WHITE STURGEON INVESTIGATIONS IN ARROW RESERVOIR AND SLOCAN LAKE

1997 STUDY RESULTS

RL&L Environmental Services Ltd.

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Prepared for

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Cover photo: Pre-spawning female captured at Beaton Flats (Arrow Reservoir), October 1997. The sturgeon is being released after processing by study team members Amber Lahti and Dan Sneep.

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EXECUTIVE SUMMARY

The presence of white sturgeon (*Acipenser transmontanus*) in Arrow Reservoir and Slocan Lake was first documented in 1995. White sturgeon in Arrow Reservoir represent a remnant population isolated from the parent population in the Columbia River by the construction of Hugh L. Keenleyside Dam. White sturgeon in Slocan Lake could originate from either Columbia River or Kootenay Lake stocks.

In 1997, additional investigations were conducted on white sturgeon in Arrow Reservoir and Slocan Lake, both located in the West Kootenay Region of British Columbia. The purpose of this study was to determine the distribution, abundance, life history characteristics, and movement patterns of white sturgeon populations in these waterbodies. Investigations were conducted in the summer and fall of 1997.

Set lines were the primary method used to capture white sturgeon. Sampling in both waterbodies was concentrated in areas where white sturgeon had previously been captured in order to maximize the catch. Captured white sturgeon were equipped with sonic transmitters (48-month life span). Movements of tagged white sturgeon were monitored on a monthly basis over the August 1997 to March 1998 period. Two white sturgeon captured in Arrow Reservoir were equipped with archival tags (two year life span) that were programmed to record data on depth and temperature at one-hour intervals. These fish will have to be recaptured to recover the tags and download the data collected.

Nine white sturgeon were captured in Arrow Reservoir. Seven of these were captured in the Beaton Flats area, located at the confluence of Beaton Arm and the main body of Arrow Reservoir. This area exhibited a flat-bottom profile with a predominantly silt-sand substrate and appeared to provide important feeding and overwintering habitat for white sturgeon. All white sturgeon equipped with sonic tags, regardless of original capture location, were located in this area during the winter period.

The white sturgeon caught in Arrow Reservoir were all adults that ranged from 126 to 226 cm in fork length. All were examined for sex and maturity; seven were males and two were females. The largest fish was a late reproductive stage female that would likely spawn in spring 1998. The other female was in an early reproductive stage and would not likely spawn for several years.

White sturgeon were not captured in Slocan Lake in 1997. Sampling in the lake in 1995, 1996, and 1997 has resulted in the capture of two white sturgeon. In 1996, a pre-spawning white sturgeon female (expected to spawn in 1997) was equipped with a sonic tag. Monitoring of this fish during the spring period of 1997 revealed numerous movements to the mouths of different tributaries. These movements were interpreted as a search by this female for a suitable spawning area. Evidence that this fish spawned in 1997 was not obtained.

The present study of white sturgeon in Arrow Reservoir represents only the first year of detailed investigations on this species status. As such, analysis of the available data was limited and additional studies are recommended.

The capture of only two white sturgeon in Slocan Lake during three years of intensive study suggest the population density in the lake is very low and may consist of only a few individuals. Additional studies on this remnant population to obtain life history, distribution, or habitat use data are not recommended. Suggested future management options for these fish are provided.

ACKNOWLEDGEMENTS

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Doug Seaton	Boat Operator
Paul Seaton	Boat Operator

The following employees of **R.L. & L. ENVIRONMENTAL SERVICES LTD.** contributed to the collection of data and the preparation of this report.

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1.0 INTRODUCTION

1.1 BACKGROUND

Historically, white sturgeon (*Acipenser transmontanus*) were likely distributed throughout the Columbia River Basin, within the mainstem Columbia and Kootenay rivers in Canada and larger tributaries and lakes within these drainages. These populations would have had access to the Pacific Ocean although there is a possibility that resident sub-populations may have existed in some parts of the drainage. Since the last glaciation age approximately 10 000 years ago, a natural barrier was formed at Bonnington Falls on the lower Kootenay River between the outlet of Kootenay Lake and the Columbia River (Northcote 1973). This barrier isolated white sturgeon in Kootenay Lake and the Kootenay River (termed the Kootenay population) from populations in the Columbia River (termed the Columbia population).

The land-locked Kootenay population has exhibited intermittent recruitment from the mid-1960s to 1974 when Libby Dam commenced operations (Partridge 1983). A complete lack of recruitment since the early 1980s was attributed to alterations in the natural hydrograph, river channel alterations, and chemical pollutants (Apperson and Anders 1991).

The construction of dams on the Columbia and Kootenay rivers has resulted in additional fragmentation and isolation of white sturgeon populations (Figure 1.1). The earliest dam constructed on the Kootenay River was built over Lower Bonnington Falls in 1897. Subsequently, three other dams, Upper Bonnington, South Slocan, and Corra Linn, were completed in 1907, 1928, and 1932, respectively. In 1944, fish movement between the Columbia and Kootenay rivers was further restricted with the completion of Brilliant Dam, located 2.8 km upstream from the Kootenay-Columbia confluence.

On the Columbia River mainstem, three dams have been constructed since the ratification of the Columbia River Treaty with the United States in 1968. Two dams, Hugh L. Keenleyside and Mica, ensure that adequate storage is available to provide the hydro generation potential and flood control required by the Treaty. Revelstoke Dam, a non-treaty dam, was constructed by BC Hydro for hydro power generation. Hugh L. Keenleyside Dam, a flow regulation facility commissioned in 1968, is the furthest downstream of the dams and is located at the south end of Arrow Reservoir. The river from Hugh L. Keenleyside Dam downstream to Lake Roosevelt is one of the few remaining flowing sections of the Columbia River and supports a small population of white sturgeon. This population also experiences frequent recruitment failures that are likely related to the effects of river regulation and industrial developments (R.L. & L. 1994).

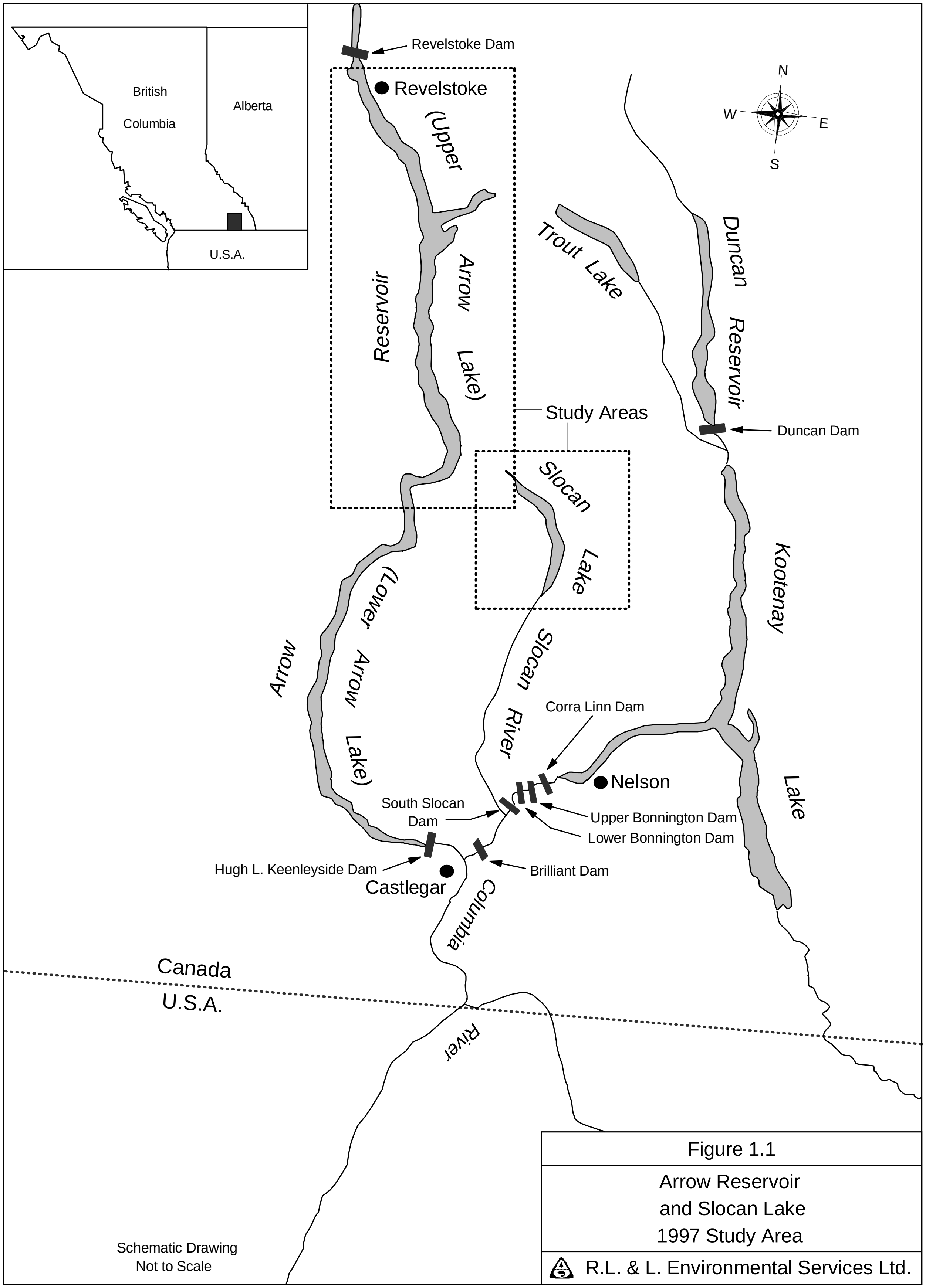


Figure 1.1

Arrow Reservoir
and Slocan Lake
1997 Study Area

R.L. & L. Environmental Services Ltd.

Anecdotal reports of white sturgeon sightings suggest that there may be several remnant populations of white sturgeon trapped behind and/or between dams on both the mainstem Columbia and Kootenay rivers and in larger lakes and tributaries to these systems. Reconnaissance level surveys conducted by Kootenay Wildlife Services Ltd. in 1995 recorded the presence of white sturgeon in Slocan Lake and also in Arrow Reservoir between Hugh L. Keenleyside Dam and Revelstoke Dam (reported in R.L. & L. 1996). To obtain additional information on these populations, R.L. & L. Environmental Services Ltd. was contracted by B.C. Environment, Lands and Parks (Kootenay Region) to conduct further sampling for white sturgeon in Arrow Reservoir and Slocan Lake in 1997. The following discussion provides the results of this sampling program.

1.2 OBJECTIVES

The 1997 Arrow Reservoir and Slocan Lake white sturgeon study program proposed by R.L. & L. Environmental Services Ltd. outlined the following objectives:

- to determine the distribution and abundance of white sturgeon in Arrow Reservoir and Slocan Lake;
- to collect life history information from captured white sturgeon, in order to determine growth rates and size-class and age-class composition;
- to determine seasonal movement patterns of white sturgeon in these systems via the use of sonic telemetry; and
- to determine the effectiveness of archival tags for collecting continuous habitat preference data from tagged white sturgeon in Arrow Reservoir.

1.3 STUDY AREA

Arrow Reservoir is located between the Monashee and Selkirk Mountain ranges. The construction of the Hugh L. Keenleyside Dam in 1968 impounded two pre-existing lakes (Upper Arrow and Lower Arrow) that were originally separated by a section of free-flowing Columbia River. As a result of the dam, these two lakes and large sections of the free-flowing Columbia River were flooded to create one long waterbody. Although the official name of this waterbody is Arrow Reservoir, the upper and lower lakes are still referred to locally as Upper Arrow and Lower Arrow lakes, respectively (Figure 1.1). Revelstoke Dam forms the upper boundary of Arrow Reservoir. At full pool, the reservoir extends to within 10 km downstream of Revelstoke Dam.

Slocan Lake lies between the Selkirk and Valhalla Mountain ranges and is approximately 39 km in length. The lake drains via the Slocan River into the Kootenay River (Brilliant Reservoir) and enters the reservoir approximately 1 km downstream of South Slocan Dam (Figure 1.1). Physical blockages to fish movement are not present in the Slocan River; therefore, white sturgeon movements between Slocan Lake and Brilliant Reservoir on the Kootenay River are possible. White sturgeon in this system likely originated either from members of the Columbia population isolated since construction of Brilliant Dam in 1944 or from members of the Kootenay population that moved downstream from Kootenay Lake.

1.4 STUDY PERIOD

Sampling was conducted in July and October in the upper portion of Arrow Reservoir and also in Slocan Lake (Table 1.1). Boat-based tracking of sonic-tagged fish was conducted in both systems on a monthly basis from July 1997 to March 1998.

Table 1.1 Sampling periods for the Arrow Reservoir and Slocan Lake white sturgeon study, 1997.

Site	Session	Date
Arrow Reservoir	Summer	19 to 23 July
	Fall - first session	1 to 5 October
	Fall - second session	20 to 23 October
Slocan Lake	Summer	24 to 26 July
	Fall	6 to 8 October

2.0 METHODOLOGY

2.1 CAPTURE TECHNIQUES

2.1.1 Set Lines

Set lines were the primary method used to capture white sturgeon in Arrow Reservoir and Slocan Lake. This method provides the greatest catch-rate of white sturgeon and is less selective than other sample gear (Elliot and Beamesderfer 1990). Three set line configurations were used: short lines (20 m mainline with four or five hooks), medium lines (40 m mainline with eight hooks), and long lines (80 m mainline with 12 hooks). The type of set line deployed was determined by habitat conditions at each sampling location. Each set line generally consisted of a 1.3 cm diameter mainline rope with circle halibut hooks attached at approximately 3.0 m intervals. The hook lines consisted of a 0.64 cm swivel snap and a 0.5 m long dropper line tied between the swivel and the hook. Hook sizes used were 12/0, 14/0, and 16/0. Sharpened barbless hooks of each size were placed in random order on each set line. Hooks were baited with kokanee obtained from Meadow Creek and Hill Creek kokanee spawning channels. To ensure the set line remained in position and the hooks rested on the bottom, 4.5 kg anchors were attached to each end of the set line during deployment. Buoys were attached to the anchors to facilitate retrieval.

Set lines were deployed from a boat and generally set overnight in nearshore areas of varying depths or in the vicinity of tributary mouths. These areas were selected based on visual assessments of surface conditions and bottom configuration as determined with a depth sounder. The number of set lines deployed varied according to the number of suitable locations within an area and the number of lines a crew could effectively set and retrieve.

Data recorded at each set line included date, location, set duration, water temperature, minimum and maximum depth, water clarity (secchi depth), number of hooks, and catch. Catch-per-unit-effort (CPUE=no. fish/100 hook-hours) was calculated for each set.

2.1.2 Fish Handling Techniques

Captured fish were brought to the boat and guided into a 2.5 m by 1.0 m stretcher constructed of a waterproof plastic laminate material. The head of the white sturgeon was placed in a hood located at one end of the stretcher. This had a calming effect on the fish and also served to retain a sufficient amount of water so the fish could respire normally during processing. Fresh lake water was continuously added to the stretcher during the processing period. After processing, fish were returned to the water and released, once normal respiration, orientation, and swimming behaviour were observed by the study team.

Incidental captures of other fish species were removed from the set lines, identified, and then measured for length and weight. Any incidental captures in good condition after processing were marked with a Floy tag and released.

2.2 SEASONAL MOVEMENT AND POPULATION ESTIMATES

2.2.1 Fish Marking

All of the white sturgeon captured during 1997 were marked with a numbered Floy™ T-anchor tag, a Passive Integrated Transponder (PIT) tag from Biosonics Inc., and by the removal of a section of the left pectoral fin (i.e., used for ageing purposes). The Floy tag and fin clip marking techniques used during the 1997 sampling program have been in use on the Columbia River system since 1990. PIT tags were introduced as a marking system in 1992, and have since been a standard component of the fish marking program.

2.2.2 Sonic Telemetry

To assist in assessing the extent and purpose (e.g., home territory, dispersal, spawning behaviour, habitat utilization) of white sturgeon movements, internally implanted sonic transmitters were used. All white sturgeon captured in the study were equipped with a sonic tag.

The sonic transmitters used (Model CT-82-3-M), were manufactured by Sonotronics. The transmitters were 65 mm in length and 18 mm in diameter, weighed 8 g in air, and had a 48-month rated life span. The transmitters had unique codes and operated within a frequency range of 32 to 83 kHz. The surgical procedures used to internally implant sonic transmitters in white sturgeon followed those described in Hildebrand and English (1991).

Tracking of sonic-tagged white sturgeon was conducted from a boat, using a directional hydrophone. Tracking in Slocan Lake was conducted from January to August 1997 by Kootenay Wildlife Services Ltd. Tracking in both Arrow Reservoir and Slocan Lake over the August 1997 to March 1998 period was conducted by R.L. & L. Environmental Services Ltd.

2.2.3 Archival Tags

Two of the white sturgeon caught in Arrow Reservoir were equipped with archival tags. These tags were programmed to continuously measure and record water pressure (depth) and temperature data at one-hour intervals. Since the archival tags must be recovered to retrieve the data, fish equipped with these tags also were also equipped with a sonic tag to increase their chance of recapture. Results of this study component will be provided in a future report (i.e., assuming the archival tags can be recovered).

The archival tags used in the 1997 program were prototype models manufactured by Advanced Telemetry Systems. The tags were 50 mm in length and 14 mm in diameter, powered by a 3.6 Volt battery. The maximum data storage capacity of the tags is 32 746 bytes. The tags measure water temperature and pressure to within an accuracy of ±0.5°C, and ±2 PSI, respectively.

2.3 LIFE HISTORY DATA

2.3.1 Length and Weight

White sturgeon were measured for fork length (FL), snout to post-opercular edge length (SL), and total length (TL) to the nearest 0.5 cm. Girth was measured behind the pectoral fins to the nearest 0.5 cm. Weight was determined using a 135 kg capacity spring scale accurate to ±2.3 kg.

2.3.2 Growth Characteristics

Brennan and Cailliet (1989) reported that calcified structures (pectoral fin rays, opercles, clavicles, cleithra, medial nuchals, and dorsal scutes) used to age white sturgeon did not result in significantly different estimates of age. Pectoral fin rays appeared to provide the highest accuracy and did not require sacrificing the fish.

A section from the leading left pectoral fin ray was removed from all captured white sturgeon for ageing purposes. Fin ray sections were obtained by making two cuts with a sterilized hacksaw blade or sidecutter pliers; the first cut was made approximately 5 mm distal from the point of articulation (knuckle) of the pectoral fin and the second was made approximately 10 mm distal from the first. Sections were then separated from the fin with a sterilized surgical knife and pliers and placed in an envelope marked with the appropriate information. Care was taken not to sever the artery close to the articulation of the fin ray. If there was any bleeding from the area of the removed fin section, the area was swabbed with an antiseptic and pressure was applied to seal the wound.

Four to six transverse sections (0.3 to 0.6 mm thickness) were obtained from each fin ray using a jewellers saw. The sections were permanently mounted on glass microscope slides using a synthetic-mounting medium. Fin ray sections were examined with a dissecting microscope using transmitted light. The age of the fish was determined by counting translucent zones (i.e., annuli) in the basal cross sections using the methods described by Cuerrier (1951), Beamesderfer et al. (1989), Brennan and Cailliet (1991), and Rien and Beamesderfer (1994).

Older fish were difficult to age due to crowded annuli caused by slow growth in later life. Fish collected in spring or early summer (i.e., prior to annulus formation) were assigned an annulus on the outer edge of the ray. Each fin ray sample was examined twice by an experienced reader and an age assigned at each reading. Ages were assigned without knowledge of fish size. In cases where the two ages disagreed by more than one year, the sample was examined a third time and a final age was established.

2.3.3 Sex and Maturity

Sex and maturity of white sturgeon were determined by surgical examination. Surgical procedures were similar to those developed for white sturgeon in the United States and described by Beamesderfer et al. (1989). The description of maturity stages generally follows the qualitative histological classifications described by Conte et al. (1988). Subjective assessments were used when the maturity stage was intermediate relative to the classification system. The following discussion presents a brief description of the surgical techniques.

The surgery was performed at the abdominal area, near the mid-ventral line three to four ventral scutes anterior to the pelvic fin insertion. The area was swabbed with Germaphine™ disinfectant and a 3.0 to 4.0 cm long incision was made with a sterile scalpel through the body wall. Mature gonads were large and often readily observed through the incision. Immature gonads or those in early stages of maturation were smaller and more difficult to find. If the gonads were not visible through the incision, an otoscope equipped with a veterinary head and speculum was inserted into the incision to locate and examine the gonads.

All surgically examined fish were administered oxytetracycline (OTC). An intraperitoneal dosage of 0.2 mL Liquamycin LP per kilogram of body weight and a concentration of 100 mg/mL was used. This dosage, equivalent to 20 mg OTC/kg of body weight, has been used successfully by U.S. researchers (Apperson and Anders 1991) during investigations of Kootenay River populations of white sturgeon and by R.L. & L. (1994) during studies on white sturgeon in the Columbia River in Canada. Oxytetracycline is an effective broad spectrum antibiotic and also serves as a marker on bony structures (i.e., fin rays) for use in age-validation studies.

The incision was closed using a half circle, CR-2 reverse cutting-edge needle, swedged to a 0 (4.0 metric) chromic gut suture. When the body wall was thick (greater than 0.5 cm), a vertical mattress stitch was used. When the body wall was thinner, a simple stitch was used. The sutures were spaced approximately 1 cm apart. Once the incision was closed, the area was swabbed with Germaphine™ and dried. A surgical adhesive (Vetbond) was sparingly applied to the incision and sutures to protect the area for a short period of time after the release of the fish.

2.3.4 Genetic Analysis

A sample of soft tissue was collected for molecular genetic DNA analysis from all white sturgeon sampled in Arrow Reservoir in 1997. A small section of the distal end of the pelvic fin was removed, cut into thin sections using surgical scissors, and preserved in labelled vials containing 99% ethanol. The DNA samples were forwarded to S. Pollard (B.C. Ministry of Environment, Lands and Parks, Victoria) for genetic analyses with results to be provided in a separate report.

3.0 RESULTS

3.1 ARROW RESERVOIR

3.1.1 Distribution and Catch

The presence of a remnant population of white sturgeon in Arrow Reservoir was confirmed in a recent study (R.L. & L. 1996). In 1995, the entire reservoir was systematically sampled by Kootenay Wildlife Services Ltd.; white sturgeon were captured only between Km 181.0 and 225.0 in the portion of the reservoir known locally as Upper Arrow Lake. Specific white sturgeon capture locations included Beaton Arm (Km 181.0-0.0), Big Eddy (Km 228.5) below Revelstoke Dam, and near an area locally known as Salmon Rocks (Km 223.5). Kilometre locations are centerline reservoir distances measured upstream from Hugh L. Keenleyside Dam; locations within sidechannels are indicated by a hyphenated value following the reservoir location of the sidechannel mouth.

In the present study, sampling efforts focussed in areas where white sturgeon had been captured in 1995, in an attempt to maximize catch efficiency. Several areas were sampled intensively (Figure 3.1); the Beaton Flats area (Km 179.0 to 183.1) at the mouth of Beaton Arm (Km 181.0), the north end of Beaton Arm (Km 181.0-16.5), and in the Salmon Rocks area located across from the Illecillewaet River (Km 223.6). Sampling also was sporadically conducted in the reservoir from McDonald Creek (Km 120.0) to the Galena Bay outlet (Km 177.0) and from the old Arrowhead townsite (Km 183.0) to Big Eddy (Km 228.5).

In the present study, nine white sturgeon were captured in Arrow Reservoir in 15 871.5 hook-hours of set line effort (Appendix A, Table A1). One fish was caught in the summer session at the north end of Beaton Arm (Km 181.0-16.6). Eight fish were caught in the fall session; of these, seven were captured in the Beaton Flats area (Km 179.0 to 183.1), and one was captured downstream from the Salmon Rocks area (Km 123.2). None of the white sturgeon caught were recaptures.

Water temperatures at set line sites ranged between 8.8 and 21.0°C in the summer, with the highest temperatures recorded in Beaton Arm. In the fall, water temperatures at sample sites ranged between 6.1 and 11.8°C. Sampled depths ranged between 0.7 and 46.0 m for both sample sessions. White sturgeon were captured at sites with depths greater than 4.0 m.

Beaton Flats (Plate 1), the area where most fish were captured, was a large (3 km by 5 km), predominantly flat-bottomed area with similar depths throughout. This area was located at the confluence of Beaton Arm and the main body of Arrow Reservoir. Substrate at this site was composed of silt-sand (based on observations from the boat and the type of material brought up on the anchors). Water currents at this location were low (estimated at less than 0.1 m/s).

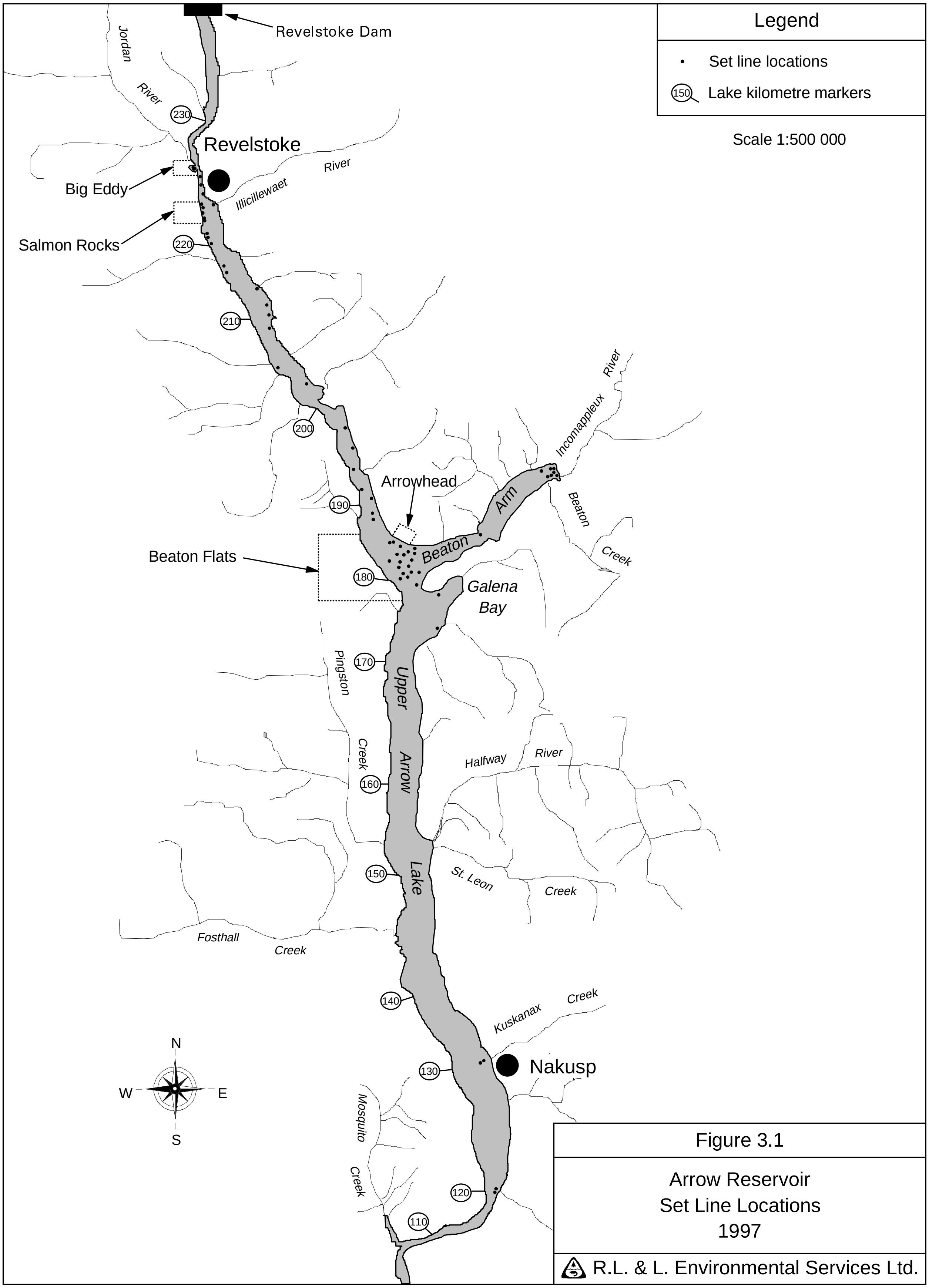


Figure 3.1

Arrow Reservoir
Set Line Locations
1997

R.L. & L. Environmental Services Ltd.

Salmon Rocks (Plate 2), another white sturgeon capture site, was located across from the mouth of the Illecillewaet River. This area was characterized by bedrock substrates along the shoreline, low current velocity (less than 0.25 m/s), and several small back eddies along the shore line. The channel thalweg in this area exhibited maximum depths of up to 25 m in a few areas although the remainder of the area was less then 5 m deep.

The third white sturgeon capture location was at the north end of Beaton Arm (Plate 3) in the vicinity of the Incomappleux River mouth. The area sampled was characterized by relatively shallow depths (less than 13 m), warm water temperatures in the summer (up to 21.0°C), and negligible current velocity (less than 0.05 m/s). Substrate was predominantly sand-silt with a fair amount of large woody debris (in which the set lines frequently became tangled). The water velocities at this sample site were minimal, and water depths were less than 13 m.

The set line sampling also yielded an incidental catch of 47 burbot (*Lota lota*); most of these (n=36) were captured in the fall sampling session (Appendix A, Table A1). The majority (66%) were captured at the Beaton Flats area (Km 179.0 to 183.1, and within 1 km into Beaton Arm). Other capture locations included Galena Bay (Km 177.0-2.0), the north end of Beaton Arm (Km 181.0-16.9), at the mouth of the Illecillewaet River (Km 223.5-1.0), and two locations within the main reservoir at Km 189.0 and 216.1.

3.1.2 Life History Data

The nine white sturgeon captured in Arrow Reservoir in 1997 ranged in length from 126.5 to 226.5 cm FL and in weight from 17.7 to 106.8 kg (Appendix B, Table B1). The smallest fish (126.5 cm FL; Plate 4) was 20 cm smaller than the smallest white sturgeon previously captured in Arrow Reservoir (R.L. & L. 1996). The majority (78%) of white sturgeon were between 150.0 and 199.0 cm FL (Figure 3.2).

All captured white sturgeon were surgically examined to determine sex and maturity. Seven of the fish were males; all were in earlier reproductive stages (Appendix B, Table B1). The largest fish was a late reproductive stage female that would likely spawn in 1998. The one other captured female was in an early reproductive stage and would not be expected to spawn for several years.

The burbot captured in 1997 ranged in size between 511 and 855 mm TL and in weight between 779 and 3456 g (Appendix B, Table B2). Twenty-one burbot that were in good condition following processing were marked with Floy tags and released.

3.1.3 Sonic Telemetry

White sturgeon equipped with sonic transmitters were tracked twice in August, and once per month subsequently until March 1998 (Appendix C, Table C1). Tracking efficiency was greatest during the winter months (October to March).

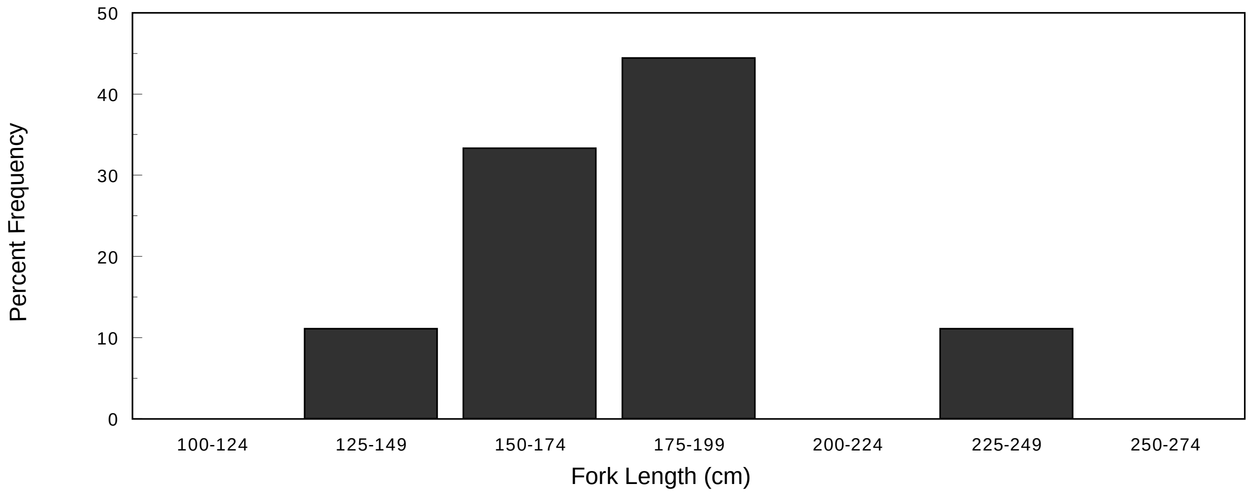


Figure 3.2 Length-frequency distribution of white sturgeon (*n*=9) captured in Arrow Reservoir, 1997.

This was likely due to the absence in the reservoir of a strong thermocline and the low densities of phytoplankton, factors that reduce signal transmission. In the fall and winter surveys, signals could be received at distances of up to 2.0 km, whereas in the summer, signal range was reduced to between 0.5 and 1.0 km. The increased signal range in the winter resulted in problems with identifying individual tag signals in instances where several tagged fish were present in the same area. In the Beaton Flats area, where most of the fish were located, the overlap of the numerous strong signals occasionally prevented the identification of individual signal codes. As a result, the failure to positively record the presence of a sonic-tagged fish during winter tracking sessions at Beaton Flats, did not necessarily mean the fish was not present in the area.

The majority of movements exhibited by white sturgeon equipped with sonic tags were between 0.0 and 2.5 km (Figure 3.3). Seven white sturgeon (two females and five males) were always located in the Beaton Flats area. One male white sturgeon moved from its release location in the upper portion of Beaton Arm to the Beaton Flats area over the late September to late October period, a distance of approximately 17 km. The male white sturgeon captured near Salmon Rocks moved from this location to the Beaton Flats area, a distance of approximately 44 km, over the early October to late November period. This fish remained in the Beaton Flats until early February. When located again in early March, this fish had moved approximately 8 km upstream.

All sonic-tagged fish were located in Beaton Flats at least twice during the winter months. For the reasons previously discussed, during most of the winter tracking sessions, the high concentration of tagged fish in this area made the identification of individual signals very difficult. As a result, there is a high probability that all nine of the sonic-tagged white sturgeon remained in the Beaton Flats area during most or all of the winter.

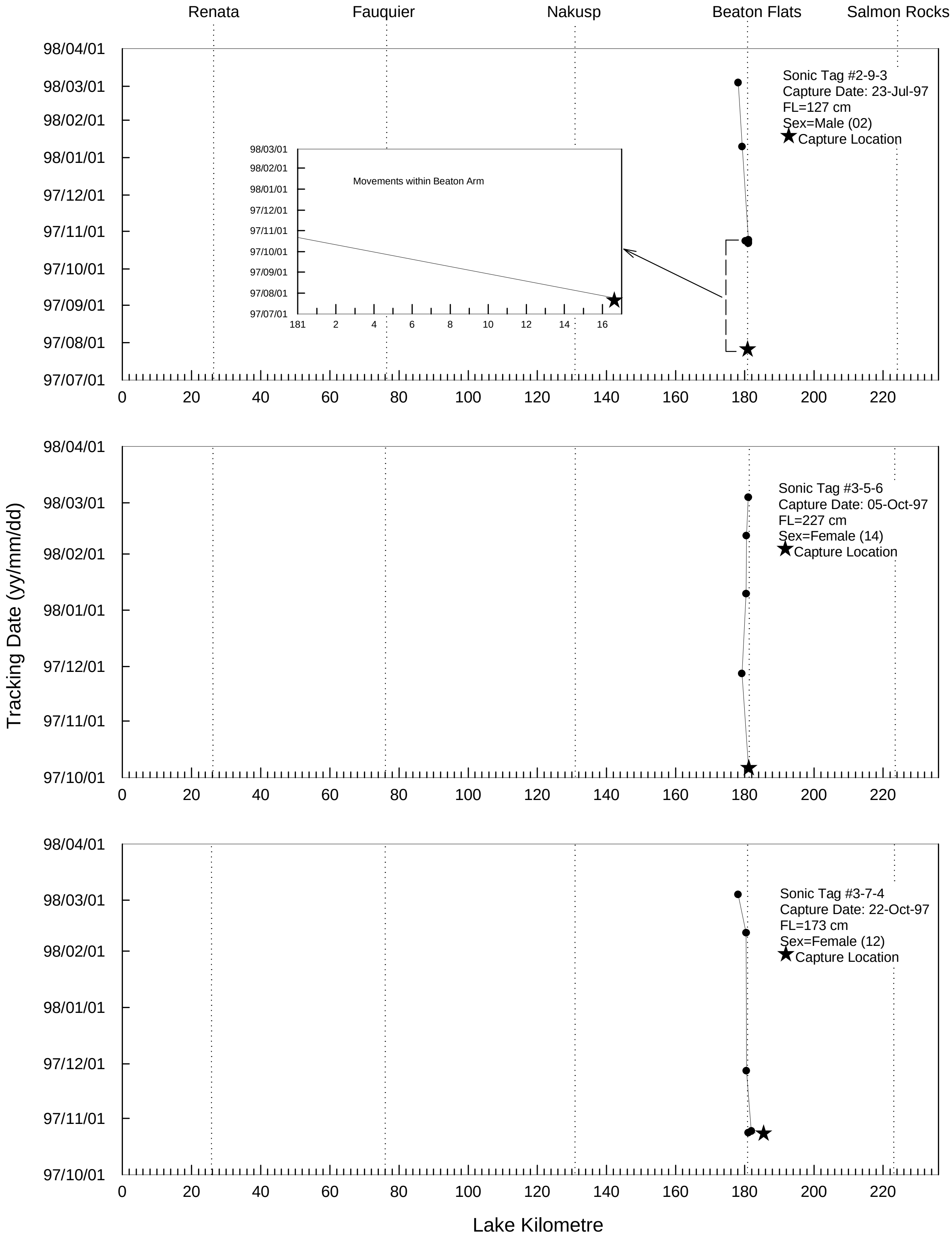


Figure 3.3 Summary of movements of sonic-tagged white sturgeon in Arrow Reservoir, 1997-1998.

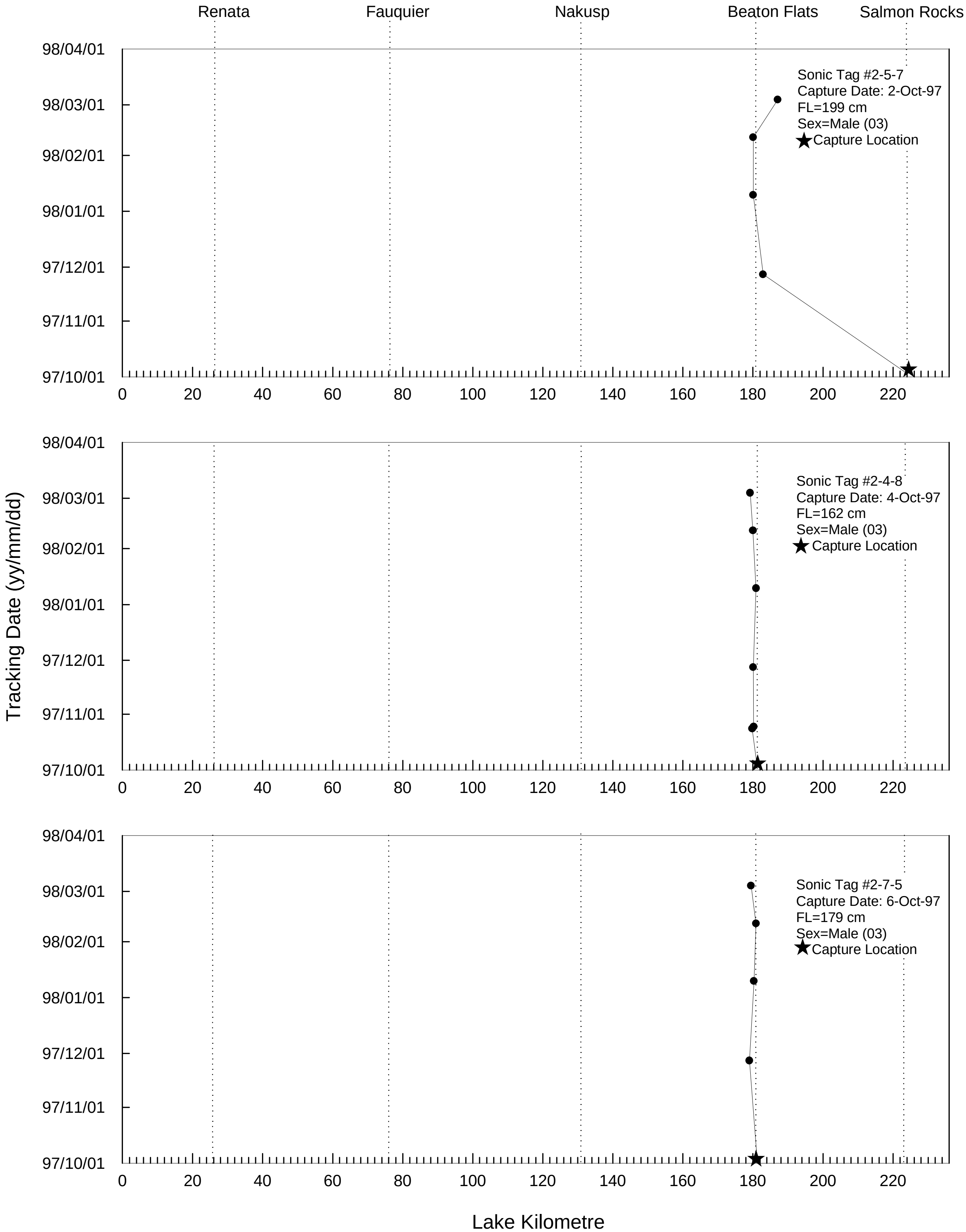


Figure 3.3 Continued.

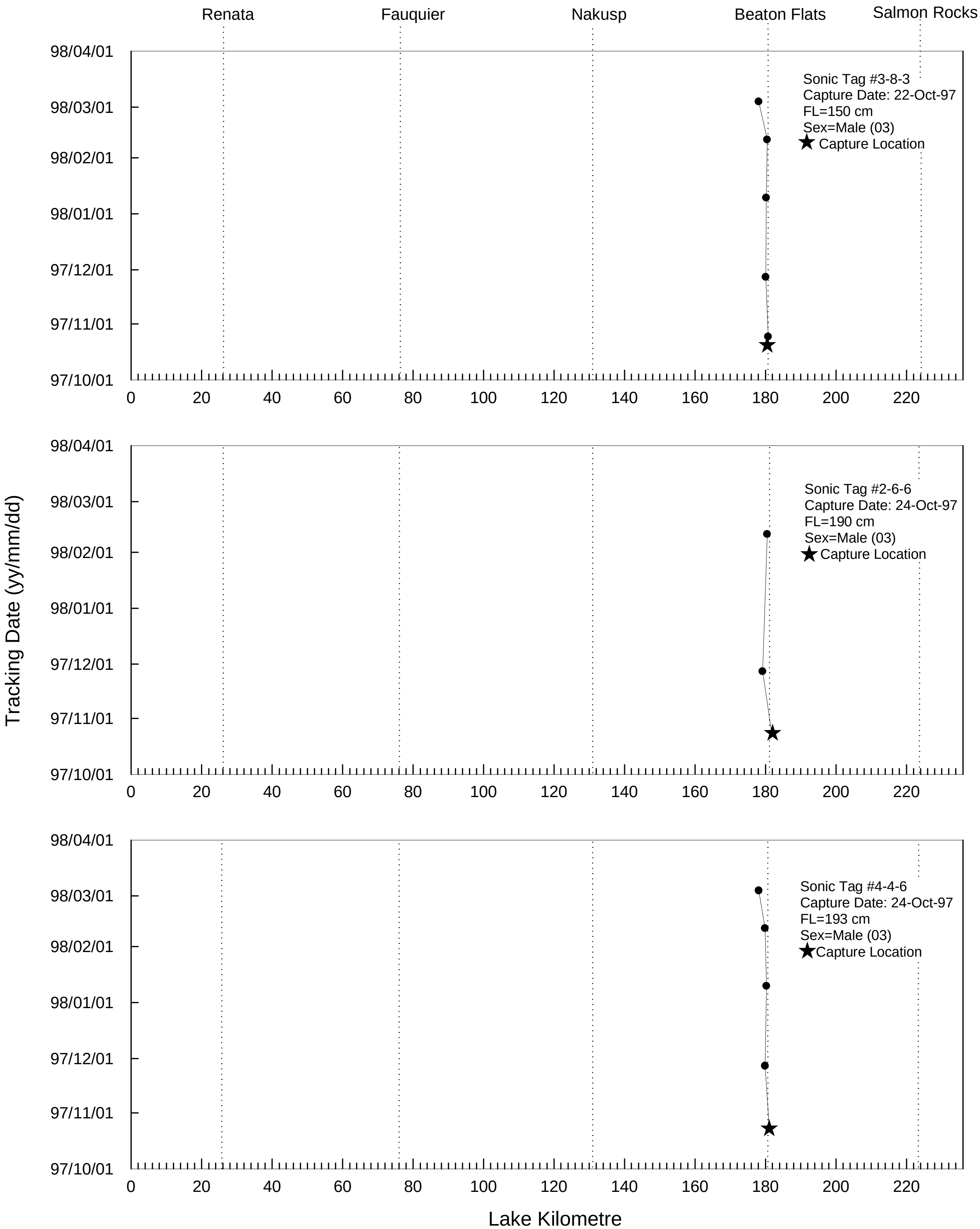


Figure 3.3 Concluded.

3.2 SLOCAN LAKE

3.2.1 Catch and Distribution

The 1997 sampling program represented the third year of white sturgeon studies in Slocan Lake (R.L. & L. 1996, 1997a). In 1995, two white sturgeon were captured; the one white sturgeon captured in 1996 was a recapture of a fish caught and tagged in 1995. All three capture events occurred near the Wragge Creek confluence (Km 34.8), located near the north end of the lake (Figure 3.4).

In 1997, sampling in Slocan Lake was concentrated at selected sites (Figure 3.4). These were the Wragge Creek Islands area (Km 33.5), and near the inlets of Wragge Creek (Km 34.8), Shannon Creek (Km 36.4), Bonanza Creek (Km 38.6), and Nemo Creek (Km 18.5). White sturgeon were not captured in 1997 during the 6096.3 hook-hours of sampling effort expended in Slocan Lake (Appendix A, Table A2).

Angling was conducted on one occasion in an additional attempt to capture the pre-spawning female white sturgeon (expected to spawn in 1997) that was captured and sonic tagged in 1996. This female was located by sonic telemetry and angling was conducted in the immediate vicinity; the 4.5 hook-hours of angling effort expended failed to capture this fish.

Water temperatures at sample sites ranged from 8.8 to 21°C in the summer and from 6.1 to 11.8°C in the fall. The depths sampled ranged from 3.0 to 130.0 m.

Other fish species captured incidentally while sampling for white sturgeon, were 13 burbot and 1 northern squawfish (Appendix B, Table B3). All of the burbot were captured at sample sites between Km 30.0 and 38.6. The northern squawfish was captured at Km 33.4.

3.2.2 Life History Data

White sturgeon were not captured in Slocan Lake during the 1997 sampling program. The burbot captured in Slocan Lake ranged in size from 496 to 702 mm total length, and weighed between 610 and 1908 g (Appendix B, Table B3). The one northern squawfish in the incidental catch escaped before it could be processed.

3.2.3 Sonic Telemetry

One white sturgeon, a late reproductive female, was sonic tagged in 1996 (R.L. & L. 1996). This female was expected to spawn in 1997. Kootenay Wildlife Services Ltd. tracked this white sturgeon monthly until the beginning of the spawning season in June, then weekly during the June and July spawning season, and once more in August. Beginning in September, R.L. & L. Environmental Services Ltd. conducted monthly tracking surveys for this fish.

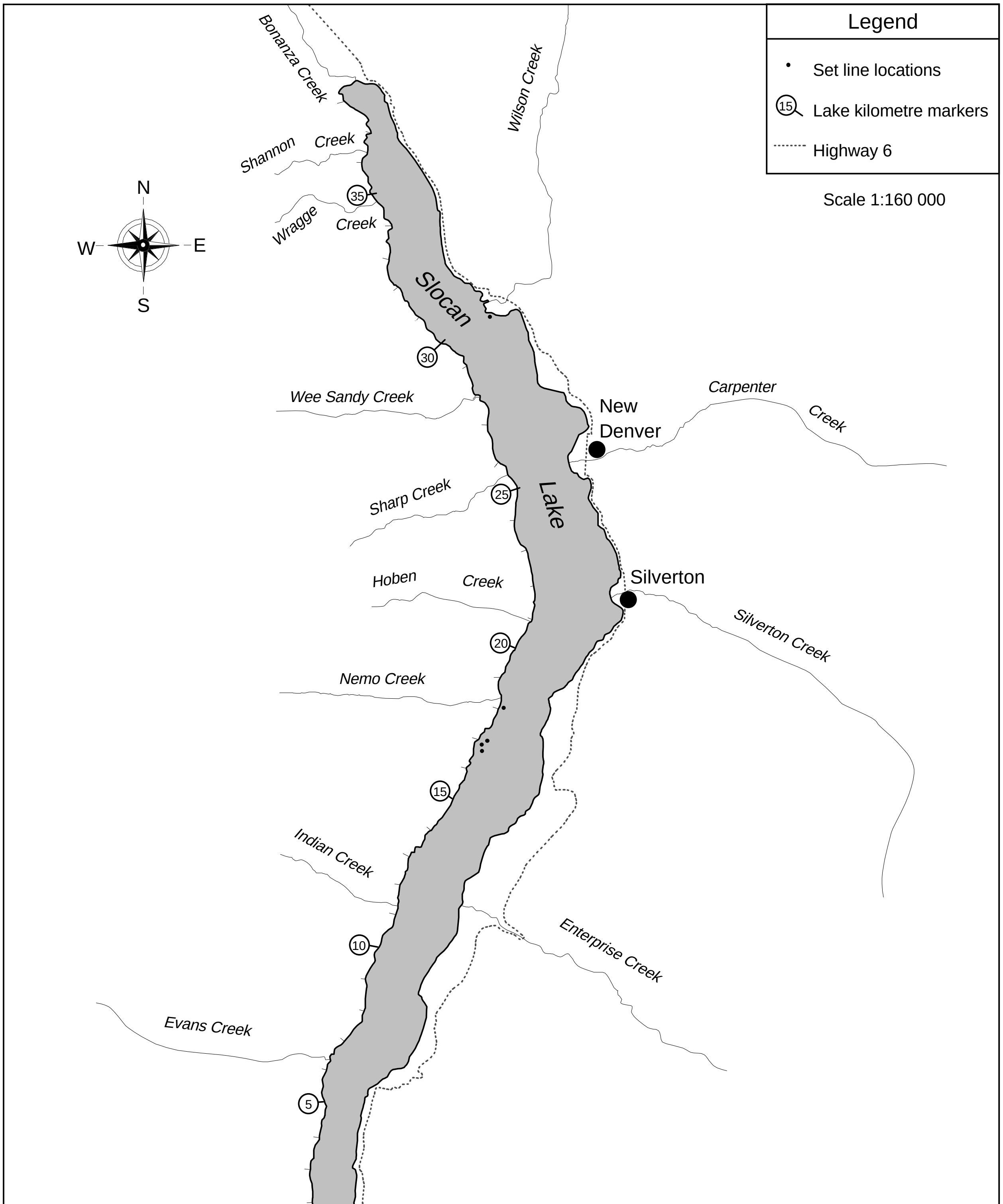


Figure 3.4

Slocan Lake
Set Line Locations
1997

R.L. & L. Environmental Services Ltd.

This female was located during all but one of the tracking sessions (Appendix C, Table C2) in 1997. She was located at or near her capture location (Wragge Creek Islands; Plate 5) throughout the winter and early spring (Figure 3.5). During the spring and summer, this fish exhibited a substantial number of upstream and downstream movements that encompassed a 29 km section of Slocan Lake. In most cases, this fish was located in the vicinity of tributary inlets (Figure 3.6). In the fall, she was located downstream of Nemo Creek and has been located in the same area during all subsequent tracking events (Plate 6).

This fish exhibited numerous movements during the late May to late July period, which corresponds to the white sturgeon spawning period in the Columbia River (R.L. & L. 1994). In late May, she was located near the mouth of Wilson Creek (Km 30.0) on the east side of the lake, then moved north to Km 34.5, and three days later was located near Bonanza Creek (Km 38.0) on the west side of the lake. In late June, the fish was located on the east side of the lake, south of Enterprise Creek (Km 9.5). By early July, she had moved to the Wee Sandy Creek Delta (Km 27.9) on the west side of the lake, and then back to the Wragge Creek Islands area (Km 33.5) in late July. Three days later, the fish was located at Km 37.5, near Shannon Creek Delta. On 29 July, the fish was initially located at the Shannon Creek Delta (Km 37.4) and then moved 3.7 km down the lake to Wragge Beach over the 1.5 hour tracking period.

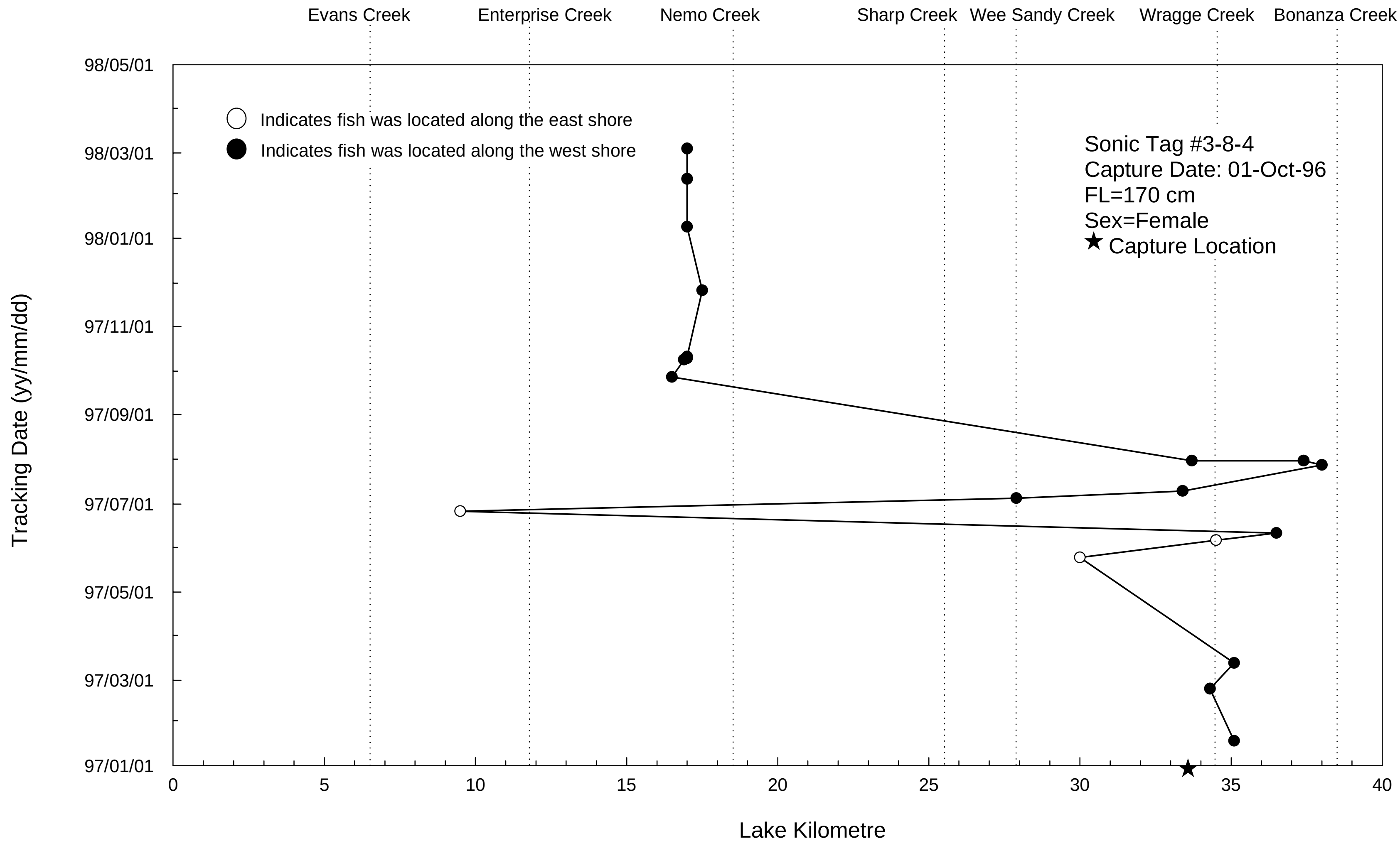
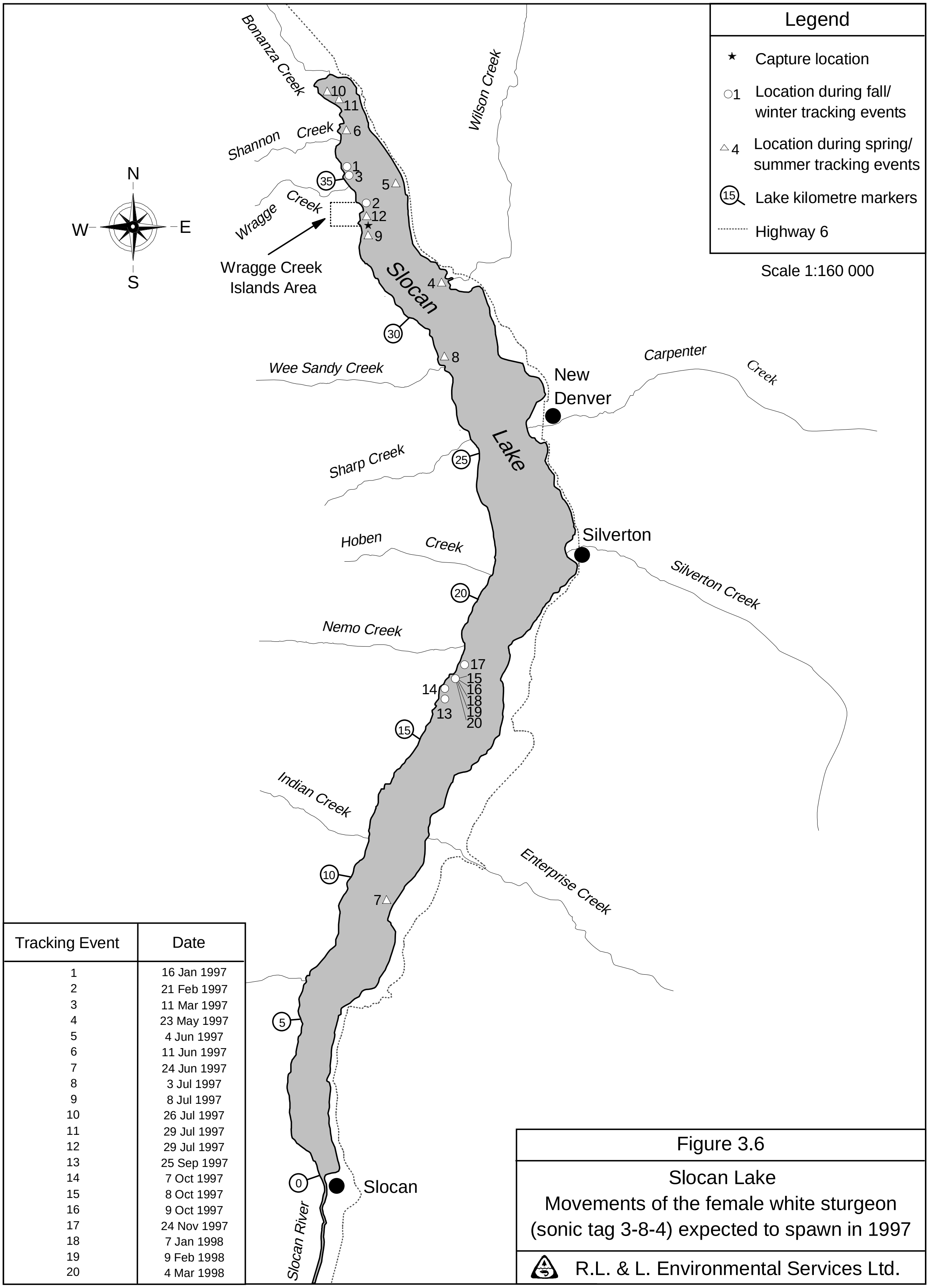


Figure 3.5 Summary of movements of the sonic-tagged female white sturgeon in Slocan Lake, 1997-1998.



Tracking Event	Date
1	16 Jan 1997
2	21 Feb 1997
3	11 Mar 1997
4	23 May 1997
5	4 Jun 1997
6	11 Jun 1997
7	24 Jun 1997
8	3 Jul 1997
9	8 Jul 1997
10	26 Jul 1997
11	29 Jul 1997
12	29 Jul 1997
13	25 Sep 1997
14	7 Oct 1997
15	8 Oct 1997
16	9 Oct 1997
17	24 Nov 1997
18	7 Jan 1998
19	9 Feb 1998
20	4 Mar 1998

Figure 3.6

Slocan Lake
Movements of the female white sturgeon (sonic tag 3-8-4) expected to spawn in 1997

4.0 DISCUSSION

4.1 ARROW RESERVOIR

4.1.1 Distribution and Catch

The distribution of white sturgeon in Arrow Reservoir is still poorly understood. The present study was only the second to capture fish in Arrow Reservoir and to date, only 14 white sturgeon have been captured in the reservoir. Most of these fish were captured in the fall (four of five in 1995, and eight of nine in 1997) and recent sample efforts have focussed on the upper portion of the reservoir. As a result, temporal and spatial distribution patterns are still unknown.

White sturgeon typically inhabit deepwater areas, often near the confluence of major tributaries. Their selection of these habitats is likely related to feeding preferences, since potential prey items are often more concentrated in these areas (Apperson and Anders 1991; R.L. & L. 1994). In 1997, all white sturgeon were captured either near the confluence of major tributaries (i.e., Salmon Rocks across from the Illecillewaet River and upper Beaton Arm at the inlet of the Incomappleux River) or at the outlet of Beaton Arm. The substrate characteristics at capture sites differed slightly, with bedrock substrates at Salmon Rocks and silt-sand substrates at Beaton Flats and upper Beaton Arm.

Several other areas in Arrow Reservoir exhibit habitat characteristics similar to those recorded at sites where white sturgeon were captured. Due to time constraints, sampling was not conducted at these locations. The Kuskanax Flats area (Km 130.0) located in the upper portion of Arrow Reservoir, exhibits similar characteristics to those recorded at the Beaton Flats area (i.e., a large, flat-bottomed reservoir area located near the confluence with Kuskanax Creek). Two areas in the portion of the reservoir known as the Narrows also appeared to provide similar habitats. One was an area at the mouth of Mosquito Creek (Km 109.0), that becomes an arm of the reservoir at high pool levels, and the other was the Burton/Caribou Flats area (Km 95.0). Potential white sturgeon habitats in the lower part of Arrow Reservoir included the mouth of Eagle Creek (Km 64.0) and the mouth of Dog Creek (Km 26.0).

The 15 871.5 hook-hours of sample effort expended in Arrow Reservoir in 1997 was approximately one-fourth of the sampling effort expended in 1995. The number of white sturgeon captured in 1997, however, was almost twice the number captured in 1995 (R.L. & L. 1996). Catch-rates were not directly comparable between the years, since sampling in 1995 was exploratory, while sampling in 1997 was focussed on areas of known white sturgeon use.

4.1.2 Life History Characteristics

White sturgeon captured in Arrow Reservoir in 1997 were classed as adults based on size and age. All white sturgeon captured were older than age 30, which suggested that these fish were trapped in the reservoir following construction of Hugh L. Keenleyside Dam in 1968. Evidence of recruitment to this population since that time was not obtained. The impounded population would have had access to potential spawning areas in the Columbia River upstream of Revelstoke prior the construction of Revelstoke Dam in 1984. In addition, larger tributaries like the Incomappleux and Illecillewaet rivers could potentially be used for spawning by white sturgeon.

The sex and maturity information collected from captured white sturgeon indicated that the population retains a limited reproductive potential. One captured female was in pre-spawning condition, and five of the seven captured males were within two years of reaching spawning condition. All of these fish captured in 1997 were equipped with sonic tags (48-month life expectancy); intensive tracking of these fish prior to and during the spawning period in future years may provide information on potential spawning sites for this population.

4.1.3 Movements

The one white sturgeon captured in the summer was not located until the end of October. All other fish were captured in the fall; therefore, most of the movements recorded represent those related to feeding and overwintering. Two fish exhibited movements of between 16 and 45 km in the fall; both fish moved in a downstream direction to Beaton Flats. All nine sonic-tagged white sturgeon were located in this area over the winter and all observed movements in this period occurred within a localized 3 km by 5 km area.

Based on this information, Beaton Flats appears to be an important wintering area for white sturgeon in Arrow Reservoir. Previous studies in the lower Columbia River and the Kootenay River have identified white sturgeon seasonal migrations to winter holding areas (Haynes et al. 1978; Apperson and Anders 1991). Haynes et al. (1978) suggested that white sturgeon display minimal movements during the fall and winter when water temperatures are the coolest, and more frequent movements in the spring and summer. Other studies suggest that white sturgeon move into shallow-water areas for feeding during the spring and summer (Apperson and Anders 1991; Setter and Brannon 1992). These types of seasonal movement patterns have not, however, been observed in the mainstem Columbia River below Hugh L. Keenleyside Dam (R.L. & L. 1994) or in the Fraser River (R.L. & L. 1998).

The available data indicate that Beaton Flats represents an important feeding and overwintering area for the remnant population of white sturgeon in the upper portion of Arrow Reservoir. Continued tracking of sonic-tagged white sturgeon is required to verify results from the present study, to determine if the white sturgeon display spring and summer migrations, and to determine the location of other important habitats within the system. This information also will assist in focussing future sample efforts needed to determine the abundance of the white sturgeon population in Arrow Reservoir.

4.2 SLOCAN LAKE

4.2.1 Distribution and Catch

Sampling in Slocan Lake during 1997 occurred in similar locations as in previous studies (R.L. & L. 1996, 1997a). Sampling effort was, however, about one-third that of previous years. White sturgeon were not captured in Slocan Lake in 1997.

4.2.2 Movements

The pre-spawning female white sturgeon tagged in Slocan Lake in October 1996, was tracked from November 1996 to March 1998. This fish exhibited localized movements in the Wragge Creek Islands area (Km 33.0 to 34.0) throughout the 1996-1997 winter period. A similar pattern of localized movements occurred during the 1997-1998 winter period, although in a different location; the female spent the 1997-1998 winter in an area south of the Nemo Creek mouth (Km 18.0).

This female, expected to spawn in 1997, exhibited frequent movements over the late May to late July period of 1997. Within this timespan, this fish was located in seven different areas of the lake and most of these areas were located at or near tributary mouths. The number of movements exhibited by this fish during this period was unusually high when compared to movements exhibited by non-spawning fish in other systems (Apperson and Anders 1991; Beamesderfer and Rien 1993; R.L & L. 1997b). This high frequency of movement by a female in pre-spawning condition combined with a consistent selection for areas near tributary mouths was strongly suggestive of a search for a spawning site. When first located in late spring, this fish was near Wilson Creek (Km 30.0), a tributary that was identified as a potential spawning area for white sturgeon in previous studies (R.L. & L. 1997a). Shallow depths and cold water temperatures during the spawning period, however, would limit use of this creek and the other tributaries for spawning by white sturgeon. These limitations and the frequent movements of the pre-spawning female (i.e., interpreted as exploratory movements to locate a suitable area) may indicate suitable spawning habitats were not available in the Slocan Lake system.

The sonic-tagged pre-spawning female was previously determined to be from the 1959 year-class (R.L. & L. 1996). This fish, therefore, could not be a member of the Columbia River population, since in 1944 the construction of Brilliant Dam effectively blocked access into the lower Kootenay River. This individual may have been naturally recruited within Slocan Lake, but considering the limited suitability of spawning habitats in tributaries to the lake, this was considered unlikely. A more likely explanation was that this fish was a member of the Kootenay Lake population that was entrained into Brilliant Reservoir and subsequently moved into Slocan Lake via the Slocan River.

5.0 RECOMMENDATIONS

5.1 ARROW RESERVOIR

The 1995 and 1997 Arrow Reservoir white sturgeon monitoring programs provided baseline information on white sturgeon within the reservoir. Suggested future studies that would help to clarify aspects of the status, movements, habitat preferences, and life history attributes of this population are:

- Conduct a systematic, seasonal capture program throughout the reservoir with emphasis on sampling areas with characteristics similar to those in areas of known white sturgeon use (i.e., as identified in the present study). Potential sample sites should include Kuskanax Flats, Burton Flats, and the inlet areas of Mosquito, Eagle, and Dog creeks. This extended sampling program would provide important information on the distribution, relative abundance, and habitat selection of white sturgeon in the reservoir. This program also could provide evidence to indicate if recruitment has occurred since construction of upstream or downstream dams.

- Continue monthly tracking of sonic-tagged white sturgeon to determine seasonal movement patterns, including spring migrations to feeding and spawning areas, summer residency, and fall migrations to overwintering and staging areas. Information provided by this program also should increase the efficiency of future capture programs.

- Increase tracking frequency in the May to July period and focus tracking efforts on the pre-spawning female in an attempt to determine the location of potential spawning areas. The recapture of this female in late summer or early fall should also be given a high priority to determine whether spawning actually occurred.

- In the fall or winter of 1999, attempt to recapture the two white sturgeon equipped with archival tags in order to retrieve the tags and download the habitat preference data.

5.2 SLOCAN LAKE

Three years of intensive sampling in Slocan Lake has resulted in the capture of two white sturgeon, with one individual being caught twice. The available data indicate that the population density of white sturgeon in Slocan Lake is very low and may consist of only a few individuals. The low numbers of white sturgeon combined with a lack of evidence to indicate recent recruitment, suggests that these fish are strays, likely from Kootenay Lake, and represent a non-reproducing population with a nil to low reproductive potential. If this is the case, then these fish may live out the remainder of their life in Slocan Lake.

Additional studies of white sturgeon in Slocan Lake to obtain additional life history, distribution, or habitat use data are not recommended. Based on past studies, the low fish densities in the system do not warrant the level of effort that will be required to obtain the information necessary for management decisions. Future management efforts directed to Slocan Lake white sturgeon are essentially limited to the following choices:

- leave the fate of these fish to natural forces;

- increase the population abundance in Slocan Lake through artificial supplementation and then provide suitable spawning habitat in the hopes of eventually creating a self-reproducing population; or

- capture the white sturgeon in Slocan Lake and transplant them into either Kootenay Lake or the Columbia River, where they would have the potential ability to reproduce and contribute to the genetic diversity of a functionally reproductive population.

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PHOTOGRAPHIC PLATES

Plate 1 View northwest across Beaton Flats (Km 181.0) looking toward the old townsite of Arrowhead, Arrow Reservoir.

Plate 2 Bedrock shoreline at Salmon Rocks sample site (Km 223.4), Arrow Reservoir.

Plate 3 View of the Incomappleux River mouth at the north end of Beaton Arm (Km 181.0-16.6), Arrow Reservoir.

Plate 4 A white sturgeon (126.5 cm fork length) captured on 23 July 1997 at the north end of Beaton Arm (Km 181.0-16.6), Arrow Reservoir.

Plate 5 View of one of the Wragge Creek Islands (Km 33.5) in Slocan Lake, where the pre-spawning female was captured in October 1996.

Plate 6 View of area downstream of Nemo Creek (Km 18.0), Slocan Lake. The sonic-tagged female was located here between September 1997 and March 1998.

APPENDIX A

CAPTURE DATA

Table A1 Summary of catch and catch-rate for white sturgeon (WST) and other fish species captured by set line in Arrow Reservoir, summer and fall 1997.

Survey	Lake	Set		Pulled		Duration	Water				No.		Catch				Total	*Total*
							Secchi	Temp.	Depth (m)				WST		Other			
Session	Km[a]	Date	Time	Date	Time	(h)	(m)	(°C)	Min.	Max.	Hooks	Hook-Hours	No.	*CPUE*[b]	No.	*CPUE*	Catch	*CPUE*
Summer	228.5	19-Jul	12:15	20-Jul	13:03	24.8	3.0	9.3	12.0	16.0	4	99.2	0	*0.00*	0	*0.00*	**0**	***0.00***
	228.4	19-Jul	12:26	20-Jul	13:39	25.2	3.0	9.3	8.0	23.0	4	100.9	0	*0.00*	0	*0.00*	**0**	***0.00***
	228.4	19-Jul	12:41	20-Jul	13:27	24.8	3.0	9.3	21.0	24.0	4	99.1	0	*0.00*	0	*0.00*	**0**	***0.00***
	226.8	19-Jul	13:45	20-Jul	12:49	23.1	3.7	9.3	7.0	7.0	4	92.3	0	*0.00*	0	*0.00*	**0**	***0.00***
	225.8	19-Jul	15:02	20-Jul	11:10	20.1	2.5	9.8	6.0	8.0	4	80.5	0	*0.00*	0	*0.00*	**0**	***0.00***
	223.6	19-Jul	15:22	20-Jul	10:25	19.1	2.3	9.8	7.0	11.0	4	76.2	0	*0.00*	0	*0.00*	**0**	***0.00***
	221.1	19-Jul	15:34	20-Jul	9:55	18.4	3.1	9.8	6.0	6.0	8	146.8	0	*0.00*	0	*0.00*	**0**	***0.00***
	223.7	19-Jul	15:38	20-Jul	10:34	18.9	2.3	9.8	6.0	20.0	4	75.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	223.9	19-Jul	15:55	20-Jul	10:47	18.9	2.3	9.8	10.0	20.0	4	75.5	0	*0.00*	0	*0.00*	**0**	***0.00***
	224.1	19-Jul	16:14	20-Jul	10:57	18.7	2.3	9.8	7.0	10.0	4	74.9	0	*0.00*	0	*0.00*	**0**	***0.00***
	223.5-1.0	19-Jul	16:31	20-Jul	10:11	17.7	0.8	10.0	5.0	6.0	4	70.7	0	*0.00*	1	*1.42*	**1**	***1.42***
	220.0	19-Jul	17:09	20-Jul	9:38	16.5	2.8	8.8	7.0	10.0	8	131.9	0	*0.00*	0	*0.00*	**0**	***0.00***
	228.4	20-Jul	14:00	21-Jul	9:17	19.3	3.2	9.8	10.0	24.0	8	154.3	0	*0.00*	0	*0.00*	**0**	***0.00***
	223.6	20-Jul	15:26	21-Jul	9:45	18.3	3.3	9.8	10.0	22.0	8	146.5	0	*0.00*	0	*0.00*	**0**	***0.00***
	217.0	20-Jul	16:00	21-Jul	10:12	18.2	2.8	9.8	10.0	15.0	4	72.8	0	*0.00*	0	*0.00*	**0**	***0.00***
	216.1	20-Jul	16:24	21-Jul	10:31	18.1	2.8	9.8	10.0	19.0	4	72.5	0	*0.00*	1	*1.38*	**1**	***1.38***
	213.5	20-Jul	16:43	21-Jul	10:57	18.2	2.0	12.2	0.7	2.0	4	72.9	0	*0.00*	0	*0.00*	**0**	***0.00***
	212.2	20-Jul	17:09	21-Jul	11:10	18.0	2.0	14.0	2.0	2.0	4	72.1	0	*0.00*	0	*0.00*	**0**	***0.00***
	210.0	20-Jul	17:27	21-Jul	11:22	17.9	1.8	16.0	5.0	11.0	4	71.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	208.5	20-Jul	17:45	21-Jul	11:35	17.8	2.2	16.1	12.0	12.0	4	71.3	0	*0.00*	0	*0.00*	**0**	***0.00***
	205.0	20-Jul	18:06	21-Jul	11:50	17.7	2.8	11.0	5.0	8.0	4	70.9	0	*0.00*	0	*0.00*	**0**	***0.00***
	203.2	20-Jul	18:38	21-Jul	12:10	17.5	2.8	12.0	7.0	18.0	8	140.3	0	*0.00*	0	*0.00*	**0**	***0.00***
	228.4	21-Jul	9:25	22-Jul	9:23	24.0	2.7	9.8	10.0	24.0	8	191.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	223.6	21-Jul	9:56	22-Jul	9:47	23.8	2.6	9.5	10.0	22.0	8	190.8	0	*0.00*	0	*0.00*	**0**	***0.00***
	197.0	21-Jul	14:15	22-Jul	13:45	23.5	2.5	12.0	20.0	20.0	4	94.0	0	*0.00*	0	*0.00*	**0**	***0.00***
	195.1	21-Jul	14:34	22-Jul	13:59	23.4	1.9	10.9	10.0	16.0	4	93.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	193.0	21-Jul	15:05	22-Jul	14:11	23.1	2.1	11.0	20.0	23.0	4	92.4	0	*0.00*	0	*0.00*	**0**	***0.00***
	192.5	21-Jul	15:26	22-Jul	14:23	23.0	2.1	12.2	7.0	10.0	4	91.8	0	*0.00*	0	*0.00*	**0**	***0.00***
	191.4	21-Jul	15:48	22-Jul	14:35	22.8	2.6	15.0	8.0	8.0	4	91.1	0	*0.00*	0	*0.00*	**0**	***0.00***
	189.0	21-Jul	16:10	22-Jul	14:51	22.7	2.4	12.8	19.0	19.0	8	181.5	0	*0.00*	1	*0.55*	**1**	***0.55***

Continued…

[a] Distances are measured upstream from Hugh L. Keenleyside Dam to Revelstoke Dam through the main channel (refer to Figure 3.1). For hyphenated locations, first value indicates distance to Galena Bay (Km 177.0), Beaton Flats (Km 181.0), or Salmon Rocks (Km 223.5); second value indicates distance into Galena Bay, Beaton Arm, or Illecillewaet River, respectively.

[b] CPUE=no. fish/100 hook-hours.

[c] Data not available.

Table A1 Continued.

Survey Session	Lake Km[a]	Set		Pulled		Duration	Water				No.	Hook-Hours	Catch				Total	Total
							Secchi	Temp.	Depth (m)				WST		Other			
		Date	Time	Date	Time	(h)	(m)	(°C)	Min.	Max.	Hooks		No.	CPUE[b]	No.	CPUE	Catch	CPUE
Summer	187.9	21-Jul	16:36	22-Jul	15:28	22.9	2.4	12.8	20.0	20.0	8	182.9	0	0.00	0	0.00	0	0.00
	183.0	22-Jul	12:37	23-Jul	12:58	24.4	2.2	17.0	16.0	20.0	8	194.8	0	0.00	0	0.00	0	0.00
	181.0-0.5	22-Jul	16:06	23-Jul	16:24	24.3	1.8	15.0	18.0	18.0	4	97.2	0	0.00	1	1.03	1	1.03
	181.0-7.2	22-Jul	16:51	23-Jul	14:49	22.0	2.4	18.1	22.0	36.0	8	175.7	0	0.00	0	0.00	0	0.00
	181.0-16.9	22-Jul	17:40	23-Jul	17:18	23.6	1.7	21.0	5.0	7.0	4	94.5	0	0.00	3	3.17	3	3.17
	181.0-16.6	22-Jul	17:50	23-Jul	15:37	21.8	0.3	11.0	5.0	7.0	4	87.1	0	0.00	0	0.00	0	0.00
	181.0-16.5	22-Jul	18:11	23-Jul	15:23	21.2	2.3	20.0	10.0	10.0	4	84.8	0	0.00	0	0.00	0	0.00
	181.0-16.6	22-Jul	18:22	23-Jul	16:33	22.2	2.1	20.3	10.0	10.0	4	88.7	1	1.13	0	0.00	1	1.13
	181.0-15.5	22-Jul	18:43	23-Jul	18:49	24.1	1.4	20.1	10.0	13.0	4	96.4	0	0.00	0	0.00	0	0.00
	181.0	22-Jul	19:32	23-Jul	12:22	16.8	2.0	14.0	20.0	20.0	8	134.7	0	0.00	1	0.74	1	0.74
	177.0-2.0	23-Jul	11:23	24-Jul	14:36	27.2	2.6	16.0	2.0	18.0	5	136.1	0	0.00	3	2.20	3	2.20
	177.0-1.0	23-Jul	12:11	24-Jul	15:08	27.0	2.2	16.0	16.0	19.0	4	107.8	0	0.00	0	0.00	0	0.00
	181.0	23-Jul	12:43	24-Jul	14:14	25.5	2.0	14.0	20.0	20.0	8	204.1	0	0.00	0	0.00	0	0.00
	181.0-7.2	23-Jul	15:06	24-Jul	13:40	22.6	0.7	16.1	19.0	22.0	8	180.5	0	0.00	0	0.00	0	0.00
	181.0-16.9	23-Jul	16:06	24-Jul	12:25	20.3	1.6	20.0	5.0	7.0	4	81.3	0	0.00	0	0.00	0	0.00
	181.0-0.5	23-Jul	16:30	24-Jul	13:59	21.5	0.6	15.0	18.0	18.0	4	85.9	0	0.00	0	0.00	0	0.00
	181.0-16.6	23-Jul	18:27	24-Jul	12:50	18.4	1.5	20.2	8.0	10.0	11	202.2	0	0.00	0	0.00	0	0.00
Summer subtotal												**5330.7**	**1**	**0.02**	**11**	**0.21**	**12**	**0.23**
Fall	228.4	1-Oct	10:27	2-Oct	9:55	23.5	3.3	8.4	15.0	20.0	7	164.3	0	0.00	0	0.00	0	0.00
	228.4	1-Oct	10:51	2-Oct	10:22	23.5	2.6	8.4	12.0	13.0	8	188.1	0	0.00	0	0.00	0	0.00
	224.1	1-Oct	11:31	2-Oct	11:07	23.6	2.6	8.4	7.0	9.0	8	188.8	0	0.00	0	0.00	0	0.00
	223.7	1-Oct	11:49	2-Oct	11:36	23.8	3.3	8.4	7.0	14.0	8	190.3	0	0.00	0	0.00	0	0.00
	223.9	1-Oct	12:08	2-Oct	11:22	23.2	3.3	8.4	6.0	19.0	8	185.9	0	0.00	0	0.00	0	0.00
	223.2	1-Oct	12:39	2-Oct	11:56	23.3	3.3	8.4	4.0	4.0	8	186.3	1	0.54	0	0.00	1	0.54
	225.1	1-Oct	13:00	2-Oct	10:53	21.9	2.6	8.4	12.0	14.0	4	87.5	0	0.00	0	0.00	0	0.00
	228.4	2-Oct	10:12	3-Oct	10:08	23.9	2.3	8.4	6.0	11.0	7	167.5	0	0.00	0	0.00	0	0.00
	225.1	2-Oct	11:00	3-Oct	11:17	24.3	2.3	8.4	12.0	14.0	4	97.1	0	0.00	0	0.00	0	0.00
	224.1	2-Oct	11:17	3-Oct	12:24	25.1	2.3	8.5	7.0	9.0	8	200.9	0	0.00	0	0.00	0	0.00
	223.9	2-Oct	11:32	3-Oct	12:12	24.7	2.3	8.5	6.0	19.0	8	197.3	0	0.00	0	0.00	0	0.00
	223.7	2-Oct	11:43	3-Oct	11:59	24.3	2.3	8.5	7.0	14.0	8	194.1	0	0.00	0	0.00	0	0.00

Continued…

[a] Distances are measured upstream from Hugh L. Keenleyside Dam to Revelstoke Dam through the main channel (refer to Figure 3.1). For hyphenated locations, first value indicates distance to Galena Bay (Km 177.0), Beaton Flats (Km 181.0), or Salmon Rocks (Km 223.5); second value indicates distance into Galena Bay, Beaton Arm, or Illecillewaet River, respectively.

[b] CPUE=no. fish/100 hook-hours.

[c] Data not available.

Table A1 Continued.

Survey	Lake	Set		Pulled		Duration	Water				No.		Catch				Total	*Total*
							Secchi	Temp.	Depth (m)				WST		Other			
Session	Km[a]	Date	Time	Date	Time	(h)	(m)	(°C)	Min.	Max.	Hooks	Hook-Hours	No.	*CPUE* [b]	No.	*CPUE*	Catch	*CPUE*
Fall	223.2	2-Oct	14:22	3-Oct	11:44	21.4	2.3	8.5	4.0	4.0	7	149.6	0	*0.00*	0	*0.00*	**0**	***0.00***
	221.2	2-Oct	14:45	3-Oct	11:27	20.7	3.3	8.5	4.0	5.0	4	82.8	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0	3-Oct	15:07	4-Oct	11:11	20.1	5.7	11.7	16.0	16.0	8	160.5	1	*0.62*	0	*0.00*	**1**	***0.62***
	183.0	3-Oct	15:31	4-Oct	14:06	22.6	5.7	11.7	13.0	22.0	8	180.7	0	*0.00*	3	*1.66*	**3**	***1.66***
	181.0-0.5	3-Oct	15:53	4-Oct	14:32	22.6	5.7	11.7	15.0	15.0	8	181.2	0	*0.00*	1	*0.55*	**1**	***0.55***
	181.0-1.0	3-Oct	16:13	4-Oct	10:28	18.3	5.6	11.8	11.0	13.0	8	146.0	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0-0.5	3-Oct	16:24	4-Oct	10:46	18.4	5.7	11.7	15.0	16.0	4	73.5	0	*0.00*	0	*0.00*	**0**	***0.00***
	177.0-2.0	3-Oct	16:45	4-Oct	10:07	17.4	5.6	11.7	16.0	18.0	7	121.6	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0-0.1	4-Oct	11:02	5-Oct	10:53	23.9	6.9	11.7	16.0	16.0	8	190.8	1	*0.52*	0	*0.00*	**1**	***0.52***
	181.0	4-Oct	11:29	5-Oct	13:18	25.8	6.9	11.7	16.0	16.0	8	206.5	0	*0.00*	1	*0.48*	**1**	***0.48***
	181.0-0.1	4-Oct	13:14	5-Oct	13:39	24.4	6.9	11.7	26.0	42.0	8	195.3	0	*0.00*	1	*0.51*	**1**	***0.51***
	181.0-16.2	4-Oct	14:01	5-Oct	9:45	19.7	1.8	11.1	6.0	6.0	7	138.1	0	*0.00*	1	*0.72*	**1**	***0.72***
	181.0-0.5	4-Oct	14:38	5-Oct	10:28	19.8	6.9	11.7	15.0	15.0	8	158.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0-16.9	4-Oct	15:30	5-Oct	9:22	17.9	0.8	8.2	4.0	5.0	8	142.9	0	*0.00*	2	*1.40*	**2**	***1.40***
	181.0-16.8	4-Oct	15:51	5-Oct	9:36	17.8	0.8	6.1	4.0	6.0	8	142.0	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0-0.1	5-Oct	13:11	6-Oct	10:57	21.8	5.4	11.3	12.0	12.0	8	174.1	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0	5-Oct	13:30	6-Oct	10:42	21.2	5.4	11.3	17.0	18.0	8	169.6	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0-0.1	5-Oct	13:50	6-Oct	9:02	19.2	5.4	11.3	23.0	34.0	8	153.6	1	*0.65*	0	*0.00*	**1**	***0.65***
	129.0	5-Oct	16:10	6-Oct	13:09	21.0	6.8	10.6	11.0	11.0	8	167.9	0	*0.00*	0	*0.00*	**0**	***0.00***
	130.0	5-Oct	16:36	6-Oct	13:21	20.8	5.8	10.7	7.0	8.0	9	186.8	0	*0.00*	0	*0.00*	**0**	***0.00***
	120.2	5-Oct	16:58	6-Oct	13:46	20.8	5.7	10.6	4.0	6.0	7	145.6	0	*0.00*	0	*0.00*	**0**	***0.00***
	120.0	5-Oct	17:10	6-Oct	13:54	20.7	6.4	10.8	7.0	8.0	7	145.1	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0-0.1	20-Oct	12:08	21-Oct	9:11	21.0	-[c]	9.3	20.0	21.0	8	168.4	0	*0.00*	2	*1.19*	**2**	***1.19***
	181.0-0.1	20-Oct	12:31	21-Oct	9:41	21.2	-	9.3	16.0	16.0	8	169.3	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0	20-Oct	13:03	21-Oct	10:47	21.7	-	9.3	16.0	17.0	8	173.9	0	*0.00*	3	*1.73*	**3**	***1.73***
	180.3	20-Oct	13:21	21-Oct	10:04	20.7	-	9.3	44.0	45.0	7	145.0	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0	20-Oct	13:34	21-Oct	10:23	20.8	-	9.3	16.0	17.0	8	166.5	0	*0.00*	1	*0.60*	**1**	***0.60***
	181.0-0.1	20-Oct	13:47	21-Oct	11:25	21.6	-	9.3	11.0	12.0	8	173.1	0	*0.00*	1	*0.58*	**1**	***0.58***
	181.5	20-Oct	14:06	21-Oct	11:49	21.7	-	9.3	10.0	10.0	8	173.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0-0.1	21-Oct	9:35	22-Oct	13:17	27.7	-	9.2	20.0	21.0	8	221.6	0	*0.00*	1	*0.45*	**1**	***0.45***

Continued…

[a] Distances are measured upstream from Hugh L. Keenleyside Dam to Revelstoke Dam through the main channel (refer to Figure 3.1). For hyphenated locations, first value indicates distance to Galena Bay (Km 177.0), Beaton Flats (Km 181.0), or Salmon Rocks (Km 223.5); second value indicates distance into Galena Bay, Beaton Arm, or Illecillewaet River, respectively.

[b] CPUE=no. fish/100 hook-hours.

[c] Data not available.

Table A1 Concluded.

Survey Session	Lake Km[a]	Set		Pulled		Duration (h)	Water				No. Hooks	Hook-Hours	Catch				Total Catch	*Total CPUE*
							Secchi (m)	Temp. (°C)	Depth (m)				WST		Other			
		Date	Time	Date	Time				Min.	Max.			No.	*CPUE*[b]	No.	*CPUE*		
Fall	181.0-0.5	21-Oct	9:49	22-Oct	13:39	27.8	5.6	9.2	25.0	28.0	8	222.7	0	*0.00*	2	*0.90*	**2**	***0.90***
	180.3	21-Oct	10:15	22-Oct	9:13	23.0	-	9.2	43.0	46.0	8	183.7	0	*0.00*	1	*0.54*	**1**	***0.54***
	181.0	21-Oct	10:40	22-Oct	14:06	27.4	-	9.2	16.0	17.0	8	219.5	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0	21-Oct	11:14	22-Oct	14:21	27.1	5.6	9.2	16.0	17.0	8	216.9	0	*0.00*	1	*0.46*	**1**	***0.46***
	181.0-0.0	21-Oct	11:40	22-Oct	9:36	21.9	-	9.2	16.0	17.0	7	153.5	1	*0.65*	0	*0.00*	**1**	***0.65***
	181.0	21-Oct	12:58	22-Oct	11:42	22.7	-	9.2	15.0	15.0	8	181.9	1	*0.55*	0	*0.00*	**1**	***0.55***
	180.3	22-Oct	9:22	23-Oct	9:33	24.2	5.9	9.1	41.0	43.0	8	193.5	0	*0.00*	3	*1.55*	**3**	***1.55***
	181.0-0.0	22-Oct	11:05	23-Oct	11:06	24.0	5.9	9.1	17.0	17.0	7	168.1	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0	22-Oct	13:06	23-Oct	10:06	21.0	5.9	9.1	15.0	16.0	8	168.0	0	*0.00*	2	*1.19*	**2**	***1.19***
	181.0-0.5	22-Oct	13:32	23-Oct	13:02	23.5	5.9	9.3	14.0	14.0	8	188.0	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0-1.0	22-Oct	13:56	23-Oct	12:39	22.7	5.9	9.3	18.0	22.0	8	181.7	0	*0.00*	2	*1.10*	**2**	***1.10***
	181.0	22-Oct	14:15	23-Oct	11:23	21.1	5.9	9.1	17.0	18.0	8	169.1	0	*0.00*	2	*1.18*	**2**	***1.18***
	183.1	22-Oct	14:38	23-Oct	10:33	19.9	5.9	9.2	16.0	17.0	8	159.3	0	*0.00*	1	*0.63*	**1**	***0.63***
	180.0	23-Oct	10:01	24-Oct	13:25	27.4	6.3	8.9	40.0	43.0	8	219.2	0	*0.00*	2	*0.91*	**2**	***0.91***
	181.0	23-Oct	10:23	24-Oct	11:23	25.0	6.3	8.9	17.0	17.0	8	200.0	1	*0.50*	2	*1.00*	**3**	***1.50***
	183.1	23-Oct	10:48	24-Oct	9:50	23.0	6.3	8.9	17.0	17.0	8	184.3	1	*0.54*	0	*0.00*	**1**	***0.54***
	181.0	23-Oct	12:29	24-Oct	10:56	22.5	6.3	8.9	16.0	16.0	8	179.6	0	*0.00*	1	*0.56*	**1**	***0.56***
	181.0-0.5	23-Oct	12:56	24-Oct	9:28	20.5	6.3	8.9	18.0	20.0	8	164.3	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0-0.5	23-Oct	13:10	24-Oct	9:15	20.1	6.3	8.9	14.0	14.0	8	160.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	181.0	23-Oct	13:19	24-Oct	11:06	21.8	6.3	8.9	16.0	16.0	8	174.3	0	*0.00*	0	*0.00*	**0**	***0.00***
Fall subtotal												**10540.8**	**8**	***0.08***	**36**	***0.34***	**44**	***0.42***
Grand totals												**15871.5**	**9**	***0.06***	**47**	***0.30***	**56**	***0.35***

[a] Distances are measured upstream from Hugh L. Keenleyside Dam to Revelstoke Dam through the main channel (refer to Figure 3.1). For hyphenated locations, first value indicates distance to Galena Bay (Km 177.0), Beaton Flats (Km 181.0), or Salmon Rocks (Km 223.5); second value indicates distance into Galena Bay, Beaton Arm, or Illecillewaet River, respectively.

[b] CPUE=no. fish/100 hook-hours.

[c] Data not available.

Table A2 Summary of catch and catch-rate for white sturgeon (WST) and other fish species captured by set line in Slocan Lake, 1997.

Survey Session	Lake Km[a]	Set Date	Set Time	Pulled Date	Pulled Time	Duration (h)	Water Secchi (m)	Water Temp. (°C)	Water Depth (m) Min.	Water Depth (m) Max.	No. Hooks	Hook-Hours	Catch WST No.	Catch WST *CPUE*[b]	Catch Other No.	Catch Other *CPUE*	Total Catch	*Total CPUE*
Summer	35.1	24-Jul	18:05	25-Jul	12:29	18.4	4.7	15.0	20.0	30.0	4	73.6	0	*0.00*	0	*0.00*	**0**	***0.00***
	34.5	24-Jul	18:20	25-Jul	12:18	18.0	4.7	11.0	14.0	26.0	4	71.9	0	*0.00*	0	*0.00*	**0**	***0.00***
	33.4	24-Jul	18:32	25-Jul	11:32	17.0	4.7	11.9	5.0	12.0	4	68.0	0	*0.00*	0	*0.00*	**0**	***0.00***
	33.4	24-Jul	18:41	25-Jul	11:52	17.2	4.7	11.9	12.0	13.0	4	68.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	33.4	25-Jul	11:42	26-Jul	9:40	22.0	6.1	11.4	8.0	16.0	8	175.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	33.4	25-Jul	11:54	26-Jul	9:52	22.0	6.1	11.6	12.0	13.0	4	87.9	0	*0.00*	0	*0.00*	**0**	***0.00***
	34.4	25-Jul	12:08	26-Jul	10:04	21.9	6.2	12.3	8.0	12.0	4	87.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	34.5	25-Jul	12:20	26-Jul	10:15	21.9	5.8	10.0	14.0	26.0	4	87.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	35.1	25-Jul	12:30	26-Jul	10:23	21.9	6.0	11.7	20.0	30.0	4	87.5	0	*0.00*	1	*1.14*	**1**	***1.14***
	38.6	25-Jul	13:31	26-Jul	11:41	22.2	5.7	11.7	14.0	17.0	4	88.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	38.6	25-Jul	13:56	26-Jul	12:00	22.1	5.9	13.5	7.0	17.0	4	88.3	0	*0.00*	0	*0.00*	**0**	***0.00***
	37.0	25-Jul	14:17	26-Jul	11:24	21.1	6.0	11.7	22.0	31.0	4	84.5	0	*0.00*	1	*1.18*	**1**	***1.18***
	36.5	25-Jul	14:33	26-Jul	11:10	20.6	6.0	11.7	9.0	18.0	4	82.5	0	*0.00*	0	*0.00*	**0**	***0.00***
	36.2	25-Jul	14:50	26-Jul	10:51	20.0	5.8	10.6	7.0	11.0	4	80.1	0	*0.00*	0	*0.00*	**0**	***0.00***
	31.0	25-Jul	15:57	26-Jul	13:22	21.4	5.5	13.5	99.0	130.0	4	85.7	0	*0.00*	0	*0.00*	**0**	***0.00***
	30.0	25-Jul	16:19	26-Jul	13:37	21.3	5.8	13.7	30.0	47.0	4	85.2	0	*0.00*	1	*1.17*	**1**	***1.17***
	33.4	26-Jul	9:47	27-Jul	9:43	23.9	7.4	13.2	8.0	16.0	8	191.5	0	*0.00*	0	*0.00*	**0**	***0.00***
	33.4	26-Jul	9:53	27-Jul	10:02	24.1	7.4	13.4	12.0	13.0	4	96.6	0	*0.00*	0	*0.00*	**0**	***0.00***
	34.5	26-Jul	10:19	27-Jul	10:20	24.0	7.4	11.5	14.0	26.0	4	96.1	0	*0.00*	0	*0.00*	**0**	***0.00***
	35.1	26-Jul	10:35	27-Jul	10:36	24.0	7.4	12.4	20.0	30.0	4	96.1	0	*0.00*	0	*0.00*	**0**	***0.00***
	36.2	26-Jul	10:57	27-Jul	10:49	23.9	6.4	13.7	7.0	11.0	4	95.5	0	*0.00*	0	*0.00*	**0**	***0.00***
	37.0	26-Jul	11:30	27-Jul	11:13	23.7	6.0	13.7	22.0	31.0	4	94.9	0	*0.00*	1	*1.05*	**1**	***1.05***
	38.6	26-Jul	11:42	27-Jul	11:43	24.0	5.8	13.3	14.0	17.0	4	96.1	0	*0.00*	0	*0.00*	**0**	***0.00***
	38.0	26-Jul	12:12	27-Jul	12:03	23.9	5.8	14.0	17.0	25.0	4	95.4	0	*0.00*	0	*0.00*	**0**	***0.00***
	31.0	26-Jul	13:26	27-Jul	13:18	23.9	7.3	14.4	99.0	112.0	8	190.9	0	*0.00*	0	*0.00*	**0**	***0.00***
	30.0	26-Jul	13:42	27-Jul	13:35	23.9	6.5	14.7	30.0	47.0	4	95.5	0	*0.00*	1	*1.05*	**1**	***1.05***
	21.5	26-Jul	14:34	27-Jul	14:06	23.5	5.9	17.9	15.0	19.0	4	94.1	0	*0.00*	0	*0.00*	**0**	***0.00***
	25.9	26-Jul	15:05	27-Jul	14:47	23.7	5.5	16.0	10.0	20.0	4	94.8	0	*0.00*	0	*0.00*	**0**	***0.00***
Summer subtotal												**2740.9**	**0**	***0.00***	**5**	***0.18***	**5**	***0.18***
Fall	30.5	6-Oct	15:50	7-Oct	11:59	20.2	9.0	13.1	9.0	17.0	8	161.2	0	*0.00*	0	*0.00*	**0**	***0.00***
	33.4	6-Oct	16:08	7-Oct	11:23	19.3	9.0	13.2	3.0	13.0	8	154.0	0	*0.00*	0	*0.00*	**0**	***0.00***
	34.5	6-Oct	16:25	7-Oct	11:12	18.8	9.0	13.2	10.0	15.0	8	150.3	0	*0.00*	0	*0.00*	**0**	***0.00***

Continued…

[a] Distances are measured upstream from the Slocan River inlet to the Bonanza Creek outlet (refer to Figure 3.4).

[b] CPUE=no. fish/100 hook-hours.

Table A2 Concluded.

Survey Session	Lake Km[a]	Set		Pulled		Duration	Water				No.	Hook-Hours	Catch				Total	*Total*
							Secchi	Temp.	Depth (m)				WST		Other			
		Date	Time	Date	Time	(h)	(m)	(°C)	Min.	Max.	Hooks		No.	*CPUE*[b]	No.	*CPUE*	Catch	*CPUE*
Fall	36.2	6-Oct	16:37	7-Oct	11:03	18.4	9.0	13.3	10.0	13.0	8	147.5	0	*0.00*	0	*0.00*	**0**	***0.00***
	38.6	6-Oct	16:55	7-Oct	10:17	17.4	9.0	13.2	8.0	16.0	8	138.9	0	*0.00*	3	*2.16*	**3**	***2.16***
	37.9	7-Oct	10:51	8-Oct	11:10	24.3	9.0	12.7	15.0	20.0	8	194.5	0	*0.00*	0	*0.00*	**0**	***0.00***
	36.2	7-Oct	11:06	8-Oct	11:30	24.4	7.7	12.9	14.0	25.0	8	195.2	0	*0.00*	0	*0.00*	**0**	***0.00***
	34.5	7-Oct	11:17	8-Oct	11:42	24.4	7.7	12.6	7.0	18.0	8	195.3	0	*0.00*	0	*0.00*	**0**	***0.00***
	33.4	7-Oct	11:26	8-Oct	11:52	24.4	7.7	13.0	3.0	13.0	8	195.5	0	*0.00*	0	*0.00*	**0**	***0.00***
	33.4	7-Oct	11:47	8-Oct	12:00	24.2	7.7	13.0	12.0	13.0	7	169.5	0	*0.00*	0	*0.00*	**0**	***0.00***
	16.7	7-Oct	13:14	8-Oct	12:52	23.6	7.7	13.0	3.0	19.0	8	189.1	0	*0.00*	0	*0.00*	**0**	***0.00***
	16.9	7-Oct	13:30	8-Oct	13:24	23.9	7.7	13.0	3.0	20.0	7	167.3	0	*0.00*	0	*0.00*	**0**	***0.00***
	38.6	8-Oct	11:20	9-Oct	10:15	22.9	8.5	12.5	20.0	22.0	8	183.3	0	*0.00*	1	*0.55*	**1**	***0.55***
	36.2	8-Oct	11:36	9-Oct	10:30	22.9	8.5	12.6	19.0	21.0	8	183.2	0	*0.00*	2	*1.09*	**2**	***1.09***
	34.5	8-Oct	11:46	9-Oct	10:45	23.0	8.5	12.5	19.0	21.0	8	183.9	0	*0.00*	1	*0.54*	**1**	***0.54***
	33.4	8-Oct	11:55	9-Oct	11:03	23.1	8.5	12.5	5.0	16.0	8	185.1	0	*0.00*	1	*0.54*	**1**	***0.54***
	33.4	8-Oct	12:05	9-Oct	11:15	23.2	8.5	12.5	12.0	13.0	7	162.2	0	*0.00*	1	*0.62*	**1**	***0.62***
	18.0	8-Oct	13:14	9-Oct	14:28	25.2	8.5	12.7	11.0	17.0	8	201.9	0	*0.00*	0	*0.00*	**0**	***0.00***
	16.9	8-Oct	13:30	9-Oct	14:12	24.7	8.5	12.7	3.0	23.0	8	197.6	0	*0.00*	0	*0.00*	**0**	***0.00***
Fall subtotal												**3355.4**	**0**	***0.00***	**9**	***0.27***	**9**	***0.27***
Grand totals												**6096.3**	**0**	***0.00***	**14**	***0.23***	**14**	***0.23***

[a] Distances are measured upstream from the Slocan River inlet to the Bonanza Creek outlet (refer to Figure 3.4).

[b] CPUE=no. fish/100 hook-hours.

APPENDIX B

LIFE HISTORY DATA

Table B1 Life history information for white sturgeon captured by set line in Arrow Reservoir, 1997.

Capture Date	Lake Km[a]	Length (cm)			Girth (cm)	Weight (kg)	Age	Sex Code[b]	Floy Tag		PIT Tag Number	Sonic Tag (Freq. 760)	Archival Tag Number
		Fork	Total	Snout					Colour	Number			
23-Jul-97	181.0-16.6	126.5	145.0	35.0	47.5	17.7	31	02	P	29864	7F7D432C07	2-9-3	-[c]
2-Oct-97	223.2	199.0	220.0	43.0	76.0	59.9	45	02	O	30800	4158522117	2-5-7	300
4-Oct-97	181.0	161.5	180.5	39.5	64.0	33.2	35	03	O	30799	4158666119	2-4-8	302
5-Oct-97	181.0-0.1	226.5	254.0	53.5	93.5	106.8	56	14	O	30798	415867575E	3-5-6	-
6-Oct-97	181.0-0.1	179.0	198.5	40.5	74.0	50.4	38	03	O	30797	4158546F6D	2-7-5	-
22-Oct-97	181.0-0.0	150.0	169.5	34.5	62.0	33.2	34	03	O	30792	4158693015	3-8-3	-
22-Oct-97	181.0	172.5	192.5	41.5	66.5	31.8	48	12	O	30791	4158636864	3-7-4	-
24-Oct-97	183.1	190.0	211.0	43.0	72.0	52.4	-	03	O	30790	415859106D	2-6-6	-
24-Oct-97	181.0	192.5	217.0	42.5	77.0	58.3	47	03	O	30789	4158683235	4-4-6	-

[a] Distances are measured upstream from Hugh L. Keenleyside Dam to Revelstoke Dam through the main channel. For hyphenated locations, first value indicates distance to Beaton Flats (Km 181.0); second value indicates distance into Beaton Arm.

[b] For explanation of sex codes refer to Appendix D, Table D1.

[c] Data not available or not applicable.

Table B2 Summary of the incidental burbot (*n* =47) catch from Arrow Reservoir, 1997.

Lake Km[a]	**Sample Date**	**Weight (g)**	**Total Length (mm)**	**Floy Tag (Colour)**[b]
223.5-1.0	20-Jul	1541	630	(P) 29859
216.1	21-Jul	1183	591	(P) 29860
189.0	22-Jul	828	514	
181.5-0.5	23-Jul	882	534	(P) 29861
181.0-16.9	23-Jul	1325	695	(P) 29862
181.0-16.9	23-Jul	1359	635	(P) 29863
181.0-16.9	23-Jul	2604	724	
181.0	23-Jul	1414	670	
177.0-2.0	24-Jul	903	568	(P) 29865
177.0-2.0	24-Jul	1294	655	(P) 29866
177.0-2.0	24-Jul	1055	583	
183.0	4-Oct	1061	630	
183.0	4-Oct	1466	620	
183.0	4-Oct	1251	650	
181.5-0.5	4-Oct	915	620	
181.0-16.9	5-Oct	996	576	
181.0-16.9	5-Oct	2861	750	
181.0	5-Oct	1064	600	
181.0-0.1	5-Oct	883	539	
181.0-16.2	5-Oct	1105	625	(O) 32087
181.0-0.1	21-Oct	923	550	
181.0-0.1	21-Oct	-[c]	545	
181.0	21-Oct	-	583	
181.0	21-Oct	-	600	
181.0	21-Oct	-	511	(O) 30794
181.0	21-Oct	-	679	
181.0-0.1	21-Oct	-	595	(O) 30793
181.0	22-Oct	-	-	
181.0-0.1	22-Oct	779	569	(O) 32092
180.3	22-Oct	-	-	
181.0-0.5	22-Oct	878	595	(O) 32093
181.0-0.5	22-Oct	921	572	
181.0	23-Oct	1050	576	(O) 32096
181.0	23-Oct	1059	603	(O) 32097
180.3	23-Oct	1404	623	(O) 32094
180.3	23-Oct	1326	635	
180.3	23-Oct	-	-	
181.0	23-Oct	1937	727	(O) 32095
181.0	23-Oct	-	-	
183.1	23-Oct	1140	612	
181.0-1.0	23-Oct	1803	705	(O) 32098
181.0-1.0	23-Oct	900	573	
181.0	24-Oct	982	582	(O) 32099
181.0	24-Oct	1379	611	(O) 32100
181.0	24-Oct	3456	855	
180.0	24-Oct	1234	578	(O) 31522
180.0	24-Oct	949	615	(O) 31523

[a] Distances are measured upstream from Hugh L. Keenleyside Dam to Revelstoke Dam. For hyphenated locations, firs indicates distance to Galena Bay (Km 177.0), Beaton Flat (Km 181.0), or Salmon Rocks (Km 223.5); second value i distance into Galena Bay, Beaton Arm, or Illecillewaet River, respectively.

[b] P=pink; O=orange.

[c] Data not available.

Table B3 Summary of the incidental burbot (*n* =13) and northern squawfish (*n* =1) catch from Slocan Lake, 1997.

Species	Lake Km[a]	Sample Date	Weight (g)	Length (mm)	Floy Tag (Colour)[b]
Burbot	30.0	26-Jul	1530	553	
Burbot	35.1	26-Jul	851	589	
Burbot	37.0	26-Jul	845	565	(P) 29875
Burbot	30.0	27-Jul	1898	702	
Burbot	37.0	27-Jul	-[c]	NA	
Burbot	38.6	7-Oct	610	534	(O) 32088
Burbot	38.6	7-Oct	1647	650	(O) 32089
Burbot	38.6	7-Oct	974	571	(O) 32090
Burbot	33.4	9-Oct	-	576	
Burbot	34.5	9-Oct	-	496	
Burbot	36.2	9-Oct	1144	595	
Burbot	36.2	9-Oct	1908	535	
Burbot	38.6	9-Oct	981	598	
Northern squawfish	33.4	9-Oct	-	-	

[a] Distances are measured upstream from the Slocan River inlet to the Bonanza Creek outlet.

[b] P=pink; O=orange.

[c] Data not available.

APPENDIX C

SONIC TELEMETRY RESULTS

Table C1 Descriptive movement summary for white sturgeon equipped with sonic transmitters in Arrow Reservoir, 1997.

Sonic Tag #	Released Date	Released Km[a]	Sex[b]	Tracking Date	Location (Km)[a]	Movement (Km)[c]	Movement Summary
2-9-3	23-Jul-97	181.0-16.6	02	11-Aug-97	-[d]	-	This maturing male was captured at the north end of Beaton Arm in July. The fish was not located using sonic telemetry until the end of October, when it was found in Beaton Flats at the confluence of Beaton Arm and Arrow Reservoir. The male was located in Beaton flats during two (January and March) of the next four tracking sessions.
				18-Aug-97	-	-	
				24-Sep-97	-	-	
				23-Oct-97	181.0	-16.6	
				25-Nov-97	-	-	
				8-Jan-98	179.3	-1.7	
				9-Feb-98	-	-	
				4-Mar-98	178.1	-1.2	
Maximum Movement Range						**+0.0/-19.6**	
2-5-7	2-Oct-97	223.2	03	23-Oct-97	-	-	This early reproductive male was captured just downstream of Salmon Rocks (Km 223.5) near Revelstoke in early October and was next located at Beaton Flats (a downstream movement of 44 km) in November. This fish was located in the same general area during all subsequent tracking sessions.
				25-Nov-97	179.2	-44.0	
				8-Jan-98	180.4	+1.2	
				9-Feb-98	180.5	+0.1	
				4-Mar-98	178.1	-2.4	
Maximum Movement Range						**+0.0/-45.1**	
2-4-8	4-Oct-97	181.0	03	23-Oct-97	180.2	-0.8	This early reproductive male was captured at Beaton Flats in early October and was located in the same general area during all subsequent tracking sessions.
				25-Nov-97	180.1	-0.1	
				8-Jan-98	180.9	+0.8	
				9-Feb-98	179.9	-1.0	
				4-Mar-98	179.2	-0.7	
Maximum Movement Range						**+0.0/-1.8**	
3-5-6	5-Oct-97	181.0-0.0	14	23-Oct-97	-	-	This late reproductive female was captured at Beaton Flats in early October and was located in Beaton Flats during each subsequent tracking session.
				25-Nov-97	179.2	-1.8	
				8-Jan-98	180.4	+1.2	
				9-Feb-98	180.5	+0.1	
				4-Mar-98	181.0	+0.5	
Maximum Movement Range						**+0.0/-1.8**	

Continued…

[a] Distances are measured upstream from Hugh L. Keenleyside Dam to Revelstoke Dam. For hyphenated locations, first value indicates distance in the lake; second value indicates distance into Beaton Arm.

[b] For description of sex codes refer to Appendix D, Table D1.

[c] A negative movement designates a downstream movement; a positive movement designates an upstream movement.

[d] Data not available.

Table C1 Concluded.

Sonic Tag #	Released Date	Released Km[a]	Sex[b]	Tracking Date	Location (Km)[a]	Movement (Km)[c]	Movement Summary
2-7-5	6-Oct-97	181.0-0.0	03	23-Oct-97	-[d]	-	This early reproductive male was captured at Beaton Flats in early October and was located at Beaton Flats during November, January, February and March tracking events.
				25-Nov-97	179.0	-2.0	
				8-Jan-98	180.3	+1.3	
				9-Feb-98	180.9	+0.6	
				4-Mar-98	179.5	-1.4	
Maximum Movement Range						**+0.0/-2.0**	
3-8-3	22-Oct-97	183.3	03	23-Oct-97	180.8	-2.5	This early reproductive male was captured in the main channel near the old town site of Arrowhead in late October. Subsequent tracking sessions located the fish downstream at Beaton Flats.
				25-Nov-97	180.1	-0.7	
				8-Jan-98	180.2	+0.1	
				9-Feb-98	180.5	+0.3	
				4-Mar-98	178.1	-2.4	
Maximum Movement Range						**+0/0/-5.2**	
3-7-4	22-Oct-97	183.1	12	23-Oct-97	181.0-0.9	-3.0	This maturing female was captured at Beaton Flats in late October. The following day the sturgeon was located 4 km northwest, 1 km into the mouth of Beaton Arm. Tracking events in November, February and March events located the sturgeon at Beaton Flats.
				25-Nov-97	180.5	-1.4	
				8-Jan-97	-	-	
				9-Feb-98	180.4	-0.1	
				4-Mar-98	178.1	-2.3	
Maximum Movement Range						**+0.0/-5.0**	
2-6-6	24-Oct-97	181.6	03	25-Nov-97	179.2	-2.4	This early reproductive male was captured at Beaton Flats southwest of Arrowhead in late October and was located at Beaton Flats in the November and February tracking sessions.
				8-Jan-98	-	-	
				9-Feb-98	180.5	+1.3	
				4-Mar-98	-	-	
Maximum Movement Range						**+0.0/-2.4**	
4-4-6	24-Oct-97	181.0	03	25-Nov-97	179.9	-1.1	This early reproductive male was captured on Beaton Flats in late October, and was located in the same area in all subsequent tracking sessions.
				8-Jan-98	180.3	+0.4	
				9-Feb-98	179.9	-0.4	
				4-Mar-98	178.1	-1.8	
Maximum Movement Range						**+0.0/-2.9**	

[a] Distances are measured upstream from Hugh L. Keenleyside Dam to Revelstoke Dam. For hyphenated locations, first value indicates distance in the lake; second value indicates distance into Beaton Arm.

[b] For description of sex codes refer to Appendix D, Table D1.

[c] A negative movement designates a downstream movement; a positive movement designates an upstream movement.

[d] Data not available.

Table C2 Descriptive movement summary of the female white sturgeon in Slocan Lake, 1997-1998.

Sonic Tag #	Released Date	Released Km[a]	Sex[b]	Tracking Date	Location (Km)[a]	Movement (Km)[c]	Movement Summary
3-8-4	1-Oct-95	33.5	14	16-Jan-97	35.1	+1.6	This pre-spawning female was captured on 1 October 1996 at Wragge Creek Islands (Km 33.5) and equipped with a sonic transmitter; she was located in this same area in all tracking sessions between January and mid-May. From late May to late July, the female exhibited frequent movements around the lake; from Wragge Creek Islands she moved across the lake to the mouth of Wilson Creek, then up the lake to Km 34.5, and across the lake to the Shannon Creek Delta (Km 37.4). She was next located at the southeastern end of the lake downstream of Enterprise Creek (Km 9.5); then at the Wee Sandy Creek Delta (Km 27.9). By late July, the fish was located back in the Wragge Creek Islands, and upstream at the Shannon Creek Delta. On 29 July, the female was tracked moving downstream from Km 37.4 to Km 33.7 in 1.5 hours. The fish was next located in September, downstream of Nemo Creek, where she was located in all subsequent winter tracking sessions.
				21-Feb-97	34.3	-0.8	
				11-Mar-97	35.1	+0.8	
				23-May-97	30.0	-5.1	
				4-Jun-97	34.5	+4.5	
				9-Jun-97	36.5	+2.0	
				11-Jun-97	-[d]	-	
				24-Jun-97	9.5	-27.0	
				3-Jul-97	27.9	+18.4	
				8-Jul-97	33.4	+5.5	
				26-Jul-97	38.0	+4.6	
				29-Jul-97	37.4	-0.6	
				29-Jul-97	33.7	-3.7	
				25-Sep-97	16.5	-17.2	
				7-Oct-97	16.9	+0.4	
				8-Oct-97	17.0	+0.1	
				9-Oct-97	17.0	0.0	
				24-Nov-97	17.5	+0.5	
				7-Jan-98	17.0	-0.5	
				9-Feb-98	17.0	0.0	
				4-Mar-98	17.0	0.0	
Maximum Movement Range						**+4.5/-24.0**	

[a] Distances are measured upstream from the town of Slocan to the mouth of Bonanza Creek (refer to Figure 3.4).
[b] For description of sex codes refer to Appendix D, Table D1.
[c] A negative movement designates a downstream movement; a positive movement designates an upstream movement.
[d] Data not available.

APPENDIX D

SEX AND MATURITY DATA

Table D1 Sexual development state descriptions used to determine sex and maturity of white sturgeon in Arrow Reservoir in 1997.

Sex	Code	Development State Description[a]
Male	01	Non-reproductive, testes appear as thin strips with no pigmentation.
	02	Maturing; small testes; some folding may be apparent; translucent, smoky pigmentation.
	03	Early reproductive; large testes, folds beginning to form lobes; some pigmentation still present; testes more white than cream coloured.
	04	Late reproductive; testes large, often filling posterior of body cavity; white with little or no pigmentation.
	05	Ripe; milt flowing; large white lobular testes; no pigmentation.
	06	Spent; testes pinkish-white, flaccid, and strongly lobed.
	10	General unknown maturity.
Female	11	Non-reproductive; ovaries small, folded with no visible oocytes; tissue colour white to yellowish.
	12	Pre-vitellogenic, moderate size ovary with small eggs present (0.2 to 0.5 mm diameter); may have "salt and pepper" appearance.
	13	Early vitellogenic; large ovary varying in colour from white to yellowish-cream to light grey; eggs 0.6 to 2.1 mm in diameter.
	14	Late vitellogenic; ovaries large with pigmented oocytes still attached to ovarian tissue; eggs 2.2 to 2.9 mm in diameter; sometimes with "salt and pepper" appearance.
	15	Ripe; eggs fully pigmented and easily detached from ovarian tissue; eggs 3.0 to 3.4 mm in diameter.
	16	Spent; ovaries are flaccid with some residual fully developed eggs.
	17	Pre-vitellogenic with attritic oocytes; small eggs (<0.5 mm diameter) present; dark pigmented tissue present that may be reabsorbed eggs.
	20	General unknown maturity.
Unknown	97	Gonad undifferentiated or not visible; adult based on size.
	98	Gonad undifferentiated or not visible; juvenile based on size.