, and T.A. Rien. 1993. Distribution and movements of white sturgeon in three lower Columbia River reservoirs. Northwest Science 67:105-111.

North, J. A., T. A. Rien, and R. A. Farr. 1996. Report A. Evaluate success of developing and implementing a management plan for white sturgeon in reservoirs between Bonneville and McNary dams in enhancing production and Evaluate growth, mortality, and contributions to fisheries of juvenile white sturgeon transplanted from areas downstream from The Dalles Dam to areas in The Dalles and John Day reservoirs. Pages 5 to 36 *in* K. T. Beiningen, editor. Effects of mitigative measures on productivity of white sturgeon populations in the Columbia River downstream of McNary Dam, and determine the status and habitat requirements of white sturgeon populations in the Columbia and Snake rivers upstream from McNary Dam. Annual Progress Report. Project Number 86-50, Contract Number DE-AI79-86BP63584 to Bonneville Power Administration, Portland, OR.

NPPC (Northwest Power Planning Council). 1994. 1994 Columbia River Basin fish and wildlife program. Northwest Power Planning Council, Portland, OR.

Paragamian, V.L., G. Kruse, and V.D. Wakkinen. 1999. Kootenai River white sturgeon investigation: Kootenai River White Sturgeon spawning and recruitment evaluation. Annual Progress Report. Project Number 88-65. Contract Number DE-AI79-88B193497 to Bonneville Power Administration, Portland, OR.

Parsley, M.J., L.G. Beckman, and G.T. McCabe. 1993. Spawning and rearing habitat use by White Sturgeons in the Columbia River downstream of McNary Dam. Transactions of the American Fisheries Society. 122:217-227.

Parsley, M.J., and K.M. Kappenman. 2000. White Sturgeon spawning areas in the Lower Snake River. Northwest Science. 74:192-201.

Rien, T.A., J.A. North, and R.A. Farr. 1997. Report A1. Description of the life history and population dynamics of subadult and adult white sturgeon in the Columbia River between McNary, Priest Rapids, and Ice Harbor dams. Pages 7 to 29 *in* T.A. Rien and K. T. Beiningen, editors. Effects of mitigative measures on productivity of white sturgeon populations in the Columbia River downstream of McNary Dam, and Determine the status and habitat requirements of white sturgeon populations in the Columbia and Snake rivers upstream from McNary Dam. Annual Progress Report. Project Number 86-50, Contract Number DE-AI79-86BP63584 to Bonneville Power Administration, Portland, OR.

Rossiter, A., D.L.G. Noakes, and F.W.H. Beamish. 1995. Validation of age estimation for the lake sturgeon. Transactions of the American Fisheries Society. 124:777-781.

Schnabel, Z.E. 1938. The estimation of the total fish population of a lake. American Mathematics Monograph 45:348-352.

Seber, G. A. F. 1982. A note on the multiple recapture census. Biometrika 52:249-259.

Sherrod, P.H. 1992. NLREG, Nonlinear Regression Analysis Program. Version 5.1. Nashville, TN.

Thomas, M.V., and R.C. Hass. 1999. Capture of Lake Sturgeon with setlines in the St. Clair River, Michigan. North American Journal of Fisheries Management. 19:610-612.

Tracy, C.A., and M.F. Wall. 1994. Length at age relationships for White Sturgeon in the Columbia River downstream from Bonneville Dam. Pages 185-200 *in* R.C. Beamesderfer and A.A. Nigro, editors. Status and habitat requirements of the White Sturgeon populations in the Columbia river downstream of Mc Nary Dam, Final Report of Research, Volume II. Project Number 86-50, Contract Number DE-AI79-86BP63584 to Bonneville Power Administration, Portland OR.

Tuell, M.A., and S.R. Everett. 2000. Evaluation of potential means of rebuilding sturgeon populations in the Snake River between Lower Granite and Hells Canyon dams. 1998 Annual Report. Report to Bonneville Power Administration. Contract Number 97AM30423, Project 199700900. Portland, OR.

Tuell, M.A., and S.R. Everett. 2003. Evaluation of potential means of rebuilding sturgeon populations in the Snake River between Lower Granite and Hells Canyon dams. 1999 Annual Report. Report to Bonneville Power Administration. Contract Number 97AM30423, Project 199700900. Portland, OR.

Wilson, N.C. 1987. Age determination of Lake Sturgeon (Acipenser fulvescens) by use of the marginal pectoral fin ray. Pages 77-83 in C.H. Oliver, editor. Proceedings of a workshop on the Lake Sturgeon. Ontario Ministry of Natural Resources, Ontario Fisheries Technical Report Series 23, Toronto.

Zar, J.H. 1996. Biostatistical Analysis. Prentice-Hall, Englewood Cliffs, New Jersey.

APPENDIX A

2001 White Sturgeon Capture and Marking Data

Table A-1. White sturgeon capture data collected in 2001.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
6-Feb-01	1510083239		284.8	72	82.5	25	2.6
6-Feb-01	1510100032	843	169.5	73.5	82.5	3.2	26.5
6-Feb-01	1510080154	958	175.5	78	87	3.4	28
7-Feb-01	151008282A	511	170	81	93	4.4	32
8-Feb-01	1510105C6C	844	179.5	172	182	47.6	76
10-Apr-01	1510103118	846	126	75.5	86	3.2	32.5
10-Apr-01	7F78035639	845	126	102	117	9.0	49.5
17-Apr-01	151010506E		138.5	55.5	65.5	1.0	22
20-Apr-01	1510103A66	513	138.5	44.5	51	0.6	17
20-Apr-01	1510101E14	847	131	52	58.5	1.1	19.5
20-Apr-01	1510082462	514	139	88	98.5	5.6	36.5
20-Apr-01	1510080062	360	131.5	84.5	95.5	5.9	37.5
1-May-01	1510103449	515	166	109.5	121	10.2	44.5
2-May-01	1510101C12	519	164.5	62	70.5	1.5	23.5
2-May-01	1510081426	518	166	59.5	69.5	1.9	23
2-May-01	1510103A3A	517	168	73.5	86.5	3.0	20.5
2-May-01	1510084409	520	164.5	81.5	95	3.1	29
2-May-01	1510106150	521	164.5	171.5	199.5	37.3	68.5
2-May-01	151010322A	522	164.5	173.5	192	41.7	76
3-May-01	151008440C	848	168	127	139.5	14.5	49
8-May-01	1510102E58	533	183.5	56.5	65	1.5	21.5
8-May-01	1510103A24	534	183.5	59.5	69	1.8	22
8-May-01	1510101A56	535	183.5	61	71	1.8	20
8-May-01	1510084A41	527	172	66	76.5	2.0	22.5
8-May-01	1510083C60	536	183.5	65.5	77	2.1	23
8-May-01	1510107A50	528	172	67	78.5	2.3	27
8-May-01	1510102841	523	169	68.5	79	2.4	26
8-May-01	1510103172	538	183.5	74	84	2.7	26.5
8-May-01	1510083C46	524	169	75.5	85	2.9	25.5
8-May-01	1510080674	567	183.5	79.5	93	3.7	30
8-May-01	1510103939	526	172	83	96.5	4.1	30
8-May-01	1510102C36	531	179	98.5	111	6.0	34
8-May-01	1510100831	532	182	101.5	116.5	6.6	34.5
8-May-01	1510106110	525	169	120.5	139	13.4	53
8-May-01	1510082464	530	173	147	165.5	24.7	65
8-May-01	151010484E	91	188	190.5	221		84
9-May-01	1510100E58	540	180	53	63.5	1.1	19.5
9-May-01	1510083E66	539	179	57	63	1.4	20.5

Table A-1 cont. White sturgeon capture data collected in 2001.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
9-May-01	1510103036	544	173.5	73	83.5	2.3	26.5
9-May-01	1510106E60	543	173.5	78	87	2.9	28.5
9-May-01	1510102424	809	173.5	79	92	3.0	28
9-May-01	1510100A71	542	174.5	80	86	3.0	28.5
9-May-01	1510103221	1001	169	91	100	5.9	38
9-May-01	1510106E38	541	183.5	206	231.5	59.0	82
10-May-01	1510102650	545	179	60	68	1.4	22.5
10-May-01	1510103276	302	173.5	64	74	1.6	24
10-May-01	1510082A34	550	173.5	67	72	1.6	20
10-May-01	1510101C50	547	179.5	59	67	1.9	21.5
10-May-01	1510105218	548	180	71	79	2.1	22
10-May-01	1510102904	546	179	78	88	3.4	30
10-May-01	151010214C	549	180	147.5	161	26.2	67
11-May-01	1510080152	856	173.5	59	66	2.0	24
11-May-01	1510081E68	304	179	74	81.5	2.4	24.5
11-May-01	7F7D020633	857	173.5	69.5	80	2.7	28
11-May-01	1510102469	858	173.5	77	87.5	3.6	27.5
11-May-01	1510103179	859	176	185.5	205.5	47.4	72.5
16-May-01	1510083A4C	306	126	92.5	103	5.8	39
16-May-01	151008505E	262	122	150.5	165.5	26.4	63
21-May-01	151008223A		130.5	150.2	187	32.2	69.5
23-May-01	1510102210		137.5	104.5	120.5	8.2	43.5
23-May-01	1510103E0A		137.5	101	116.5	9.4	47
23-May-01	1510105411		134.5	139.5	156.5	24.5	64.5
24-May-01	1510084404		130	88	99.5	5.1	36.5
24-May-01	1510080039		130.5	85.5	98	5.7	44.5
24-May-01	1510101A7E		130.5	109	123	8.3	46
24-May-01	1510102A6E		131.5	108	116	9.4	40
24-May-01	1510102648	756	135.5	151	171	26.5	63
24-May-01	1510105164		139.5	147.5	160	27.1	60
5-Jun-01	1510102672	308	142.5	74	84	2.5	25
5-Jun-01	151008361E		140.5	107.5	121.5	9.3	45
5-Jun-01	1510100C02	845	140.5	106	118	10.4	48
5-Jun-01	421E143178		143	113	125	11.5	48.5
5-Jun-01	1510100902	307	142	128	142	16.1	55.5
5-Jun-01	1510083E6C	757	143	127.5	140	17.1	55
5-Jun-01	4158683316		140.5	151.5	168.5	27.8	68
12-Jun-01	1510083156	309	162.5	58	64	1.3	11.5
12-Jun-01	1510102259	272	167	68	78	2.5	24.5
12-Jun-01	151008312A		162.5	77.5	89	2.5	29.5

Table A-1 cont. White sturgeon capture data collected in 2001

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
12-Jun-01	1510104218		160.5	78.5	85	3.0	29.5
12-Jun-01	1510081456	315	165	98	111	6.4	47
12-Jun-01	1510106814		162.5	100	112	6.7	39
12-Jun-01	1510104930	1083	161.5	113	125	9.5	44
12-Jun-01	1510102954	798	167	181	203.5	44.5	76
13-Jun-01	1510105920	610	159.5	37.5	41.5	0.5	15.5
13-Jun-01	1510083211	612	162.5	58.5	67	1.4	22
13-Jun-01	1510101C21	316	167	75	84.5	2.8	26.5
13-Jun-01	1510102A68	317	167	208.5	234.5	91.6	94
14-Jun-01	1510083A61	608	162.5	53.5	63	1.3	20
14-Jun-01	1510107A7C	609	160.5	79	91	3.1	30
14-Jun-01	1510101106	1042	165	76.5	86	3.3	30
14-Jun-01	1510106E56	604	167	151	164	29.7	67
15-Jun-01	1510102488		156.5	222	235		89
20-Jun-01	1510105870	603	169	48.9	56.5	0.6	18.5
20-Jun-01	1510082851	732	184	52	60	0.7	21
20-Jun-01	1510085126	731	183	61	69.5	0.8	20.5
20-Jun-01	1510085A34	711	172.5	53	59.5	0.9	19.5
20-Jun-01	1510104036	704	170	57.5	65.5	1.0	20
20-Jun-01	1510082831	733	186.5	64	73	1.1	25
20-Jun-01	1510103416	708	172	54	65	1.1	20
20-Jun-01	151010263E	729	181.5	63.5	70.5	1.4	21
20-Jun-01	151010310C	709	172	66.5	76.9	1.5	21.5
20-Jun-01	151008061A	710	172	56.5	66.5	1.5	31.5
20-Jun-01	1510080679	719	175.5	66	73.5	1.6	22.5
20-Jun-01	1510102260	714	175	66	73	1.6	23.5
20-Jun-01	1510080E2C	728	181.5	66	73	1.6	24.5
20-Jun-01	1510101C2E	713	172.5	64	72	1.6	23.5
20-Jun-01	1510106E72	1027	177	66.5	78.4	1.7	22.5
20-Jun-01	1510082828	826	175.5	67.5	75.5	1.7	22.5
20-Jun-01	1510082A26	722	177	62	72	1.7	25
20-Jun-01	1510103A06	712	172.5	65	73.5	1.8	23.5
20-Jun-01	1510102C72	721	175.5	64.5	73	1.8	23.5
20-Jun-01	151010144A	707	172	73	82	1.9	25.5
20-Jun-01	1510105C5C	726	177	62	70.5	1.9	26
20-Jun-01	1510102034	717	175.5	76	85	2.0	25
20-Jun-01	151010296E	724	177	71	77.5	2.0	24.5
20-Jun-01	151010215E	725	177	70	77.5	2.2	25.5
20-Jun-01	151008210C	703	169.5	71.5	83	2.2	25
20-Jun-01	151008482E	720	175.5	71.5	81.9	2.3	25
20-Jun-01	1510084959	801	169.5	76	88.5	2.4	26.5

Table A-1 cont. White sturgeon capture data collected in 2001.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
20-Jun-01	151003831	727	177	75.5	86.5	2.4	26.5
20-Jun-01	151008390A	602	169.5	70.5	82.5	2.5	26
20-Jun-01	1510102E49	718	175.5	78	87.5	2.7	26.5
20-Jun-01	1510101629	723	177	79	89.5	2.8	27
20-Jun-01	1510100E04	601	169.5	91	104	3.8	32.5
20-Jun-01	1510101A62		169.5	86	97.5	4.3	33.5
20-Jun-01	1510104C5C		170	143.5	167	21.5	55
20-Jun-01	1510081864	734	187	246	266		101.5
20-Jun-01	151010321A		181.5	190	217.5		93.5
20-Jun-01	1510080078	730	181.5	95.5	105.5		41.5
20-Jun-01	1510124266	706	172	60	68		20
20-Jun-01	151010313A	705	172	45.5	52		17
21-Jun-01	1510082926	746	175.5	59	67.5	0.7	22.5
21-Jun-01	1510106E2C	865	177	54.5	60	0.9	20.5
21-Jun-01	1510080618	750	175.5	56.5	65.5	1.0	23
21-Jun-01	151010307E	738	172	61	69	1.1	23
21-Jun-01	1510102479	864	177	54.5	60.5	1.1	21.5
21-Jun-01	1510100E22	749	175.5	62.5	72	1.2	21.5
21-Jun-01	1510106E00	739	172.5	61	69	1.3	23
21-Jun-01	1510102440	744	175.5	64	72.5	1.4	23.5
21-Jun-01	81FT3C983DL	873	186.5	62	70	1.4	22
21-Jun-01	1510106219	862	177	58.5	66	1.4	22
21-Jun-01	1510084222	737	172	61.5	69.5	1.5	24
21-Jun-01	1510085E46	740	172.5	65	73	1.6	21.5
21-Jun-01	1510100E06	869	181.5	65	73	1.6	24
21-Jun-01	1510100679	748	175.5	71	80.5	1.7	24.5
21-Jun-01	1510103A5C	745	175.5	70	80.5	1.8	27.5
21-Jun-01	1510104451	863	177	64	73.5	1.8	25
21-Jun-01	1510104E59	819	175.5	77	89.5	2.2	28.5
21-Jun-01	1510105972	861	177	84	91	2.5	28.5
21-Jun-01	1510101A4A	741	175	76	86.5	2.6	30
21-Jun-01	151010322E		175.5	76.5	88.5	2.7	30
21-Jun-01	1510104069	866	178	79	87.5	2.7	26
21-Jun-01	1510105619	868	180.5	76.5	82	2.7	27
21-Jun-01	151010365E	871	181.5	78	89	2.9	28.5
21-Jun-01	1510103010	673	181.5	90.5	99	4.1	31
21-Jun-01	1510104669	735	170	93.5	106.5	6.0	35
21-Jun-01	151008194C	870	181.5	99.5	105.5	7.3	42
21-Jun-01	1510080149	674	181.5	159	172.5	29.3	64
21-Jun-01	1510083E0C	736	170	184.5	210	53.9	81.5
22-Jun-01	1510101464	886	177	50	57.5	0.7	19.5

Table A-1 cont. White sturgeon capture data collected in 2001.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
22-Jun-01	1510103234	874	185.5	51	58.5	0.9	18
22-Jun-01	1510083E06		170	63.5	72	1.1	21.5
22-Jun-01	1510100068	884	177	59	69.5	1.4	22
22-Jun-01	1510107A41	880	180.5	55	62	1.4	21.5
22-Jun-01		881	177	64	71.5	1.6	22
22-Jun-01	1510100E46	885	177	63	69.5	1.6	23.5
22-Jun-01	1510084114	875	183	61	68	1.6	23.5
22-Jun-01	1510103230		175.5	60.5	70.5	1.8	24.5
22-Jun-01	151008125C	283	177	70.5	77.5	2.0	24.5
22-Jun-01	1510104472	877	181.5	67.5	75.5	2.0	22.5
22-Jun-01	1510104816	878	181.5	66	74.5	2.0	25.5
22-Jun-01	1510082659		175.5	67	78.5	2.2	23.5
22-Jun-01	1510103A22	883	177	71	81.5	2.3	26
22-Jun-01	1510100E6A	876	183	66	75	2.3	26
22-Jun-01	1510102442	879	181.5	74.5	84	2.9	27.5
22-Jun-01	1510100A71	542	175.5	81	93	3.5	28.5
22-Jun-01	1510103626		170	95.5	107	6.2	38.5
22-Jun-01	1510085132		175.5	201	223.5		86
26-Jun-01	1510101A34		11.5	103	117	7.7	44.5
26-Jun-01	1510102C64	887	18.5	121	134	13.8	49.5
26-Jun-01	1510101228		1.5	203.5	223	49.4	92.3
27-Jun-01	1510082909		1.5	60.5	66	1.6	24
27-Jun-01	15101017A54	888	10.5	208	234.5	72.6	89
28-Jun-01	1510105C66		16.5	144	155	24.7	64
28-Jun-01	151010242A		15.5	160	182.5	50.3	69.5
29-Jun-01	151008247C	894	0	82	93.5	3.4	29
29-Jun-01	1510103F51	893	10.5	109	121.5	10.9	46
29-Jun-01	1510082231	890	14.5	157	173.5	31.3	64
29-Jun-01	1510082950	889	15	164	186	34.9	68
29-Jun-01	1510104A14	891	14.5	215.5	230.5	62.1	80
6-Jul-01	151010562A	895	276.7	89	99	39	4.6
10-Jul-01	151010562A	896	130	64	72.5	2.0	25.5
17-Jul-01	1510106141		143	58	64	2.0	23
17-Jul-01	1510104E6A		143.5	73	79	3.3	28
17-Jul-01	1510082E6E	998	140	98.5	112	7.8	40
17-Jul-01	1F2E2E0C79		141	116	131	14.2	52.5
17-Jul-01	1510105458		140	134	158	25.2	66
18-Jul-01	1510102901		140.5	64	73	2.3	28
18-Jul-01	1510083C62		140	122	134	17.2	60
19-Jul-01	151010583A	899	261.5	55	62.5	19.5	1.1
19-Jul-01	1510102A6C	898	261.5	62.5	70	22.5	1.6
19-Jul-01	151008264A	900	261.5	71	79.5	24.5	2.3

Table A-1 cont. White sturgeon capture data collected in 2001.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
19-Jul-01	1510100032		261.5	73	83.5	26	2.3
19-Jul-01	1510083206	850	261.5	80.2	92	32	3.6
19-Jul-01	151008340A	473	261.5	91.5	103	34	5.0
19-Jul-01	1510106231		261.5	94	104	36.5	8.2
19-Jul-01	1510083E12		140.5	48.5	55.5	1.4	19
19-Jul-01	1510103650		140	112	121	9.9	46.5
24-Jul-01	1510083144	908	117.5	90	104	2.3	35.5
24-Jul-01	1510083214		122.5	98	109	6.8	40
24-Jul-01	1510083E29		125	142	157	23.6	63
24-Jul-01	1510105610		111.5	169.5	184.5	37.4	74.5
25-Jul-01	1510102146		121.5	55	65	0.9	21.5
27-Jul-01	1510085C71		125	75	87	3.7	34
27-Jul-01	1510103019		125	77	87	4.0	35
27-Jul-01	1510084A34		117.5	111	126	13.6	53
31-Jul-01	151010465C		165.5	51.5	61	1.2	17.5
31-Jul-01	1510081868	1039	162	73	83.5	3.0	27.5
31-Jul-01	1510103602		165.5	77.5	87	3.4	28
31-Jul-01	1510105018		160.5	85	95	4.3	32
31-Jul-01	1510102626		165.5	102	116	6.9	36.5
31-Jul-01	1510101962		164.5	141	156	19.4	46.5
31-Jul-01	151008265C		165.5	139	156	22.5	57
31-Jul-01	1510081916	1047	160.5	145	165	22.7	62
31-Jul-01	151008312C		161.5	171	194.5	46.4	81
31-Jul-01	1510101A5A		164	190.5	217.5	54.6	76.5
31-Jul-01	1510102232		167	246	276.5		118.5
31-Jul-01	1510082A29		162	227.5	253		104
31-Jul-01	1510101662		160.5	226	250.5		101
1-Aug-01	1510084418		162	55	64	1.1	22
1-Aug-01	1510100E2C		162	61.5	67	1.4	22
1-Aug-01	1510105409		160.5	66	72.5	1.6	25
1-Aug-01	1510082206		162	63	73	1.7	22.5
1-Aug-01	1F4D194D2E		161.5	68.5	79.5	1.9	23
1-Aug-01	151010611C		160.5	87	96.5	3.9	30
1-Aug-01	1510101C6C		162	66.5	78	3.9	24.5
1-Aug-01	1510101014	117	160.5	88	98.5	4.3	33
1-Aug-01	1510102C16		160.5	99	112.5	6.8	40.5
1-Aug-01	151010764C		164.5	235	268	106.0	95
2-Aug-01	1510101A70	853	162	73	81	2.5	26.5
2-Aug-01	1510107036		160.5	72	84	2.6	26
2-Aug-01	41582A7464		160.5	85	98	4.5	33
2-Aug-01	415B544202		164.5	218	239	102.6	104

Table A-1 cont. White sturgeon capture data collected in 2001.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
3-Aug-01	415C080C0A		161.5	51.5	62	1.2	20
3-Aug-01	1510083C12	773	160.5	83.5	90	3.9	30
3-Aug-01	1510105250		160.5	94	106	5.9	36
3-Aug-01	151008007A	249	160.5	137	153.5	22.5	55
14-Aug-01	1510101A10		179	62	71	1.4	23.5
14-Aug-01	7F7F535C06		177.5	61	68.5	1.6	21
14-Aug-01	1510103E31		174	74	82.5	2.5	25
14-Aug-01	1510105A3C		178	153.5	170.5	27.2	61.5
14-Aug-01	1510101E4A		179	177	193.5	45.4	58
14-Aug-01	1510102270		179	236	255		90
15-Aug-01	415B576E2E		187.5	48	55	0.9	18.5
15-Aug-01	151010617E		182	52	59	1.2	21
15-Aug-01	1510105A70		187	61	69	1.2	23
15-Aug-01	415B601272		187.5	59	62.5	1.4	19.5
15-Aug-01	7F7D0D735E		182	77	88	1.4	29
15-Aug-01	7F7F571709		187.5	63	70	1.5	21.5
15-Aug-01	415B68171C		188	63	68	1.5	32
15-Aug-01	415E5B5C3C		182	62	69	1.8	22.5
15-Aug-01	1510101448		178	69	75	2.1	23
15-Aug-01	415C197727		187.5	82	93	3.0	30
15-Aug-01	1510107908	284	177	76	86.5	3.4	27
15-Aug-01	41585A301D		177.5	81.5	90	3.6	27
15-Aug-01	1510107628	174	177	99	114	5.9	36.5
15-Aug-01	1510085E6A		178	146	168	19.0	57
15-Aug-01	1510081E04		181.5	169	196	28.5	63
16-Aug-01	415B452117		182	62	72.5	1.4	22.5
16-Aug-01	415B072111		179.5	61.5	72.5	1.4	22.5
16-Aug-01	415B504119		182	61	70.5	1.4	23
16-Aug-01	41560C1F20		187.5	64.5	74.5	1.8	22
16-Aug-01	415A612572		197.5	64	72.5	1.8	23
16-Aug-01	415C1B4509		182	67	77.5	2.0	26.5
16-Aug-01	415A7B1553		197.5	70	81.5	2.4	25.5
16-Aug-01	1510106250		177	80	89	2.9	25
16-Aug-01	415B445729		178.5	85.5	98.5	3.2	29
16-Aug-01	415866332A		177	78.5	86	3.2	27
16-Aug-01	415B5D7008		187.5	77	87	3.3	31
16-Aug-01	1510085679		177	82	92	3.6	30
16-Aug-01	1510084E4E	967	177	83	91	4.1	30.5
16-Aug-01	1510081238		187.5	98	111.5	6.8	39
16-Aug-01	1510083201	676	179	116	130	8.6	37
16-Aug-01	415C164A0D		187.5	112	129	10.0	43.5

Table A-1cont. White sturgeon capture data collected in 2001.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
16-Aug-01	1510101E56	817	174	123.5	131.5	16.6	54.5
16-Aug-01	1510080149	674	181.5	160	184.5	26.7	63.3
16-Aug-01	1510085A39		174	192.5	218	48.1	78
16-Aug-01	415B584908		182	192.5	222	69.2	82.5
16-Aug-01	4158141354		179.5	270.5	306.5		112.5
17-Aug-01	4158560D44		181.5	59.5	66	1.6	24.5
17-Aug-01	4158566E29		187.5	59.5	65	1.6	21
17-Aug-01	4158557278		181.5	67.5	76	1.8	22.5
17-Aug-01	41586B5B59		177	70.5	75	1.8	21.5
17-Aug-01	41586A3C3A		177	67.5	73.5	2.0	25
17-Aug-01	151010215E	725	177	71.5	75	2.5	24.5
17-Aug-01	415C197727		187.5	79	90	2.7	20
17-Aug-01	1510101629	723	177	80.5	84.5	2.9	27
17-Aug-01	1510083616		181.5	167	189	27.7	62
21-Aug-01	415B452034		125.5	72	85	3.0	30
21-Aug-01	1510082650		125.5	115.5	133	9.8	48
22-Aug-01	1F4D47430A		117.5	100	114	11.2	35.5
22-Aug-01	22154A7F30		125.5	107	125	12.9	51
22-Aug-01	1510106E2A	378	127	152.5	176	28.4	67
22-Aug-01	415A722C08		127	152	181	30.1	71
23-Aug-01	1510102E28	558	116.5	87	100.5	4.6	33.5
23-Aug-01	1510104C00		127	122	137	13.7	51
24-Aug-01	1510104121	44	114	150	161	24.5	63
24-Aug-01	41581D1E68		127	139.5	160	25.7	67.5
28-Aug-01	1510082904		131.5	168	185.5	39.9	75.5
29-Aug-01	4158615F73		131.5	121	130.5	18.8	62.5
30-Aug-01	41585E5645	11	133	142	152.5	25.4	73
12-Sep-01	1510100218		142.5	77.5	90	3.5	29.5
13-Sep-01	1510101029	1276	142.5	99	115	5.1	44
17-Sep-01	151008264A		261.5	74	81	24	2.3
17-Sep-01	1510100032		261.5	74	83	24	2.5
18-Sep-01	151008242E	1283	258.2	83.5	93	29	3.6
18-Sep-01	151010611C	1285	258.2	87.5	101.5	29.5	3.9
18-Sep-01	4159042321	1284	258.2	91	104	30.5	4.0
18-Sep-01	41586B7411		160	64.5	71.5	1.8	25.5
18-Sep-01	151010705E		160	70	79	2.3	25.5
18-Sep-01	41584D5363	1282	161.5	78.5	92	2.7	24
18-Sep-01	1510101108	1096	164.5	78	89.5	3.1	27
18-Sep-01	151010447A	1278	164.5	89	102	4.7	31
18-Sep-01	415851603E	1281	164.5	90.5	104.5	5.2	35
18-Sep-01	1510101630	1280	164.5	95	108.5	5.5	34.5

Table A-1 cont. White sturgeon capture data collected in 2001.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
18-Sep-01	1510102626	1277	165.5	97	113	7.4	40
19-Sep-01	415847432D		276.7	69.5	80	27	2.3
19-Sep-01	4158591A1F		160	58	63.5	1.1	21.5
19-Sep-01	1510101030	1283	164.5	82	95	3.3	29.5
19-Sep-01	4158652F7B	1284	164.5	114	131	11.4	44
20-Sep-01	7F7F76213D		258.2	77.5	88.5	29.5	2.9
20-Sep-01	41585A6634	1289	261.5	84	97	29.5	3.5
20-Sep-01	4159042321	1284	258.2	91	104	30.5	4.0
20-Sep-01	1510105018		258.2	86	97	32.5	4.1
20-Sep-01	1510083206	850	261.5	84.5	98.5	30	4.1
20-Sep-01	1510101014		258.2	90	103.5	32.5	4.3
20-Sep-01	151008484A		261.5	86.5	100.5	31	4.9
20-Sep-01	1510102C16		258.2	100.5	111.5	40.5	7.0
20-Sep-01	415B5C1371	1288	167.5	100	115.5	8.2	44.5
20-Sep-01	415860675C		160	113.5	128	14.5	55
21-Sep-01	415857586E	1290	164.5	61	63.5	1.0	22
21-Sep-01	41585D5018	1291	164.5	76.5	87	1.9	22
21-Sep-01	41585A7373	1293	164	70.5	81	2.2	26
21-Sep-01	4159604618	1292	164.5	116	131	12.9	47.5
21-Sep-01	415010322A	522	164.5	170	192	41.1	70
24-Sep-01	1510101828	767	261.5	70.5	76.5	20.5	1.6
24-Sep-01	1510105210		261.5	76	83	25.5	2.5
24-Sep-01	1F4D4F566F		261.5	81	89	30	3.2
24-Sep-01	1510103A7C		261.5	84	96	35	4.3
3-Oct-01	151008340A		261.5	89	101.5	35	4.8
23-Oct-01	1510106879	613	169.5	65.5	77.5	2.0	23.5
23-Oct-01	4158454447		175	72	83	2.5	25.5
23-Oct-01	1510107908	284	176.5	77	81	2.7	26
23-Oct-01	151010423A	261	188	77	90	3.1	28
23-Oct-01	4158532C7C		169.5	106.5	121.5	7.9	40
23-Oct-01	151010162A	831	175	106	120	11.3	54
23-Oct-01	1510101442		184.5	142.5	161.5	23.7	63
23-Oct-01	4158692D14		172	162.5	187	25.9	56.5
23-Oct-01	41584F7975		180	168	190	38.3	75.5
23-Oct-01	1510106129		176.5	188.5	218.5	44.5	72.5
23-Oct-01	1510101856		176.5	175	189.5	46.7	76.5
23-Oct-01	415972066A		179.5	181	203	51.0	82
23-Oct-01	4159071F73		172	209.5	228.5	67.1	80
24-Oct-01	4158610B6E		184.5	51	60	0.8	18.5
24-Oct-01	415A612572		188	63	74	1.6	24
24-Oct-01	151010246A		179.5	72	83.5	2.0	24.5

Table A-1 cont. White sturgeon capture data collected in 2001.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
24-Oct-01	1510100219		179.5	68.5	79	2.0	24.5
24-Oct-01	4158591F26		179.5	66	77	2.0	24.5
24-Oct-01	4158613355		169.5	70.5	74.5	2.4	29
24-Oct-01	4158645F6B		180	76	87.5	2.7	28
24-Oct-01	1510102861		180	81	94.5	2.9	25
24-Oct-01	415857210F		176.5	74	85.5	2.9	26
24-Oct-01	1510102438	617	176.5	112	130.5	10.0	48
24-Oct-01	41586A7B4E		180	163	186	24.0	63
24-Oct-01	1510103242		171	149	162	29.9	66
24-Oct-01	415A577F17		188	162.5	185	40.4	80
25-Oct-01	151008284E		171	73	84.5	2.0	23
25-Oct-01	1510102911		171	74.5	87	2.3	27
25-Oct-01	415863651B		180	68	76.5	2.3	27
25-Oct-01	1510085679		176.5	80.5	86	3.9	21.5
25-Oct-01	1510082464		173.5	152	167.5	28.1	62.5
25-Oct-01	415872634D		173.5	200.5	211		87.5
26-Oct-01	415A6F7F3B	1294	188	61.5	71	1.3	21
26-Oct-01	1510103A68		176.5	70	82.5	2.0	24
26-Oct-01	1510101624		185.5	73	83.5	2.2	25
26-Oct-01	4159683E0D		180	72	84	2.3	28
26-Oct-01	1510101A40	1298	182	71	84	2.4	26
26-Oct-01	415C082342	1296	188	70	81	2.7	26
26-Oct-01	415867410E		169.5	76.5	85.5	2.9	28
26-Oct-01	41585E725C		169.5	81	87.5	3.4	27
26-Oct-01	415B533F06	1295	188	79	92.5	3.9	33.5
26-Oct-01	1510106178		169.5	107.5	116.5	9.8	47
26-Oct-01	41586E614E		173.5	123.5	131	14.1	53
26-Oct-01	1510104172		176.5	166.5	178	23.8	71
26-Oct-01	1510103102	1003	172	160.5	173	34.2	75
26-Oct-01	415B510811	1297	187.5	161	184	38.1	73
26-Oct-01	1510105422	791	184	159	183	40.0	69
26-Oct-01	1510101E4A		179.5	171	195	40.4	70
26-Oct-01	1510107C4E		173.5	180	192.5	46.9	79
26-Oct-01	41586B5D77		171	197	216.5		91
15-Nov-01	151008391E	1091	258.2	77.5	84.5	30	2.9
15-Nov-01	1510105250		258.2	93.5	106	40	6.1

APPENDIX B

2001 White Sturgeon Young-of-the-Year (YOY) Captures and Marking Data

Table B-1. White sturgeon capture data collected during YOY setline sampling in the Snake River 2001.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
8-May-01	1510105024	851	261.5	47.5	54.5	19	1.4
8-May-01	1510080608	849	261.5	63	73.5	24	2.7
8-May-01	1510106818	852	261.5	60	65	22.5	2.7
8-May-01	1510101A70	853	261.5	72.5	82	26	2.7
8-May-01	1510083206	850	261.5	81	90.5	31	4.1
10-May-01	1510080C3E	854	261.5	71.5	77.5	25.5	1.9
10-May-01	1510105210	855	261.5	77	87	25.5	2.5
11-May-01	151008392E	303	261.5	50	59.5	20.5	1.0
11-May-01			261.5	72.5	80	24.5	2.2
11-May-01	1F4D4F566F	231	261.5	80.5	91	30	3.5
12-Jun-01	1510100A59	312	265.2	62.5	73	24	2.0
12-Jun-01	1510085C66	313	265.2	65	73.5	25	2.2
12-Jun-01	1510102C6E	311	265.2	65	75	23	2.2
12-Jun-01	1510105426		261.5	70	80	25	2.6
12-Jun-01	1510083669	310	263.4	79	89	31.5	3.7
13-Jun-01	151010247C	611	261.5	46.5	52	19	0.9
13-Jun-01	1510101114	318	265.2	53.5	60	20	1.0
13-Jun-01	1510083918	319	265.2	60.5	67	21.5	1.5
13-Jun-01	1510106879	613	265.2	66	78.5	25.5	2.3
13-Jun-01	1510101C0C	320	265.2	79	87.5	29.5	3.3
14-Jun-01	1510102242	607	261.5	51.5	59	19.5	1.0
14-Jun-01	1510103C58	605	261.5	61.5	70.5	20	1.3
14-Jun-01	151008264A		261.5	72.5	83	21.5	1.9
14-Jun-01	1510101A00	606	261.5	77.5	87.5	226	2.9
15-Jun-01	1510104E74	860	261.5	51	59	18.5	1.1
20-Jun-01	151010460E	741	280.0	60	68	22	0.9
20-Jun-01	1510100650	714	280.0	65	71.5	24.5	1.7
20-Jun-01	151008247A	715	280.0	65	74	24	1.7
21-Jun-01	1510082160	867	288.0	60	67	23	1.6
21-Jun-01	15100561A	690	288.0	79	87.5	26	2.0
10-Jul-01	1510102E1A	897	212.0	80	91.5	35	4.1
31-Jul-01	151010114	318	264.7	53	59	19	1.2
31-Jul-01	1510083918		264.7	59	67	20.5	1.7
31-Jul-01	1510100032		260.7	74	85	25	2.2
1-Aug-01	1510101C12	519	263.9	66	75	20	1.5
1-Aug-01	151008217C	1022	260.7	71.5	83.5	25	2.3
1-Aug-01	1510100260		264.7	84	94	20.5	2.4

Table B-1 cont. White sturgeon capture data collected during YOY setline sampling in the Snake River 2001.

Date	PIT Tag	Floy Tag	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
1-Aug-01	1510107A76		260.7	77	87	27.5	3.0
2-Aug-01	1510102C18	1084	260.7	59.5	70	24	1.6
2-Aug-01	1510102A6C	898	260.7	63	73	21.5	1.6
2-Aug-01	335Q89EDCD		264.7	63	72.5	23	1.8
2-Aug-01	415B7B7D0B		264.7	74	86.5	26	2.4
2-Aug-01	1510102E14	1079	264.7	69.5	80.5	28	2.4
3-Aug-01	151008264A		260.7	73	85	24	2.4
14-Aug-01	1510103A7E		276.7	59	66.5	20.5	1.4
15-Aug-01	41586F6868		273.5	64	69	22	1.5
17-Aug-01	4158620575		291.2	67	77	21.5	2.0
23-Aug-01	1510104874		191.5	72	80	29	1.9

APPENDIX C

2001 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
5/11/01	Snake	180.5	5.2	Sand	0.72	13	1
5/15/01	Snake	181	3.7	Sand	1.16	12	1
5/21/01	Snake	182.5	4.3	Sand	1.61	13.5	1
5/23/01	Snake	166	3.4	Sand	0.89	15	2
5/25/01	Snake	182.5	4.9	Sand	0.72	16.5	1
6/4/01	Snake	166	3.4	Sand	1.03	14.5	3
6/11/01	Snake	174	6.7	Sand	1.27	16	1
6/19/01	Snake	166	3.4	Sand	1.03	17.5	1
6/21/01	Snake	174	6.7	Sand	0.78	19	1
6/25/01	Snake	182.5	4.9	Sand	1.26	18.5	1
7/2/01	Snake	164.5	7.6	Sand	1.84	21.5	1

APPENDIX D

2001 White Sturgeon Radio Tag Data

Table D-1. White sturgeon fitted with Combined Acoustic/Radio Tags (CART) in the Snake and Salmon Rivers, 2001.

Tag Date	Code*	River	Location (Rkm)	Gender	Total Length (cm)
3/15/01	3	Snake	285.0	Female	232
3/22/01	96	Snake	213.3	Male	167.5
5/8/01	50	Snake	302.5	Female	221
6/12/01	120	Snake	265.5	Undetermined	111
6/13/01	70	Snake	268.7	Male	234.5
6/20/01	132	Snake	300.1	Female	266
6/21/01	138	Snake	292.0	Undetermined	89
7/30/01	116	Snake	268.7	Female	276.5
7/31/01	14	Snake	258.2	Male	250.5
10/25/01	71	Snake	279.2	Male	211

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