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

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

ANNUAL REPORT 1998

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TABLE OF CONTENTS

Contents **Page**

ABSTRACT

In 1998 white sturgeon (*Acipenser transmontanus)* were captured, marked, and population data were collected in the Snake River between Lower Granite Dam and the mouth of the Salmon River. A total of 13,785 hours of setline effort and 389 hours of hook-and-line effort was employed in 1998. Of the 278 white sturgeon captured in the Snake River, 238 were marked for future identification. Three sturgeon were captured in the Salmon River and none were captured in the Clearwater River. Since 1997, 6.9% of the tagged fish have been recovered. Movement of recaptured white sturgeon ranged from 98.5 kilometers downstream to 60.7 kilometers upstream, however, less than 25% of the fish moved more than 16 kilometers (10 miles). In the Snake River, white sturgeon ranged in total length from 51.5 cm to 286 cm and averaged 118.9 cm. Differences were detected in the length frequency distributions of sturgeon in Lower Granite Reservoir and the free-flowing Snake River (Chi-Square test, $P<0.05$). In addition, the proportion of white sturgeon greater than 92 cm (total length) in the free-flowing Snake River has shown an increase of 37% since the 1970's. Analysis of the length-weight relationship indicated that white sturgeon in Lower Granite Reservoir were slightly larger than white sturgeon in the free-flowing Snake River.

INTRODUCTION

Development of the Columbia River Basin hydroelectric system has created impoundments that have altered the habitat and movement of white sturgeon (*Acipenser transmontanus*) and their principal food resources in the Lower Snake River between Hells Canyon and Lower Granite dams. As a result, 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 underseeded 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 conservative 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.

Traditionally, the Nez Perce People harvested Snake River white sturgeon for subsistence purposes. However, subsistence fishing has been severely limited as a result of low sturgeon numbers between Hells Canyon and Lower Granite dams. The objective 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 23-28 years since the completion of Lower Granite Dam in 1975, and the closure of catch-and-keep fishing in 1970, implementation of scientifically sound mitigative strategies would be needed to realize the harvest objective.

The initial Phase I biological risk assessment was completed during 1997. This biological risk assessment identified: 1) potential mitigative actions to meet the project objective, and 2) data needs to fully assess the risks associated with applied actions. A plan to collect information identified by the biological risk assessment was also developed. Phase II, the data collection phase of the project, was

also initiated in 1997. White sturgeon were captured, marked, and population data were collected between Lower Granite Dam and the mouth of the Salmon River.

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 Biological Risk Assessment Team (BRAT; Carmichael et al. 1997) using biological data collected, 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.

Table 1. Proposed Phase II research tasks designed to collect information to fully assess the risk and effectiveness associated with potential management actions.

Collect biological and environmental data identified by the *Upper Snake River White Sturgeon Biological Risk Assessment* that will allow identification and assessment of mitigative actions designed to restore, protect and enhance the sturgeon population between Hells Canyon and Lower Granite dams and will establish a baseline on which to assess effectiveness of applied mitigative actions.
Task 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 1.3 Collect life history data for subadult and adult white sturgeon to model population dynamics.
Task 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 sturgeons.
Task 3 Develop plans to address other informational needs identified by the BRAT not covered by tasks listed above.

The primary objective of sampling in 1998 was to capture and mark white sturgeon using a stratified random design between Lower Granite Reservoir and the mouth of the Salmon River to estimate population structure, distribution and size. In addition, several attempts were made to sample the Salmon River; however, inclement weather and inadequate flows restricted access to most of the river. This report presents preliminary results from 1998 Phase II data collection.

METHODS

White sturgeon were captured in the Snake River between Lower Granite Dam (River Kilometer; Rkm 174) and the mouth of the Salmon River (Rkm 303) and in the Salmon River from it's mouth to Vinegar Creek (Rkm 185). The Snake River between Lower Granite Dam and the mouth of the Snake River was divided into five sampling reaches, while the Salmon River was divided into four sampling reaches (Table 2). 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 sampling design called for one randomly selected reach to be sampled weekly from June through December (Table 2). Sampling sites for setlines and hook-and-line fishing were randomized within each reach. Each 0.5 kilometer of the river reach was considered a potential sampling site. Twenty sample sites were randomly chosen within a reach, and sampled with either setlines or hook-and-line, depending on flow characteristics. Sampling sites were not stratified by habitat characteristics (depth, velocity, substrate type), thus catches were unbiased by habitat conditions to which white sturgeon may or may not be responding.

Concurrent with the work being done by the Nez Perce Tribe (NPT), 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, NPT and IPC have a formal agreement for data sharing (MOU). Thus, our 1998 randomized sampling conducted for population estimations did not include the Snake River above the mouth of the Salmon River. The Clearwater River was sampled using both setlines and hook-and-line. Because the number of white sturgeon

reported in the Clearwater River is historically low, areas where white sturgeon have been reported in the Clearwater River were targeted instead of applying a randomized sampling design. The objective of sampling in the Clearwater River was to document the current distribution of white sturgeon, not to conduct a population estimate.

Table 2. Study reaches and dates sampling was conducted on the Snake River.

Study Reach	Location	River Kilometer Lower	Upper	Weeks Sampled
1	Lower Section L. Granite Reservoir	174	207	25 26 27 28 32 36 39 44 50
2	Upper Section L. Granite Reservoir	207	224	25 26 27 29 32 36 44 47 50
3	Clearwater River - Tenmile Rapids	224	240	43 48
4	Tenmile Rapids -Grand Ronde River	240	271	30 32 39 46 51
5	Grand Ronde River - Salmon River	271	303	30 35 37 45 49 53
9a	Lower Salmon Gorge	0	42	31 34 35 38 42 45 47
9b	Upper Salmon Gorge	42	84	
10	Middle Salmon Reach	84	132	33 40 43
11	Upper Salmon Reach	132	185	
12	Clearwater River	0	65	14 15 38 48

Setlines and hook-and-line sampling were used to estimate the size and structure of the white sturgeon population. Setlines consisted of 30 m of anchored bottom-line with ten gangen lines attached by snaps approximately every 3 m (Lepla 1994, Apperson and Anders 1990). Gangen were rigged with circle hooks to reduce potential hooking injury. A combination of ten 12/0, 14/0, and 16/0 galvanized barbed circle hooks were used on each line. Pickled squid and lamprey were used as bait. Setlines were checked twice a day and empty hooks rebaited. Set hours were recorded and the catch-per-unit-effort (CPUE) was calculated based on the hours a line with ten hooks was fished.

Hook-and-line sampling was also conducted. Hook-and-line was used primarily in the upper reaches of the Salmon River to supplement setline sampling and when water conditions prevented use of setlines. Sixty pound or greater test Dacron line with either barbless 'J' hooks or barbless circle hooks of varying size (8/0 to 12/0) were used. A variety of bait types (e.g. lamprey, pickled squid) were also used. Hours fished were recorded, and the CPUE was calculated based on man-hours spent fishing.

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 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.

Total length frequency distributions were compared for fish captured in Lower Granite Reservoir (reaches 1-3) and the free-flowing Snake River (reaches 4-5). White sturgeon were separated into three size classes: <92 cm, 92-183 cm, and >183 cm (Coon et al. 1977). Comparisons were made using a Chi-squared analysis on the proportion of fish sampled in each size class (Ott 1993). Paired samples of total length and weight were regressed for fish caught throughout the study area.

RESULTS

Distribution of white sturgeon in the Snake and Salmon rivers

During 1998, 278 white sturgeon were captured in the Snake River and three in the Salmon River (Appendix A). Of these, 238 were newly marked and 40 were previously marked fish. These 238 fish plus the 298 from 1997 bring the total number of marked fish in the study area to 536. White sturgeon captured with setlines in the Snake River between Lower Granite Reservoir and the mouth of

the Salmon River ranged from 51.5 to 286 cm total length and averaged 118.9 cm (Figure 1). Using hook-and-line sampling, the six fish captured ranged from 76 to 124 cm and averaged 90.4 cm.

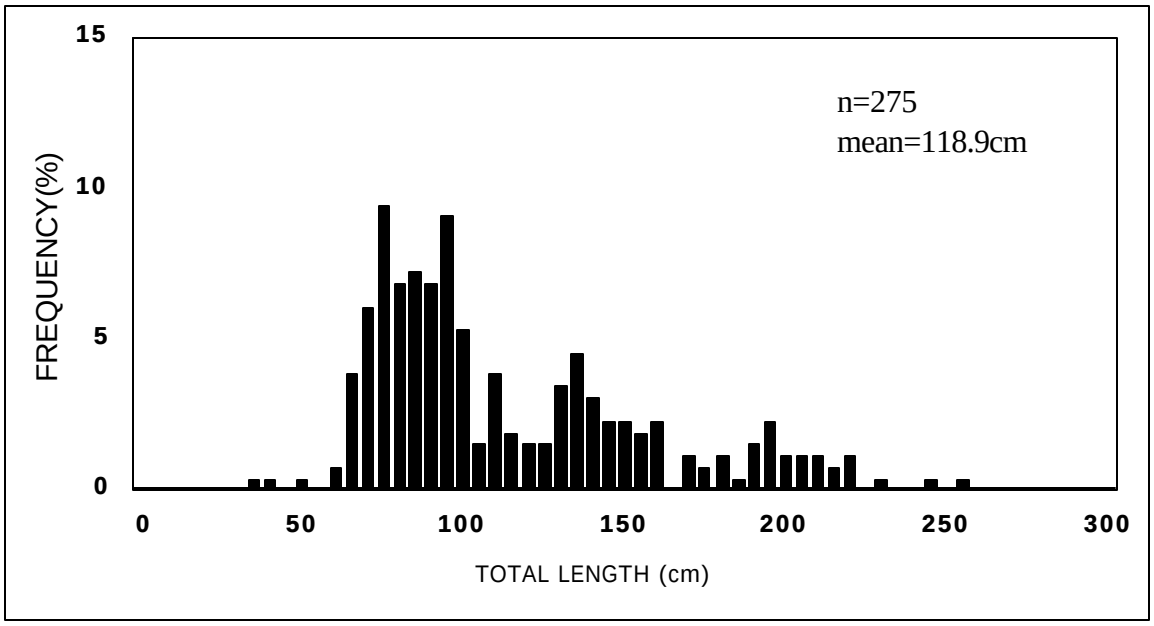

Figure 1. Total length frequency distribution of white sturgeon captured throughout the Snake River between Lower Granite Reservoir and the mouth of the Salmon River using setlines.

In Lower Granite Reservoir white sturgeon ranged from 51.5 cm to 247 cm total length and averaged 122 cm (Figure 2). White sturgeon captured in the free-flowing reaches of the Snake River ranged from 37 cm to 286 cm total length and averaged 116 cm (Figure 3). 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 reaches of the Snake River in 1998. Similarly, these proportions differed significantly (Chi-Square test, $P<0.05$) between these two river segments in 1997 (Hoefs 1998). However, within each river segment, no significant differences (Chi-Square test, $P>0.05$) were detected in the proportions of different size classes between 1997 and 1998.

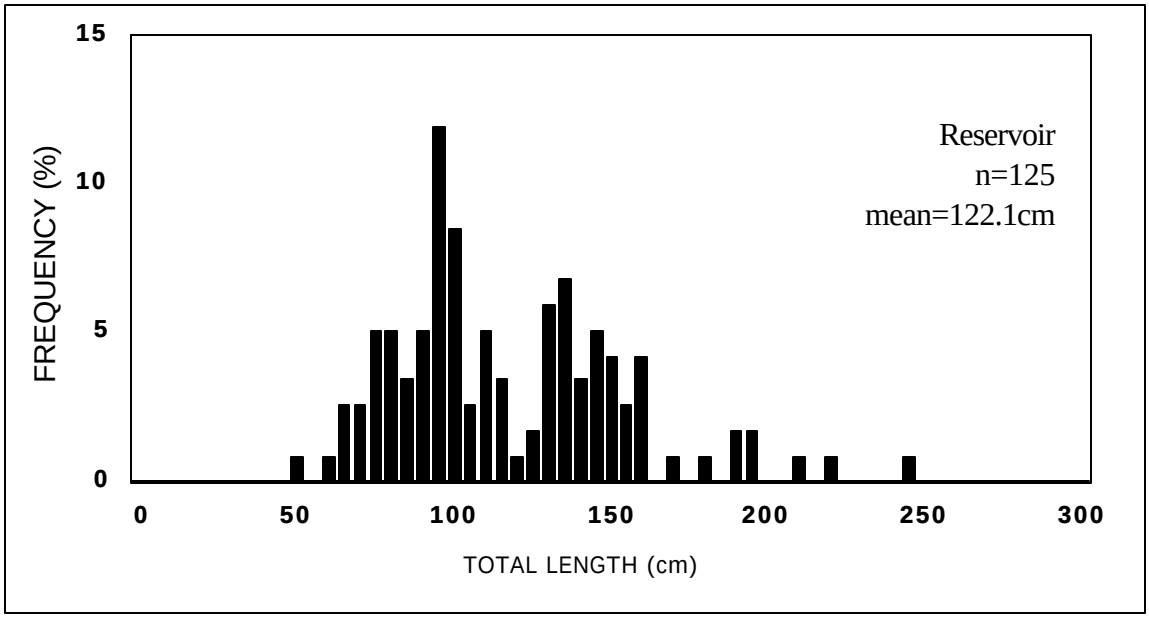

Figure 2. Total length frequency distribution of white sturgeon captured in Lower Granite Reservoir in 1998.

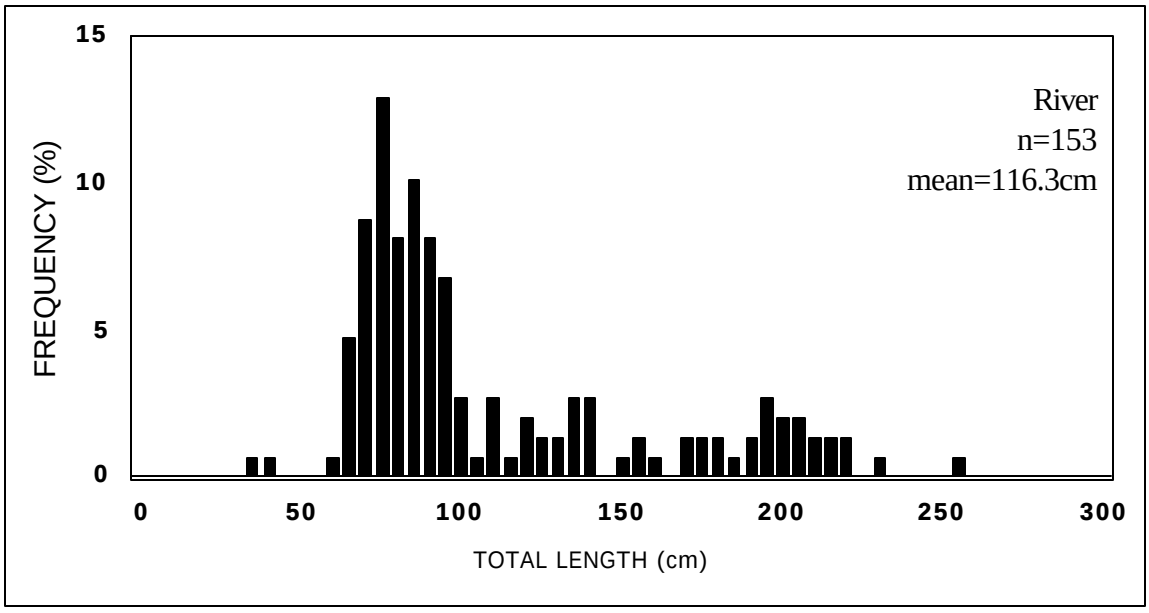

Figure 3. Total length frequency distribution of white sturgeon captured in the free-flowing Snake River in 1998.

Length-Weight Relationships

A total of 264 of the 278 white sturgeon from the Snake River was measured for weight (kg). These fish ranged from 37 to 258 cm in total length and weighed between 0.5 and 127 kg. The allometric relationship between weight (kg) and total length (cm) derived for white sturgeon collected in Lower Granite Reservoir was $W = 1.58 \text{ E-}006 \ L^{3.26}$ (Figure 4). The allometric relationship was $W = 3.41 \text{ E-}006 \ L^{3.08}$ (Figure 5) for white sturgeon collected in the free-flowing Snake River. Within each of these river segments, the total length and weight relationship was similar between both the 1997 and 1998 data (Figures 6 and 7).

Sampling Effort

A total of 13,785 hours of setline effort and 389 hours of hook-and-line effort was employed in 1998. No nets were used in 1998. In Lower Granite Reservoir, 9,302 hours of setline sampling was conducted with no hook and line effort. In the free-flowing Snake River, 3,262 hours of setline sampling was conducted with 69 hours of hook and line effort. In the Salmon River, 1,221 hours of setline sampling was conducted with 320 hours of hook and line effort. Although greater effort was employed in Lower Granite Reservoir, the overall catch was greater in the free-flowing Snake River reaches. Moreover, the overall CPUE in the free-flowing Snake River reaches was 3.5 times greater than the CPUE in Lower Granite Reservoir (Table 3).

Movements of Recaptured Fish

A total of 37 different white sturgeon were recaptured in 1998. Of these, 31 were fish that had been previously tagged in 1997 (Appendix B). Since 1997, 6.9% (37 of 536) have had tags detected at least once. An additional three fish have been recaptured twice. Recaptured white sturgeon ranged from 81.5 cm to 198.5 cm in total length. White sturgeon were recaptured throughout the entire year. Movements of ten recaptured white sturgeon were less than or equal to 0.8 km (1 mile) or had no discernable movement. Fourteen fish moved more than 0.8 km up to 16 km (10 miles) while nine

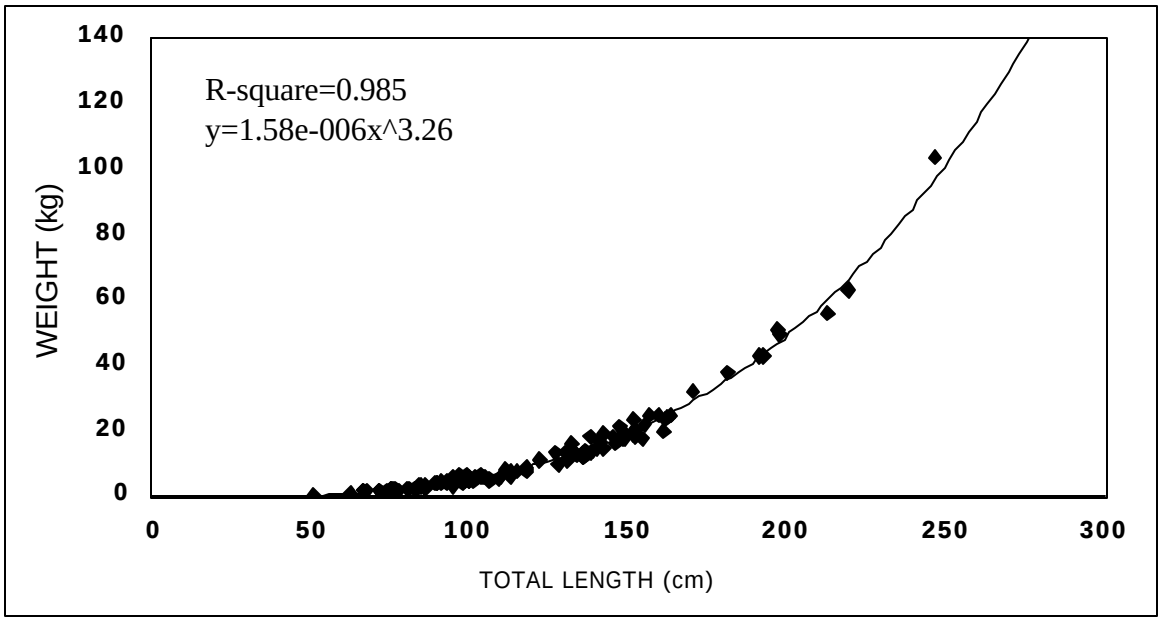

Figure 4. Total length (cm) and weight (kg) relationship of 117 fish collected in Lower Granite Reservoir in 1998.

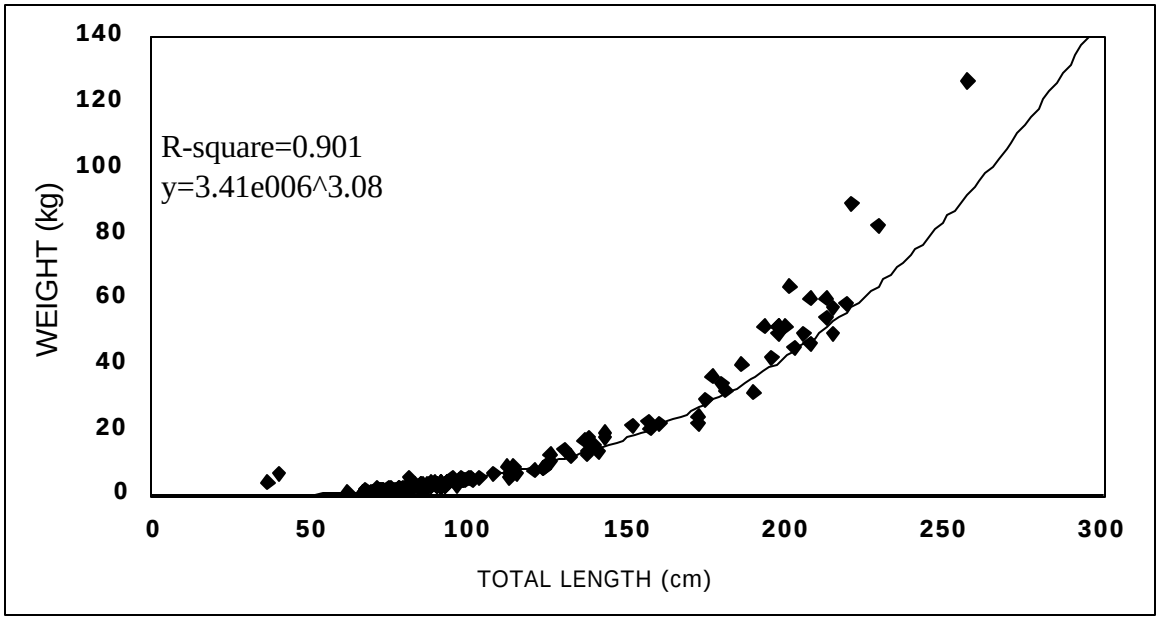

Figure 5. Total length (cm) and weight (kg) relationship of 147 fish collected in the free-flowing reaches of the Snake River in 1998.

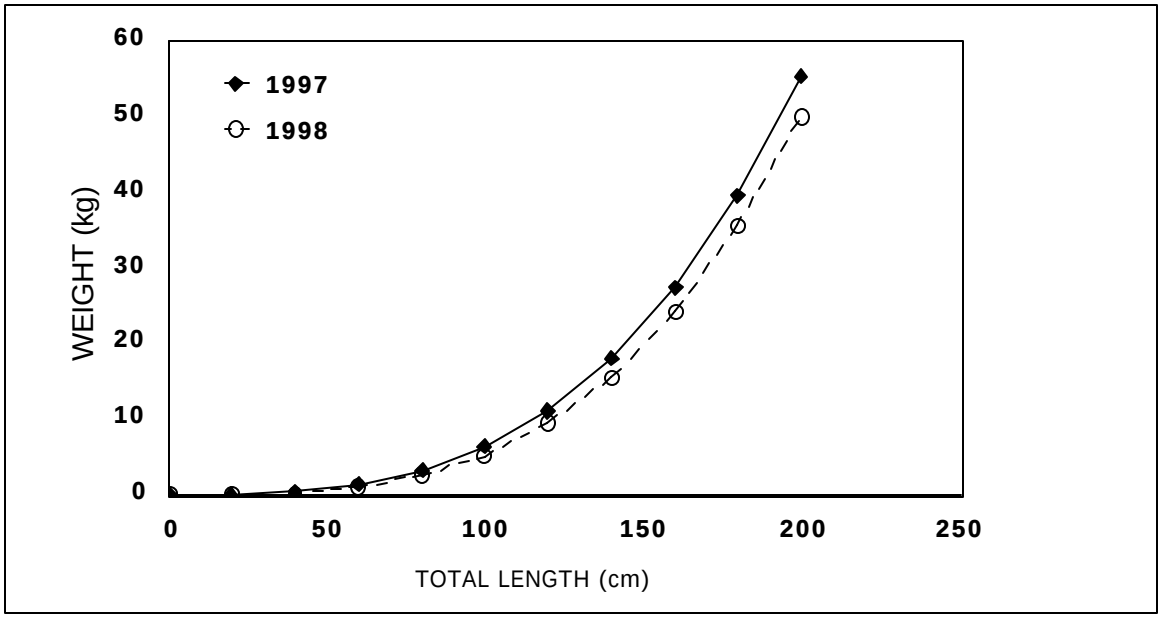

Figure 6. Total length (cm) and weight (kg) relationship for white sturgeon captured in Lower Granite Reservoir in 1997 and 1998.

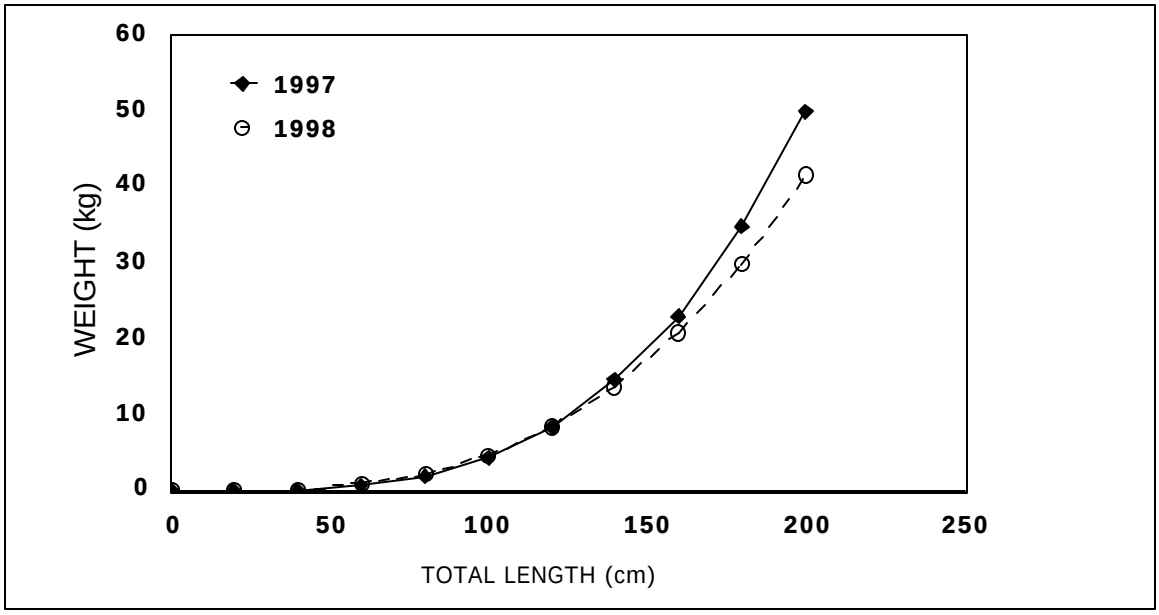

Figure 7. Total length (cm) and weight (kg) relationship for white sturgeon captured in the free-flowing Snake River in 1997 and 1998.

Table 3. Catch and sampling effort and catch per unit effort (CPUE) per reach using setlines and hook-and-line sampling in the Snake River reaches sampled in 1998.

	Setline			Hook-and-Line		
Reach	**Effort**	**Catch**	**CPUE**	**Effort**	**Catch**	**CPUE**
1	5,326	62	.012	0	0	0
2	3,332	62	.019	0	0	0
3	644	1	.002	0	0	0
4	1,632	39	.024	30	3	.102
5	1,630	108	.066	39	3	.078
9	944	3	.003	50	0	0
10	0	0	0	148	0	0
11	257	0	0	0	0	0
12	20	0	.020	122	0	0
Total	13,785	275	.020	389	6	.015

others moved more than 16 km up to 98.5 km (61 miles). Movement of four white sturgeon was undetermined. Duration between captures ranged from to 23 to 593 days. Movements were both upstream and downstream, with three fish moving from the free-flowing Snake River into Lower Granite Reservoir and only one moving from Lower Granite Reservoir into the free-flowing Snake River. White sturgeon originating in Lower Granite Reservoir moved an average of 8.8 km between recaptures, whereas white sturgeon originating from the free-flowing Snake River moved an average of only 2.8 km. In addition, no movement pattern was detected among fish of different size-classes originating from Lower Granite Reservoir (Figure 8). All but two fish moved greater than 10 km. However, within the free-flowing Snake River, white sturgeon smaller than 130 cm total length appeared to make shorter movements (Figure 9). Of these white sturgeon less than 130 cm, none moved greater than 10 km and most (64%: 9 of 14) moved less than 2 km. In comparison, of the

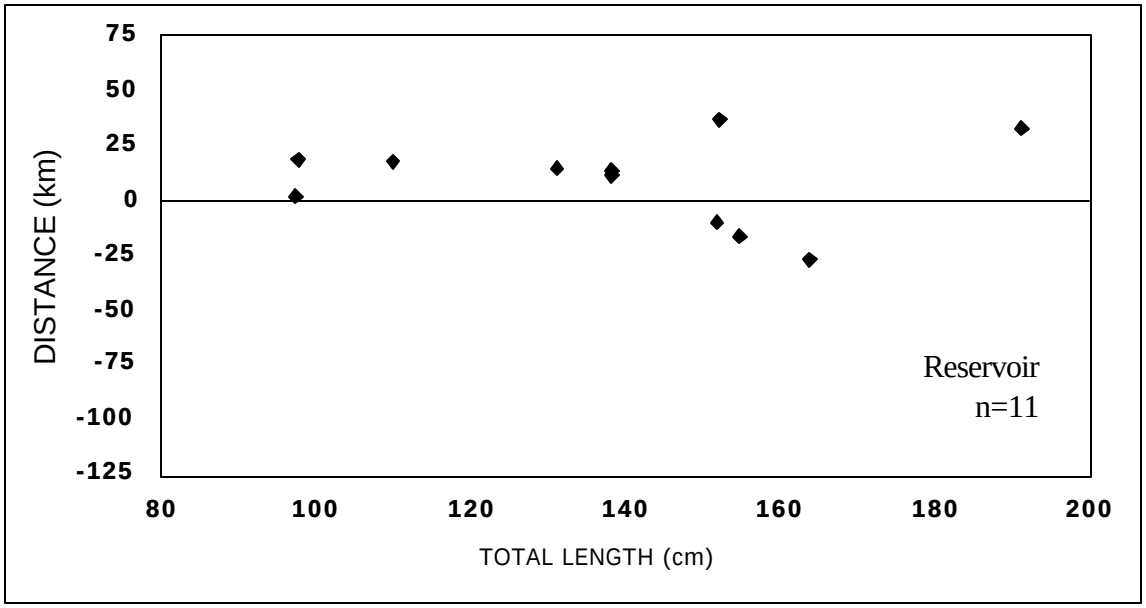

Figure 8. Total movement of 11 white sturgeon recaptured during 1998 in Lower Granite Reservoir. Negative values indicate movement downstream and positive values indicate movement upstream.

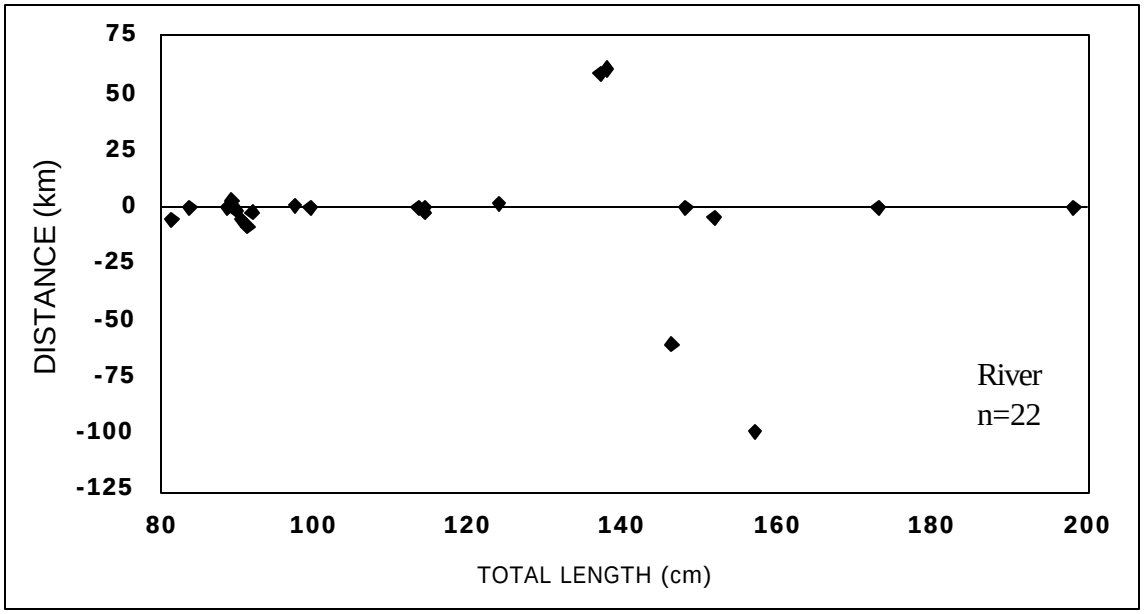

Figure 9. Total movement of 22 white sturgeon recaptured during 1998 in the free-flowing Snake River. Negative values indicate movement downstream and positive values indicate movement upstream.

white sturgeon greater than 130 cm, 50% (4 of 8) moved greater than 50 km.

Distribution of white sturgeon in the Clearwater River

Approximately 106.7 hours of hook-and-line and 19.6 hours of setline sampling were conducted in the Clearwater River during 1998. No fish were captured. Sampling was concentrated around Slaughter House Hole near Orofino (Rkm 67), the mouth of the North Fork near Orofino (Rkm 65), Pink House Hole near Orofino (Rkm 63), the mouth of Big Canyon Creek near Peck (Rkm 56), Big Eddy near Lenore (Rkm 45), the bridge near Cherry Lane (Rkm 34), the beach at Myrtle (Rkm 29), and Lapwai Creek near Spalding (Rkm 19).

DISCUSSION

In 1997, the analysis of the length frequency distributions of white sturgeon focused on the differences between Lower Granite Reservoir, the mid-Snake River reaches and the upper-Snake River reaches. No differences were detected during the 1997 analysis (Hoefs 1998). However, in 1998 the data from the mid and upper Snake River reaches were combined into the free-flowing Snake River segment and reexamined. Differences were thus detected in the size class composition of white sturgeon with total lengths <92 cm, between 92, and 183 cm and >183 cm between fish captured in Lower Granite Reservoir and the free-flowing Snake River. Moreover, due to the similarity in the length frequency distributions within each river segment between 1997 and 1998 (after combining the mid and upper reaches of the Snake River), the data were pooled to analyze trends in the available historic data. For both 1997 and 1998, the mean total length of the fish collected in Lower Granite Reservoir was larger than fish collected in the free-flowing Snake River. However, the white sturgeon population in Lower Granite Reservoir is dominated by sturgeon measuring between 92 and 183 cm, with few large sturgeon (>183 cm). In contrast, white sturgeon in the small (< 92 cm) and middle (between 92 and 183 cm) size classes are more evenly distributed in the free-flowing Snake River. Furthermore, the proportion of large sturgeon is more than twice as large in the free-flowing Snake River than in Lower Granite Reservoir. Prior to the closure of Lower Granite Dam, Coon et al. (1977) also observed differences in the percent of the populations 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. 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 45% and 37%, respectively.

Examining the entire Snake River study area, we see a similar trend in the change of the length frequency distribution of white sturgeon (Figure 10). 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 (Coon et al. 1977), and in 1982-84, 80 percent (Lukens 1985), 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, only comprised 4 and 18 percent of the populations sampled in the 1970's and 1980's, respectively (Coon et al. 1977, Lukens 1985). In contrast, of the white sturgeon collected during 1997-98, only 49 percent were less than 92 cm, while 40 percent ranged between 92 and 183 cm. Before these findings can be attributed to changes in the population, or the recovery of a size class that was over harvested, further sampling is needed.

Furthermore, the majority of the sampling in 1997 and 1998 was done with setlines rigged with 12/0, 14/0 and 16/0 hooks. Elliott and Beamesderfer (1990) determined that white sturgeon did not fully recruit to setline gear until they reached 90 cm in fork length or greater. In addition, examining the length frequency distribution for white sturgeon captured throughout the study area shows few fish smaller than 60 cm fork length (10 of 275). In earlier studies, smaller hooks were used and sturgeon appeared to be recruited to the gear at smaller sizes (Coon et al. 1977, Lukens 1985, Lepla 1994). In 1999 a wider range of hook sizes will be employed to determine whether the length frequency distribution of the sample of white sturgeon collected in 1997-98 is reflective of the population at large or an artifact of sampling methods.

Lukens (1985) and Lepla (1994) both suggested that white sturgeon condition in the Snake

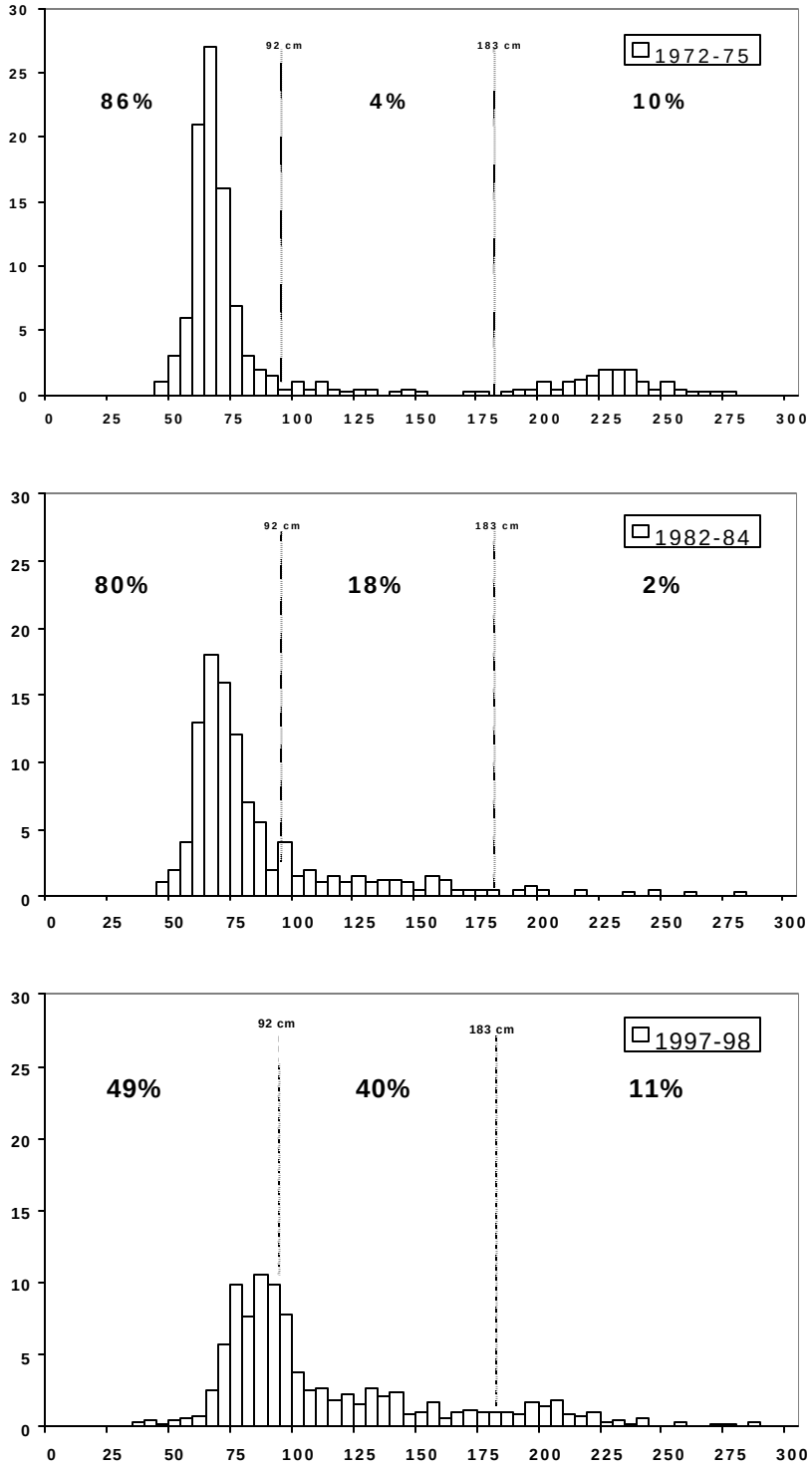

Figure 10. The length (total length) frequency distributions of sturgeon sampled from Hells Canyon reaches of the Snake River, 1997 98, 1982-84 (Lukens 1985), and 1972-75 (Coon et al. 1977) and the percent of the population <92 cm, between 92 and 183 cm, and >183 cm.

River has improved since the 1970's. Lukens (1985) suggested that white sturgeon condition improved between the 1970's and 1980's, particularly for large sturgeon. The length-weight relationship of white sturgeon captured in the free-flowing Snake River in 1972-75 (Coon et al. 1977) was intermediate to that found in 1997-98 and by Lukens (1985) in 1982-84 (Figure 11). Because few white sturgeon >183 cm are typically captured, data from these sturgeon can significantly affect the relationship (Sokal and Rohlf 1981, Zar 1974). Thus, inferences on changes in the condition of the population should be based only on total populations responses. Our results suggest that white sturgeon condition in the free-flowing Snake River has fluctuated since the 1970's. The condition of white sturgeon in Lower Granite Reservoir appears to have remained stable since 1990-91 (Figure 12). Lepla (1994) compared the length-weight relationship of white sturgeon inhabiting Lower Granite Reservoir (1990-91) with white sturgeon sampled from the free-flowing Snake River prior to the closure of Lower Granite Dam (Coon et al. 1977) and after its closure (Luken 1985). Lepla (1994) showed that the condition of white sturgeon collected after impoundment was higher than white sturgeon sampled prior to impoundment. In addition, the condition of white sturgeon collected in Lower Granite Reservoir was higher than white sturgeon sampled in the free-flowing Snake River after impoundment. Our results corroborate Lepla's findings. The length-weight relationship for white sturgeon collected in Lower Granite Reservoir in 1997-98 indicates a slightly higher condition than that of white sturgeon from the free-flowing Snake River in 1997-98 (Figure 13).

In 1998, an additional 238 white sturgeon were sampled in the study area bringing the total number of marked fish to 536. Recapture data from these marked fish in 1999 and beyond will allow us to estimate the current population and more accurately assess the movement dynamics of white sturgeon in the study area. Since 1997, 6.9% of the tagged fish have been recovered. North et al. (1993) reported a similar tag recovery rate of 7.3% (79 of 1,081) of PIT tagged white sturgeon in 1994 in two Lower Columbia River reservoirs using both setlines and gillnets. Furthermore, long term PIT tag retention was reported at 97%. The multi-year study plan (Hoefs 1997) calls for five years of data collection in order to adequately develop an white sturgeon moved between the two segments.

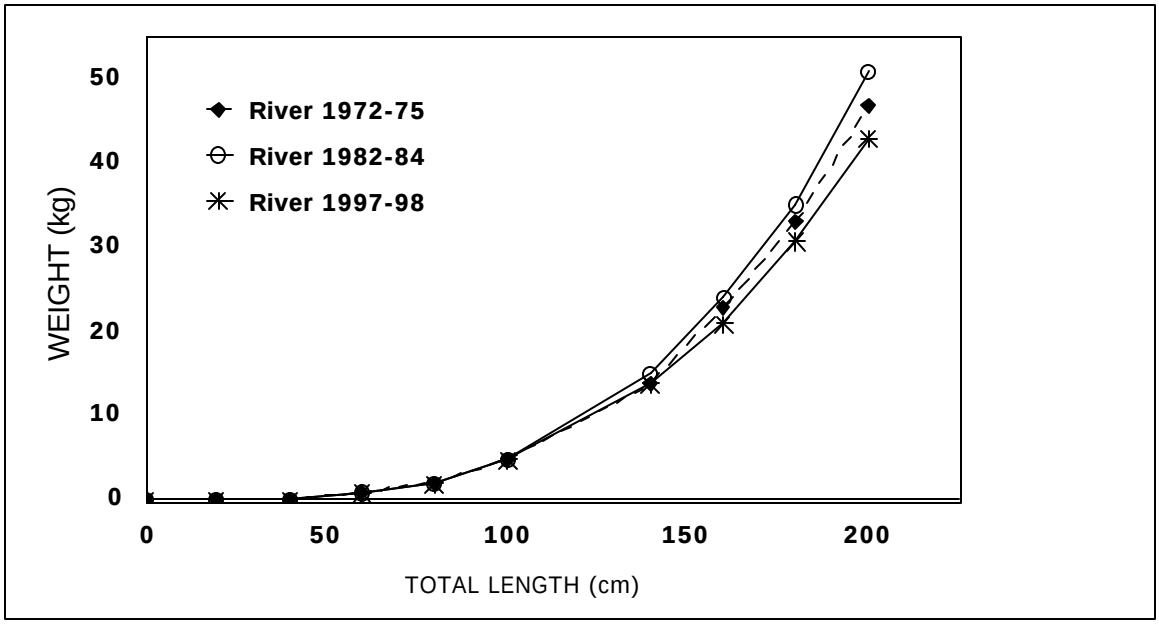

Figure 11. Length-weight relationships for white sturgeon captured in the Snake River in 1972-75 (Coon et al. 1975), 1982-84 (Lukens 1985) and 1997-98.

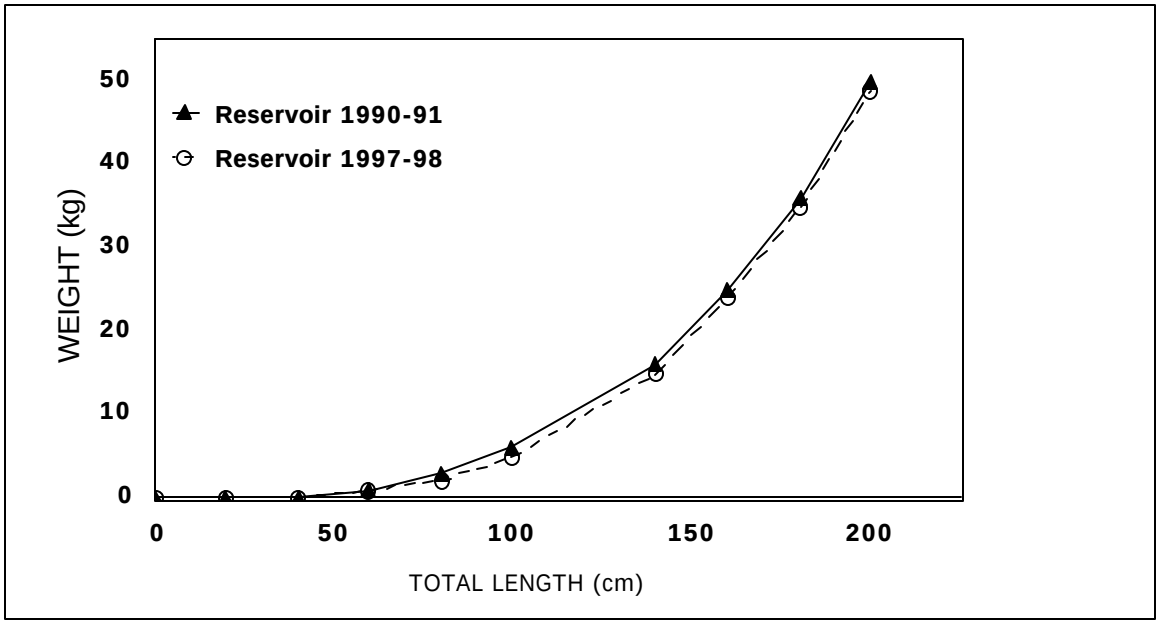

Figure 12. Length-weight relationships for white sturgeon captured in the Snake River in 1990-91 (Lepla 1994), and in 1997-98.

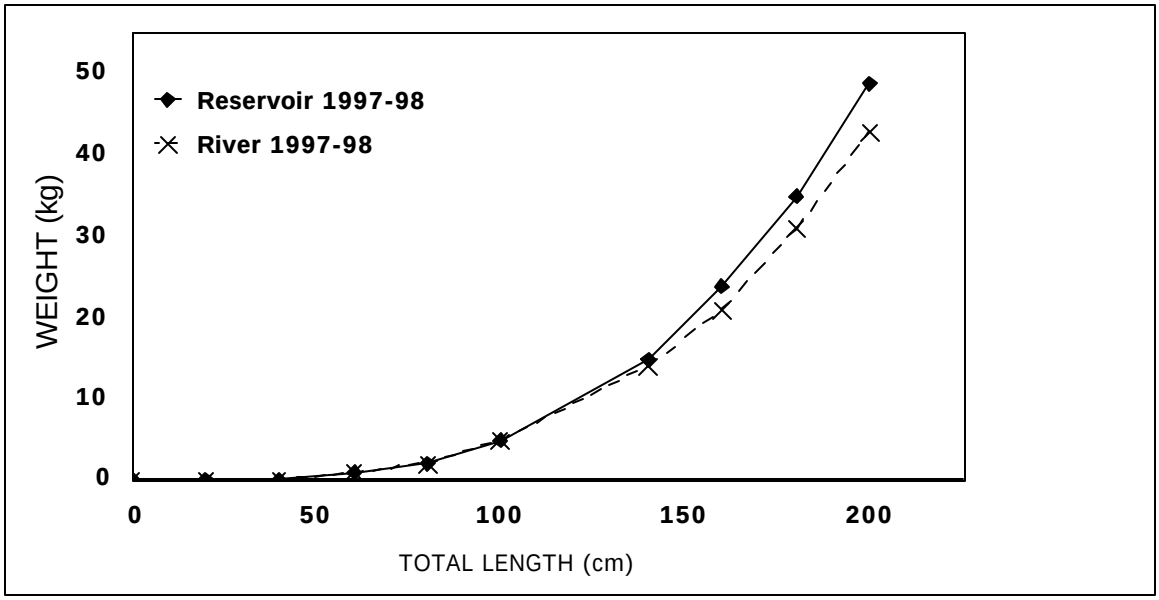

Figure 13. Length-weight relationships for white sturgeon captured in Lower Granite Reservoir and the free-flowing Snake River 1997-98.

North et al. (1993) reported only 4% (27 of 636) of the recaptured white sturgeon from three reservoirs in the Columbia River moved between reservoirs or out of the study area. However, a majority of our recaptured fish (33 of 40) 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. In addition, these large time intervals between recaptures made seasonal movement patterns difficult to assess, and were not attempted in 1998. Further sampling is needed in order to accurately quantify the degree of movement between the river segments.

Similar to other studies, movement of white sturgeon in the river was varied. Coon et al. (1977) found that white sturgeon less than 92 cm in length generally tended to move downstream, while larger sturgeon, although movements were localized, moved both upstream and downstream. In contrast, Lepla (1994) and North et al. (1993) found no relationship between white sturgeon length and direction or distance traveled. In 1998, no discernable directional movement was apparent for white sturgeon captured within either river segment. However, within the free-flowing Snake River, white

sturgeon smaller than 130 cm in total length appeared to make smaller movements. The difference in water velocities encountered by white sturgeon between the two river segments may explain this. Presumably smaller fish would be limited in their upstream movement by the higher water velocities. Nevertheless, we did not observe any downstream movement trend in smaller sturgeon as reported by Coon et al. (1977). Tracking 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.

Although we did not find any white sturgeon in the Clearwater River in 1997 or 1998 this does not indicate that white sturgeon do not utilize the Clearwater River. Use may be seasonal or numbers may be low enough that they were undetected. We will continue to periodically sample for white sturgeon in the Clearwater River throughout the year.

PLANS FOR 1999

Specific sampling plans and objectives for 1999 are outlined in the multi-year Study Plan (Hoefs 1997). In 1999, we will continue to capture white sturgeon using a randomized sampling design between Lower Granite Dam and the mouth of the Salmon River. Recapture data and new capture data will be used to estimate population size and collect additional population data as outlined by Task I (Table 2). To complete Task I we intend to expand our sampling to include the Salmon River and begin measuring environmental conditions at locations where white sturgeon are sampled. We intend to begin our assessment of habitat use by white sturgeon for spawning and rearing (Task 2). This will be accomplished by tracking 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 sturgeon eggs in order to verify spawning locations and timing. During late summer and fall young-of-the-year sturgeon will be collected to identify movement and rearing habitat. Finally, in 1999 age and growth data will be collected and analyzed.

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APPENDIX A

1998 White Sturgeon Data

Table A. White sturgeon data collected in 1998.

Fish No.	Date	PIT tag number	Floy tag number	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
1	06/16/98	1510083149	460	183.4	138	153	55	20.6
2	06/16/98	1510085C6C	458	183.4	130	153	59	18.6
3	06/16/98	1510082106	398	183.4	103	113.5	41	8.0
4	06/16/98	1510103119	300	183.3	128	141	52	15.0
5	06/16/98	1510085044	399	183.4	115	137	51	13.8
6	06/16/98	1510082460	400	183.4	119	133	55	16.5
7	06/23/98	1510084871	397	183.4	125.5	146	59.5	18.6
8	06/23/98	1510104974	396	184.1	123.5	138.5	67.5	18.1
9	06/23/98	1510106142	395	185.0	91	104	46	7.1
10	06/23/98	114D105331	394	185.0	98	112	46	8.1
11	06/24/98	1510084239	390	221.2	148	171	29.5	32.2
12	06/24/98	1510065C20		218.5	157.5	177.5	67	
13	06/24/98	1510083131	381	218.8	154	182	80	38.0
14	06/24/98	1F4D443B15	389	221.1	85	95	37	4.9
15	06/24/98	1510083132	392	221.6	108	118.5	17	8.0
16	06/24/98	1F4D2E4C1A	149	203.1	150	166	71	
17	06/24/98	151008262C	836	203.1	185	210	89	
18	06/25/98	1510102410	385	205.6	120.5	131.5	53	13.7
19	06/25/98	1510083E29	384	204.3	115	134.5	50	12.9
20	06/25/98	151008312C	383	202.3	160	182	83	
21	06/30/98	1F4D31461D	379	174.4	144	163	63	24.3
22	06/30/98	1510083920	373	175.1	129.5	142.5	60	18.9
23	06/30/98	1510106E2A	378	175.1	113	127.5	54	13.5
24	06/30/98	151008207A	382	177.3	87	98	39	5.3
25	06/30/98	1510084874	380	174.3	120	137	55.5	13.8
26	06/30/98	1510085052	381	174.1	134.5	148	60	21.1
27	06/30/98	1510105C40	427	177.8	143	157	61.5	24.8
28	07/01/98	151008223A	372	206.0	130.5	149	52	17.5
29	07/01/98	1F4D084D3F	371	206.4	132	148.5	53	17.8
30	07/07/98	1510083E6A	367	186.3	111.7	122.5	47.6	11.1
31	07/07/98	1510083E02	366	188.3	81.2	89.3	35.5	4.2
32	07/07/98	151010361C	370	184.2	184	203	86	
33	07/07/98	1510083C49	368	185.8	89.5	98.7	36.5	4.5
34	07/08/98	151008563E	359	207.1	105	118	43	9.0
35	07/08/98	151010272	346	220.4	94.2	99.7	41.3	6.1
36	07/08/98	1510105A1E	347	220.4	66.5	76.5	29	2.3
37	07/08/98	1510102C58	348	220.4	40.6	76	27	2.2
38	07/08/98	1510101C26	349	220.4	60	67	23.5	1.6
39	07/08/98	1510084A11	361	207.1	66.5	74.5	28	2.0
40	07/08/98	1510080062	360	207.6	64	72.5	26.5	2.0

Table A. continued.

Fish No.	Date	PIT tag number	Floy tag number	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
41	07/08/98	1F4C7F6E28	362	207.1	81.5	92	35.5	4.4
42	07/08/98	1510085062	363	206.3	124	141.5	56	16.6
43	07/08/98	1510101C1E	364	206.0	76	84.5	30.5	3.0
44	07/08/98	1510082422	365	206.0	87	96.5	38.5	5.0
45	07/09/98	151008300C	354	182.6	79	90	36	3.9
46	07/09/98	151OO82E66	352	180.9	138.5	152	65	23.2
47	07/09/98	1510082EO2	358	182.9	60	67	26.5	1.5
48	07/09/98	1510085071	355	182.9	92	101	40	5.7
49	07/09/98	15100819OE	356	182.9	55	63	23.5	1.1
50	07/15/98	1510085064	253	216.9	193	213	82	55.7
51	07/15/98	1510083138		215.9	127	133.5	51.5	
52	07/15/98	1510065A29	351	217.5	82	93.5	35	4.2
53	07/15/98	151008314E	252	217.5	70	81.5	25	2.2
54	07/15/98	1510085002	254	216.9	140.5	161.5	58.5	19.8
55	07/15/98	1510082E56	255	216.9	88	98	37	4.5
56	07/15/98	1510085A69	256	216.2	84	95	32	3.3
57	07/21/98	1510082850*	257	261.9	69	76	22	1.8
58	07/21/98	1510082669*	258	261.9	91	102	32	4.4
59	07/22/98	1510085134*	264	259.0	69	76	23	1.4
60	07/22/98	151008486C	263	257.4	72	78.5	27	2.2
61	07/22/98	1510085O5E	262	257.4	130	143.5	56	18.0
62	07/22/98	1510105EOE	247	259.0	178	198.5	82.5	51.7
63	07/22/98	151010423A	261	257.4	75	84	29	2.9
64	07/22/98	1510083679	260	258.2	84.5	94	32	3.7
65	07/22/98	1510064111	442	258.2	88	99	39.5	5.0
66	07/22/98	1510083E4O	259	258.2	80	87.5	29	2.8
67	07/23/98	1510106231	267	262.3	95.5	104	35	5.6
68	07/23/98	1510080066	270	262.3	58	67.5	21.5	1.2
69	07/23/98	151008291E	179	262.3	61.5	67.5	19	1.3
70	07/23/98	1510082E08	266	262.3	71	76	25	2.1
71	07/23/98	1510085634	256	257.8	75	85.5	30	3.1
72	08/05/98	1510082134	276	261.9	70.5	82.5	24	2.0
73	08/05/98	151008313C	343	257.4	106	121	38	7.6
74	08/05/98	151008284C	341	243.8	77	85.5	31.5	3.3
75	08/05/98	1510105272	345	257.4	72	91.5	28	2.3
76	08/05/98	1510082951	277	261.8	54	62	20.5	0.9
77	08/05/98	151008367E	344	257.4	82	93.5	31	3.6
78	08/05/98	1510084420	275	259.0	82	91.5	32	3.7
79	08/05/98	1510102259	272	259.0	66.5	74.5	25	2.0
80	08/05/98	1510105018	437	259.0				

Table A. continued.

Fish No.	Date	PIT tag number	Floy tag number	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
81	08/05/98	1510106108	273	259.0	78	89	30	3.5
82	08/06/98	1510085A18	279	206.0	77	86.5	30	2.9
83	08/06/98	1510082A7A	281	197.9	126.5	143	52	14.8
84	08/06/98	1510105164	461	197.9				
85	08/06/98	1510104974	396	197.9				
86	08/06/98	1510082E51	280	199.5	94.5	95.5	39	6.0
87	08/06/98	151010397A	278	206.0	79	92	36	4.1
88	08/06/98	1510104C5C	337	220.4	133	152.5	55	19.8
89	08/06/98	1510082159	338	222.8	95	104.5	39	5.9
90	08/18/98	1510104602	282	17.2	204	231.5	81	55.5
91	08/24/98	151008125C*	283	284.8	69	78.9	24.5	2.2
92	08/24/98	1510107908*	284	284.8	76	85.5	25.5	2.6
93	08/25/98	1510083640	295	279.2	63	69.5	21.5	1.4
94	08/25/98	1510083912		280.0	72	81.5	27.5	2.6
95	08/25/98	1510101431	294	280.0	66	75.5	20.5	1.5
96	08/25/98	1510084466		273.5	80	90.5	30.5	3.2
97	08/25/98	1510100A71	296	279.2	83	93.5	27.5	3.1
98	08/25/98	151010162A	297	275.9	90.5	98.5	35.5	4.7
99	08/25/98	1510104C49	298	280.0	182	200	77.5	52.0
100	08/25/98	1510082949		273.5	62	70.5	21	1.3
101	08/25/98	1510085679	293	280.0	82.5	88	29	3.4
102	08/25/98	1510105E16	291	289.6	63	70	20	1.4
103	08/25/98	1510100831	292	289.6	104	115.5	38	6.8
104	08/25/98	1510085E72	290	289.6	66	72.5	19.5	1.3
105	08/25/98	151010511C	286	298.0	65	73	21	1.5
106	08/25/98	1510105470	299	289.6	86	94	30	3.9
107	08/25/98	1510104172	405	272.4	140	152	61.5	21.4
108	08/25/98	1510082268	285	301.7	197	220	78	58.6
109	08/25/98	1510082848	484	271.9	80	89	30	3.2
110	08/25/98	151008264A	287	296.1	71	80	23	2.0
111	08/25/98	1510105E34	289	291.6	189	208.5	80	60.6
112	08/25/98		91	296.1	70	78	24	2.1
113	08/25/98	1510100C3E	288	295.1	74	82	20	1.6
114	09/03/98	1510085A29	351	219.6	88	97.5	40.5	6.5
115	09/03/98	1510083E3A	901	218.0	67	77.5	30	2.5
116	09/03/98	1510105634	906	217.2	66	76	28	2.2
117	09/03/98		903	218.0	85	100	38.5	6.1
118	09/03/98		904	218.0	82.5	93.5	35	4.4
119	09/03/98		905	218.0	91	106.5	35.5	5.0
120	09/03/98		902	218.0	88	100	35	4.5

Table A. continued.

Fish No.	Date	PIT tag number	Floy tag number	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
121	09/03/98	1510103856	909	217.2	122	136.5	49	12.2
122	09/03/98	1510083E19	907	217.2	84	90.5	32.5	3.8
123	09/03/98	1510083144	908	217.2	63.5	72	24	1.5
124	09/03/98	1510082E42		216.4	101.5	115.5	41.5	7.6
125	09/03/98	151010045C	910	216.4	99	112	40.5	7.4
126	09/03/98	1510100C21	912	216.4	89.5	100	38.5	5.4
127	09/03/98	1510105171		216.4	148	160	62.5	25.3
128	09/03/98	1510104450		216.4	135	149	58	19.4
129	09/03/98	1510082C0C		220.4	112	128.5	46.5	9.8
130	09/03/98	1510104E60	911	216.4	89.5	102	34	4.6
131	09/09/98	1510101628		274.0	81	89.5	29	3.7
132	09/09/98	151008285C		275.3	101.5	113	36.5	6.7
133	09/09/98	1510105A36		280.0	127.4	140	50	15.3
134	09/09/98	1510080679		283.2	63	72.5	21	1.4
135	09/09/98	1510082168		283.2	73	86	23	2.0
136	09/09/98	1510104E59		283.2	76.5	86	26.5	2.9
137	09/09/98	1510102021		280.0	163	181.5	68	32.1
138	09/09/98	1510103C42		274.0	73	81	23	1.9
139	09/09/98	1510005E6A		283.2	144	173	57.5	22.0
140	09/09/98	1510082874		274.0	87	96	31	4.3
141	09/09/98	1510104C48		277.4	38.5	41	38.5	6.5
142	09/09/98	1510085131	466	279.3	150	173	60.5	24.3
143	09/09/98	1510103216		280.0	78	84.5	23	2.2
144	09/09/98	1510082E74		283.2	114.5	126.5	50	12.5
145	09/09/98	1510101242		280.0	93	101	34	5.3
146	09/09/98	1510103962		284.8	72	82	25	5.2
147	09/09/98	151008223C		284.8	182	202	78	63.7
148	09/09/98	1510083C5A		275.3	74.5	85	26	2.6
149	09/09/98	151008561A		275.3	67.5	78	24	1.8
150	09/09/98	151008461A		284.8	256	286	102	
151	09/09/98	151008143E		275.3	63	73	21	1.4
152	09/09/98	1510081960		275.3	78.8	85	27	2.5
153	09/09/98	1510084E4E		275.3	81	91.5	31	4.0
154	09/10/98			293.5	190	208	77	46.6
155	09/10/98			288.8	66.5	75	24	2.2
156	09/10/98			288.8	160	180	72.5	34.3
157	09/10/98			298.6	60	69	20	1.1
158	09/10/98			293.5	195	213	80	60.3
159	09/10/98			298.6	57.5	73.5	20	1.5
160	09/10/98			298.6	204	241	86	

Table A. continued.

Fish No.	Date	PIT tag number	Floy tag number	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
161	09/22/98	1510105250	335	257.8	89	99	34.5	4.7
162	09/22/98	1510101101	336	257.8	91	100	37.5	5.6
163	09/22/98	1510106161	96	257.8	123	138	51.5	12.7
164	09/22/98	1510082434	334	257.9	105	114.5	44	9.3
165	09/22/98	1510084111		257.9	87	97.5	32	4.6
166	09/22/98	151010044A	333	257.9	68	76.5	23	1.6
167	09/22/98	1510105016		257.9	33.5	37	15.5	3.8
168	09/23/98	1510107036	332	257.9	68.5	77	25.5	2.0
169	09/23/98	1F3E7A1A0F		257.9	87.5	99.5	34	4.4
170	09/23/98	1510103448	331	261.6	66	75	24.5	1.8
171	09/23/98	151010114C	330	270.6	112	124	39	8.1
172	09/24/98	1510101019		198.6	119	136	49	12.0
173	09/24/98	1510083458		195.5	78	87	31	2.7
174	09/24/98	151008385E		198.6	145.5	162	61	23.4
175	09/24/98	1510104A40		198.6	69	81	28	2.4
176	09/24/98	1F4D084D3F	371	190.7	140.5	155	51.5	17.7
177	09/24/98	1510083836		196.6	59	68	25	1.5
178	09/24/98	151010041		195.5	73	85	33	3.0
179	09/24/98	1510104A44		193.9	112	131	46	11.3
180	09/24/98	151010541E	328	190.7	89	100.5	35.5	4.8
181	09/24/98	1510101C20	329	190.7	67	75	27	1.9
182	10/20/98	151008367A		229.0	86	98.5	32	4.0
183	10/27/98	1510083C31		180.5	170	193	75	43.0
184	10/28/98	1510106E64		196.8	135	152	54	18.9
185	10/28/98	151010A7E		198.4	94	106.5	35	5.3
186	10/28/98	1510104A5C		200.0	113	133.5	53.5	13.5
187	10/28/98	151010586E		201.4	72	83	28.5	2.5
188	10/28/98	1510101664	152	201.4	145.5	164	68	25.0
189	10/29/98	1510101238		220.4	139.5	156	60.5	22.3
190	10/29/98	151010496C		214.0	91.5	102.5	37.5	6.0
191	10/29/98	151008504C	188	212.4	91.5	104	38.5	5.8
192	10/29/98	151010463E		212.4	90	99.5	37.5	5.3
193	10/29/98	1510107C6A	191	212.4	118	131.5	53	13.2
194	10/29/98	1510081240		210.8	184	198	83	49.5
195	10/29/98	1510101148		218.8	119	136.5	51.5	13.3
196	10/29/98	1510083E29		215.6	132.5	138.5	51	13.3
197	10/29/98	1510105A5E		214.0	99	113.5	37	6.3
198	10/29/98	151010104C		214.0	98	110.5	38.5	6.5
199	10/29/98	1510100462		214.0	170.5	197.5	84.5	50.9
200	10/29/98	151010084A		214.0	73	84	28	2.5

Table A. continued.

Fish No.	Date	PIT tag number	Floy tag number	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
201	11/03/98	1510104608		276.7	77	87.5	37	3.1
202	11/03/98	1510101272		281.3	132	138.5	56.5	17.7
203	11/03/98	1510104E02		278.5	159	177.5	72.5	36.4
204	11/03/98	151010484E		273.5	189	213	81.5	54.9
205	11/03/98	1510082E64		281.3	82	92	34	4.3
206	11/03/98	1510100446		274.0	181	203.5	75.5	45.1
207	11/03/98	151010263A		273.5	122.5	137.5	49.5	13.6
208	11/03/98	1510101272		281.3	65	73	22	1.8
209	11/03/98	1510101E56		278.5	119	130.5	54.5	14.2
210	11/03/98	1510107628	174	284.1	99.5	113.5	34	5.5
211	11/03/98	1510105844		282.5	142.5	157	60	23.0
212	11/03/98	1510106230		284.5	201	221	111.5	89.0
213	11/03/98	1510101974		284.5	181	206	77.5	49.6
214	11/03/98	1510105638		278.5	141	158	60	20.4
215	11/04/98	1510105442		288.0	65	74	21	1.5
216	11/04/98	1510104069		276.7	87	96.5	26	2.9
217	11/04/98	151008313A		299.3	240	258	98	127.3
218	11/04/98	1510100864		288.0	84.5	93.5	32.5	3.6
219	11/04/98	1510082641		298.5	98	108	35	6.7
220	11/04/98	1510105830		286.4	170	186.5	74.5	40.2
221	11/04/98	1F4D13463B		286.4	81.5	90.5	31.5	3.6
222	11/04/98	1510101C1C		283.2	61	68	22.5	1.5
223	11/04/98	1510105C02		283.2	85	95	35.5	5.1
224	11/04/98	151010297C		288.0	68.5	75	25	2.1
225	11/04/98	1510103A7C		288.0	73.5	80	24	2.0
226	11/04/98	151010403C		276.7	58	67	20.5	1.4
227	11/04/98	1510103269		281.6	178	194	84	51.8
228	11/04/98	1510105E68		278.4	194	215.5	87	57.8
229	11/04/98	1510100219		276.7	70	78	23	1.6
230	11/04/98	1510083616		278.4	154	175	65	29.2
231	11/04/98	1510100C44		276.7	64	72	21.5	1.6
232	11/04/98	1510104C7E		280.0	70	78	19.5	1.5
233	11/04/98	1510105452		281.6	169	196	78	42.1
234	11/04/98	1510105242		281.6	182	198	85	49.7
235	11/05/98	1510080628		0.4	63	72.5	23	1.7
236	11/10/98		334	257.4	102	112.5	23.5	8.9
237	11/10/98	1510081248		257.4	140	161	63.5	22.0
238	11/10/98		249	257.4	114.5	126.5	47.5	10.6
239	11/16/98	1510102C01		72.1	89	98.5	89	
240	11/19/98	1510083C31		213.2	172	191.5	75	42.9

Table A. continued.

Fish No.	Date	PIT tag number	Floy tag number	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
241	11/19/98	1510083919		220.4	102.5	118	40.5	7.7
242	11/19/98	1510102631		222.0	96	105.5	40	6.2
243	11/19/98	1510084440		210.0	198	220	85	63.4
244	11/19/98	1510083A69		220.4	232	247	107	103.4
245	11/19/98	1510080158		210.0	41.5	51.5	19	0.5
246	11/19/98	4158470F08		215.6	122	130.5	45	13.4
247	11/19/98	1510082176		207.6	71	83	28	2.5
248	11/19/98	1510082E51		210.0	96.5	99.5	38	6.6
249	11/19/98	1510105164	461	210.0	127.5	146.5	53.5	15.9
250	11/19/98	1510080008		210.0	125	139	51	14.3
251	11/19/98	151008321A		210.0	68.5	78	27.5	2.1
252	12/01/98	1510082842*		294.4	111.5	124	41	8.0
253	12/01/98	1510081218		284.5	179.5	198.5	78	51.5
254	12/01/98	1510083148		284.5	207	230	91	82.9
255	12/01/98	151008227A		284.5	72	80	28	2.5
256	12/01/98	1510106E01		284.5	67	75	24	2.1
257	12/01/98	1510084959		271.9	74.5	84.5	26	2.8
258	12/01/98	1510103146		281.3	92.5	98.5	32.5	5.2
259	12/01/98	4158670177		275.9	130	137	66	16.8
260	12/01/98	1510081809		281.3	60	68	20	1.3
261	12/01/98	1510104020		271.9	86	96.5	30.5	4.0
262	12/01/98	1510085A39		278.4	193.5	215.5	77	49.5
263	12/08/98	1510101E06		217.2	87	98	36	4.5
264	12/08/98	1510082422	365	223.7	89.5	110	37	5.5
265	12/08/98	1510084821		223.7	87	95	38	5.3
266	12/14/98	1510101828		261.5	67.5	71.5	26	2.3
267	12/14/98	1510083E00		267.1	179.5	202.5	80	
268	12/14/98	1510107919		270.3	132	143.5	69	19.0
269	12/29/98	1510107649	223	297.7	80	90	28	3.0
270	12/29/98	1510082642		299.3	187	206	75	
271	12/29/98	1510106E1C		299.3	191.5	207	81	
272	12/29/98	1510103E0C		299.3	66	72	25	1.8
273	12/29/98	1510106E5C		297.7	121	132.5	46	12.2
274	12/29/98	151010316A		286.4	72	81	26	2.0
275	12/29/98	1510103E09		297.7	66.5	78	23	1.8
276	12/29/98	151008196		286.4	127	141.5	50.5	13.6
277	12/29/98	1510081436		286.4	69	76	26	2.2
278	12/29/98	1510084441		286.4	77.5	89	30.5	3.5
279	12/29/98	1510103E59		286.4	70	79.5	26.5	2.3
280	12/29/98	1510082E06		299.3	169	190	72	31.4

Table A. continued.

Fish No.	Date	PIT tag number	Floy tag number	Location Rkm	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (kg)
281	12/29/98	1510102A7C		286.4	82.5	89	33	4.0

APPENDIX B

1998 White Sturgeon Recapture Data

Table B. Movements of white sturgeon recaptured in the Snake River during 1998.

PIT Tag Number	Fork Length (cm)	Dates	Days at Large	Capture 1 (Rkm)	Recapture 2 (Rkm)	Recapture 3 (Rkm)	Distance Moved (km)
1510083C31	191.5	10/27/98-11/19/98	23	180.5	213.2		32.7
1510104974	138.5	06/23/98-08/06/98	44	184.1	197.9		13.8
1510082434	114.5	09/22/98-11/10/98	49	257.9	257.4		-0.5
1510064A29	97.5	07/15/98-09/03/98	50	217.5	219.6		2.1
1F4D08D3F	155	07/01/98-09/24/98	85	206.4	190.6		-15.8
1510083E29	138.5	06/25/98-10/29/98	126	204.3	215.6		11.3
1510082422	110	07/08/98-12/08/98	153	206	223.7		17.7
1510105C40	157	10/29/97-06/30/98	244	276.3	177.8		-98.5
1510105E0E	198.5	11/05/97-07/22/98	259	259	259		0
151010423A	84	11/04/97-07/22/98	260	257.4	257.4		0
1510105018	89.5	11/04/97-11/17/97-8/5/98	274	258.2	255.8	259	-2.4,3.2
1510085131	173	12/03/97-09/09/98	280	279.1	279.3		0.2
1510104172	152	10/27/97-08/25/98	302	276.3	272.4		-3.9
1510082130	98	09/16/97-07/15/98	302	197.9	216.9		19
1510082848	89	10/27/97-08/25/98	302	271.9	271.9		0
1510084E4E	91.5	10/27/97-09/09/98	317	284	275.3		-8.7
1F3E7A1A0F	99.5	11/06/97-09/23/98	321	258.2	257.9		-0.3
1510084111	97.5	11/04/97-7/22/98-9/22/98	322	257.4	258.2	257.9	0.8,-0.3
1F4D2E4C1A	166	08/05/97-06/24/98	323	n/a	203.1		n/a
1510082E64	92	12/04/97-11/03/98	334	283.2	281.3		-1.9
1510105164	146.5	12/18/97-8/6/98-11/19/98	336	258	198	210.1	-60,12.1
1510085161	133.5	08/05/97-07/15/98	344	n/a	215.9		n/a
1510082E42	115.5	09/17/97-09/03/98	351	n/a	216.4		n/a
1510104C5C	152.5	08/07/97-08/06/98	364	182.7	220.4		37.7
151008007A	114.5	11/05/97-11/10/98	370	259.1	257.4		-1.7
151C085052	148	08/20/97-08/25/98	370	296.1	296.1		0
1510101664	164	10/22/97-10/28/98	371	228.1	201.4		-26.7
1510083912	81.5	08/19/97-08/25/98	371	284.8	280		-4.8
1510106161	138	09/15/97-09/22/98	372	197.1	257.8		60.7
151017649	90	12/02/97-12/29/98	392	298.5	297.7		-0.8
1510107628	113.5	10/01/97-11/03/98	398	284.8	284.2		-0.6
1F4D13463B	90.5	09/29/97-11/04/98	401	292	286.4		-5.6
151008504C	104	09/17/97-10/29/98	407	n/a	212.4		n/a
1510107C6A	131.5	09/17/97-10/29/98	407	197.9	212.4		14.5
1510082842	124	09/29/97-12/01/98	428	292	294.4		2.4
1510106E64	152	08/07/97-10/28/98	447	206	196.8		-9.2
4158670177	137	04/17/97-12/01/98	593	217.2	275.9		58.7