2001/2002 Assessment of Upper Fraser River White Sturgeon

Prepared For:

Upper Fraser Nechako Fisheries Council (UFNFC)

and

Fisheries Renewal British Columbia (FsRBC)

March 2002

UFNFC File: 0201-119

Produced By The
Lheidli T'enneh Band
1041 Whenun Road
Prince George, B.C.
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Prepared By:

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Table of Contents

List of Figures

List of Figures cont'd

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List of Tables

List of Appendices

Acknowledgements

Funding for this endeavor was provided by Fisheries Renewal British Columbia and administered through the Upper Fraser and Nechako Fisheries Council (UFNFC). Todd French Stewardship Coordinator for the UFNFC, provided administrative support for the project. This project was conceptualized and designed with the assistance of Ted Zimmerman, Senior Fisheries Biologist for the Omineca Peace Region. John DeVore and Michael Wall of the Washington State Department of Fish and Wildlife assisted in the training of Lheidli T'enneh personnel in sturgeon age structure preparation and analysis. Their assistance in this capacity was greatly appreciated. Leona Prince and Irvine Gagnon provided technical services for the duration of the field component of the 2001 project.

1.0 Executive Summary

Funding to conduct the third year of upper Fraser River white sturgeon assessment work was received from Fisheries Renewal B.C. via the Upper Fraser Nechako Fisheries Council in June of 2001. Activities in 2001 paralleled the study design implemented in 1999 and continued through 2000, as developed by the Lheidli T'enneh Band and the B.C. Ministry of Water, Lands, and Air Protection (MoWLAP). Sampling activities within the Fraser River mainstem, and associated tributary habitats, were focused from Woodpecker Rapids (near Hixon B.C.) upstream to the Grand Canyon (near Longworth B.C.), June - October 2001. Relative to the study design and activities implemented in 1999 and continued in 2000, the 2001 program saw a reduction in setline effort and a significant increase in angling and gillnet efforts. The overall study area was reduced, as the primary objective of the 2001 program was to capture juvenile sturgeon and identify habitats utilized, and continue synoptic and index site sampling within known sub-adult and adult sturgeon holding areas to collect life history and population information. All "new" sturgeon captured were sampled for morphological parameters, aging structures, tissue and tagged with T-anchor tags and PIT tags prior to being released. Through the period of June 4th to October 4th 2001, sampling efforts included a total of 13016.5 setline hook hours, 325.8 hours of angling, 654.7 panel hours of gillnetting and 4.7 hours of trapping effort. Three of four methods were successful in capturing sturgeon. A total of 27 sturgeon were captured using setlines (CPUE=0.21/100 hook hours), 29 angling (CPUE=8.9/100 hook hours) and 21 using gillnets (3.2/100 panel hours effort). Of the 77 sturgeon captured, 19 had been previously captured and tagged during the course of this study in 1999 and 2000. The age class composition of 55 of 58 "new fish" (not previously tagged) for which an accurate age could be determined was 38%, 49%, 7%, 4%, and 2% within the age classes of 0-10, 11-20, 21-30, 31-40, 91-100 years, respectively. Total lengths ranged from 52cm to 232cm with a proportional composition of 90%, 3%, 7% for the size classes <100cm, ≥ 100cm ≤ 150cm, and >150cm respectively, indicating that the 2001 sample was composed of 90% juveniles, 3% sub-adults, and 7% adults, based on classifications developed in similar studies on the Fraser River. Based on recaptures of "marked" fish throughout three years of tagging and sampling sturgeon throughout the study area a population estimate of 630 (+/- 109 95% CI) sturgeon ≥50cm<100cm total length and 185 (+/- 29 95% CI) sturgeon ≥100cm has now been generated.

2.0 Introduction and Background

The Fraser River is the largest river system contained entirely within British Columbia, draining an area of 220,000 km2 (Figure 1). The headwaters of the Fraser occur within the central eastern portion of the province and flow northwest to Prince George, where it begins to flow in a southward direction that is maintained until it drains into the Straight of Georgia at Vancouver. The Fraser River watershed contains 52 species of fish, including the full compliment of anadromous Pacific fishes plus numerous other resident, fluvial and adfluvial coarse and game fish species that utilize the mainstem of the Fraser and its many tributary watersheds (McPhail and Carveth 1993). Included within this assemblage of fish species that inhabit the Fraser River watershed is the white sturgeon (*Acipenser transmontanus*) (Scott and Crossman 1973). White sturgeon populations within the Fraser River have been impacted by direct commercial harvesting and by-catch within commercial salmon fisheries (Semakula and Larkin 1968), sport-kill fisheries (Dixon 1986) and anthropogenic alterations to habitat (Rochard et. al 1990).

In response to concerns regarding the status of the Fraser River white sturgeon populations, the B.C. Ministry of Environment, Lands and Parks (now the Ministry of Water, Lands and Air Protection, herein referred to as MoWLAP), the agency responsible for the maintenance of biological diversity within the province, instituted no-kill regulations on the sport fishery for this species within the Fraser River watershed in 1994 for conservation reasons. This action was initiated in response to the lack of knowledge regarding the status of this population and their habitat requirements, as well as concerns regarding the unexplained death of several large adult fish within the lower Fraser. In order to address these concerns, MoWLAP committed to a monitoring/ inventory program for white sturgeon in 1995. This program involved juvenile and adult sampling and tagging programs within the Fraser River watershed in MoWLAP Regions 2, 3, 5 and 7. This program resulted in evaluations of sturgeon populations within portions of the majority of the mainstem of the Fraser River downstream of the confluence of the Blackwater River, which serves as the MoWLAP boundary between Region 5 and 7. Until 1999, the white sturgeon assessment work undertaken in Region 7 had mainly involved the assessment of sturgeon populations and movements within the Nechako River mainstem and the Stuart River (Nechako River tributary) (Zimmerman pers. comm. 1999). In 2000, the culmination of the Nechako research resulted in the "imperiled" classification of the Nechako white sturgeon and the closure of the Nechako to sturgeon angling (Cadden pers. comm. 2000).

The Nechako River, a major tributary to the Fraser River, enters the Fraser at Prince George. The Fraser River watershed upstream of this confluence is known as the upper Fraser Basin. The upper Fraser watershed, which is within the MoWLAP Region

7: Omineca-Peace, is the most sparsely populated and least developed portion of the Fraser River watershed. It is also one of the most poorly inventoried and studied portions of the watershed, which is reflected in the absence of knowledge and literature regarding the white sturgeon populations within this section of the river. As previously discussed, prior to 1999 the intensive white sturgeon assessment work completed within Region 7 had focussed on the Nechako River. Preliminary efforts to improve this knowledge base within the upper Fraser basin were commissioned by MoWLAP in 1995-96 (LGL Ltd. 1996) and 1998 (RL&L Ltd. 1998). With the exception of the LGL study undertaken in 1995-96, which was an intensive inventory of the lower Bowron River, with emphasis on the use of this area by juvenile sturgeon, these investigations mainly involved a synoptic-level of sampling effort throughout the upper Fraser River. Effort applied and capture success was low.

This upper portion of the Fraser River watershed falls within the Traditional Territory of the Lheidli T'enneh First Nation (LTN). Portions of this area were also traditionally, and are presently, utilized by the Shuswap First Nation peoples. The Lheidli T'enneh Band historically utilized sturgeon and all other species of fish within the area as a food source. Since the MoWLAP imposed a no-kill regulation on white sturgeon harvest within the Fraser watershed in 1994, most Fraser River First Nations have voluntarily complied with this regulation. As well, in recent history prior to 1994, since the industrialization of the Prince George area and the subsequent development of several milling operations that discharge effluent directly into the river, the practice of harvesting resident species of fish from the river has been severely curtailed by First Nation food fishers.

As First Nations people who have inhabited this area for thousands of years, utilizing and benefiting from the wealth of natural resources that are present within the area, the Lheidli T'enneh people have a strong desire and inherent obligation to contribute to the sustainable management of all resources within their Traditional Territory. The Lheidli T'enneh previously contributed to work assessing the health of upper Fraser sturgeon stocks in 1991 (Lheidli T'enneh 1994). In 1999, the Lheidli T'enneh conducted the first year of a proposed multi-year project to begin collection of basic life history data on upper Fraser River white sturgeon (Lheidli T'enneh 2000). In 2000, the second year of this study was conducted, resulting in an increase in study area coverage and overall sampling efforts (Lheidli T'enneh 2001). The 2001 program intensified efforts targeting juvenile sturgeon through an increase in angling and gillnetting effort, relative to the previous years of the study. This report summarizes the activities of the 2001 upper Fraser study, in relation to the findings of work completed in 1999 and 2000.

3.0 Methodology

Knowledge gained from the sturgeon assessment work conducted within the upper Fraser watershed in 1999 and 2000 was utilized to guide the activities undertaken in the third year of sampling, which was designed to continue the assessment of the status of the white sturgeon population in the upper Fraser River. Sampling efforts concentrated on the portion of the study area from the Woodpecker Rapids south of Prince George to the Grand Canyon near Longworth. The lower portions of Bowron, McGregor and Nechako rivers also received sampling effort throughout the project. The "basic" objective of this project was to apply sampling effort throughout the areas identified, utilizing setlines, gillnets, various trap designs and angling, with the goal of "filling" data gaps identified and/or questions "raised" as a result of the previous work completed.

Two of the main data anomalies identified by the 1999 and 2000 work included the lack of juvenile fish (< 50cm and 5 years of age) within the sample of fish collected, as these fish did not appear to recruit to setline gear, and an apparent low density of sturgeon within the southern portion of the study area (downstream of Prince George). In 2001, effort was again applied below Prince George in an attempt to capture sturgeon in this area. As well, sampling efforts in 2001 included the use of "fine-mesh" sinking gillnet utilized on other studies for the capture of juvenile sturgeon. In addition, in attempt to develop and assess an alternative passive method of capturing egg and larval forms of sturgeon, a sunken, anchored "fyke-type" trap was constructed and tested briefly in early July. Although successful deployment of this net is possible, further refinements in design and anchoring systems are required. The specifics of all sampling efforts and methodologies employed in 2001 are described below.

As in 1999 and 2000, captured sturgeon were sampled for morphological parameters, aging structures, tissue samples for DNA analysis and tagged with T-anchor tags and PIT tags prior to being released. Extensive records of all sampling activities, and data with respect to the habitat characteristics of all sampling, were recorded on an ongoing basis. In order to interpret and correlate the results of sampling efforts and observations of fish behavior to environmental conditions, water temperature and discharge information from within the study area was gathered through a variety of means.

3.1 Discharge

Water Survey of Canada information collected on the discharge of the Fraser River at Shelley was obtained from the Data Management and Applications Department of Environment Canada. Period of record for this information is January 1, 2001 to November 29, 2001.

3.2 Water Temperature

Data collected on the daily water temperature regime of the Fraser River at Shelley was obtained from the Department of Fisheries and Oceans. The period of record for this temperature data was from July 14, 1994 to September 20, 2001. Only data applicable (i.e. from June 1, 2001 to September, 2001) to interpretation of the results of 2001 sampling activities was utilized. As in 1999 and 2000, temperature data for Fraser River tributaries, including the Nechako and Holmes rivers, was also obtained from this source for the time periods June 27, 1993 to September 20, 2001 and July 9, 1997 to September 30, 2001 respectively. Only data applicable to the 2001 study was used. In addition, "Onset" Tidbit temperature loggers were deployed in the Bowron River and the Fraser River at Penny. These two loggers recorded water temperature hourly during the period June - October, 2001.

3.3 Sampling Techniques

Setlines, angling, multi-panel gill nets and "box" type traps were utilized in an attempt to capture sturgeon. In addition, a fyke-type net was designed and tested.

3.3.1 Gill Nets and Box Traps

A multi-panel small-mesh gillnet was deployed on multiple occasions. This sinking gillnet consisted of panel mesh sizes of 3.8cm, 4.4cm and 5.1cm and was deployed in a variety of combinations to make a net up to 27m length (6 panels, each 4.5m in length). Depth of each of the panels was 2.4m. The mesh itself was a fine white twine (multiple fiber), known as a "herring-type" net, and had been used successfully in the capture of juvenile sturgeon in the Columbia River (Wall pers. comm. 2001). The benefit of the white mesh is an apparent reduction of by-catch (under certain water conditions). Because the mesh was a multi-fiber, as opposed to monofilament, gill and tissue damage is greatly reduced. These gillnets were targeting juvenile fish and as such were deployed in habitats such as backwaters, slow confluences of tributaries and blind channels where these fish have been documented in past studies (Lane and Rosenau 1995). All aspects of their use were recorded on data forms specific to this sampling method.

Box-type traps, initially deployed during the 2000 study, were again tested briefly during the 2001 program. These rectangular traps were 45cm wide, 30cm deep and 77cm in length with an opening of 9cm diameter at each end. The fabric mesh on the traps measured 0.75cm corner to corner. Traps were baited with sockeye carcasses. These non-lethal/harmful juvenile type traps were employed as a juvenile sampling device but due to their lack of success in 2000, use was minimal in 2001. The specifics of the time of deployment and the time of retrieval were recorded on data forms and total effort was calculated for each sampling period. The habitat characteristics (habitat unit, depth, velocity) at the location of deployments were also recorded.

3.3.1.1 Gillnet Deployment and Retrieval

The gillnet was typically deployed in areas of know sturgeon presence, based on previous setline and angling success. Some synoptic sampling was also undertaken in habitats that related literature had identified/characterized as juvenile habitat from previous work in the lower Fraser River. When deployed in flowing water, the gillnet was set with the direction of flow or crosscurrent. However, locations of deployment were frequently in areas of little or no flow. Gillnets were anchored to shore to prevent loss and aid in maintaining the position of the net. Four 8lb lead cannon balls were attached along the length of the leadline to prevent the net from drifting far from its set position. The net was deployed as the boat backed through the site allowing for the net to be checked for twisting as it was stretched towards shore. A small marker buoy was attached at the end to assist in the retrieval process. The gillnet was retrieved from the buoy end and picked up from the bow of the boat. Fish were removed as they were encountered, non-target species were released and sturgeon were placed into a large tub of water for "processing."

3.3.2 Angling

Angling was conducted with a variety of tackle that consisted of heavy action 3-4m rods with large spinning type or level-wind reels filled with 30-40 lb test braided Tuff line. Gamagatsu bait hooks ranging in sizes between 3/0 and 9/0 were fished on the bottom with pyramid weights ranging from 6-14 oz. Baits utilized included salmon roe, pieces of salmon flesh, and eulachon. All habitat types were fished, with an emphasis placed on areas were sturgeon had been caught previously or where habitats identified in relevant literature indicated likely sturgeon presence. Angling was performed from both mid-river (anchored boat) and shore, depending upon the site. Captured fish were retrieved as fast as possible, while the remaining crew prepared for immediate processing of the sturgeon.

3.3.3 Setlines

Setlines were constructed in a standard length of 40m with the ability to combine these lines to make an 80m or 120m setline. The mainline was a 3/8" double braid nylon of an approximate 5100lb test setting. Carabiners (3/8" galvanized boat snaps) were attached to each end of the setline. Halibut (circle) hooks in sizes 11/0,12/0, 14/0, and 16/0 were attached to 1/8" ganging twine (450lb test) using aluminum hammer clamps to form the dropper line. The dropper line was 24" in length and attached to a 2-way swivel, which in turn was attached to a quick release halibut snap. Dropper lines were attached to the setline using the halibut snaps. The droppers were generally placed on the setline with a 5m interval between each hook leader. A 40m setline would deploy 8 hooks as a standard. Sockeye salmon flesh was the primary bait utilized on these hooks, although chinook flesh was also used on a number of occasions.

Metal anchors weighing 9kg each were placed at each end of the setline to hold the line and hook leaders close to the bottom and prevent drifting. An additional variable length of rope was attached to the upstream end of the setline at the point of anchor attachment. This line was run to shore and attached to a sturdy stationary object, typically a tree or rock. At the downstream end of the setline, an additional 10m length of rope was attached that ran from the anchor to the waters surface, where it was attached to an A-2 type 50cm diameter polyform red buoy.

3.3.3.1 Setline Deployment and Retrieval

Setlines were normally deployed in an upstream to downstream direction. Alternately, they would also be deployed with the direction of flow, if flow direction was reversed in an eddy situation. After a site was selected for setline deployment, the shoreline rope was attached to an object on the shore nearest to the site selected for deployment. This rope was then attached to the end of the setline at the first anchor point using a carabiner. As the boat backed through the site, baited hooks were then attached to the line in 5m intervals. An additional anchor and marker bouy line was attached to the carabiner at the downstream end of the line. This line was used to lower the anchor on the end of the setline to the bottom. A red buoy was attached to the end of this line to mark the location of the setline for the crew and other boaters. Buoys were marked with the project name and a contact phone number in case of loss or general inquiry. When lines were retrieved, the buoy was picked up from the bow of the boat and the setline was removed in an upstream direction. Hooks were removed as they were encountered, and information pertaining to the size of the hook, its position on the setline, and the state of the bait/hook was recorded.

3.4 Sturgeon Handling and Data Collection

When setlines and gillnets were retrieved and fish were encountered, they were immediately removed and placed into a large tub of water, if size permitted. Particularly in the case of larger setline captured fish, they were maneuvered from the bow of the boat to the side using the setline, allowing the fish to stay in the water. These larger fish then had a 2m tail noose placed on them that was then tied off to a cleat on the gunnel of the boat. Upon securing the fish, the hook was then removed. The remainder of the setline was retrieved and any other "hooked" fish were dealt with in a similar manner. Angled fish, depending upon size, were either placed immediately into the water-filled stretcher or tail noosed until they could be brought on board using a gunnel-mounted winch boom. The boat was then either anchored mid-channel or tied off to the shore for data collection purposes. Depending on the size of the fish captured, it was either processed in the tub of water (TL< 70cm) or in the stretcher designed specifically to hold larger fish (TL>70cm). Captured sturgeon from 2kg or more were processed in the water-filled stretcher that was suspended in a metal frame mounted on the gunnels of the boat and manufactured specifically for this purpose. The mounts held the stretcher on a 15° angle that maintained the head (anterior) end of the fish sloping downward into a vinyl fabric hood. Fresh water was flooded into the stretcher manually to provide the fish with a constant supply of fresh oxygenated water.

Morphological parameters were collected from all fish sampled. Length and girth measurements were collected using a cloth metric tape. Measurements taken include total length, fork length, post orbital length, post opercular length (snout) and girth, and all were recorded to the nearest 0.5cm. Table 1 lists the measurements that were taken from captured fish and the specific methodologies associated with each. Weights of fish were determined using a 135 ±2.3 kg capacity spring scale calibrated with known 10 kg weights. Fish were examined for any external anomalies or damage such as missing scutes and scars. They were also assessed visually for general health and previous tag application/sampling. The relative maturity of the fish was estimated based on length and recorded as a code (developed for other sturgeon assessments). The codes utilized and their definitions are provided in Table 2. Because no internal/surgical attempt was made to assess gonad state, the sex and/or sexual status of captured sturgeon was not estimated in this study.

Table 1. Measurements taken from each captured sturgeon sampled from 1999 to 2001, 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.

Fish received a uniquely numbered external spaghetti type tag (FLOY T-anchor $1^{1/8"}$) in yellow, blue, or bright green. Yellow FLOY tags included the band name and a contact number.

Table 2. Description of "Sexual Maturity Code" applied to sturgeon sampled within the upper Fraser study area from 1999 to 2001.

Length	Maturity Code	Maturity Code Definition
<100cm	98	Sex unknown, gonad undifferentiated or not visible, juvenile based on size
>100cm	97	Sex unknown, gonad not visible, adult based on size

A uniquely coded internal tag (PIT TX 1400L Destron 11.5mm x 2.1mm) was also used. The external FLOY tag was applied using a Dennison Mark II tagging gun and was inserted through the dorsal fin rays at an approximate 45° angle to the right anterior of the fish. This would leave the tag trailing to the left posterior of the fish. The internal PIT tag was inserted under the skin approximately half way between the lateral line and dorsal fin on the left side of the fish. PIT tags were injected using a plunge type PIT tag injector. The unique digital PIT tag code was "scanned" and recorded prior to injection, and "scanned" and confirmed post injection. PIT tags were scanned using a "Power Tracker II Reader".

A small piece of tissue for genetic analysis was removed from the tip of the left pectoral fin, except where fin damage or anomalies were present, in which case sampling took place on the right side. Tissue samples were placed in a 2ml sample vial in 70% ethanol. The size of the sample varied between fish, but rarely exceeded a $0.5cm^2$ piece of tissue. The labeled sample vial was placed in a labeled scale envelope. Recaptured fish did not require a repeat of this sampling procedure.

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. This sample was removed approximately 2cm away from the articulation where the pectoral fin meets the body. Using a small hacksaw with a carbon steel blade, a small piece of the fin ray was removed by cutting at right angles to the pectoral fin. This fin ray section was then placed in a labeled envelope. Recaptured fish did not require a repeat of this sampling procedure.

The time required to complete this sampling procedure was normally less than 10 minutes. All instruments used for intrusive procedures were sterilized in a bath of isopropanol prior to each sampling event and storage.

3.5 Data Management

A set of TRIM base maps encompassing the study area were developed at a scale of 1:50,000. These maps highlighted the mainstem of the Fraser River from the mouth of the Blackwater River to the mouth of the Goat River upstream of Crescent Spur. Features included on these maps were streams, lakes, contours, islands, railways and roads from the TRIM base. A digital program was used to label the thalweg of the mainstem of the Fraser River with kilometer markings from the confluence of the Blackwater River to the mouth of the Morkill River. These kilometer designations started at 700.2 km at the Blackwater River, and continued to 1084 km at the mouth of the Morkill River. The starting point of 700.2 km was utilized to standardize our kilometer markings with those of RL&L Environmental Services Ltd., who had previously worked in this section of the river. All locations where sampling effort was applied were described in terms of the kilometer description of that point, with reference to the proximity of the sampling site to the right or left upstream bank. Due to the digital nature of our labeling technique, there was a slight difference between our kilometer designations and those applied by RL&L. The magnitude of this difference increased in magnitude in an upstream direction.

All sampling effort applied was given a site label based on the type of effort applied and the location in the river relative to the kilometer designation (i.e. setline deployment at kilometer 850.0 would be site SL850.0R). In this case, SL refers to setline, 850.0 is the mainstem river kilometer at the site of deployment, and R refers to the proximity of the site in relation to the right upstream bank, as where L would imply left upstream bank. A label of AS or AB indicates angling from shore or a boat, respectively. A label of GN or BX indicates multi-panel gillnet or box trap, respectively. All site location effort codes were transcribed to the digital base map of the study area. Information relating to the sampling effort and results for all techniques was recorded on forms designed specifically for sturgeon capture and sampling. These forms were created and utilized on similar projects in different locations by RL&L Environmental Services Ltd. All information relating to the specifics of the equipment used, date and time of deployment and retrieval, and the results of the effort applied were entered on a form that was specific to the site label applied to that site. Examples of these forms are provided in Appendix 1.

3.6 Aging Analysis

Age determination of 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 the left pectoral fin. The structures removed were air dried then sectioned using a Piercing or Jewelers saw. The average section was approximately 0.5mm thick. These sections were then polished on 1500 grit wet-dry sandpaper and mounted on a glass slide using a clear household glue. Aging was performed with the aid of a dissecting microscope, with a light source directed from the underside. Ages were assigned by counting pairs of opposing ring density. Narrow bands of higher density are assumed to have been formed during the winter growth phase due to the reduced growth rates and metabolic processes these fish experience. A pair of rings represent a complete annulus (Tracy and Wall, 1993). Aging analyses were conducted by LTN staff, with verification from the Washington State Department of Fish and Wildlife. Personnel from this agency have performed age analysis on sturgeon sampled throughout the Columbia River watershed, thus ensuring they are familiar with white sturgeon and aging procedures.

3.7 Genetic Analysis

In 1999 two types of DNA analyses were performed on sturgeon tissue samples collected from various portions of the Fraser and Nechako rivers during the last 5 years of sampling, including samples from the 1999 upper Fraser assessment work. Samples collected from the upper Fraser in 2000 and 2001 have not yet been analyzed. This genetic analysis was coordinated by Susan Pollard, Fish Geneticist for the Conservation Section of BC Fisheries, and completed by Ben Koop and Christian Smith (both from the University of Victoria) and John Nelson (Seastar Biotech Inc.). The first technique used in the DNA analysis involved an examination of the D-loop section of the mitochondrial DNA (mt DNA), a genetic unit that is maternally inherited and does not undergo recombination. Therefore, this is a useful marker to track dispersal patterns of different maternal lines. Because mtDNA has a higher mutation rate than nuclear DNA, it often can provide a higher resolution for discriminating populations than nuclear DNA can. The second method of DNA analysis involved the evaluation of 5 nuclear DNA microsatellite loci, which are biparentally inherited, and do undergo recombination. These independent loci are composed of short repeating units that individually vary in number of repeating units. Variations in the size of these loci were examined to determine if genetic differentiation reflected the geographic relationships among these samples (Pollard pers. comm. 2000).

4.0 Results

4.1 Upper Fraser River Temperature and Discharge

Figure 2 indicates the Fraser River mean daily discharge rates and mean daily temperatures measured in 2001 at the townsite of Shelley, approximately 20km upstream of Prince George. Mean daily discharge rates (m^3/sec) are indicated for the period of May 15th to October 15th, 2001. Mean daily temperatures are shown for the period of May 15th to September 20th, 2001. The dates at which sturgeon sampling efforts were initiated and terminated are also indicated on this figure for reference.

After peaking at a maximum of 16.6°C during the period of record on August 16th, mean daily temperature within the upper Fraser River generally declined somewhat correlated with declining discharge. September 20th was the final day that DFO recorded temperature information for this portion of the Fraser River. Temperature was tightly linked to discharge rates, increasing with decreased discharge. Only when discharge began to approach base fall flows in late September, did the temperature regime of the river become more closely linked to air temperature. Figure 3 is a demonstration of mean daily water temperature for a number of sites in the upper Fraser River watershed. Included is data from the Nechako (km 793.2), McGregor (km 895.5), mainstem Fraser at Penny (km 992.4), Morkill (km 1082.3), and the Holmes rivers (upstream of McBride). Temperature data from all sites showed a similar trend, although mean temperature within the Nechako River was approximately 5°C higher than the other systems with the upper Fraser watershed.

4.2 Effort and Catch Per Unit Effort

A total of 325.8, 654.72 and 13,016.5 hours of angling hook hours, gillnet panel hours and setline hook hours of effort respectively, were applied within the study area in 2001. In addition, 4.7 hours of box trap effort was deployed. Sampling was initiated on June 4 and terminated on October 4, 2001. Table 3 below is a summary of this effort and the number of sturgeon captured. Specific descriptions of the sampling gear utilized is provided in Section 3.0. Sturgeon were captured via all methods with the exception of the box trap, which was deployed minimally in 2001. Previously unsuccessful for capturing sturgeon in 1999 and 2000 work, angling and gillnet effort in 2001 resulted in the capture of a number of sturgeon. Specific data records pertaining to sampling effort applied in the upper Fraser study area in 2001 are provided for all methods utilized in Appendices 2 (setline), 3 (gillnetting and trapping), and 4 (angling).

Angling efforts yielded a total of 29 sturgeon within the study area. The resulting catch per unit effort (CPUE) was 8.9 sturgeon per 100 hook hours of effort. Angling CPUE is "expressed" as a function of 100s of hours of hook effort to aid in the comparison with setline hook data. Figure 4 represents angling effort and corresponding CPUE. As the majority of angling effort was applied in water temperatures over 10°C, success was largely a factor of location/habitat selected. However, with temperatures approaching 6°C at angling sites as of October 4th, catch success remained quite high (Fig 4.). Observations in 1999 indicated that when water temperatures dropped below 5°C sturgeon feeding behavior declined, as evidenced by decreasing CPUE (Lheidli T'enneh 2000).

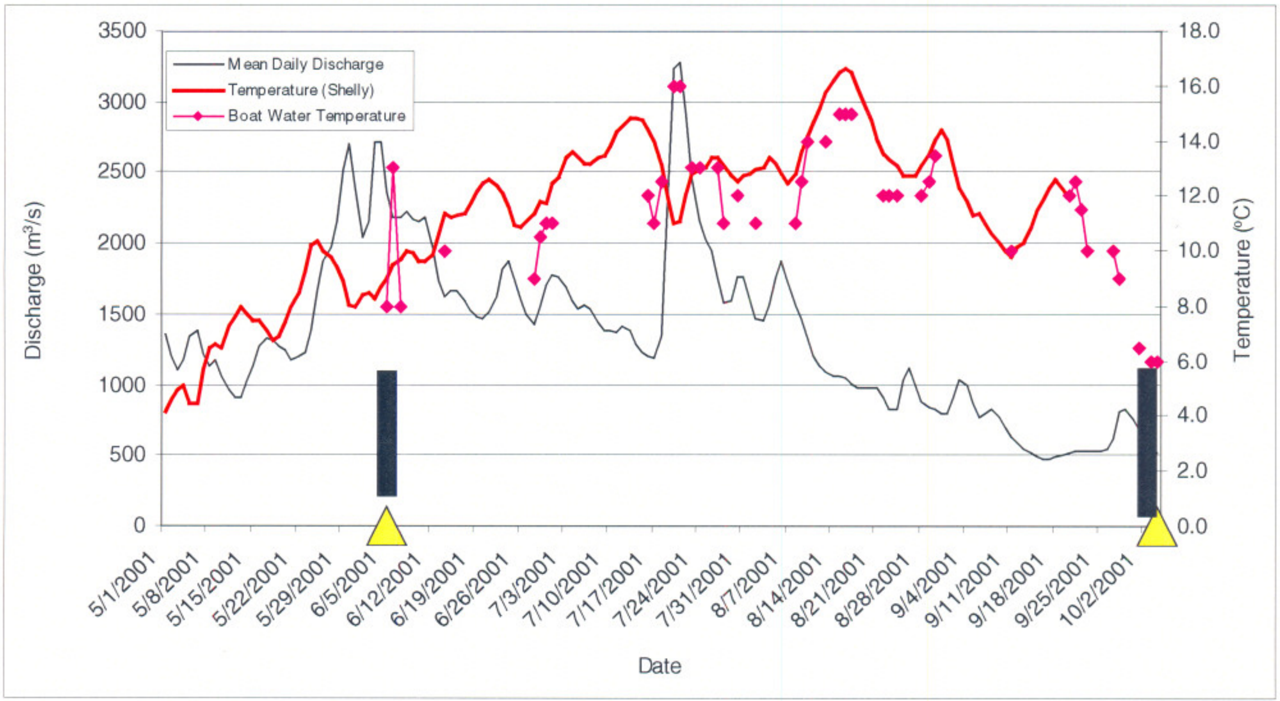

Figure 2. Mean daily discharge and mean daily temperature measured in the Fraser River in 2001 at the Shelley townsite, approximately 20km upstream of Prince George. Triangles indicate the dates sampling efforts were initiated and terminated. Boat temperature date is not site specific, but recorded daily at sample site location.

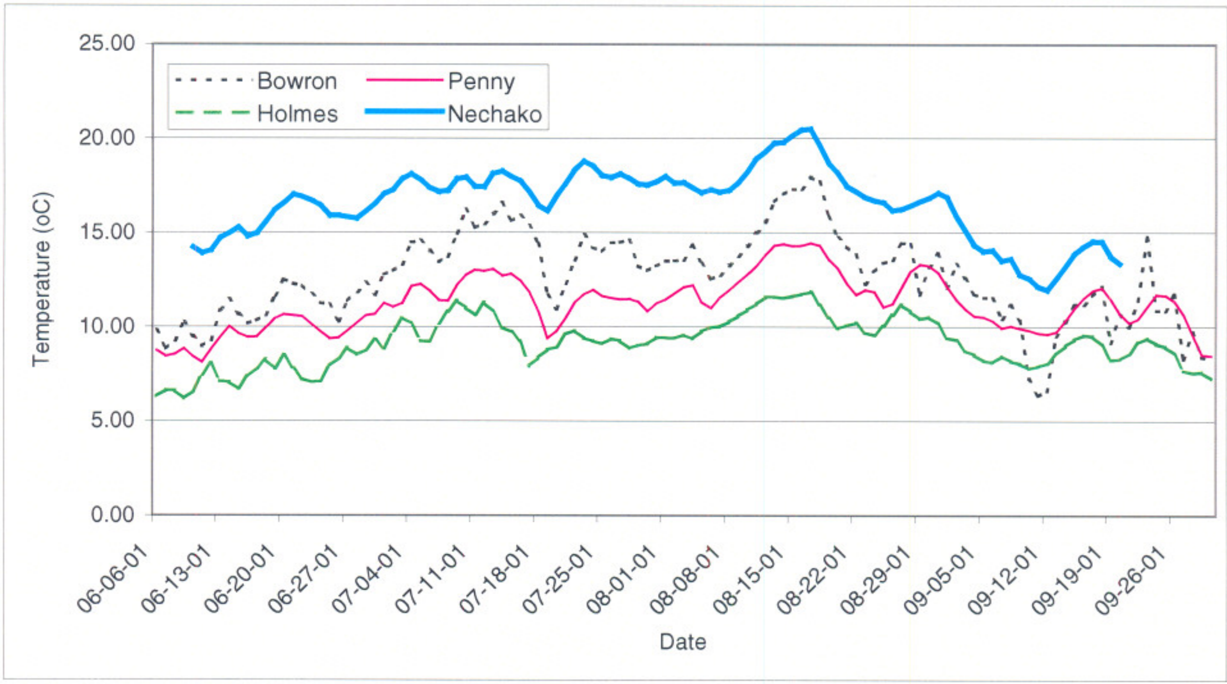

Figure 3. Mean daily temperatures within the upper Fraser River watershed including both the mainstem (at Penny) and a number of tributaries in the 2001 field season.

Table 3. Summary of angling, gillnetting, trapping and setline effort applied to the upper Fraser Study area in 2001.

Method	Effort	Sites/ Deployments	Sturgeon Catch	Catch per Unit Effort (CPUE)
Angling	325.8 hook hours	36	29	8.9/100 hook hours
Gillnetting	654.72 panel hours	29	21	3.2/100 panel hours
Trapping	4.7 trap hours	1	0	0
Set lining	13,016.5 hook hours	33	27	0.21/100 hook hours

Combined angling efforts within the Nechako and Fraser River watersheds in 1997 and 1998 produced CPUE estimates of 3.5 and 0.42 sturgeon/100 hook hours of angling effort, respectively (RL&L Ltd. 1997 and 1998). The high angling CPUE value obtained on the upper Fraser in 2001 is a result of knowledge gained from previous setline efforts directed at index sites, and better understanding of sturgeon habitat preferences and timing of presence within this portion of the watershed. Values within the 1997 and 1998 Nechako and 1999 upper Fraser studies were lower due to high rates of synoptic sampling throughout these areas.

Gillnet effort was applied through a variety of different habitats, although typically at sites where sturgeon had been documented previously. The CPUE was 3.2 sturgeon/100 panel hours of effort. A panel hour of effort is documented as an hour of "fishing" a 64.8m^2 panel of gillnet, which allows for a standard CPUE to be generated for a multi-panel net fished over a period of time. As this was the first season of intensive use of a gillnet of this type, there are no values with which to compare in the upper Fraser. Temperature and discharge did not appear to change the ability of the gillnet to recruit/capture sturgeon. As with the angling effort applied, the majority of gillnetting took place in water temperatures above 10^{o}C, and application of gillnetting in early October, when water temperature was approaching 6^{o}C, continued to result in sturgeon captures. As well, gillnetting appeared to be effective throughout all discharge regimes experienced throughout the sampling period, from the highest to the lowest.

Temperature and discharge fluctuations were, however, noted to alter the distribution of juvenile sturgeon, making gillnetting somewhat less effective. Gillnetting with the "herring-type" of mesh proved to be the most effective means of capturing juvenile sturgeon that was utilized during the three years of this study (Lheidli T'enneh 2002). Previous attempts to gillnet sturgeon on the upper Fraser included the application 11.8 panel hours (37.2m^2 per panel) of effort (RL&L 1997) and 188.1 panel hours of effort (RL&L 1998) with no sturgeon captures resulting from this effort. These attempts were made with standard monofilament mesh. A total of 654.7 panel hours of effort were applied to the upper Fraser in 2001 utilizing the white "herring-type" mesh. Figure 5 indicates this gillnetting effort by date, and the corresponding CPUE for the 2001 effort.