2004 Assessment of Juvenile White Sturgeon (*Acipenser transmontanus*) Abundance and Distribution in the Nechako River; Development of an Index of Juvenile Recruitment

Funded By Alcan Primary Metal – B.C., The Habitat Conservation Trust Fund, and The Carrier Sekani Tribal Council

March 2005

Prepared For The

NECHAKO RIVER WHITE STURGEON RECOVERY INITIATIVE

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Acknowledgements

This work was made possible through funds received from the Habitat Conservation Trust Fund, Species at Risk Account. In addition, Alcan Primary Metal - B.C. greatly enhanced the scope of this work through funding provided to the Carrier Sekani Tribal Council (CSTC). Justus Benckhuysen, Supervisor, Environment and Corporate Affairs, Alcan Primary Metal - B.C., provided direction and guidance.

Staff from Golder Associates Ltd. under the direction of Scott McKenzie, including Corey Stefura, Bob Chapman and Francine Audi, provided professional guidance and technical assistance to the field program throughout its duration. CSTC technical staff including James (Jako) Prince, Terrence Furlong, Michelle Walsh, Margo French, and other occasional staff from the Tl'azt'en and Saik'uz First Nations comprised the field crew. Preparation of ageing structures was completed by Golder Associates Ltd. and DNA analyses were provided by SeaStar Biotech Inc.

Marcel Shepert, former CSTC Fisheries Program Manager, provided guidance and support for the initiation and administration of this project. Sharolise Baker, CSTC Fisheries Program Manager, provided administrative and managerial support for the project.

Brian Toth, CSTC Biologist, led development of the program, assisted with the coordination of administrative and field logistics, and led project reporting. Jason Yarmish served as the Project Biologist, and led data management and assisted with reporting activities.

The guidance and support of the members of the Nechako White Sturgeon Recovery Initiative Recovery Team was appreciated. In particular, Steve McAdam, Ministry of Water, Land and Air Protection (MoWLAP) and Cory Williamson (MoWLAP) provided extensive input.

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Executive Summary

Field sampling in the Nechako River was conducted over three, one week, intervals during the periods July 23-29, August 24-30 and September 21-24. Sampling in July took place from river kilometer (rkm)66.2 to rkm179.3, in August from rkm90.2 to rkm134.8, and in September from rkm110.1 to rkm134.1. Sampling was directed at a range of habitats, including locations where sturgeon had been previously encountered. Due to increased flows in the Nechako during the July sampling event, which allowed better boat-access, the range of sampling was more extensive than the August and September events. Sampling consisted of gillnetting with individual 37.2m^2 sinking panels in mesh sizes of 2.54cm, 3.81cm, 5.08cm, 6.35cm, 7.6cm, 8.9cm, and 9.53cm. Panels of varying mesh sizes were combined to maximize the range of mesh types deployed. In most sampling locations, habitat and flows limited net length to ~30meters (i.e. 2 panels), although up to three panels were deployed in some sites. Study design and sampling procedures were developed jointly by CSTC and Golder and Associates Ltd. staff, with input from the NWSRI and Alcan Primary Metal - B.C.

The primary objectives of the 2004 juvenile white sturgeon sampling program on the Nechako River was to sample a wide range of habitats in the designated study area, and to capture as many juvenile white sturgeon as possible, documenting morphological characteristics, applying tags, and recording habitat characteristics at capture locations. A sub-objective was to utilize the results of this work to contribute to the development of an index-type program to monitor juvenile sturgeon recruitment in the Nechako's population into the future. This was intended to be year-1 of a multi-year study. The targeted size class of sturgeon for the purposes of this work was deemed to be < 1meter total length (TL).

Sampling effort applied included 248.45 panel hours of effort in July, 449.26 panel hours in August and 219.16 panel hours in September. A total of eight sturgeon were captured during the three sampling sessions; 2 in July, 3 in August, and 3 in September. This included 5 juveniles (TL 59cm – 97cm) and 3 sturgeon that exceeded 1m TL. Age of the 7 fish successfully sampled ranged from 5-14years and none had been previously captured. All appeared to be in good physical health. Despite widely distributed effort, all sturgeon were encountered within a 6km length of the Nechako River. Physical conditions (discharge and temperature) varied considerably during the three sampling shifts and seasonal differences in by-catch composition and rate were observed. Data collected during year-1 of this study provides valuable insight into the development of future recruitment monitoring activities.

Introduction

The white sturgeon population in the Nechako River is one of four genetically distinct stock groupings within specific geographically bounded portions of the Fraser watershed (Nelson et al. 1999; Pollard 2000; Smith et al. 2002). The status of white sturgeon within the Nechako River has been examined in several investigations over the past two decades (Dixon 1986; RL&L 1996, 1997, 1998, 1999 & 2000a). Work by Dixon (1986) and subsequent investigations into the Nechako white sturgeon populations by RL&L Environmental Services (*now* Golder Associates Ltd.) between 1995 and 1999 identified a number of issues with regards to this population, the most notable of which was the negligible level of juvenile recruitment that appeared to be occurring (RL&L 2000b).

The population of white sturgeon within the Nechako are presently “red listed” or “critically imperiled” by the BC CDC (2002), inferring that this unique stock is facing imminent extirpation without intervention. More recently, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the North American White Sturgeon as Endangered, including populations within all portions of the known range of the species in the Fraser and Columbia/Kootenay watersheds north of the US/Canada border.

The capture of very few juvenile sturgeon in the Nechako River during studies undertaken over the last 25 years has been a critical piece of evidence for the conclusion that there is a continuing recruitment failure.

Following the conclusion of assessment activities in 1999, the Ministry of Water, Land and Air Protection (MoWLAP) initiated a recovery planning process for the Nechako River white sturgeon stock. This *Nechako White Sturgeon Recovery Initiative* (NWSRI) includes a Recovery Team (RT) comprised of government and non-government technical personnel assembled to recommend technical directions for recovery actions. The Nechako White Sturgeon Recovery Team, through the development of a Recovery Plan, indicated that a focused juvenile sampling program should be carried out on the Nechako River (Golder 2003).

Purpose

The intent of a multi-year sampling program focussing on juvenile white sturgeon in the Nechako River is to gather further information about the status of juvenile white sturgeon recruitment into the Nechako population, and factors that may be directly or indirectly impacting recruitment success. As well, the development of information about juvenile sturgeon distribution and habitat usage will provide insight into factors affecting their survival. Further, as a result of several years of data collection, information from a program of this nature is intended to contribute to the development of a standardized "index-type" program to assess juvenile sturgeon recruitment in the Nechako population on an ongoing basis. An "index type" program will be required to periodically monitor the population to assess the success or failure of recovery actions in improving the rate of juvenile recruitment into the population.

Efforts in 2004 are the first year of what will be a multi-year study for the purposes outlined above, to meet the objectives described below.

Objectives

The primary objectives of this project were stated as follows:

1. Assess the abundance, distribution, and life history characteristics of juvenile white sturgeon within the study area.
2. Based on capture locations, determine characteristics of juvenile sturgeon habitat use.
3. Collect detailed biological and morphological information from any sturgeon captured, including tissue samples for DNA analysis.
4. Apply identifying tags (PIT and FLOY) to sturgeon captured that have not been previously captured.
5. Qualitatively assess the abundance and distribution of other species within the Nechako River.

Secondary objectives of this sampling program, and subsequent uses of the data generated, were to include:

a. Establish a strategy and methodology for an effective and efficient annual juvenile white sturgeon monitoring program of "index" sites for the Nechako River (and possibly tributary habitats).
b. Utilize age determinations of any juveniles captured to back-calculate year of hatching and prevalent physical/environmental conditions in the year of hatching (i.e. determine recruitment response to 1997 discharge regime or other years.)
c. Utilize any information collected relating to juvenile habitat use and preference to assess the relevance of habitat loss/alteration theories relative to sturgeon recruitment failure.
d. Generate a juvenile abundance estimate utilizing recaptures of marked fish.
e. Assess the movement and behavior of juvenile white sturgeon utilizing recapture information.

The objectives outlined above were to be pursued within the context of a multi-year study.

Methodology

Sample plan design was a collaborative effort by both CSTC staff and Golder Associates biologists, with the assistance and input of the NWSRI. It was determined that sampling for juveniles (defined as TL<1m) would take place in the months of July, August, and September, and sampling would occur in as wide a range of feasible habitats as possible in the Nechako River from the mouth of the Nautley River to Isle Pierre Rapids. Sampling in July (23-29) and August (24-30) took place over two seven day periods, with a further four days in September (21-24). Two crews operated in a coordinated fashion to sample portions of the approximately 150km length of identified study area (Figure 1).

Sampling during this study consisted of small-mesh monofilament sinking gillnets, deployed in a "set" or stationary fashion in selected sampling locations. Nets consisted of 1-3 standardized panels of 2.4m x 15.2m (37.2m^2) with the following mesh sizes: 2.54cm, 3.81cm, 5.08cm, 6.35cm, 7.6cm, 8.9cm, and 9.53cm. Nets were typically set using an anchor with a line and buoy attached at one end, and were deployed while backing through the site in the direction of the set, and completed with a second anchor and float upon release from the boat. Sets were made either parallel or perpendicular to the current or eddy. The gillnets were attached using a "bridal system" to both the anchor and the buoy rope, to ensure the net's led-line was in contact with the substrate, and reduce the likelihood of the net collapsing due to water velocity. Typically, sets consisted of two panels, however, depending upon the sampling site, anywhere from one to three panels were deployed. On several occasions, nets were attached to shore using a shore rope.

Set times for gillnets were variable. The standard approach upon selecting a site consisted of setting for approximately 1 hour, the net was then checked, and fish encountered were removed and processed. A field based decision regarding reset time was then made based on the level of by-catch and net fouling. Typically, the second sample at the selected site was approximately 2 hours. However, if high rates of by-catch, net fouling, or fish stress were observed, sample times were either adjusted accordingly (reduced to anywhere from 0.5 hours to 1.5 hours) or the gear was pulled all together for re-deployment in a new sample site location.

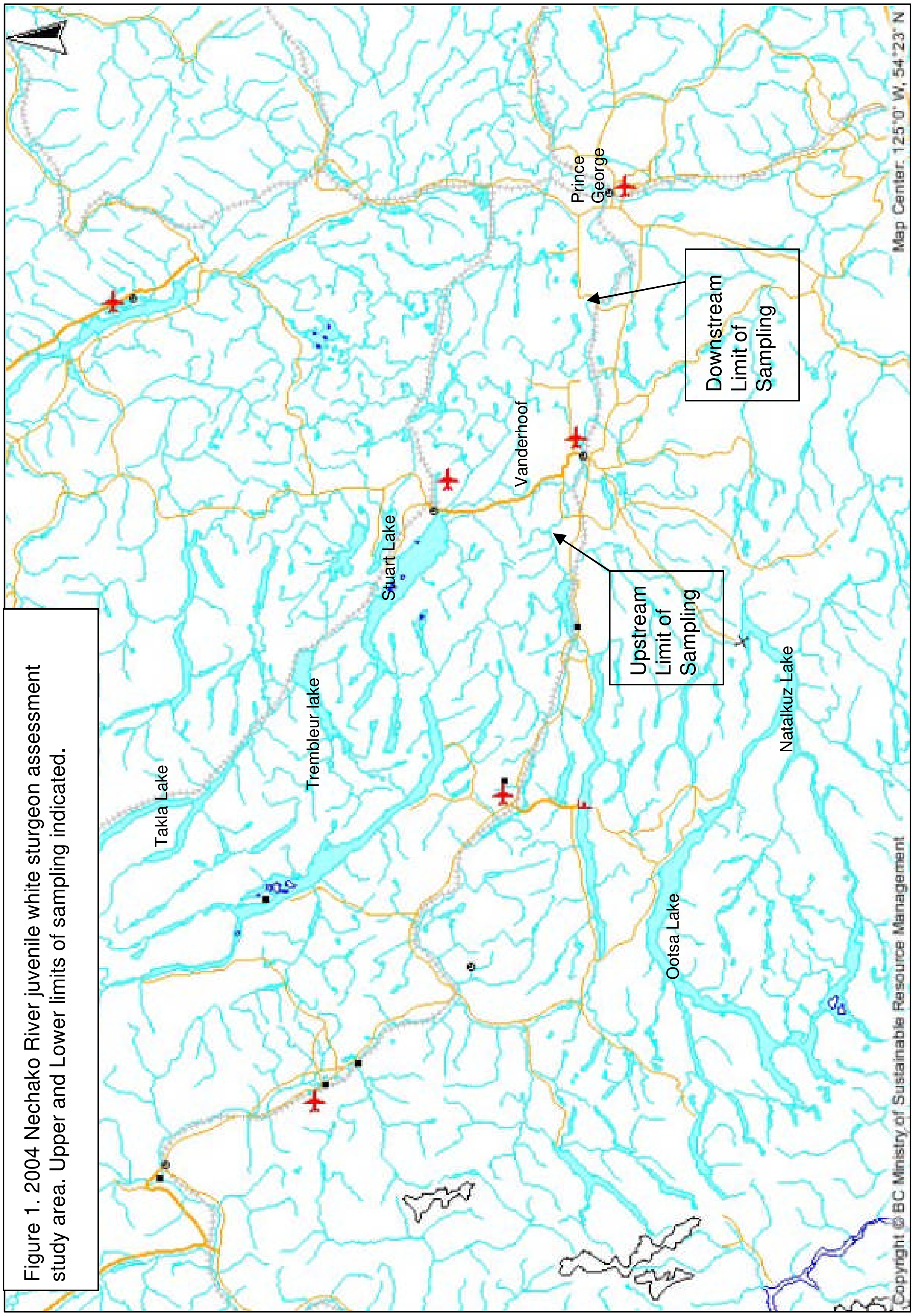

Figure 1. 2004 Nechako River juvenile white sturgeon assessment study area. Upper and Lower limits of sampling indicated.

Standard data forms were used to record all data pertaining to each sampling event (i.e. each gillnet deployment) (Appendix 1). Also included on the data forms are fields for sturgeon encountered and by-catch. Comments regarding habitat were also recorded. All staff were familiarized with the data forms prior to the field sessions to ensure consistency between individuals recording data and between vessels operating in possible isolation.

Sturgeon encountered were immediately removed from the net and placed into a container of fresh water. Basic parameters of capture were documented including capture depth and the mesh size responsible for capture. A range of morphological parameters were collected from all fish sampled, which were consistent with other Fraser watershed sturgeon studies (i.e., RL&L 2001). Table 1 lists the specifics of the external measurements that were collected from captured fish and the methodologies associated with each. Fish were examined for any external anomalies or damage such as missing scutes and scars, general health, and previous tag application.

Captured sturgeon received a uniquely numbered external spaghetti type tag (FLOY T-anchor $1^{1/8}$") in red or florescent green, and a uniquely coded internal tag (PIT TX 1400L Destron 11.5mm x 2.1mm). PIT tags were inserted under the skin approximately half way between the lateral line and the centerline of the back, on the left side of the fish behind the back of the head.

Table 1. External measurements taken from each captured sturgeon sampled in 2004, and the specific techniques for taking measurements.

Measurement	Specific Technique For Measurement
Total Length	From the center of the curvature of the snout, along the lateral line to the posterior terminus of the caudal peduncle, where the tape was held and redirected along the dorsal length of the caudal fin to its tip.
Fork Length	From the center of the curvature of the snout, along the lateral line, to the fork of the tail.
Post Orbital Length	From the center of the curvature of the snout to the back of the eye socket.
Post Opercular Length	From the center of the curvature of the snout to the posterior edge of the opercular plate. In the case of a gap between the operculum and the bony structure located posterior of the opercular plate, the gap was included in this measurement.
Girth	Taken as the circumference of the fish's body on the posterior side of the pectoral fins.

A small piece of tissue for genetic analysis was removed from the tip of the pectoral fin. Bone structures for determining fish age were removed from the leading ray of the pectoral fin. These samples were typically removed from the left pectoral fin, except where fin damage or anomalies occurred, in which case the fin ray sample was removed from the right pectoral.

Internal Examinations and Tag Implantation

Internal examinations of captured sturgeon (two instances in 2004) were completed to assess gonad development and for the purpose of implanting radio tags. Internal examinations followed standard techniques (CSTC 2003). Internally assessed sturgeon were assigned a maturity code based on the sex and level of gonad development. The visual criteria that are utilized to assign a sex and maturity code are described in Table 2 below, as described in Conte et al. (1998).

Table 2. Description of "Sexual Maturity Codes" utilized to classify the status of gonad development, as applied to sturgeon sampled within the Nechako River study area in 2004.

Sex	Code	Development State Description
Male	**1**	non-reproductive, testes appear as thin strips with no pigmentation
Male	**2**	maturing; small testes; some folding may be apparent; translucent, smoky pigmentation
Male	**3**	early reproductive; large testes, folds beginning to form lobes; some pigmentation still present; testes more white than cream coloured
Male	**4**	late reproductive; testes large, often filling posterior of body cavity; white with little or no pigmentation
Male	**5**	ripe; milt flowing; large white lobular testes; no pigmentation
Male	**6**	spent; testes pinkish-white, flaccid, and strongly lobed
Male	**10**	general unknown maturity
Female	**11**	non-reproductive; ovaries small, folded with no visible oocytes; tissue colour white to yellowish
Female	**12**	pre-vitellogenic, moderate size ovary with small eggs present (0.2 to 0.5 mm diameter); may have "salt and pepper" appearance
Female	**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
Female	**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
Female	**15**	ripe; eggs fully pigmented and easily detached from ovarian tissue; eggs 3.0 to 3.4 mm in diameter
Female	**16**	spent; ovaries are flaccid with some residual fully developed eggs
Female	**17**	pre-vitellogenic with attritic oocytes; small eggs (<0.5 mm diameter) present; dark pigmented tissue present that may be reabsorbed eggs
Female	**20**	general unknown maturity
Unknown	**97**	adult based on size, no surgical examination
Unknown	**98**	juvenile/sub-adult based on size, no surgical examination
Unknown	**99**	gonad undifferentiated or not visible during surgical examination

By-catch encountered was retained in containers of fresh water on board the boat until all fish were removed from the panel being checked, resulting in the sorting of by-catch by their mesh size of capture. For each fish, species, fork length, mesh size responsible for capture, and the ultimate fate of the fish were recorded. In several cases where larger numbers of similarly sized fish of the same species were captured, the total number, and maximum and minimum fork lengths were obtained. Sport fish encountered were processed in the same manner, but where mortalities occurred, some weights and age structures were taken. All healthy fish were released at the location of capture.

Habitat and Physical Parameters

Temperatures were obtained during sampling using a digital hand-held thermometer or the onboard echosounder (through the transducer). Water depth at the site of gear deployment was also measured utilizing the onboard echosounder, which was tested for accuracy using a known length of rope with weight attached. Water clarity was estimated utilizing a standard size secchi disc deployed and interpreted in the standard manner.

Nechako River temperature and discharge information collected at Vanderhoof was received from Water Survey of Canada personnel for the duration of sampling activities in 2004 and is presented in this report.

Habitat parameters required for the data forms and other descriptive purposes were assessed visually in combination with the interpretation of digital depth information. Flow velocity information was not successfully collected due to limitations in available equipment and the nature of habitats being assessed (i.e. 10+m depth).

Temperature and oxygen profiles were collected utilizing a YSI (Yellow Springs Instrument) digital meter.

Aging Analysis

The age of individual sturgeon captured was determined through an examination of the annuli patterns visible on the fin ray section that was removed from the leading ray of either the left or right pectoral fin. Age structure preparation and analyses were conducted by staff from Golder Associates Ltd.

Mitochondrial DNA Analysis

Pair-wise tests of genetic homogeneity and F_{ST} (a measure of population sub-structuring) were carried out with the genetic analysis program ARLEQUIN (Nelson 2005).

Results

Sampling Summaries and Physical Conditions

Repetitive sampling was undertaken on three separate occasions during July, August and September, encompassing a range of Nechako River discharge, temperature and water clarity conditions (Figures 2 and 3). Following are descriptions of the portions of the study area sampled during each shift and conditions observed. Complete data relating to sampling Effort, CPUE, By-Catch and Sturgeon Captured are available in Appendices 2, 3, 4 and 5, respectively. Maps (July - 3 maps, August - 1 map, September - 1 map) indicating the distribution of sampling effort and locations of sturgeon captures immediately follow this report.

July 23-29, 2004 Sampling Event

Sampling in July occurred between rkm179.3 (below the Nautley River confluence) and rkm66.2 (upstream of Isle Pierre Rapids), over a 113km length of the Nechako River. Prior sampling knowledge, very limited amounts of viable habitat and the difficultly of navigating waters in the area of the Nautley River and in the Isle Pierre area resulted in their exclusion from sampling. Additionally, due to the extreme distance and time constraints, it was deemed necessary to reduce the study area in order to sample areas of known sturgeon presence more effectively. Sampling was initiated near the upper limit of the study area and continued downstream over the next seven days. Water levels were high at this time due to cooling-flow releases from the Skins Lake Spillway, which enabled sampling to occur in areas not accessible under lower flow conditions. Sampling in July took place only during daylight periods, but often continued into the evening.

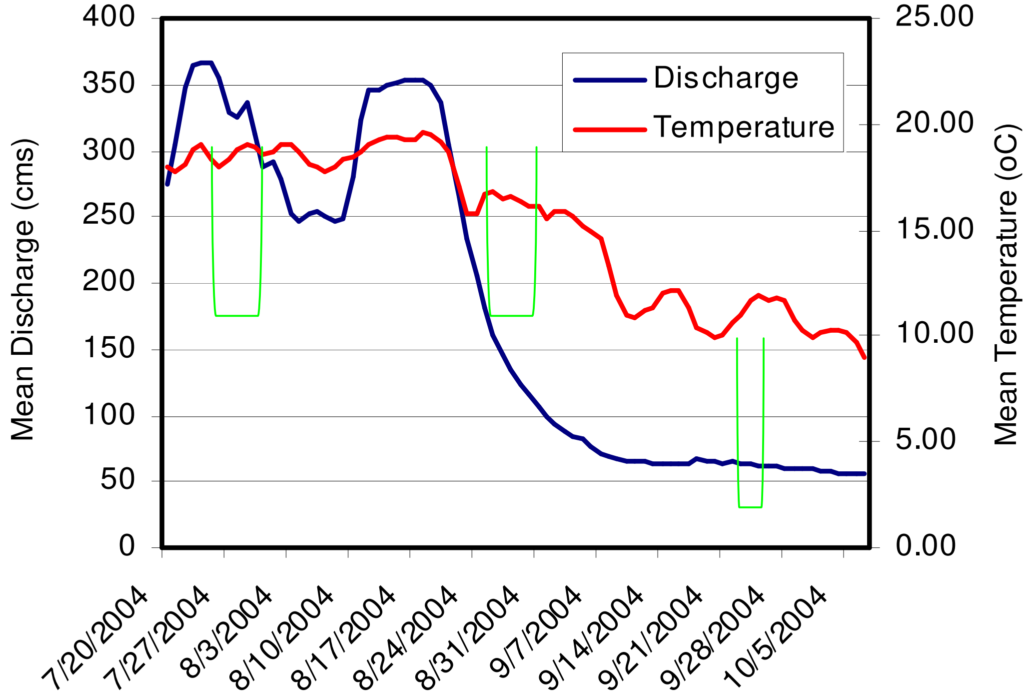

Figure 2. Nechako discharge and temperature measured at Vanderhoof. The green bars represent an approximation of the dates during which sampling was undertaken.

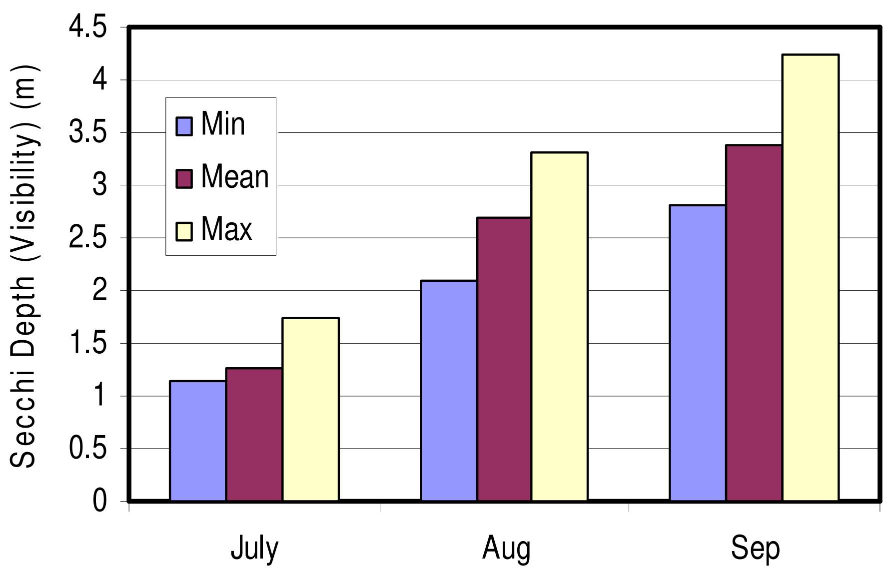

Figure 3. Minimum, maximum and mean secchi depth noted during each of the three sampling shifts undertaken in 2004.

Average daily surface water temperatures during this sampling period ranged from 18.0°C to 21.2°C. Figure 4 below demonstrates the mean daily observed temperature (collected at the time of gear deployment) during the three sampling periods within July, August, and September.

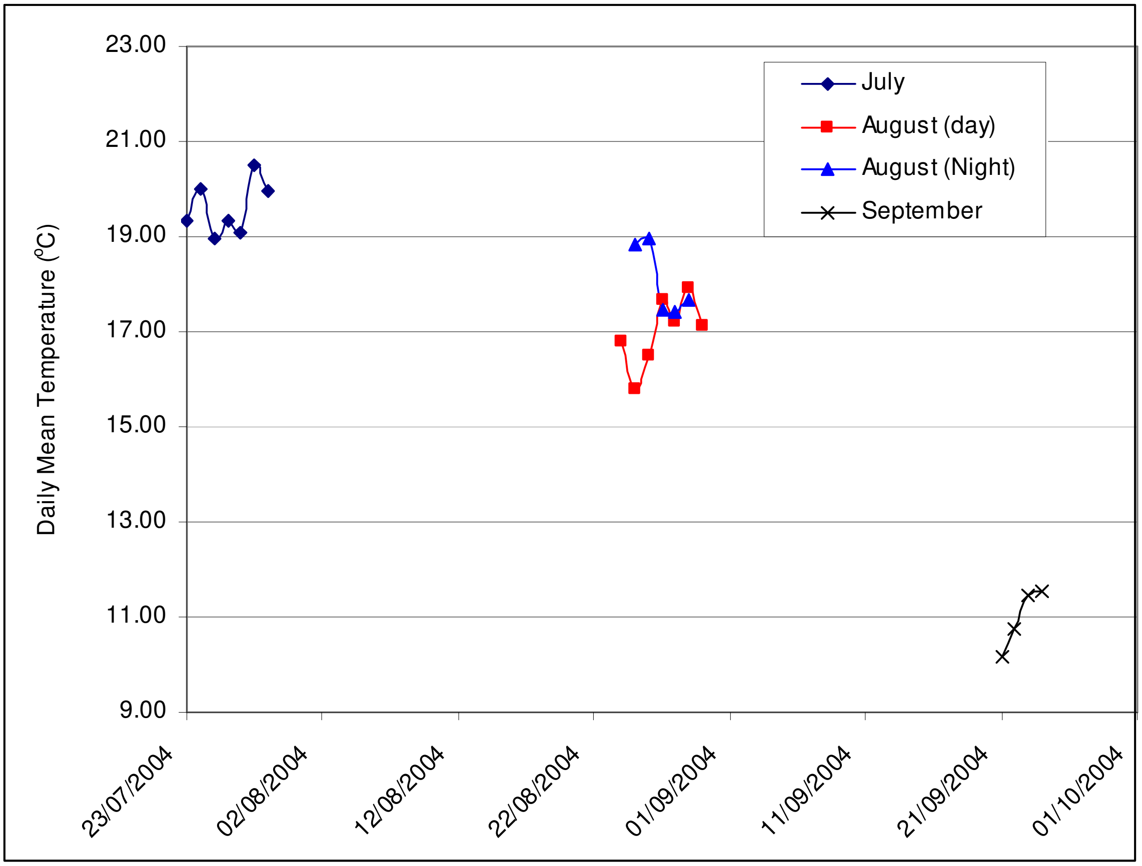

Figure 4. Daily average Nechako River temperatures (°C) observed at the time of gear deployment during sampling occurring in July, August, and September. Daily averages for the month of August reflect the difference between day and night sampling.

Secchi depths obtained daily during the July sampling session averaged 1.27m with a minimum observed value of 1.14m and maximum of 1.75m. Flows were high and the water column contained large amounts of free floating aquatic macrophytes, fine particulate matter, and small woody debris. Net fouling occurred often during this period, making cross-current sets difficult.

In total 187 panels were deployed in the July sampling period over 248.45 hours of effort. Table 3 below summarizes effort by mesh size and the resulting CPUE. Two sturgeon were captured, both at the same location (rkm 110.1) in two different sets, approximately 30minutes and 50meters apart. Both juvenile sturgeon appeared healthy, and had no physical evidence that suggested previous capture (Table 6). Appendix 5 contains the morphological parameters related to sturgeon captured.

Table 3. Summary of sampling efforts and CPUE during the July sampling period.

JULY								
Mesh Size (cm)	Total Panel Hours	Panel Area (m)	Hours fished for Net Area	Number By-Catch	Number WSG	Total Number Fish	By-Catch CPUE (per $100m^2$/hr)	Total CPUE (per $100m^2$/hr)
2.54	77.00	37.20	2864.40	69		69	2.409	2.409
3.81	21.00	37.20	781.20	30		30	3.840	3.840
5.08	41.00	37.20	1525.20	30		30	1.967	1.967
6.35	31.00	37.20	1153.20	32		32	2.775	2.775
7.60	68.00	37.20	2529.60	21	2	23	0.830	0.909
8.90	5.65	37.20	210.18	0		0	0.000	0.000
9.53	5.27	37.20	196.04	1		1	0.510	0.510

August 24 - 30, 2004 Sampling Event

Sampling in August occurred between rkm134.8 (below Vanderhoof townsite) and rkm90.2 (Stuart River confluence), over a total river length of 44.6km. This was a significantly smaller area than that surveyed in July, and sampling focused on re-sampling the habitats sampled during the July session. Cooling flows stopped approximately 4 days prior to sampling, making the Nechako River upstream of Vanderhoof and downstream of the Stuart confluence difficult to navigate. During this period, one crew sampled during daylight periods, with the second crew conducting duplicate sampling at night. Both crews operated together on the first day of the shift to ensure sampling procedure and site selection was consistent between the two crews.

Average surface water temperatures were recorded during both day and night shifts and are presented below in Figure 5.

Secchi depths were obtained daily during the August sampling session and averaged 2.69m with a minimum observed value of 2.10m and maximum of 3.30m. With decreasing water levels and temperatures, visibility improved during this session. Nets were rarely fouled with free floating debris, and there was a notable reduction in fine particulate matter in the water column.

During the August sampling period a total of 304 net panels were deployed resulting in a total of 449.26 panel hours of effort. Table 4 below summarizes effort by mesh size and the resulting CPUE for each mesh size.

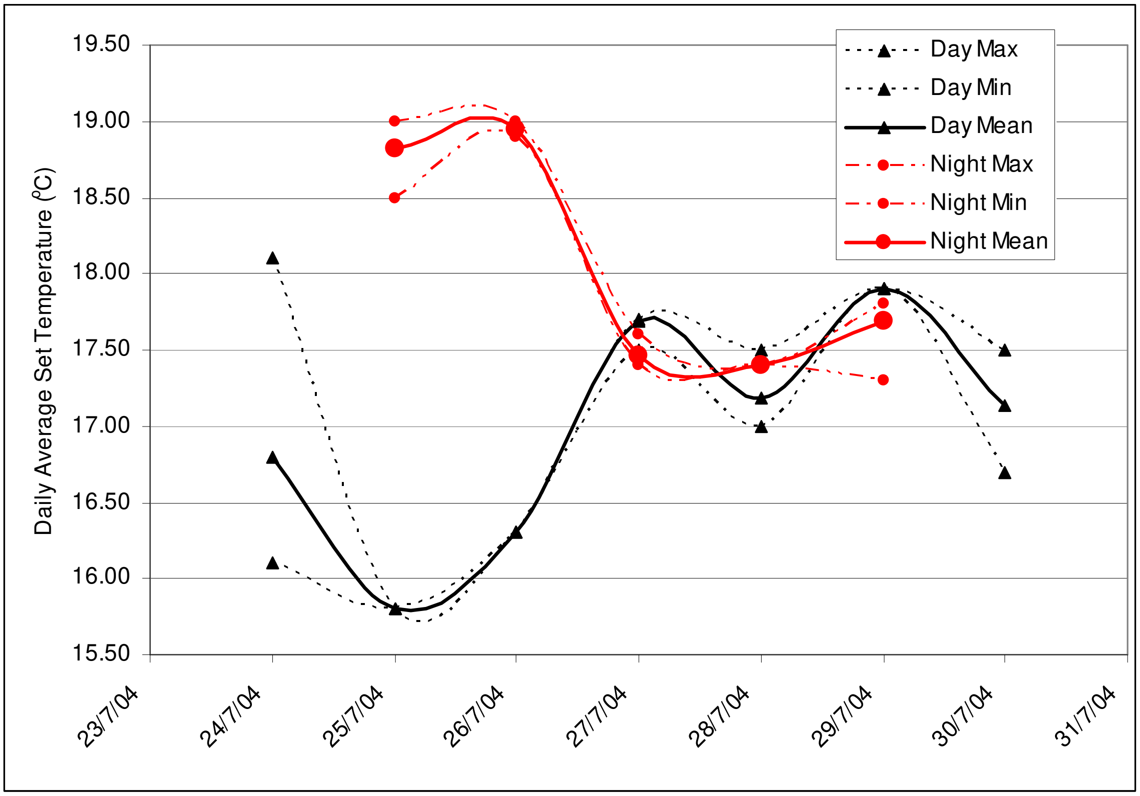

Figure 5. Daily average Nechako River temperatures (°C) noted at time of gear deployment for the August sampling period. Daytime and evening/night time sampling sessions are displayed using maximum, minimum and average temperatures by date.

Three sturgeon (TLs 59cm, 97cm ~110cm) were captured in the habitat unit at rkm110.1, where two sturgeon were also captured during the July sampling event. All were captured during night sampling and all were captured within a 2-3m section of the net, suggesting an aggregation of fish at this site.

Table 4. Summary of efforts deployed during the August sampling period and the resulting catch statistics by mesh size.

August								
Mesh Size (cm)	Total Panel Hours	Panel Area (m)	Hours fished for Net Area	Number By-Catch	Number WSG	Total Number Fish	By-Catch CPUE (per 100m^2/hr)	Total CPUE (per 100m^2/hr)
2.54	170.24	37.20	6332.93	179		179	2.826	2.826
3.81	41.34	37.20	1537.85	56		56	3.641	3.641
5.08	35.80	37.20	1331.76	27		27	2.027	2.027
6.35	54.28	37.20	2019.22	27		27	1.337	1.337
7.60	120.64	37.20	4487.81	69	3	72	1.537	1.604
8.90	12.50	37.20	465.00	2		2	0.430	0.430
9.53	14.46	37.20	537.91	2		2	0.372	0.372

Both fish landed (the third escaped during retrieval) were processed and tagged (Table 6).

<u>September 21-24, 2004 Sampling Event</u>

Sampling in September was conducted between rkm134.1 (below Vanderhoof townsite) and rkm110.1 (approximately 20km above the Stuart River confluence), over a total distance of 24.0km. The sampling area during September was concentrated into this portion of the river due to the lower water levels, the reduced time available in which to sample (4 days instead of 7), and a continuing refined sampling-focus on the most suitable habitats.

Secchi depths obtained daily averaged 3.38m with a minimum observed value of 2.80m and maximum of 4.25m. Visibility was the highest of the three periods. Water levels were low, aquatic macrophytes had yet to begin any significant amount of decay, however, a green string algae was present in large quantities, and was often found in the nets in large mats.

A total of 154 net panels were deployed in September with a total of 219.16 hours sampling effort. Table 5 below summarizes effort by mesh size and the resulting CPUE for each size mesh for this period.

Table 5. Summary of efforts deployed during the September sampling period and the resulting catch statistics by mesh size.

September								
Mesh Size (cm)	Total Panel Hours	Panel Area (m)	Hours fished for Net Area	Number By-Catch	Number WSG	Total Number Fish	By-Catch CPUE (per $100m^2$/hr)	Total CPUE (per $100m^2$/hr)
2.54	47.00	37.20	1748.40	186		186	10.638	10.638
3.81	55.00	37.20	2046.00	86		86	4.203	4.203
5.08	14.00	37.20	520.80	42		42	8.065	8.065
6.35	22.00	37.20	818.40	53		53	6.476	6.476
7.60	58.00	37.20	2157.60	170	3	173	7.879	8.018
8.90	23.90	37.20	889.08	13		13	1.462	1.462
9.53	0.00	37.20	0.00			0		

Three sturgeon were captured during this sampling session (TLs 94cm, 101cm, 103cm). Two were captured at the overwintering site at rkm115.9, and one juvenile sturgeon was captured at rkm114.7, opposite the confluence of the Sinkut River.

Sturgeon Captures

As can be seen in Table 6 below, a total of 8 sturgeon were encountered during sampling in 2004, including one that was lost at the side of the boat and was therefore not sampled. Its length was estimated to greater than one meter placing it into an “adult” classification. Two of the 7 sturgeon sampled were also slightly longer than a meter. All fish captured appeared to be of good health, had not been previously sampled, and were released successfully. Two of the larger fish sampled were affixed with radio tags for the purposes of tracking their movements. Ages of the fish captured and aged (7) ranged from 5-14years and all of the fish were captured within a 6km length of the Nechako, and all were captured in 7.6cm (3”) mesh.

By-Catch

The numbers of fish by-captured, by-CPUE and by-catch species composition varied considerably during each shift. Given the intended frequency with which a juvenile sturgeon recruitment monitoring program would be required to be implemented, the impact of any such program in terms of harm and mortality to non-intended catch is considered highly important. The following describes the observed trends related to the capture of non-target species over the course of the three sampling shifts.

Sport Fish By-Catch

A total of 6 non-targeted (i.e. other than sturgeon) sport fish species were captured during sampling in 2004 (Figure 6). The most commonly by-captured sport fish species during all shifts was mountain whitefish, which were captured more than twice as commonly as all other by-captured sport species combined. Sport fish by-CPUE approximately doubled during the second and third shift, relative to the first shift, largely due to increases in the number of whitefish caught. This appeared to be the only substantial seasonal effect notable. By-catch of other sport species was negligible (≤2) during each shift. The size range of each by-captured species and the resulting mortality that occurred is provided in Table 7. The selectivity of particular mesh sizes for sport fish appeared related to the size range of the catch (i.e. large fish were captured in larger mesh sizes and vice versa).

Table 6. Summary information relating to sturgeon captured in 2004 (see Appendix 5 for comprehensive data).

Date	Station	Capt. Depth (m)	Capt. Mesh Size	Sex Mat. Code	Total Length (cm)	Weight (g)	Age	Tags at Release	Comments
27-Jul-04	GN110.1L	8	3"	98	74	1882	9	FT-PT-N	Excellent condition; no distinguishing marks.
27-Jul-04	GN110.1L	7	3"	98	86.5	2552	5	FT-PT-N	Hemorrhage in left eye, RP split. Right side of face is deformed, looks like a gash. Leach on left along ventral scute line.
29-Aug-04	GN110.1L	9	3"	98	59	589.7	8	FT-PT-N	1 small leach. Double nares. Healthy. Minor tear in dorsal fin. Not a recap. Good condition at release.
29-Aug-04	GN110.1L	9	3"	98	97	3765	10	FT-PT-N	Double nares. Odd minor lesion from net. Very healthy and active. Good condition at release.
29-Aug-04	GN110.1L	9	3"	97	approx. 110 total				Lost at boat but observed by entire crew.
23-Sep-04	GN115.9L	4.2	3"	98	94	3084	13	FT-PT-N	Dorsal-old wound and couple of tears (scars). Lower caudal fin has a small tear, split nares, 4 barbels in good shape, scutes not too sharp. Pectoral and pelvic fins good, no signs of previous tagging or surgery. No Pit tag. No radio tag, too small of a fish for the size of tags on hand. Photo frames 12 and 13, roll 2. Decided to suture fish and release quickly to minimize stress. Was not able to determine sexual maturity.
23-Sep-04	GN115.9L	4.3	3"	97	103	4445	8	FT-PT-RT	Healthy juvenile, no abnormal marks, surgery went well. Fish too small to determine sex visually. Photo frames 16 and 17, roll 2.
23-Sep-04	GN114.7L	5	3"	97	101	4173	14	FT-PT-RT	Double nares, very sharp scutes. On stomach (ventral) and near pelvic and pectoral fins has small blister like bumps. Tear on dorsal fin. No Tags. Photo frames 14 and 15, roll 2. Released upriver at UTM 10.445440.5982293 so it could be processed with crew from other boat. Fish was released into rkm116 overwintering site. Gonads too small to determine sex.

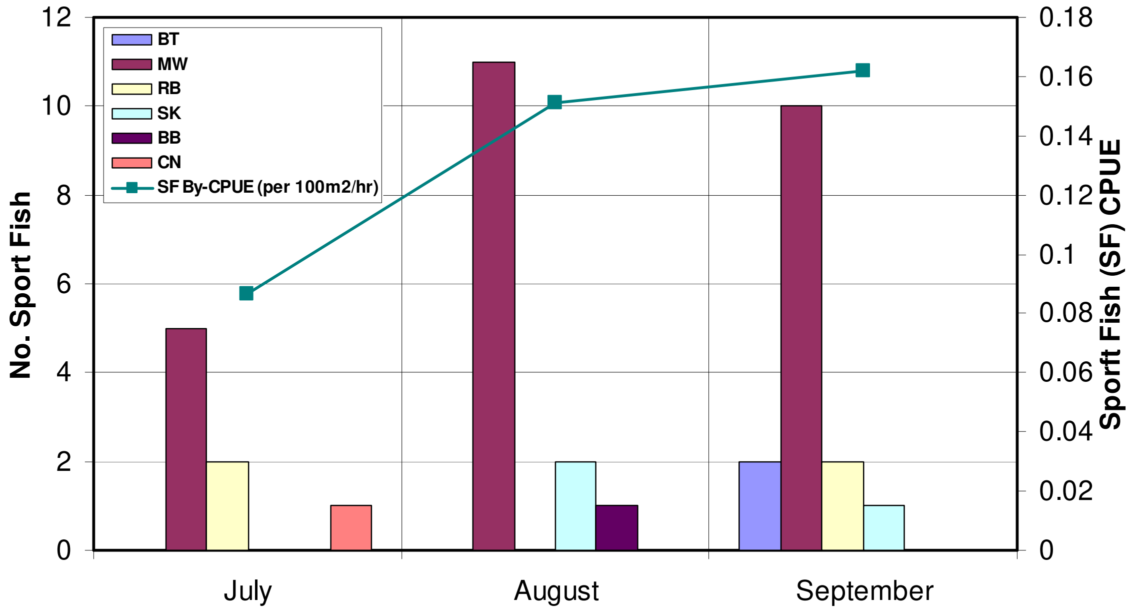

Figure 6. Summary of sport fish species by-captured during sampling in each shift (July, August, September) and corresponding by-CPUE (per 100m^2/hr) for sport fish. See Table 7 below for definitions for fish species codes within the figure's legend.

Table 7. Summary statistics and fates for by-captured species during the study.

By-Catch Species	Min FL (mm)	Max FL (mm)	No. By-Captured	No. Released	No. Mortalities
Mountain whitefish (MW)	141	325	26	21	5
Burbot (BB)	320	320	1	1	0
Bull trout (BT)	350	425	2	1	1
Chinook (CN)	770	770	1	1	0
Sockeye (SK)	540	550	3	1	2
Rainbow trout (RB)	214	319	4	1	3
Largescale sucker (CSU)	99	440	81	76	5
Longnose Sucker (LSU)	90	430	55	52	3
Northern pikeminnow (NSC)	108	430	434	374	60
Peamouth (PCC)	103	338	435	343	92
Redside Shiner (RSC)	82	132	41	34	7
White Sucker (WSU)	164	420	12	10	2

Non-Sport Fish By-Catch

Non-sport fish were more commonly by-captured than sport fish (Table 7 and Figure 7). Non-sport by-catch overall was dominated by northern pikenminnow and peamouth, which combined comprised approximately 80% of the non-sport catch. Of note is the dominance of non-sport catch by pikeminnow in July and August and a substantial increase in peamouth by-catch in September, when that species comprised the majority of the non-sport catch. This is not explained by the spatial distribution of effort and is likely related to seasonal behavioral change in the peamouth population that made them susceptible to capture.

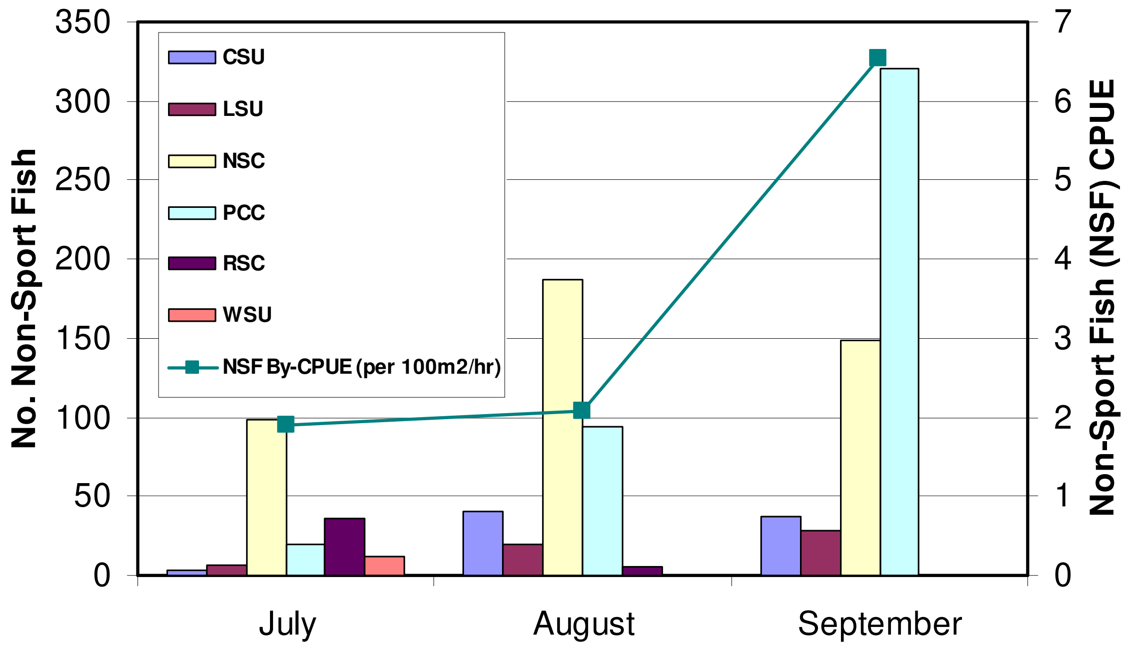

Figure 7. Summary of non-sport fish species by-captured during sampling in each shift (July, August, September) and corresponding by-CPUE (per 100m^2/hr) for sport fish. See Table 7 above for definitions for fish species codes within the figure's legend.

The increased occurrence of peamouth in the catch had the effect of increasing non sport by-CPUE threefold during the September shift, relative to the previous two shifts. Other items of note include the presence of redside shiner and white sucker within the first shift and their near absence in subsequent sampling, as well a far more frequent occurrence of largescale and longnose suckers during the second and third shifts, relative to the first (Figure 7).

By-CPUE (number of non-sport fish captured per hour of 100m^2 net deployment) by mesh size was considerably different in September for nearly all mesh sizes utilized, relative to mesh size by-CPUE observed in July and August (Figure 8). This related to the increase in peamouth occurrence in the catch during the September shift, and the large size range (103-338mm) that these fish possessed, which made them susceptible to a large range of mesh sizes.

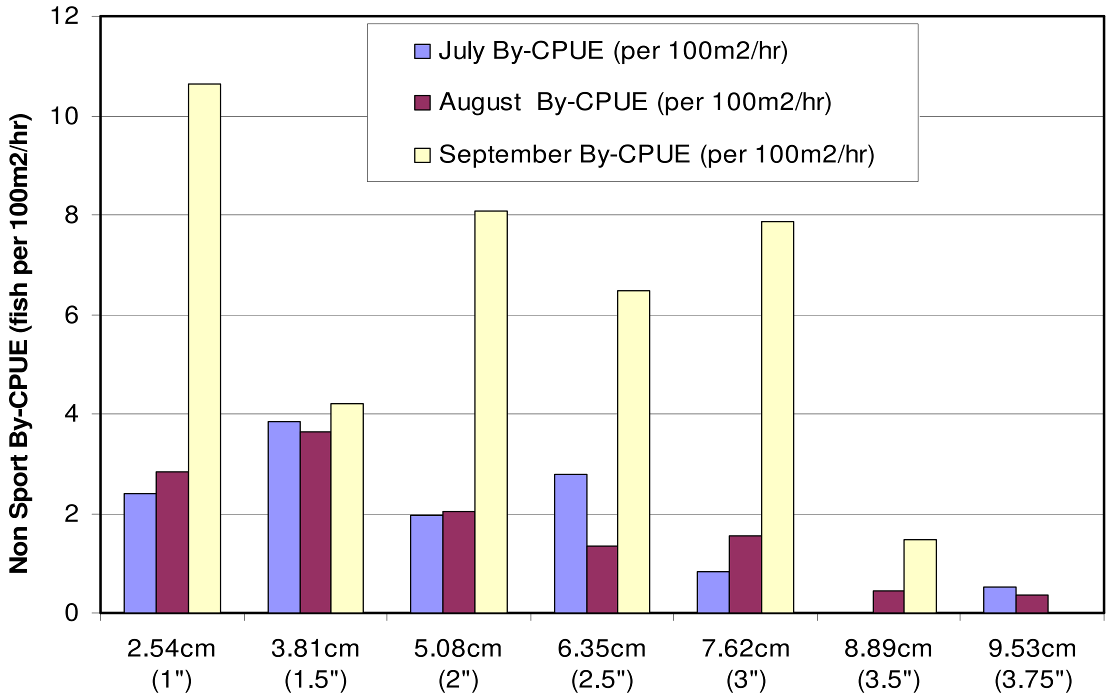

Figure 8. Comparison of by-CPUE by mesh size for sampling during the months of July, August and September.

Discussion

Sampling Effectiveness and Efficiency

The following provides a summary of factors experienced during the 2004 study that had the potential to affect the success of sampling efforts.

Physical Conditions

The conduciveness of any of the physical conditions encountered over the differing sampling periods is not readily apparent in terms of success of capturing sturgeon, as nearly equal numbers of sturgeon were encountered during each shift. Less effort was applied during sampling in September with good results, however, this was somewhat influenced by collective knowledge relating to habitat and seasonal behavior patterns gained during this program and previous sampling programs. A factor identified that could influence sampling effectiveness was the large amounts of drifting plant material observed during the first shift. This condition resulted from the initiation of sampling in association with the peak of flow ramping related to the Summer Stream Temperature Monitoring Program. This condition was not present during August and September shifts. While visibility improved from the July-September shift, it did not appear to negatively impact sturgeon catchability.

Overall, in terms of the seasonality of sampling and the physical conditions that would be expected, it appears the majority of the implications that relate to this sampling program may be more logistical in nature (access, etc.). Other seasonal shifts were noted in relation to the non-sport fish by-catch, which are discussed in the Recommendations Section below.

Sturgeon CPUE

As can be seen in Figure 9 below, total net-panel hours varied from shift to shift. During the first shift temperatures were high and nets were checked frequently and a greater proportion of time was spent traveling due to the large size of the study area to be covered. The smaller study area covered in August reduced the amount of travel time and allowed for increased sampling. Further, cooler water temperatures and known-proven juvenile holding areas caused effort to be focused on specific areas rather than searching out plausible habitats. Total effort dropped during the third shift due to the decreased amount of time available. The total number of fish captured per shift increased, while the number of sturgeon encountered varied little from 2-3 per shift.

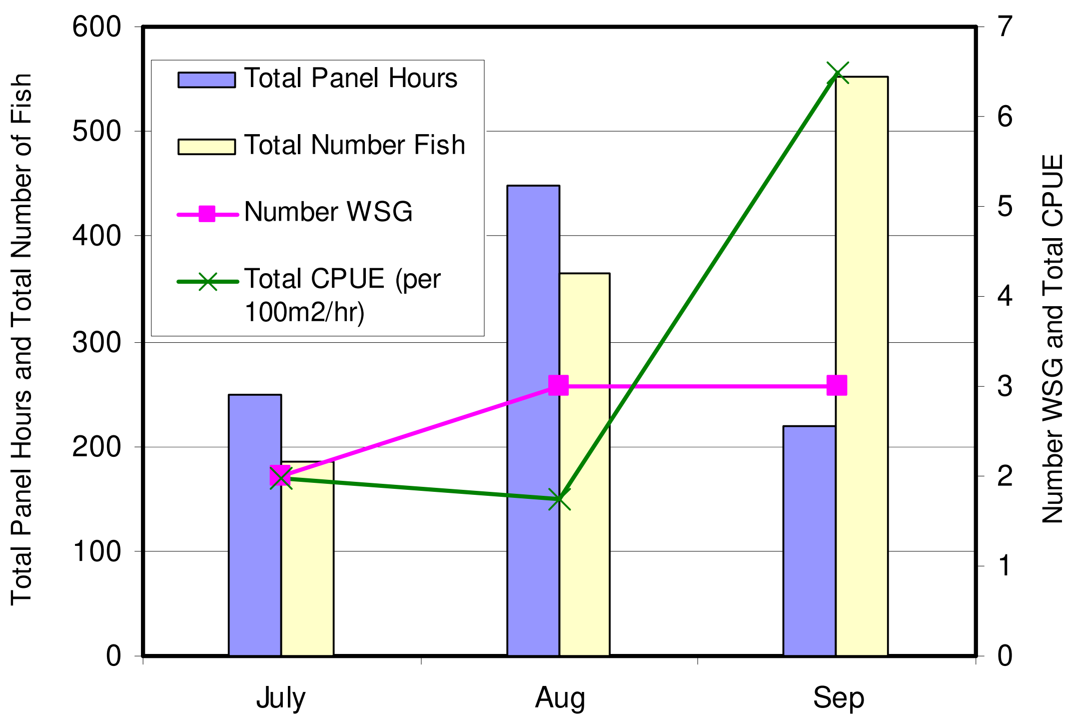

Figure 9. Total number of panel hours of gillnetting, total number of fish captured, total number of white sturgeon captured and total CPUE (fish per hour of $100m^2$ of soaked net) for sampling shifts in July, August and September.

Day vs. Night Sampling

The effects of sampling during hours of daylight and darkness were assessed during the second sampling shift (August). This was accomplished through the use of two crews, one working a daylight shift and the second working a night shift. The daylight crew always preceded the night shift and provided their sampling specifics to the night shift to facilitate as high a rate of sampling duplication as possible. Average CPUE (all fish) between daylight and darkness sampling during this shift was very similar (daylight - 0.788 fish captured per hour of 100m^2 of net deployment; and, darkness - 0.760 fish captured per hour of 100m^2 of net deployment). Paired sampling results (where daylight and darkness sampling efforts were applied at the same sites) demonstrated a CPUE that was still very similar (daylight - 0.788 fish/hour of 100m^2 and darkness - 0.734 fish/hour of 100m^2).

The 3 sturgeon captured during the second/August shift were all captured during a single set during a night sampling shift. Further comparative data of the nature collected in 2004 is required to determine the benefits of sampling during daylight or darkness periods.

Juvenile Sturgeon Abundance

This program was successful in capturing a number of sturgeon within the target size range (<1m) as well as three others that were slightly larger than 1m, but which also contribute to the understanding of the recruitment dynamic of the Nechako sturgeon population. Little can be accurately-quantifiably stated about the abundance of juvenile sturgeon within the Nechako River as a result of this work. This is due to the preliminary nature of the work, and the lack of suitable comparative sampling data available. Subsequent sampling of a similar nature will have both a marked component of the juvenile population from which to draw from as well as catch statistics with which to compare. Further, the presence of two radio tagged fish near the desired size range should benefit future work.

It should be noted that all sturgeon captured in 2004 were confirmed through DNA analyses to be of Nechako origin (Nelson 2005).

Juvenile Sturgeon; Distribution and Habitat Use

Sturgeon catch during all three sampling shifts was largely concentrated within a small area of the Nechako mainstem in 2004. All fish were encountered within three habitat units between rkm 110 – 116. This length of the river had been previously observed to be an area where Nechako sturgeon were frequently captured (RL&L 2000b). While this segment of the river was intensively sampled in 2004, sampling was not disproportionate, and the capture results observed are considered to reflect the distribution of sturgeon within the target size range. The occurrence of all 8 sturgeon encountered within this small length (6km) of stream would seem to indicate selective preference for the habitat units contained within this area.

Habitat Preference

The portion of the river (rkm 110 – 116) where all sturgeon were captured in 2004 contained a large proportion of the deepest habitats observed within the entire study area. All sturgeon captured during July and August (5 in total), when water temperatures were at their highest, were captured from the single deepest habitat unit encountered in the study area. Sturgeon encountered in September, after river temperatures had cooled substantially, were found within shallower habitats associated with a known sturgeon overwintering site. Two of these fish were radio tagged and subsequently found to be still in the same general area in November (Williamson 2004).

Following is a description of the habitat unit characteristics at the site of each sturgeon capture in 2004:

> The capture site at rkm115.9 is a small eddy along the left downstream bank; the result of a very small boulder outcrop. The deepest portion of this site occurred along the eddy line and approached 7m. The eddy is approximately 70m in length and about 1400m^2 in area. Two sturgeon were captured near the tail of this eddy, in approximately 4-5m depth. The margins of eddy along the left bank contained dense aquatic macrophytes, though the rapid change in depth at this location limited their establishment to within approximately 3m of the bank. There was some anchored large woody debris in the deepest portion of the site, however the remainder of the site was free of debris.
>
> The site at rkm114.7, opposite the Sinkut River confluence, could be described as slack water caused by an exposed dry channel (gravel bar) upstream of the site. The habitat unit was small and narrow and located on a slight outside bend, with a depth range of 4.2 to 5.4m creating a pocket of suitable habitat under the flow conditions present. No aquatic macrophytes were observed near the site, and fouling and damage to the net occurred due to large woody debris along the bottom.
>
> All other sturgeon captures in 2004 occurred in July and August in the large habitat unit at rkm 110.1. A dissolved oxygen temperature profile was developed for this site following the captures of two sturgeon at this

site in July and is plotted in Figure 10 below. Based on the uniform temperature profile, and dissolved oxygen ranging between 9 and 9.5mg/l, thorough mixing appears to be occurring at this site. While discharge measurements were not collected at this site, it is worth noting that despite anchoring in depths of 8-9m, many sets had to be double-anchored due to a tendency for the anchors to slip while sampling in this habitat unit, suggesting substantial flow velocity through the entire water column.

The eddy at rkm 110 is unique to the study area, both in its overall surface area and its depth. It displays a straight laminar section flowing against a high cutbank, which results in a tight bend in the channel and creation of a re-circulating eddy. The eddy itself is approximately 300m in length, a maximum width of 75m and depth of 11m. The left bank has aquatic vegetation, extending only 1-3m from the shoreline, and is limited to these margins due to the rapid increase in depth.

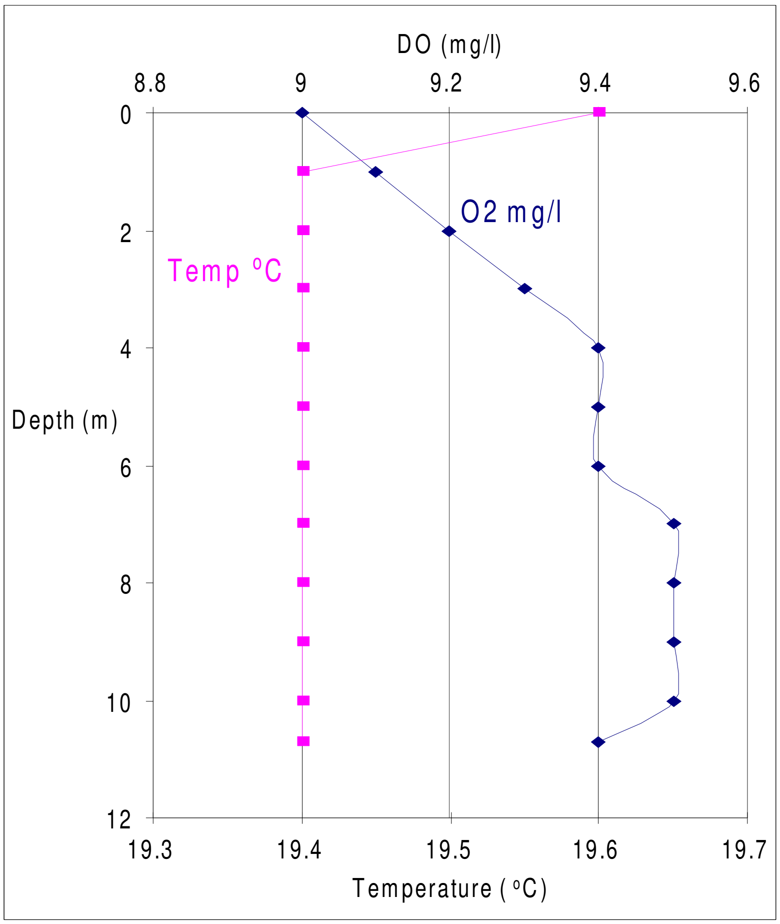

Figure 10. Dissolved oxygen/temperature profile taken July 28, 2004 at UTM 10.447769.5980737, or rkm110.1.

The sturgeon captured in 2004 were located in similar habitat types. They were generally found associated with deep eddies or pools with well scoured fine substrates indicating steady flow through the site. Established aquatic macrophytes were not present in any of the capture locations, and the presence of submerged anchored wood debris was very limited in these locations. The three sturgeon captured in September were in waters ranging from 4-5m, including two that were holding in a known overwintering site, in which all the sturgeon present (adult and juvenile) tended to hold in an approximately 5m deep section of the river. This overwintering site is associated with a small back-eddy, and the fish hold in the flows associated with the eddyline. This behavior was observed using an underwater video camera subsequent to sampling (Golder 2005).

Juvenile Recruitment

The sturgeon captured in 2004 and their confirmation as Nechako stock make it apparent that some level of juvenile recruitment has been occurring in the Nechako River. A total of 7 sturgeon were captured and successfully aged during assessment work from 1995-1999 that would have been <20years of age in the summer of 2004. The samples collected in 2004 and 1995-99 (14 fish in total) are combined in Figure 11 below, according to their age/year-of-hatch as of the summer of 2004.

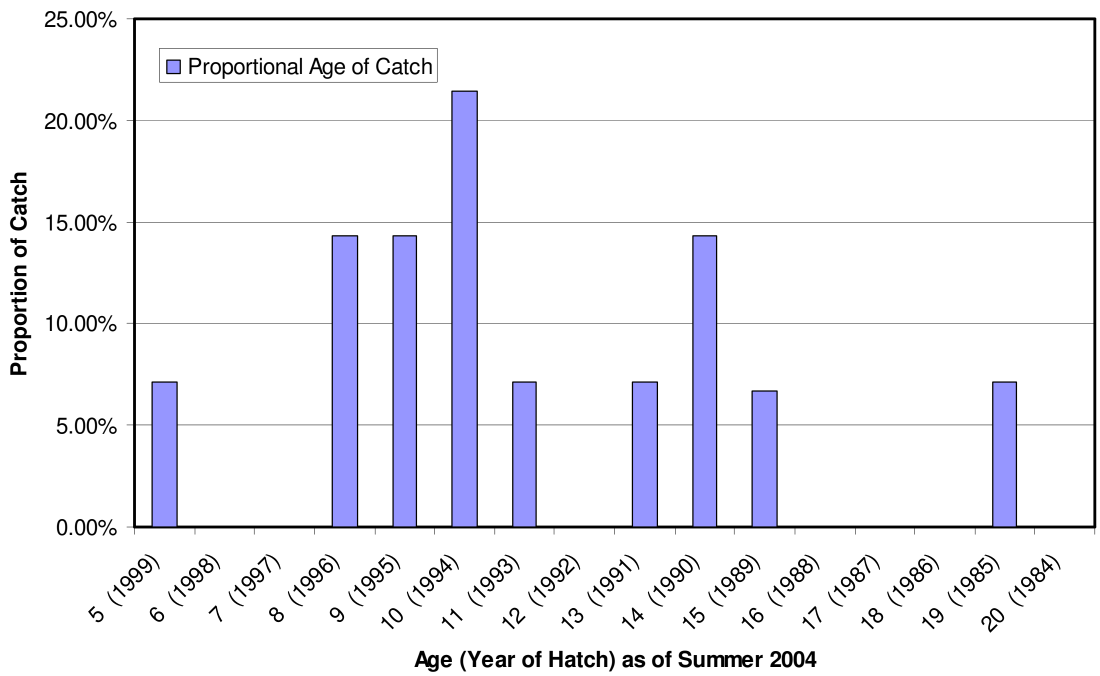

Figure 11. Proportion of 14 sturgeon captured from the Nechako River since 1985 that were aged <20years in summer 2004. This includes the seven sturgeon captured and successfully aged in 2004.

The data indicates that some amount of recruitment is occurring relatively regularly, although this is based on a very small number of fish. This data is suggestive that annual variability in seasonal discharge may not be a significant factor in recruitment success or failure, at least within the timeframe of the dates that these data allow for an examination (1999-1985). If this is the case (regularly occurring low levels of recruitment) it would seem innate that an ongoing factor (e.g. habitat impairment) is consistently constraining recruitment on an ongoing basis. Additional data similar to that collected in 2004 will assist in identifying any particular brood year flow effects that appear to benefit subsequent recruitment, or if recruitment maintains the pattern emerging above.

Recommendations

An Index of Juvenile Sturgeon Recruitment

Experiences and results from 2004 were intended to contribute to the design and implementation of a program intended to track the level of juvenile white sturgeon recruitment in the Nechako River. The following summarizes relevant information obtained in 2004 related to this objective, which should be considered preliminary, on the basis of a single season of sampling.

Seasonality/Timing

Discharge and water temperature did not appear to have an impact on the ability to capture sturgeon with gillnets. Discharge did pose logistical considerations related to the ability to travel by boat safely in certain areas. Further, large amounts of drifting macrophytes and other debris that were present shortly after initiation of cooling flows would appear to intuitively decrease sampling success due to net fouling. Further, it would also seem intuitive that sampling during the high temperatures that were seen in late July would pose more stress to captured fish. This would appear to suggest sampling during lower flows and cooler temperatures, possibly in late August and/or late September, should be considered.

Distribution of Effort

Despite a broad distribution of effort, results in 2004 indicated an apparent habitat preference for a relatively short length of the Nechako River where all sturgeon encountered in 2004 were captured. Underwater video footage of habitat units within this area in November of 2004, subsequent to this sampling program, confirmed a large proportion of the Nechako's sturgeon population congregating in this area (Golder 2005).

As logistical considerations (river access, river travel, crew accommodation, workday length, crew travel) largely drive the cost of the sampling program, it is recommended that future sampling for the purposes of an index of juvenile recruitment be focused on the Nechako mainstem from Vanderhoof to the Hulatt Rapids or the Stuart River confluence. This section of river encompasses the preferred habitats discussed above, and is fully accessible throughout a range of water flows, and the least complicated logistically to sample.

However, further investigative work should be conducted within the upper and lower portions of the 2004 study area to refine information about the distribution of the younger/smaller age/size classes of sturgeon in the Nechako. Methods should be modified as required to maximize access and sampling effectiveness in these areas.

By-Catch

Sport fish by-catch was negligible relative to the amount of effort that was applied. Non-sport fish by-catch was more of an issue and followed a seasonal pattern whereby large numbers of peamouth were present in September, driving CPUE to three times the level seen in the two earlier sampling shifts. Mortality rates for the two most commonly captured non-sport fish (pikeminnow and peamouth) were quite high. By-catch and mortality on both of these species would be reduced by increasing the average mesh size deployed, as recommended below.

Data specific to the stock status of any resident species (sport and non-sport), with the exception of sturgeon, in the Nechako does not exist. Bull trout are Provincially listed and closed to harvest by sport anglers. It is therefore difficult to assess the implications of annually implementing a program of the nature undertaken in 2004 (particularly on non-sport fish stocks). It is suggested that in the absence of this information, factors relating to improving the program's capture-efficiency for sturgeon within the target size range be utilized to guide the format and function of any subsequent sampling program, rather than factors relating to by-catch. Additional information relating to non-target species will be developed through subsequent years of this sampling.

Sampling Methodology

All sturgeon captured in 2004 were in 7.62cm (3”) mesh, despite extensive use of gillnet panels of 6 other sizes. This included sturgeon within a relatively large range of total length (50cm – 100+cm). Catch success for sturgeon within the desired size range should be increased through the use of a greater proportion of 3” mesh and greater proportions of closely related mesh sizes (2.75” and 3.25”) within the array of panels utilized in gangs. It was apparent that by-catch would also be reduced through the use of panels with a larger mesh size.

The manner in which the habitat units selected for sampling in 2004 should be continued, as it appeared a broad range of habitats and depths were sampled, and the target species was successfully captured.

Methodology related to net set duration should be maintained as a decision field crews have control over, depending on conditions encountered in the field. Being conservative (risk averse) should be the primary consideration.

Any potential benefits of sampling during periods of daylight vs. darkness were not definitively determined in 2004. Further comparative sampling should be continued in any subsequent sampling program. The design of the program should complement comparative data collected in 2004.

Depending on review and consent of the Recovery Team, there should be further consideration of the benefits available from radio tagging additional juvenile sturgeon. This could provide valuable insight into habitat selection and seasonal movements, as well as direct all types of juvenile-focussed sampling efforts.

Underwater video footage was collected in late 2004 in the area where this sampling program was conducted (Golder 2005). This method appears to have some potential use in assessing juvenile distribution and possibly abundance. Its use should be considered for incorporation into future work, where it may be beneficial.

General Summary

The following summarizes recommendations, stemming from the first year of sampling, to direct future related sampling efforts with similar objectives (i.e. providing additional information regarding preferred habitats and behaviour, past recruitment trends, and contributing to a future “Index” of recruitment).

1. Focus the distribution of sampling effort from Vanderhoof to Hulatt Rapids or the Stuart River confluence. Sampling in 2004 indicated that the most

commonly utilized habitats for sturgeon within the desired size classes occurs within this area.

2. Conduct juvenile-focussed sampling during August and/or September. The only benefit to conducting sampling in July is the higher flows that make access to the upper and lower portions of the 2004 study area more feasible.
3. Consider increasing the proportion of 7.62cm (3”) mesh panels within gangs, as well as 6.35cm (2.5”) and 8.89cm (3.5”). All sturgeon captured in 2004 were in 7.62cm mesh, which included fish from TL59cm-103cm.
4. Utilize telemetry (existing tagged fish and tag additional fish) to determine habitat usage and movement patterns, and direct further sampling.
5. Utilize underwater video footage to assess habitats and sturgeon presence and distribution and possibly abundance.
6. Consider utilization of juvenile-targeted angling to augment gillnetting.
7. Further investigate the impact of sampling during darkness vs. daylight on sturgeon capture and non-target by-catch.
8. Consider further sampling within the upper and lower portions of the 2004 study area to confirm the apparent pattern of juvenile white sturgeon distribution observed in 2004. Sampling of this nature should be done as a separate study, as it will have slightly different objectives.

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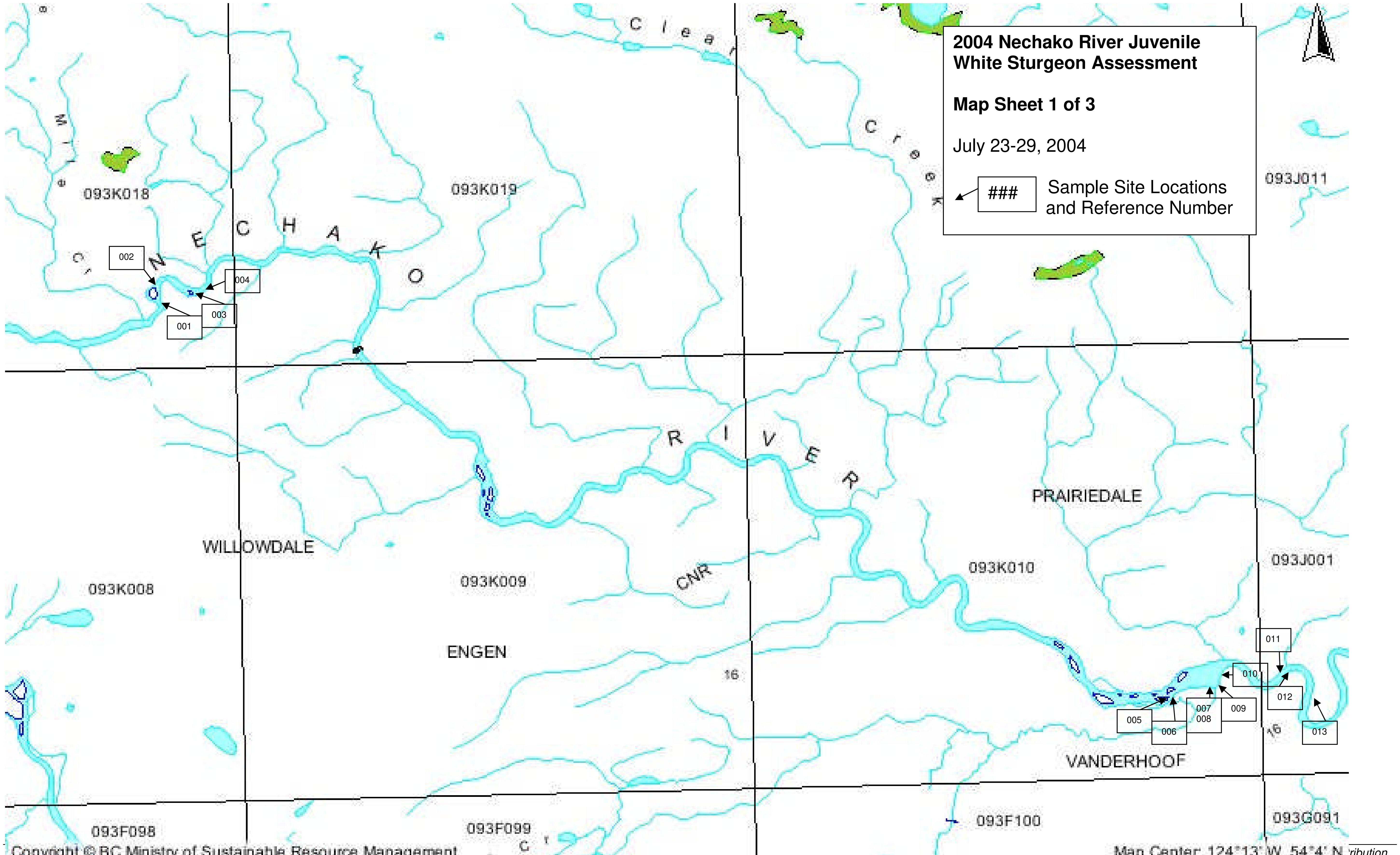
2004 Nechako River Juvenile White Sturgeon Assessment
Map Sheet 1 of 3
July 23-29, 2004
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Sample Site Locations and Reference Number
NECHAKO RIVER
Clear Creek
093K018
093K019
093J011
093K008
093K009
093K010
093J001
093F098
093F099
093F100
093G091
WILLOWDALE
ENGEN
PRAIRIEDALE
VANDERHOOF
CNR
16
001
002
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005
006
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012
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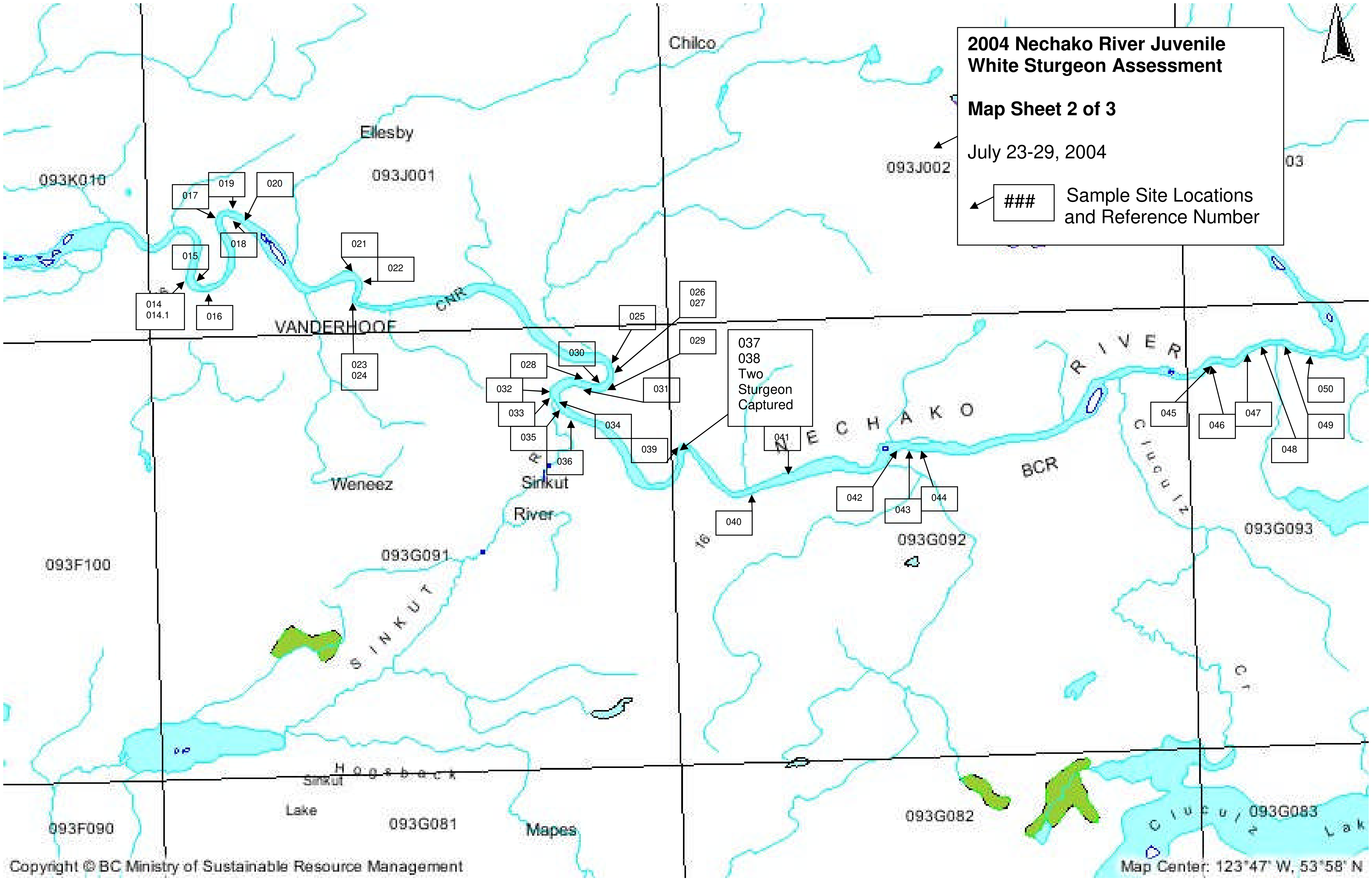
Map Center: 124°13' W, 54°4' N


2004 Nechako River Juvenile White Sturgeon Assessment
Map Sheet 2 of 3
July 23-29, 2004
Sample Site Locations and Reference Number
Chilco
Ellesby
093K010
093J001
093J002
03
VANDERHOOF
CNR
017
019
020
018
015
014
014.1
016
021
022
023
024
025
026
027
029
030
028
031
032
033
034
035
036
039
037
038
Two
Sturgeon
Captured
041
040
042
043
044
045
046
047
048
049
050
N E C H A K O
R I V E R
BCR
Weneez
Sinkut
River
S I N K U T
093G091
093F100
093G092
093G093
093F090
093G081
093G082
093G083
Lake
Sinkut
Mapes
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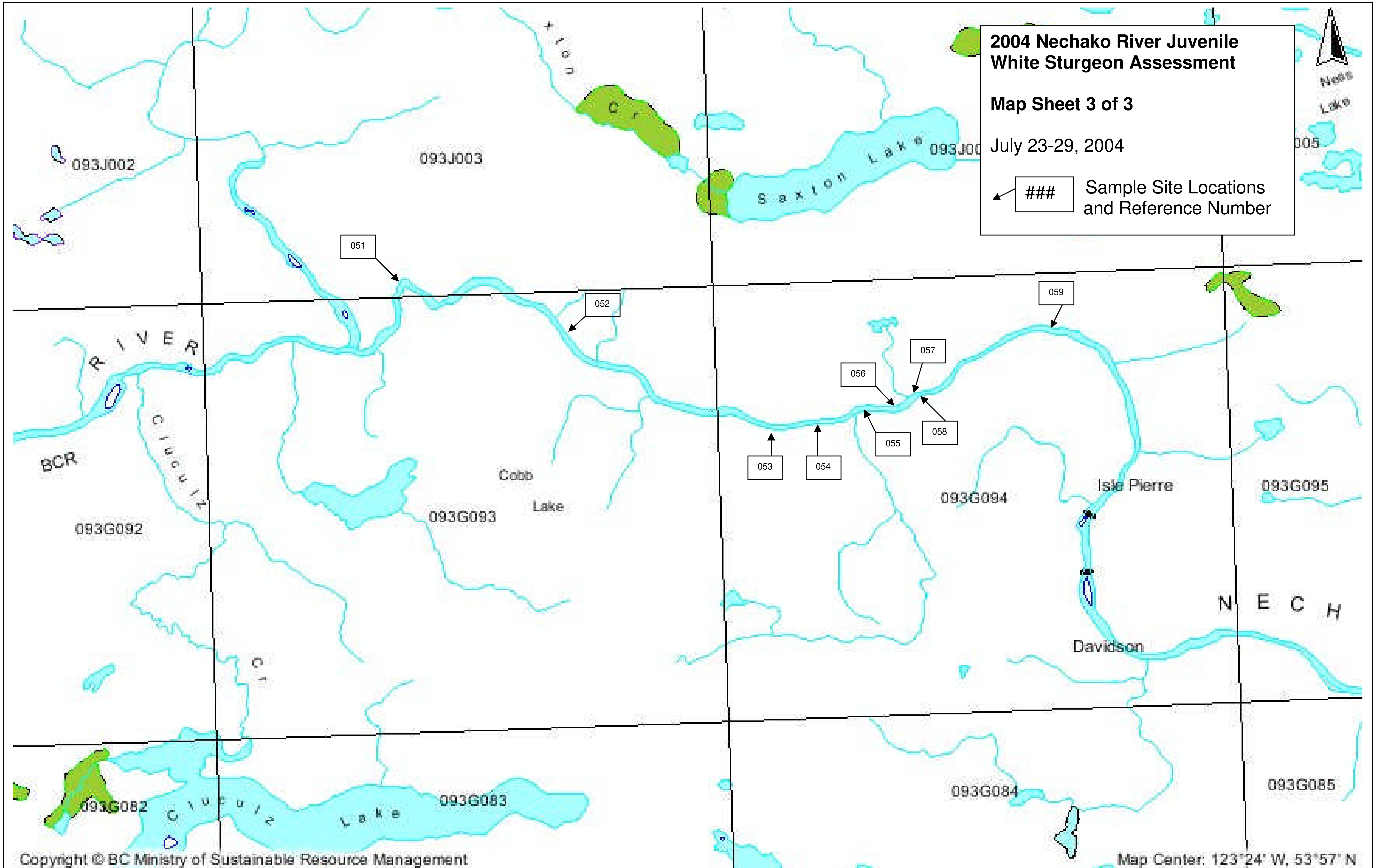
Map Center: 123°47' W, 53°58' N


2004 Nechako River Juvenile White Sturgeon Assessment
Map Sheet 3 of 3
July 23-29, 2004
Sample Site Locations and Reference Number
051
052
053
054
055
056
057
058
059
093J002
093J003
093G092
093G093
093G094
093G095
093G082
093G083
093G084
093G085
Saxton Lake
Cobb Lake
Isle Pierre
Davidson
RIVER
NECH
BCR
Cluculz Lake
Ness Lake
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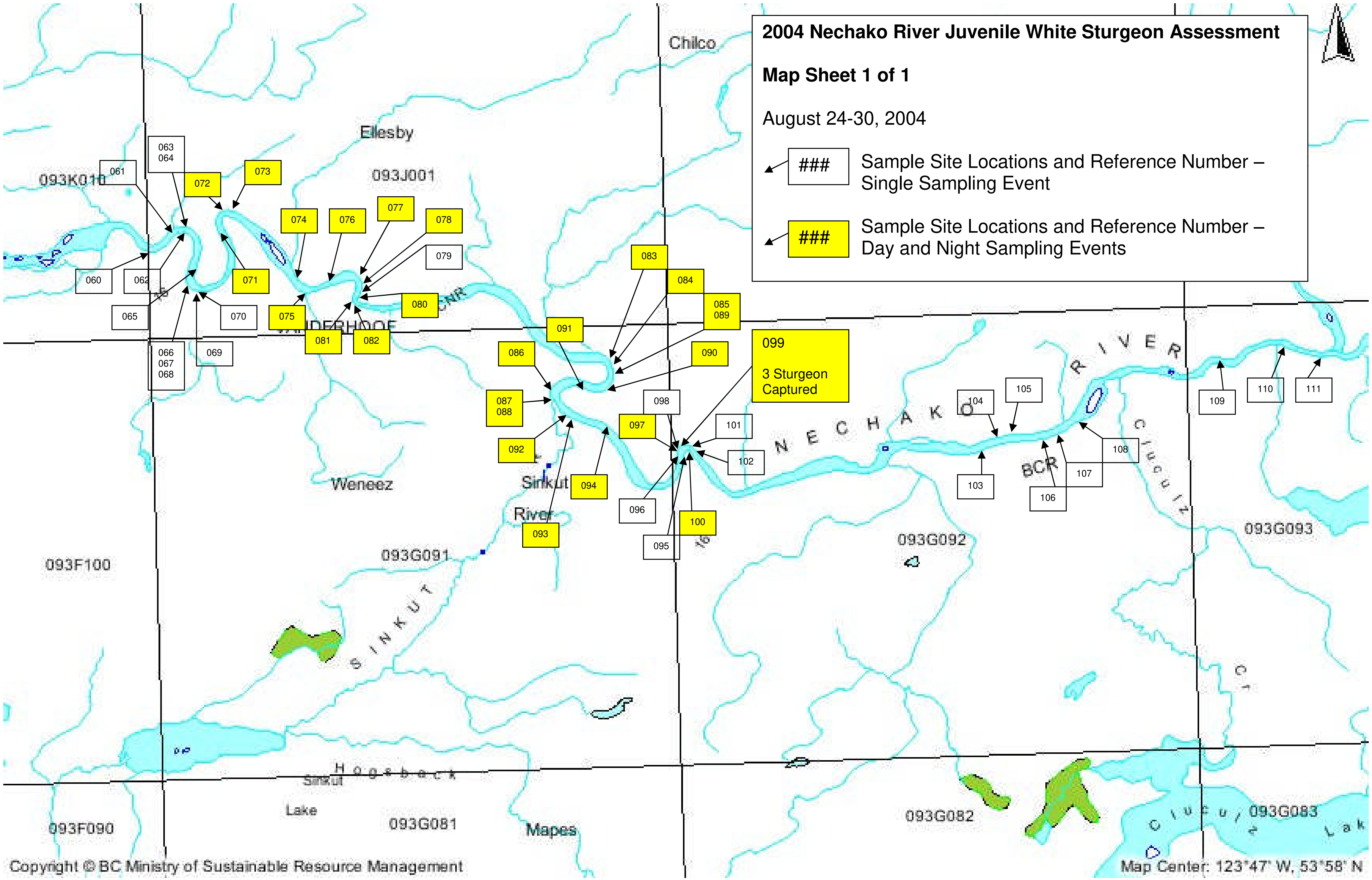
Map Center: 123°24' W, 53°57' N


2004 Nechako River Juvenile White Sturgeon Assessment
Map Sheet 1 of 1
August 24-30, 2004
###
Sample Site Locations and Reference Number – Single Sampling Event
###
Sample Site Locations and Reference Number – Day and Night Sampling Events
099
3 Sturgeon Captured
Chilco
Ellesby
093K010
093J001
Weneez
Sinkut
River
093F100
093G091
093G092
093G093
093F090
093G081
093G082
093G083
Mapes
Lake
NECHAKO RIVER
SINKUT
BCR
CNR
060
061
062
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064
065
066
067
068
069
070
071
072
073
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077
078
079
080
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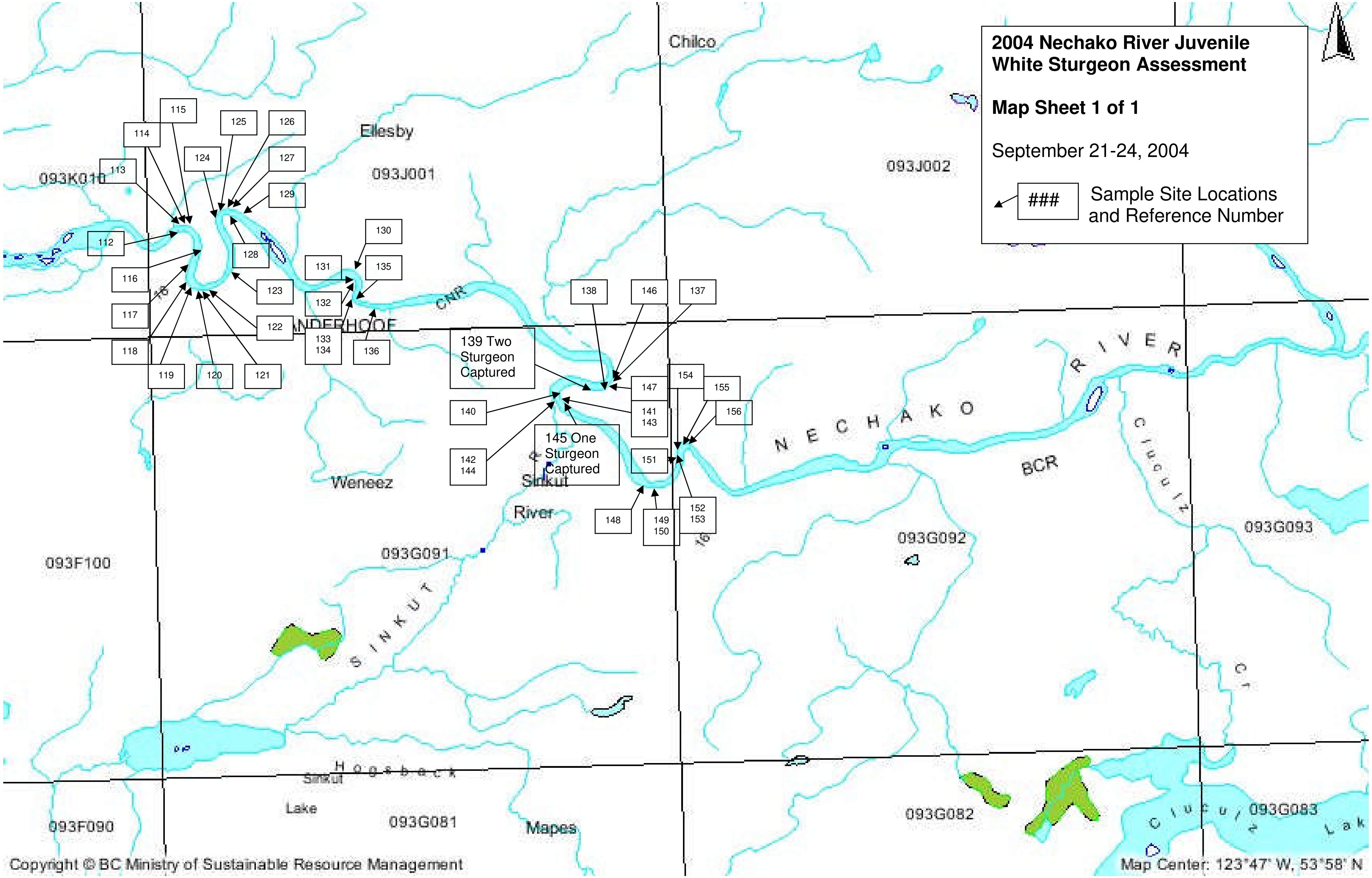
Map Center: 123°47' W, 53°58' N


2004 Nechako River Juvenile White Sturgeon Assessment
Map Sheet 1 of 1
September 21-24, 2004
Sample Site Locations and Reference Number
139 Two Sturgeon Captured
145 One Sturgeon Captured
112
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114
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125
126
127
128
129
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156
Chilco
Ellesby
093K010
093J001
093J002
CNR
Weneez
Sinkut
River
SINKUT
093G091
093F100
NECHAKO RIVER
BCR
093G092
093G093
093F090
Lake
093G081
Mapes
093G082
093G083
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Map Center: 123°47' W, 53°58' N

Appendix 5. 2004/05 Nechako Juvenile Sampling Program - Bio-Physical information for all white sturgeon captured/encountered.

Capture Location Information							Physical Characteristics									Tagging Information									
		UTM																							
Date	Station	Zone	Easting	Northing	Capt. Depth (m)	Capt. Mesh Size	Sex Mat. Code	Post Orbit. (cm)	Snout (cm)	Fork Length (cm)	Total Length (cm)	Girth (cm)	Weight (g)	Age	DNA Taken?	Fish Disp.	Tags at Capt.	Tags at Release	Mark at Capt.	Mark at Release	FLOY Tag Colour and No.	PIT Tag No.	Radio Tag Freq.	Radio Tag Code	Comments
27-Jul-04	GN110.1L	10	447753	5980742	8	3"	98	9	16.5	66	74	25	1882	9	Y - LP	B - AU	N-N-N	FT-PT-N	N	LP	R 2007	424E087403	N/A	N/A	Excellent condition; no distinguishing
27-Jul-04	GN110.1L	10	447782	5980706	7	3"	98	10	18.5	74	86.5	28.5	2552	5	Y - LP	B - AU	N-N-N	FT-PT-N	N	LP	R 2006	424B6E1700	N/A	N/A	Hemorrhage in left eye, RP split. Right side of face is deformed, looks like its been cut. Leach attached on left along
29-Aug-04	GN110.1L	10	447750	5980721	9	3"	98	7.5	14	51.5	59	18	589.7	8	Y - LP	B - AU	N-N-N	FT-PT-N	N	LP	G 00097	422E415376	N/A	N/A	1 small leach attached. Double nares. Healthy. Minor tear in dorsal fin. Not a
29-Aug-04	GN110.1L	10	447750	5980721	9	3"	98	9.5	20.5	85	97	31	3765	10	Y - LP	B - AU	N-N-N	FT-PT-N	N	LP	R 2010	5020243915	N/A	N/A	Double nares. Minor lesion from net. Very healthy and active. Good condition
29-Aug-04	GN110.1L	10	447750	5980721	9	3"	97				approx. 110 total												N/A	N/A	Lost at boat but observed by entire crew.
23-Sep-04	GN115.9L	10	445580	5982256	4.2	3"	98	10.5	23	82	94	30	3084	13	Y - LP	S - AU	N-N-N	FT-PT-N	N	LP	R 2029	424D3B7366	N/A	N/A	Dorsal-old wound and couple of tears (scars). Lower caudal fin has a small tear, split nares, 4 barbels in good shape, scutes not too sharp. Pectoral and pelvic fins good, no signs of previous tagging or surgery. No Pit tag. No radio tag applied, too small of a fish for the size of tags on hand. Photo frames 12 and 13,
23-Sep-04	GN115.9L	10	445580	5982256	4.3	3"	97	12	24	88	103	37	4445	8	Y - LP	S - AO	N-N-N	FT-PT-RT	N	LP	R 2021	423C0F640A	148.400	009	Healthy juvenile, no abnormal marks, surgery went well. Fish too small to determine sex visually. Photo frames 16
23-Sep-04	GN114.7L	10	444650	5982045	5	3"	97	11	22	83	101	35	4173	14	Y - LP	S - AO	N-N-N	FT-PT-RT	N	LP	R 2030	424F17527D	148.380	002	Double nares, very sharp scutes. On stomach (ventral) and near pelvic and pectoral fins; there are small blister like bumps. Tear on dorsal fin. No Tags. Photo frames 14 and 15, roll 2. Released upriver at UTM 10.445440.5982293 so it could be