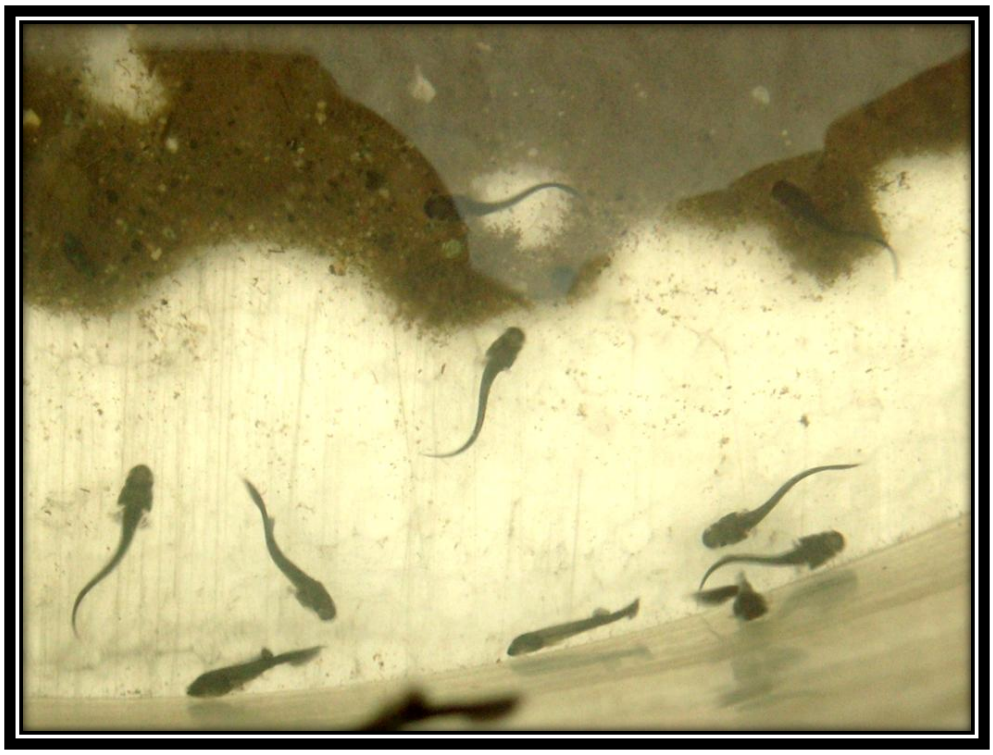
2009 Nechako White Sturgeon Larvae Release and Monitoring



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Photograph on front cover: Nechako white sturgeon larvae at the hatchery in Vanderhoof, British Columbia. Credit - Andrea Erwin

EXECUTIVE SUMMARY

The Nechako River supports a small population of white sturgeon genetically distinct from other stock groups within the Fraser River watershed. This population is provincially ranked as a "red-listed" and federally designated as "endangered" under Schedule 1 of the *Species At Risk Act*. A comprehensive study by RL&L (1995 – 1999) indicated that the reproductive success of the Nechako River population is low and that limited natural juvenile recruitment may be insufficient to maintain the population. The Recovery Plan for Nechako White Sturgeon, published in 2004 by the Nechako River White Sturgeon Recovery Initiative (NWSRI), specified that research should be conducted to identify early life history stages where juvenile recruitment is failing (NWSRI, 2004). Little is known about the early life history of white sturgeon, including larval and early juvenile stages, and their respective habitat use in the Nechako River; consequently, it is difficult to identify recruitment bottlenecks. A variety of factors, including flow regulation, substrate changes, and lack of suitable habitat (physical cover) for larvae, have been considered as possible causes of recruitment failure. This project is a continuation of various research experiments investigating potential causes of Nechako white sturgeon recruitment failure. The primary objective was to release hatchery-reared Nechako white sturgeon larvae (15 days-post-hatch) into the Nechako River and to monitor general drift rates through various habitat types.

Approximately 60,000 larvae were released and monitored at four sites located within, or in close proximity to, a braided reach of the Nechako River near Vanderhoof, British Columbia. Three sites were monitored with D-ring drift-nets to assess general drift rates. A fourth site was sampled with a seine net to determine survival and growth rates of larvae. An additional 10,000 larvae were released at two other sites but were not monitored. It was hoped that these larvae would be detectable as feeding larvae later in the summer; however, sampling for these larvae was unsuccessful.

In summary, an initial pulse of drifting larvae was observed after release at the three D-ring sampling sites. Generally, larvae released into a location with a substrate comprised mainly of sandy moved quickly through the monitoring sites. Larvae released into sites with substrates containing a mixture of gravels and fines tended to be detectable over a longer period of time at

the monitoring sites. These results suggest that larvae were able to find resting / hiding habitat before drifting downstream when released into sites containing gravel. Larval growth and survival was monitored but was unsuccessful as no sturgeon were recovered from the fourth site.

A secondary objective of this project was to sample a variety of sites with a beach seine to determine habitat use, growth rates and food of feeding sturgeon larvae and to determine the species and size of potential sturgeon predators in larval sturgeon habitat. Unfortunately, no larvae were recovered and consequently growth rates could not be determined. A variety of species of potential predators were captured and assessed including Northern pikeminnow (*Ptychocheilus oregonensis*), Prickly sculpin (*Cotus asper*), chinook (*Oncorhynchus tshawytscha)* and sockeye salmon (*Oncorhynchus nerka*).

ACKNOWLEDGEMENTS

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A huge thank you to FFSBC staff Mickey McDonald and Neil Jantz, for their efforts in successfully hatching and rearing Nechako white sturgeon larvae for use in this project and to FFSBC for undertaking the project to develop unconventional rearing methods at the request of the Nechako White Sturgeon Recovery Initiative – Technical Working Group.

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1.0 INTRODUCTION

1.1 Background

In British Columbia, white sturgeon (*Acipenser transmontanus*) inhabit portions of the Fraser, Columbia, Kootenay, and Nechako Rivers. Flows in the latter three rivers are regulated by dams, and white sturgeon populations in these rivers show chronic recruitment failure. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed the white sturgeon as a species of "special concern" in Canada (COSEWIC, 2003) in April 1990. On November 22, 2003 COSEWIC officially designated white sturgeon as "endangered" (COSEWIC, 2003), a species facing imminent extirpation or extinction. The Nechako white sturgeon, a genetically distinct population within the Fraser River watershed (Nelson et al. 1999; Smith et al. 2002), was provincially ranked as "red listed" or "critically imperilled" by the BC Conservation Data Center in 2002 (BC CDC, 2010). COSEWIC added the Nechako white sturgeon to Schedule 1 of Canada's *Species At Risk Act* in August 2006.

A long-term study (1995 – 1999) conducted by RL&L (*now* Golder & Associates Ltd), of white sturgeon throughout the Fraser River drainage, indicated that the Nechako River population exhibited low reproductive success (RL&L 2000). Chronic recruitment failure appears to be an ongoing problem which began in 1967 (McAdam *et al.* 2005). Moreover, RL&L (2000) proposed that the limited natural recruitment of juveniles may be insufficient to maintain the Nechako River population. The Ministry of Water, Land and Air Protection (*now* Ministry of Environment) initiated the recovery planning process for the Nechako white sturgeon following a review of the comprehensive study by RL&L. The Nechako River White Sturgeon Recovery Initiative (NWSRI) was established in 2000 and published the Recovery Plan for Nechako White Sturgeon in 2004. The recovery plan specified that research should be conducted to identify early life history stages where juvenile recruitment is failing (NWSRI, 2004).

While multiple factors have been considered as potential causes for recruitment failure, McAdam *et al.* (2005) linked sturgeon recruitment failure with substrate changes within the Nechako River. Understanding the impacts of substrate types on larval survival is a critical component of species recovery. Unfortunately, little is known about the early life history of white sturgeon and their respective habitat use within the Nechako River. Early life history phases include

incubation, hatching, dispersal and hiding. After hatching, larvae enter a dispersal phase in which larvae leave the substrate, become suspended in the water column, and disperse downstream into available rearing habitats (Brannon *et al.* 1985). Following dispersal, larvae enter a hiding phase in which they seek refuge in the substrate until the yolk sac is absorbed, after which they move out of the substrate and begin exogenous feeding.

Research conducted in the Kootenai River suggested that gravel provides better hiding habitat than fine materials, such as silt and sand, for free-embryo (1-3 day old) white sturgeon (Neufeld *et al.*, 2008). A laboratory study by Bennett *et al.*(2007) suggested that white sturgeon eleutheroembryos, up to 10 days old, preferred gravel substrates and avoided sand and bare-tank conditions. Investigations by Gessner *et al*. (2009) indicated that fine substrates also had an impact on larval growth and development of Atlantic sturgeon (*Acipenser oxyrinchus)* larvae. Results of recent research examining larval habitat use and drift behaviour under laboratory conditions (using hatchery-reared Nechako white sturgeon larvae) suggested that 12 to 14 day-old larvae emerge from hiding spaces within the gravel and drift during the night, but hide during the day (Steve McAdam, pers. comm). Additional information on drift behaviour of larval white sturgeon is needed to better understand the movement dynamics of sturgeon in natural environments. The overall objective of this study was to release hatchery-reared larvae (age 15 days post hatch) into the Nechako River and monitor drift rates through various habitat types. Site specific objectives will be identified in the body of the report.

1.2 Overview of Study Area

The study area included a three-kilometre stretch of the Nechako River between river kilometre (rkm) 135.5 and rkm 138.5 (as measured upstream from the mouth of the Nechako River at its confluence with the Fraser River). The majority of sites were located in the Nechako Bird Sanctuary, a braided section of the Nechako River upstream of the Burrard Avenue Bridge, Vanderhoof, British Columbia. An overview of the release and monitoring site locations are shown in Figure 1.1.

1.3 White Sturgeon Larvae

White sturgeon larvae used in this study were reared by Freshwater Fisheries Society of BC (FFSBC) staff at the Nechako white sturgeon hatchery in Vanderhoof, British Columbia. Larvae

were progeny of wild broodstock collected during the 2009 Nechako white sturgeon broodstock capture program. Larvae were either reared in non-standard tanks containing a gravel substrate (hereinafter referred to as "gravel tanks") or in standard rearing tanks containing no substrate ("bare tanks"). Previous laboratory results suggested that by rearing fish in gravel, larvae would be better "quality" and have an increased probability of survival when released into the wild.

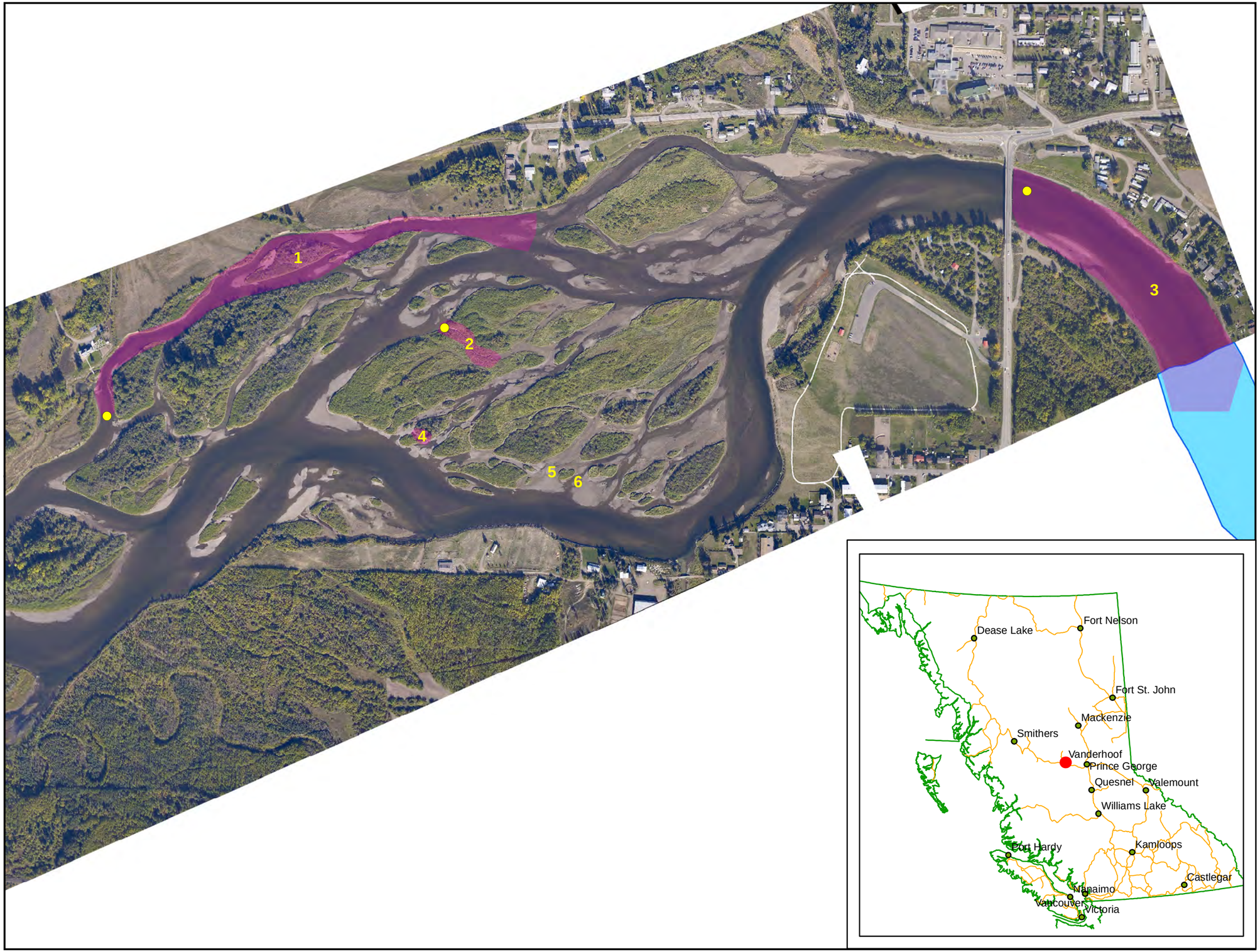

Figure 1.1 Overview of 2009 Nechako white sturgeon larvae release and monitoring locations

Legend

- Release Locations
- Monitoring Sites

1:6,800

0 0.05 0.1 0.15 0.2 0.25

Kilometers

Data Sources and Notes

N W E S

Produced for:
NWSRI

Produced by:
BRITISH COLUMBIA
Ministry of Environment
Environmental Stewardship Division

Projection/Datum: BC Albers/NAD83
Date Created: 2010-03-07
Created by: Jessica Courtier

2.0 NECHAKO RIVER PHYSICAL PARAMETERS

Nechako River discharge and water temperature information was provided by Environment Canada's Water Survey of Canada. Discharge and temperature data were collected at the Water Survey of Canada's hydrometric station 08JC001 located at the Burrard Avenue Bridge in Vanderhoof, British Columbia. The data provided are raw and are subject to revision by Water Survey of Canada.

Figure 2.1 displays the Nechako River discharge and water temperature information collected at Water Survey of Canada's hydrometric station 08JC001 throughout the study period. Temperature data were not available for dates between July 9 and 15, 2009.

Temperature fluctuated between 14 -17°C between June 20 and July 9, 2009. Temperature increased to approximately 19-20°C on July 16, 2009 after which point it declined slightly. Discharge decreased slowly from approximately 150m^3/s to 100m^3/s between June 20, 2009 to July 10, 2009; a notable increase is observed after July 16, 2009 where discharge levels increased from 125m^3/s to over 250m^3/s over a six day period.

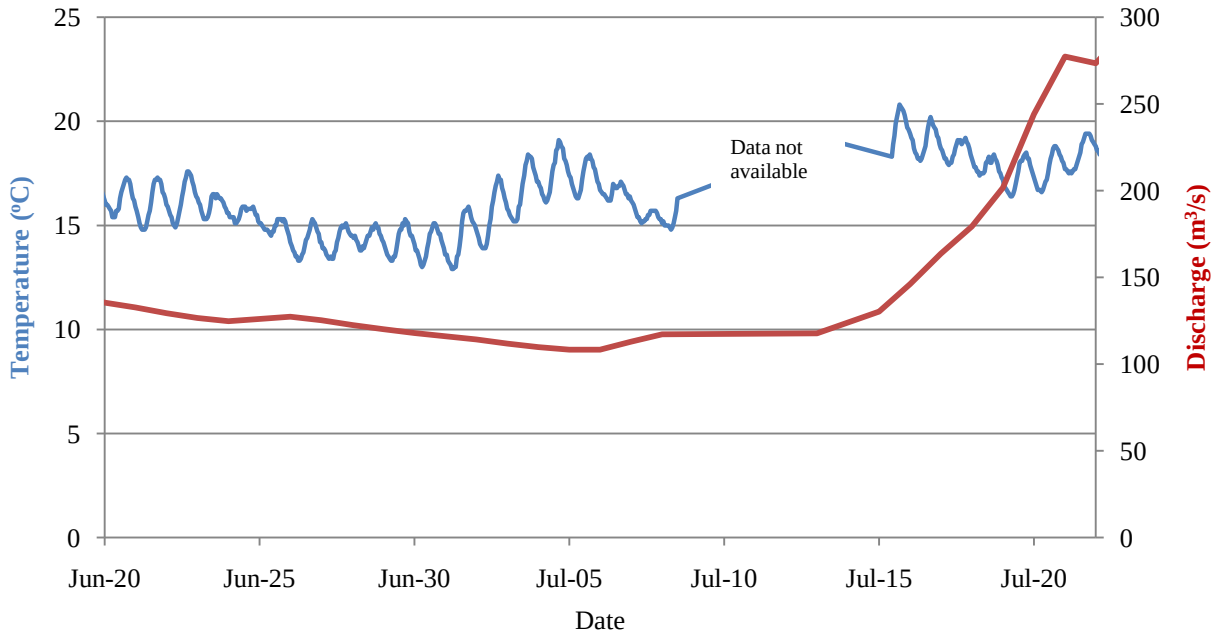

Figure 2.1 Daily average discharge (m^3/s) and water temperature (°C) for the Nechako River at Vanderhoof (Water Survey of Canada hydrometric station 08JC001) from June 20 – July 22 2009.

3.0 MONITORING SITES

3.1 SITE 1 – North Channel of Nechako Bird Sanctuary

3.1.1 Objectives

The primary objective of releases at Site 1 was to determine general drift rates of larval sturgeon released into a natural river channel with variable habitats. We also sought to determine if larvae would be detectable over the entire length of the site.

3.1.2 Location and Site Description

Site 1 was located along the length of the most northerly channel in the Nechako Bird Sanctuary. The channel was approximately 900 meters in length long and varied in width from roughly 10 m to 50 m. Substrates were variable over the length of the channel and included sections of fine materials and coarse gravels.

D-ring drift-nets were used to sample for larvae. Three-meter long conical nets, 0.5 m diameter at opening tapering to 7 cm diameter at PVC collection tube, were attached to metal frames bent in a "D" shape. These frames, measuring approximately 0.8 m wide at the base and 0.4 m high, were deployed using a rope bridal system. Weights, rock bags, were attached to the bottom corners of the D-ring frame to hold the net in an upright position. Six D-ring drift-nets were positioned in the thalwag at locations along the length of the site (Figure 3.1). The D-rings were deployed from a single piece of angle iron driven in the river bed; this enabled the nets to fish unattended for extended periods of time.

3.1.3 Larval Release and Monitoring Methods

An estimated 47,000, 15 day-post-hatch larvae were released at approximately midnight (12:30am) on June 23, 2009. These larvae were a mixture of gravel-tank and bare-tank larvae and were released as a single group on the waters surface from a boat anchored mid-river. Each drift-net was initially sampled twice, once approximately five hours after release and again at ten hours after release; the sampling times varied slightly by drift-net location. Drift-nets were then fished overnight on June 23, 26, 27, 30, 2009 and July 1, 2009 and were sampled the following morning. Each sample was carefully examined and a total number of larvae counted.

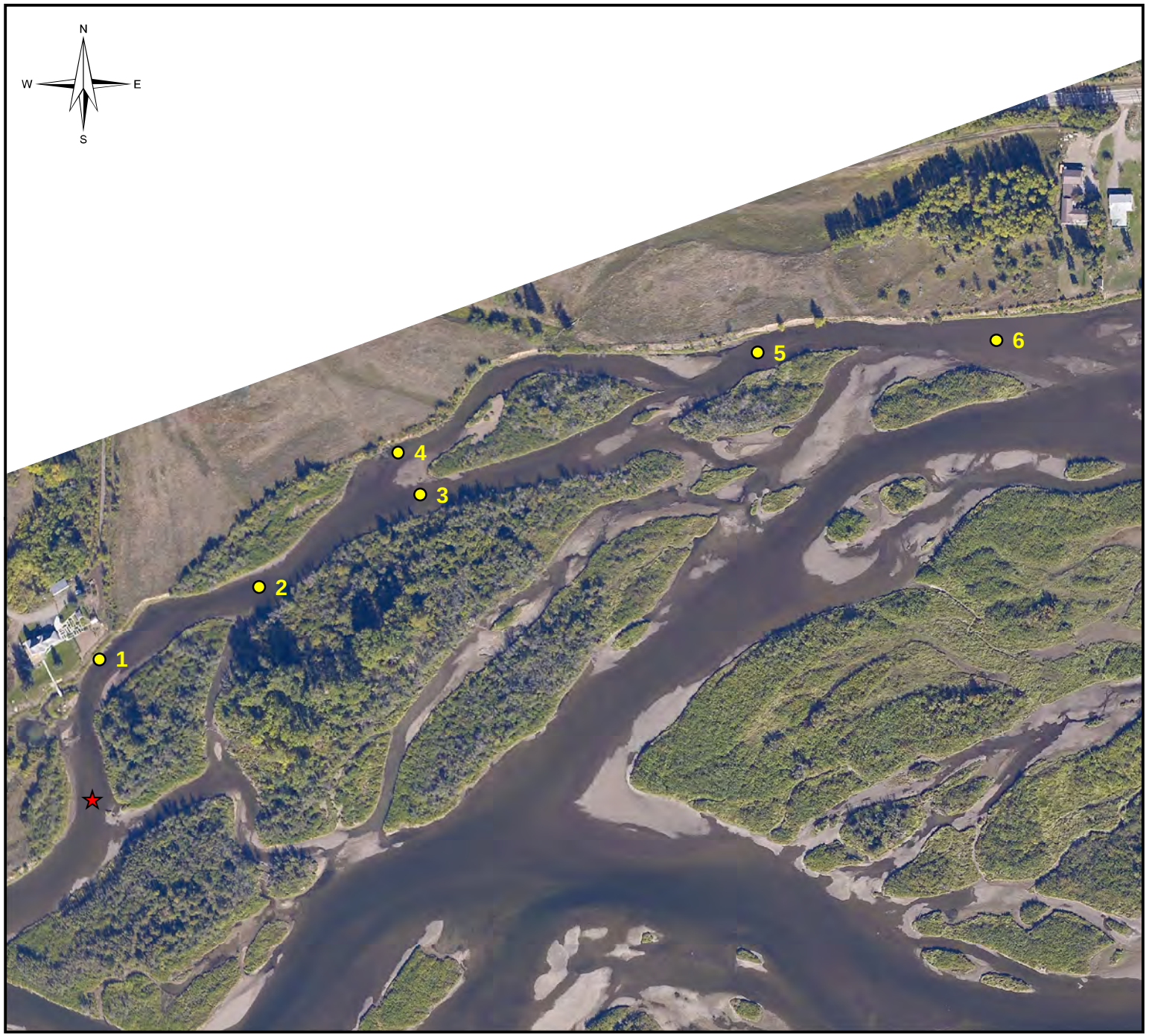

Figure 3.1 Nechako White Sturgeon Larvae Monitoring - Site 1

Legend

Release Location

Drift Net Locations

1:4,200

0 30 60 90 120

Meters

Data Sources and Notes

Produced for:

NWSRI

Produced by:

British Columbia

Ministry of Environment

Environmental Stewardship Division

Projection/Datum: BC Albers/NAD83

Date Created: 2010-03-07

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3.1.4 Monitoring Results and Discussion

Initial drift-net sampling was completed within approximately ten hours of larval release for a total effort of 68.03 hours (Appendix 1 – Table 1). A summary of the total number of white sturgeon larvae captured at each drift-net location is shown in Table 3.1. Overall, 913 larvae were captured; the majority of these (n = 832, 91.1%) were captured within the first five hours of sampling. The remaining larvae (n = 81, 8.9%) were captured between ~4.5 and 10 hours after release. In all instances, drift-nets captured more larvae during the first sampling period than during the second. This suggests that a proportion of larvae found habitat upstream of the first drift net location in which to rest/hide before drifting downstream.

Table 3.1 Summary of white sturgeon larvae captured at six drift-net locations in Site 1. Sample # 1 indicates sample taken ~ 4.5 – 5 hours after larval release. Sample #2 indicates sample taken ~10 hours after larval release.

Drift-net Location	Sample #1 - number of larvae	Sample #2 - number of larvae	Total Larvae Captured
1	282	29	311
2	312	6	318
3	68	25	93
4	16	10	26
5	121	7	128
6	33	4	37

Larvae were detectable over the entire length of the site as they were captured in each of the six drift-nets. Drift-net locations 1 and 2 captured approximately the same total number of larvae, 311 and 318, respectively. Downstream of drift-net 2 the river channel divided around an island. Drift-net locations 3 and 4 were positioned in locations to catch larvae in the thalwag of both channels. Drift-net location 4 captured the lowest number of larvae (n =27) which may be attributed to the division of the river channel as the majority of flow was diverted towards drift-net 3.

Unfortunately, as the drift nets were not sampled within a short time-frame post release it is difficult to estimate the rate at which larvae drifted the length of the channel; however, it can be concluded that larvae were able to travel the entire length of the channel within 4.5 hours of release as larvae were observed in the most downstream sample taken at that time. It is

suggested that, if a second study is conducted at this site, sampling should occur quickly post release and more frequently throughout the course of the experiment.

Night drift-net sampling was completed over five of nine nights subsequent to larval release for a total effort of 290 hours and 50 minutes (Appendix 1 – Table 2). No larvae were captured during the night sampling. It is interesting that no larvae were captured during the night sampling. Results of a previous experiment suggested that larvae hide during the day and drift to more preferable sites during the night (Steve McAdam, pers. com.). The lack of larvae captured during night sampling sets suggests that larvae either found suitable habitat in the channel in which to hide and did not drift at night or that larvae drifted through the site immediately after release and consequently were not available for capture.

3.2 SITE 2 – Experimental Channel

3.2.1 Objective

The specific objective of Site 2 was to determine general drift rates of larval sturgeon released into a controlled channel containing gravel with hiding spaces. This site was effectively a much smaller version of site 1.

3.2.2 Location, Site Description and Set-up

Site 2 consisted of a small, meandering channel that bisected an island in the Nechako Bird Sanctuary, a braided river section upstream of the Burrard Avenue Bridge (Figure 3.2). The channel was approximately 120 meters long and varied from 0.5 m to 1 m in width. The channel substrate was predominated by fine materials but included a few small sections of exposed gravel. Gravel was placed, by hand, over approximately ten meters in the upper section of the channel to provide a substrate in which sturgeon larvae could hide.

A single D-ring drift-net was placed across the entire width of the channel at the downstream end. Mesh cloth was buried under the substrate and attached to the D-ring along the submerged portion of the net to ensure that all larvae passing through the channel were captured by the drift-net. Prior to the larval release, a pole seine was passed along the length of the channel to remove any fish, including potential predators, which may have been present in the stream.

Figure 3.2 Nechako White Sturgeon Larvae Monitoring - Site 2

Legend

- Release Location
- Drift Net
- Gravel Placement

1:1,000

0 9 18 27 36

Meters

Data Sources and Notes

N W E S

Produced for:
NWSRI

Produced by:
BRITISH COLUMBIA
Ministry of Environment
Environmental Stewardship Division

Projection/Datum: BC Albers/NAD83
Date Created: 2010-03-07
Created by: Jessica Courtier

3.2.3 Larval Release and Monitoring Methods

One thousand-six hundred 15 day-post-hatch larvae were released into Site 2 at 16:15 on June 23, 2009. These larvae were a mixture of gravel and bare-tank reared larvae. Larvae were released immediately upstream of the gravel section. The drift-net was sampled 30 minutes post release and repeatedly over the duration of the evening. The drift-net was then sampled, daily or twice daily, for the next six days. Each sample was carefully examined and a total number of larvae counted. The drift-net was removed on July 2, 2009. On July 5, 2009, a D-ring drift-net was set up immediately downstream of the gravel section. Crews then disturbed the entire length of gravel, 50 cm at a time, to push any "hiding" larvae into the drift-net. Each "50-cm" sample was careful examined for the presence of any larvae.

On July 16, 2009 crews netted the entire length of the channel using a 1.5-m wide pole seine (mesh size = 5 mm) to capture fish present in the channel. Any fish encountered were identified to species, if possible, and were measured for length (to the nearest 0.1 cm) and for weight (to the nearest 0.1 g).

3.2.4 Monitoring Results and Discussion

Drift-net monitoring of Site 2 was completed over eight days and totalled 184.44 hours of effort (Appendix 1 – Table 3). The drift-net captured a total of 817 larvae. Within 30 minutes of release, 744 (46.5% of the 1600 released) larvae were captured. Another 69 larvae were captured in the second sample (0.5 hours to 1.5 hours post-release). A single larva was collected approximately 2.5 hours after release. Samples taken the following morning (June 24, 2009), approximately 19-hours post-release, produced two larvae. At this time, the D-ring set up was altered as scouring had occurred around the edge of the net. It is possible that more larvae might have been captured during the night of June 23, 2009 if scouring had not occurred around the drift-net and caused the potential loss of larvae. A single larva was found in the sample taken on June 25, 2009, approximately 40 hours after release. No other larvae were captured in the drift-net.

Gravel disturbance and sampling on July 5, 2009 produced no sturgeon larvae. It was observed at this time that the water depth in the channel had decreased to approximately 4-8 cm and the temperature over the gravel section was 19^{o}C.

Pole seining of Site 2 resulted in the capture of 57 fish, none of which were white sturgeon. Twenty-four fish were identified to species and were sampled for length and weight; the remaining 33 were less than two cm in length and were not identified to species. Northern pikeminnow were the most abundant species captured in the channel and exhibited a mean fork length of 44.8 mm.

Table 3.2 Mean fork length (± 1 standard deviation) and weight (± 1 standard deviation) for fish captured by pole seining of Site 2

Species	Count	Mean Fork Length (mm)	Mean Weight (g)
Chinook	1	52	1.3
Northern pikeminnow	16	44.8 ± 9.4	1.05 ± 0.75
Redside shiner	1	72	4
Sucker species[1]	6	51.3 ± 8.9	1.52 ± 0.85
Various[1]	33	-	-

[1] – not identified to species

In general, drift-net monitoring of this site showed a pulse of larval drift immediately after release as the majority of larvae were captured within the first 30 minutes. This observation suggests that 15 day-post-hatch larvae have a general to drift. It is possible that larvae, which did not hide soon after release, quickly left the channel possibly as a result of velocity, poor swimming ability or a general lack of resting/hiding habitat; there was relatively little exposed gravel in the channel other than the artificial gravel section at the upstream end of the site. It is also possible that the majority of larvae did not have time in which to hide before being washed downstream to unfavourable habitats due to the shallow nature and higher turbulence in section of channel immediately downstream of release or that the majority of larvae chose not to hide within the available habitats. However, it is difficult to understand factors which may limit drift of 15 day-post-hatch larvae due to the lack of larvae and/or larvae behaviours detected by drift or seine sampling during this experiment. Future detailed field and/or lab experiments may be used to evaluate factors affecting drift.

The capture of larvae in samples taken between 0.5 hours and 2.5 hours-post release, as well as the capture of two larvae on June 24, 2009 and a single larva on June 25, 2009, suggests that conditions, such as resting/hiding habitat, existed within the channel and that larvae were able to successfully utilize these habitats for a period of time.

Gravel disturbance, conducted on July 5, 2009, was unsuccessful in finding any remaining "hiding" larvae and suggested that sturgeon were no longer present in that section of channel. Relatively high water temperatures and low water levels in this section of channel may have create an unfavourable environment.

3.3 SITE 3 – Burrard Avenue Bridge

3.3.1 Objectives

The main objective of Site 3 was to determine general drift rates of larval sturgeon released in an area without hiding habitat.

3.3.2 Location, Site Description and Set-up

Site 3 was located downstream of the Burrard Avenue Bridge near river kilometre 136.5. This section of the Nechako River provided an area of poor quality habitat as the substrate material was predominately sand/fines. Two D-ring drift-nets were positioned in the thalwag of the Nechako River approximately 100 meters and 600 meters, respectively, downstream of the bridge (Figure 3.3). The drift-nets were deployed from an anchor system which enabled the nets to fish unattended. Water depth was measured at > 2 m at the 100-m site and 146 cm at the 600-m site. Water velocities at the time of sampling, measured at the 100-m site, were approximately 0.95 m/s on bottom and 0.31 m/s at the surface. A the 600-m site, water velocities were 0.31 m/s and 0.6 m/s at the bottom and surface, respectively.

3.3.3 Larval Release and Monitoring Methods

Ten thousand 15 day-post-hatch larvae were released into Nechako River at the Burrard Avenue Bridge at 14:35 on June 21, 2009. These larvae were reared in bare-tanks at the Nechako hatchery. Sampling with D-ring drift-nets was conducted over an approximate three-hour period after release. Samples, taken from each net every hour, were carefully inspected and the total number of sturgeon larvae counted.

3.3.4 Monitoring Results and Discussion

Drift-net monitoring of Site 3 totalled 5.68 hours of effort and resulted in the capture of 212 larvae (Appendix 1 – Table 4). The drift-net at the 100-m site captured a total of 210 larvae

within 30 minutes of release. No sturgeon larvae were captured in any other samples taken from the 100 meter site. The 600m site net captured a total of two larvae within forty-five minutes of release. No other sturgeon larvae were captured at this site.

Drift-net monitoring results showed a pulse of larval drift immediately after release. This suggests that larvae did not hide within the substrate and drifted quickly out of the study area. Larval drift happened rapidly, within 30 minutes of release, and may either be a consequence of the water velocities at the 100m site and/or the presumably unfavourable habitat in that section of river. If it is assumed that larvae drift through unfavourable habitats as a single pulse, one would expect to observe similar numbers of larvae in the downstream drift-net. The capture of only two larvae at the 600-m site indicated that the cohesiveness of the drifting larvae pulse noticeably decreased; this may be attributed to lateral and vertical dispersal of larvae throughout the water column between sampling sites. It is also plausible that the sampling sites were not located within the laminar flows that may have contained the pulse of larvae. As a consequence of sampling a single drift-net at the 600-m site it is unknown if, in fact, larvae dispersed throughout the river channel or if there was habitat between the 100-m and 600-m in which larvae hid. However, the lack of larvae in subsequent samples suggests that larvae did not remain in the site for an extended period of time.

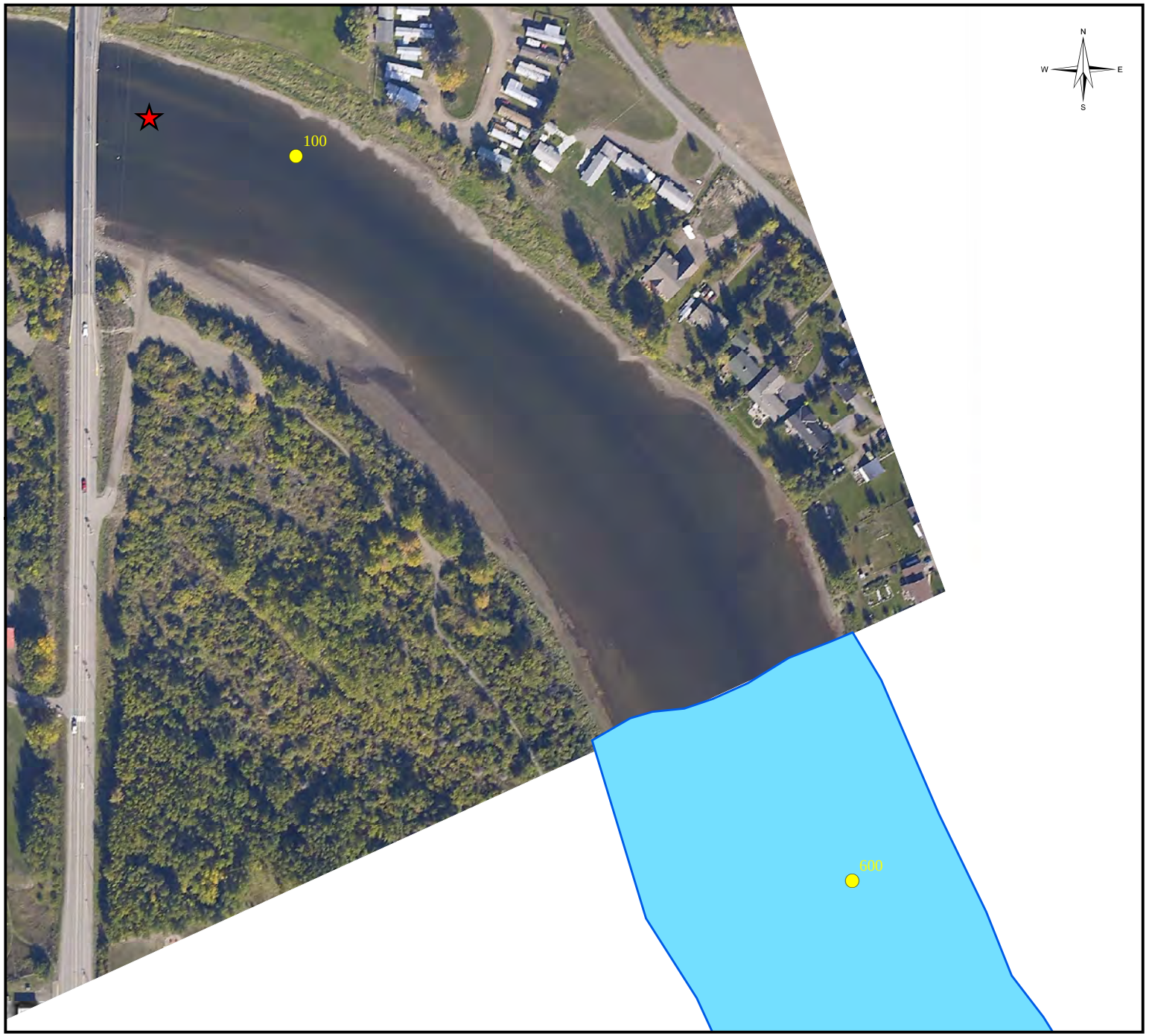

Figure 3.3 Nechako White Sturgeon Larvae Monitoring - Site 3

Legend

Release Location

Drift Net Locations

1:3,000

0 25 50 75 100

Meters

Data Sources and Notes

Produced for:
NWSRI

Produced by:

Ministry of Environment
Environmental Stewardship Division

Projection/Datum: BC Albers/NAD83
Date Created: 2010-03-07
Created by: Jessica Courtier

3.4 SITE 4 - The "Beaver Pond"

3.4.1 Objectives

The main objectives of Site 4 were to monitor both the survival and growth of larval white sturgeon in a closed system free of predators.

3.4.2 Location, Site Description and Set-up

Site 4 was a small pond situated an island within the Nechako Bird Sanctuary (Figure 3.4). This location provided a site with similarities to a flooded low-velocity habitat. The site was approximately 12 meters long and 8 meters wide. The substrate was dominated by sand and silt; woody debris and thick vegetation were also present around the edge of the site. Metal stakes were used to fix mesh panels across the pond inlet. The panels were buried in substrate across the length of the opening. The mesh was used as a barrier to prevent movement of both, potential predators into the pond and, larval sturgeon out of the pond. A section of beaver dam on the downstream outlet created a natural barrier. Prior to larval release, multiple passes with a beach-seine were completed to remove any fish (including potential) predators within the site.

3.4.3 Larval Release and Monitoring Methods

Approximately 1,600 15 day-post-hatch larvae were released into Site 4 at 15:45 on June 23, 2009. The larvae released at this site were a combination of gravel-tank and bare-tank reared larvae. Drift-nets were not used at this site as there was no objective to monitor movement in, or out, of the pond. It was planned that larval survival would be assessed approximately three weeks after release. Unfortunately, on July 15, 2009 the mesh barrier at the inlet was examined and found to have a large tear. Water levels had also increased approximately 15 to 20 cm, from the date of larval release, causing part of the mesh barrier to be submerged. Consequently, movement of fish in and out of the site was possible. A seine net (approximately 10 m wide and 2 m deep, mesh = 5mm) was used to capture fish. Two passes were completed at 11:02am and 11: 35am on July 15, 2009 and at 18:43 and 18:53 on July 16, 3009. Fish caught in the seine were counted and indentified to species, if possible. A representative sub-sample of each species was sampled for length (to the nearest 0.1 cm) and weight (to the nearest 0.1 g).

3.4.4 Monitoring Results and Discussion

A total of 464 fish were captured, however no white sturgeon larvae were recovered from Site 4. A summary of the catch is provided in Table 3.3. Juvenile suckers, species unknown, were the most abundant fish in the catch; suckers were too small to identify to species in the field. Northern pikeminnow were the only other species of fish captured at this site.

Table 3.3 Total of fish captured by seine netting of Site 4

Date	Pass	Species		
		White sturgeon	Suckers[1]	Northern pikeminnow
2009-07-15	1	0	342	28
2009-07-15	2	0	49	3
2009-07-16	1	0	25	8
2009-07-16	2	0	5	4

[1] – not identified to species

A total of 28 suckers were sampled for length; they ranged in length from16 mm to 75 mm with a mean length of 31 mm. Weights ranged from 0.1 grams to 5 grams; the mean weight was 0.75 grams. A total of 21 northern pike minnow were also sampled for length and weight. The mean length was 40mm and ranged from 24 mm to 48 mm. The mean weight was 0.7 grams and ranged from 0.1 grams to 1.2 grams.

An objective of Site 4 was to monitor larval survival in a closed system free of predators. Unfortunately, rising water levels and a large tear compromised the barrier and consequently other fish, including potential predators of sturgeon larvae, were able to enter the site. Furthermore, the objective of assessing larval growth was not achieved as no sturgeon larvae were recovered from the site

There are a variety of potential reasons why larvae were not recovered from the site. It is possible that initial larval survival was limited and consequently larvae were not available for capture. The presence of other fish species in the pond suggests that predation may have played a large role in larval survival. Conversely, it is also possible that larvae survived but vacated the site for more favourable habitat when the inlet barrier was compromised. It is also feasible that larvae survived and were present within the site but that the sampling technique used was an inadequate method of capture.

Figure 3.4 Nechako White Sturgeon Larvae Monitoring - Site 4

Legend

Mesh Barrier

Pond

1:750

0 6 12 18 24

Meters

Data Sources and Notes

Produced for:
NWSRI

Produced by:

Ministry of Environment
Environmental Stewardship Division

Projection/Datum: BC Albers/NAD83
Date Created: 2010-03-07
Created by: Jessica Courtier

4.0 OTHER LARVAL RELEASE SITES

4.1 SITES 5 & 6 - Nechako Bird Sanctuary

Ten thousand 15 day-post-hatch larvae were released into gravel channels within the braided reach of the Nechako Bird Sanctuary on June 23, 2009. Five thousand larvae were released at two locations, sites 5 and 6 (Figure 1.1), at 1:33 am and 1:37 am, respectively. The direction of flow at these release sites were such that, if the larvae were to drift, they would end up downstream of the braided section and would not interfere with other larval monitoring sites. There were no specific monitoring objectives for these sites; they provided alternative larval habitats and it was hoped that the released larvae would be detectable as feeding larvae later in the summer and as juveniles in the future.

5.0 BEACH SEINE SAMPLING

5.1 Objectives

The main objectives of the beach seine sampling were 1) to determine growth rates and food of feeding sturgeon larvae and 2) to determine the species and size of potential sturgeon predators in larval sturgeon habitat.

5.2 Sampling locations and methods

Sites were located in areas with various types of habitats (gravel bars, side channels, shoreline of main channel) and substrates (gravels, fines). A seine net (approximately 10 meters wide by 2 meters deep, mesh size: 5 mm) was used to capture fish. Two passes were made at each site, working upstream. Fish caught in the seine were counted and indentified to species if possible. A representative sub-sample of each species was sampled for length (to the nearest 0.1 cm) and weight (to the nearest 0.1 g).

5.3 Results and Discussion

A total of nine seine sites, exhibiting a variety of habitats and substrates, were sampled over five days between July 16 and 20, 2009. The seine sites are shown in Figure 5.1. Site 1 was described as a shoreline pool. Site 2 was a side channel with gravel substrate. Site 3 was described to be less than 1m-deep with a sandy substrate and woody debris. Site 4, located in the main channel, had a sand substrate and a moderate current. Site 5 was located along a beach-type area in the main channel and was described to have a very soft silty substrate. Sites 6, 7, 8 and 9 were predominated by soft sand and grassy substrates and exhibited slow velocities.

A total of 1,856 fish were captured, none of which were white sturgeon. A summary of captured fish is shown in Table 5.1. The majority of fish were not identified as they were too small to identify to species in the field (listed as "various"). Of the identified fish, juvenile suckers (*Catostomus* sp.) were the most abundant, followed by longnose dace (*Rhynichthys cataractae*) and northern pikeminnow (*Ptychocheilus oregonensis*). Northern pikeminnow and juvenile suckers were most abundant in flooded, vegetated sites. Dace (species unknown) and redside shiners (*Richardsonius balteatus*) were captured at five, and three, of the sites,

respectively. A single sculpin (*Cottus* sp.; species unknown) and a single burbot (*Lota lota)* were also captured.

Table 5.1 Summary of fish captured by seine net at nine sites between July 16 and 20, 2009

Site	Northern pike-minnow	Sockeye	Chinook	Redside shiner	Longnose dace	Sucker sp.[1]	Dace sp.[1]	Sculpin sp.[1]	Burbot	Various[1]	TOTAL
1	5	1	0	0	0	6	0	0	0	535	547
2	0	0	0	0	0	44	0	0	0	0	44
3	0	1	0	0	0	2	12	0	0	423	438
4	2	0	2	0	0	27	1	0	0	71	103
5	12	0	2	0	0	12	0	0	0	102	128
6	16	0	1	9	0	30	0	1	0	163	220
7	18	0	0	6	0	3	4	0	0	238	269
8	3	0	0	0	87	0	2	0	1	0	93
9	2	0	8	1	1	0	2	0	0	0	14
Total	58	2	13	16	88	124	21	1	1	1532	1856

[1] – not identified to species

Of the 1856 fish, 160 were sampled for length and weight. The results are shown in Table 5.2. Chinook exhibited the largest mean fork length and weight while longnose dace exhibited the smallest mean lengths and weights compared to other species.

Table 5.2 Mean lengths (±1 SD) and weights (±1 SD) of fish captured by seine net between July 16 and 20, 2009

Species	n	Mean Fork Length (mm)	Mean Weight (g)
Chinook	13	58.0 ± 6.6	2.5 ± 1.0
Dace sp.	19	45.5 ± 9.4	1.1 ± 0.7
Longnose dace	9	31.2 ± 2.9	0.4 ± 0.2
Northern pikeminnow	58	46.3 ± 10.2	1.2 ± 0.7
Redside shiner	16	55.8 ± 8.8	1.9 ± 0.8
Sockeye	2	54.5 ± 6.4	1.5 ± 0.9
Sucker Sp.	43	45.0 ± 12.6	1.2 ± 0.8

The majority of selected sites were predominated by sand/silt substrates. It was not noted by field crews if the increasing discharge and high flows towards the end of the sampling period played a part in site selection. In general, seining was effective at sampling selected habitats for potential predators; however this technique did not produce any sturgeon larvae. Consequently, the objective of determining growth rates and food of feeding larvae could not be achieved.

It is possible that 1) either sturgeon larvae were not present, whatsoever or in sufficient numbers within the selected sampling habitats, and thus were not available for capture, or 2) that the method of capture employed did not recruit sturgeon larvae. Benson *et al*. (2005) evaluated the effectiveness of various active and passive sampling techniques for capturing age-0 Lake Sturgeon (*Acipenser* fulvescens). Their investigation suggested that, in shallow lotic and lentic systems exhibiting low velocities, day-wading and night haul-seining were the most effective sampling techniques. It is suggested that alternative sampling techniques to beach-seines be employed in future to identify appropriate means of larval capture within a variety of hiding habitats.

Nevertheless, beach seines sampling was successful in capturing potential predators of Nechako white sturgeon larvae. Northern pikeminnow were found at seven of the sampling sites and are known to predate upon white sturgeon larvae. Gadomski *et al.* (2005) showed that, under laboratory conditions northern pikeminnow with mean total length of 472 mm predated upon sturgeon up to 134 mm in length. The mean length, 46.3 ± 10.2mm, of northernpike minnow captured during this study suggests that these fish may be large enough to predate upon sturgeon larvae within the Nechako River. It is recommended that, in future predation studies, stomach contents of captured fish be sampled to identify species that predate upon Nechako sturgeon larvae.

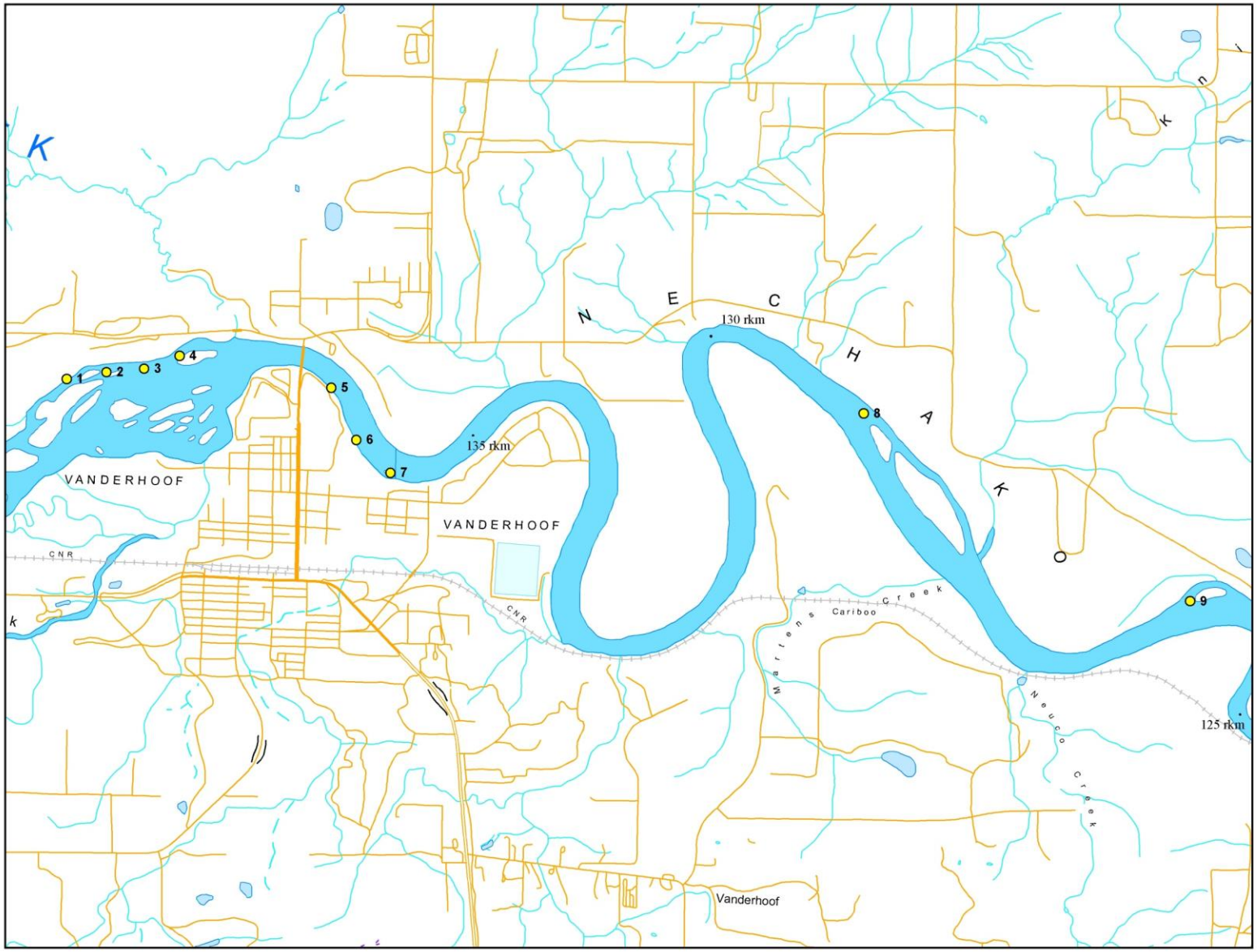

Figure 5.1 Nechako White Sturgeon Larvae Monitoring - Beach Seine Locations

Legend

Beach Seine Locations

1:23,000

0 0.2 0.4 0.6 0.8 1

Kilometers

Data Sources and Notes

Produced for:
NWSRI

Produced by:
BRITISH COLUMBIA
Ministry of Environment
Environmental Stewardship Division

Projection/Datum: BC Albers/NAD83
Date Created: 2010-03-07
Created by: Jessica Courtier

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APPENDIX I

Drift-net Data

Appendix I - Table 1 Drift-net sampling results for Site 1 (~5 and 10 hours after larval release)

Drift-net site	Set		Pull		Total Hours	Catch	
	Date	Time	Date	Time		Sturgeon Larvae	Other
1	2009-06-22	22:15	2009-06-23	4:15	6.00	282	0
2	2009-06-22	22:21	2009-06-23	4:25	6.07	312	0
3	2009-06-22	22:37	2009-06-23	4:37	6.00	68	0
4	2009-06-22	22:38	2009-06-23	4:45	6.12	16	0
5	2009-06-22	22:51	2009-06-23	4:49	5.97	121	0
6	2009-06-22	23:04	2009-06-23	5:05	6.02	33	0
1	2009-06-23	4:20	2009-06-23	9:30	5.17	29	0
2	2009-06-23	4:30	2009-06-23	9:50	5.33	6	0
3	2009-06-23	4:40	2009-06-23	9:58	5.30	25	0
4	2009-06-23	4:50	2009-06-23	10:05	5.25	10	0
5	2009-06-23	4:55	2009-06-23	10:20	5.42	7	0
6	2009-06-23	5:10	2009-06-23	10:34	5.40	4	0

Appendix I - Table 2 Drift-net sampling results for Site 1 (Night sets between June 23 and July 1, 2009)

Drift-net Site	Set		Pull		Total Hours	Catch	
	Date	Time	Date	Time		Sturgeon Larvae	Other
1	2009-06-23	21:25	2009-06-24	5:05	7.67	0	0
2	2009-06-23	21:29	2009-06-24	5:15	7.77	0	0
3	2009-06-23	21:38	2009-06-24	5:24	7.77	0	0
4	2009-06-23	21:35	2009-06-24	5:30	7.92	0	0
5	2009-06-23	21:48	2009-06-24	5:44	7.93	0	0
6	2009-06-23	21:58	2009-06-24	5:50	7.87	0	0
1	2009-06-26	22:36	2009-06-27	8:27	9.85	0	0
2	2009-06-26	22:41	2009-06-27	8:33	9.87	0	0
3	2009-06-26	22:45	2009-06-27	8:45	10.00	0	0
4	2009-06-26	22:47	2009-06-27	8:50	10.05	0	0
5	2009-06-26	22:52	2009-06-27	9:01	10.15	0	0
6	2009-06-26	22:57	2009-06-27	9:10	10.22	0	0
1	2009-06-27	21:52	2009-06-28	8:40	10.80	0	0
2	2009-06-27	21:55	2009-06-28	8:45	10.83	0	0
3	2009-06-27	22:02	2009-06-28	8:50	10.80	0	0
4	2009-06-27	22:03	2009-06-28	8:56	10.88	0	0
5	2009-06-27	22:12	2009-06-28	9:10	10.97	0	0
6	2009-06-27	22:17	2009-06-28	9:21	11.07	0	0
1	2009-06-30	22:10	2009-07-01	7:20	9.17	0	0
2	2009-06-30	22:25	2009-07-01	7:30	9.08	0	0
3	2009-06-30	22:30	2009-07-01	7:38	9.13	0	0
4	2009-06-30	22:30	2009-07-01	7:43	9.22	0	0
5	2009-06-30	22:38	2009-07-01	7:59	9.35	0	0
6	2009-06-30	22:41	2009-07-01	8:05	9.40	0	0
1	2009-07-01	21:50	2009-07-02	8:14	10.40	0	0
2	2009-07-01	22:02	2009-07-02	8:28	10.43	0	0
3	2009-07-01	22:13	2009-07-02	8:43	10.50	0	0
4	2009-07-01	22:20	2009-07-02	8:55	10.58	0	0
5	2009-07-01	22:32	2009-07-02	9:09	10.62	0	0
6	2009-07-01	22:43	2009-07-02	9:19	10.60	0	0

Appendix I - Table 3 Drift-net sampling results for Site 2

Set		Pull		Total Hours	Catch	
Date	Time	Date	Time		Sturgeon Larvae	Other Fish
2009-06-23	16:15	2009-06-23	16:45	0.50	744	0
2009-06-23	16:45	2009-06-23	17:45	1.00	69	0
2009-06-23	17:45	2009-06-23	18:45	1.00	1	0
2009-06-23	18:45	2009-06-23	20:55	2.17	0	0
2009-06-23	20:55	2009-06-24	11:25	14.50	2	0
2009-06-24	11:25	2009-06-24	14:45	3.33	0	0
2009-06-24	14:45	2009-06-25	8:10	17.42	1	0
2009-06-25	8:10	2009-06-26	21:54	37.73	0	0
2009-06-26	21:54	2009-06-27	16:10	18.27	0	0
2009-06-27	16:10	2009-06-28	16:10	24.00	0	0
2009-06-28	16:10	2009-07-01	8:41	64.52	0	3 salmonids

Appendix I - Table 4 Drift-net sampling results for Site 3

Site	Set		Pull		Total Hours	Catch	
	Date	Time	Date	Time		Sturgeon Larvae	Other fish
100 m	2009-06-21	14:00	2009-06-21	15:05	1.08	210	0
600 m	2009-06-21	14:10	2009-06-21	15:15	1.08	2	0
100 m	2009-06-21	15:05	2009-06-21	15:53	0.80	0	0
600 m	2009-06-21	15:15	2009-06-21	15:58	0.72	0	0
100 m	2009-06-21	15:53	2009-06-21	16:24	0.52	0	0
600 m	2009-06-21	15:58	2009-06-21	16:28	0.50	0	0
100 m	2009-06-21	16:24	2009-06-21	16:53	0.48	0	0
600 m	2009-06-21	16:28	2009-06-21	16:58	0.50	0	0

APPENDIX II

Photograph Plates

Plate 1: Gravel placed into upstream section of Site 2, July 16, 2009.

Plate 2: Site 4 on July 16, 2009