Columbia River Project Water Use Plan

Columbia River White Sturgeon Management Plan

Mid-Columbia River Juvenile Sturgeon Detection and Habitat Use Study

Implementation Year 10

Reference: CLBMON-21

BC Hydro and Power Authority

Study Period: January 1, 2016 to December 31, 2016

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April 2017

CLBMON-21: Mid-Columbia River Juvenile White Sturgeon Monitoring - 2016 Investigations

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Cover Photo: Juvenile White Sturgeon captured on a setline on September 12, 2016 by Okanagan Nation Alliance crew.

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Executive Summary

White Sturgeon (*Acipenser transmontanus*) in the upper Columbia River in British Columbia, Canada, was listed as endangered under the federal Species at Risk Act (SARA) in 2006 as the population is undergoing recruitment failure. One segment of the population resides in the mid-Columbia River, a section of the Columbia River located between Hugh L. Keenleyside Dam (HLK; Castlegar, BC) and Revelstoke Dam (REV; Revelstoke, BC). This small population segment is comprised of approximately 52 adult White Sturgeon (37 - 92 individuals at 95% confidence level; Golder 2006) that are older than the construction date of HLK Dam (1969). Natural recruitment to this population has not been identified.

In 2007, BC Hydro began an experimental conservation aquaculture program that releases hatchery-reared juvenile White Sturgeon into the mid-Columbia River. This program has been ongoing in an attempt to evaluate the feasibility of developing either a self-sustaining or failsafe population in this section of the upper Columbia River. In order to evaluate the success of fish released from this program, monitoring has been underway since 2008 with the main objectives being to 1) describe juvenile White Sturgeon habitat use, including quality and quantity within the mid-Columbia River, 2) determine growth and survival of juveniles released from the conservation aquaculture program, and 3) determine how hydraulic conditions from dam operations relate to habitat suitability for juvenile White Sturgeon and if modifications to dam operations can be made to protect and/or enhance habitat. These objectives have been assessed in previous years through both direct (capture efforts) and indirect (telemetry) methods, though direct capture to inform growth and habitat use was the focus of the 2016 study year.

In 2016, a total of 8 hatchery-origin juvenile White Sturgeon were captured. The majority (75%) of these captures had been released in spring 2016 at the Shelter Bay boat launch. These fish were released at a larger size (average 400 g weight) compared to previous releases (average 50-200 g) as part of a strategy to evaluate how size at release influences first year survival. On average, fish captured less than one year following release increased in length by 24% and in weight by 42%.

Since the beginning of the CLBMON-21 program, 30 juvenile White Sturgeon have been captured. Fourteen of those captures survived more than one year at large, including three multi-year survivors. The mean annual increase in length for fish captured after at least one year at large is 8.78 cm ± 3.6 (range: 3.70 – 14.56 cm) and mean annual increase in weight is 0.21 kg ± 0.19 (range: 0.02 – 0.70 kg). As a result of low capture rates of juvenile White Sturgeon, increased capture effort is recommended as well as concentrating effort in locations of previous capture.

The current state of knowledge for the juvenile White Sturgeon program in the mid-Columbia River with respect to BC Hydro's management questions is provided in the table below.

Management Question	Status
1. Where are the habitat locations utilized by juvenile sturgeon in the Mid-Columbia?	Juvenile White Sturgeon exhibit highest use of habitats starting near Greenslide Cr. (RKm 212) and moving downstream to Beaton flats and further south into Arrow Lakes Reservoir. Juveniles have not been directly captured below the Beaton Flats area but telemetry has identified a few individuals further downstream towards Nakusp.
2. What are the physical and hydraulic properties of this habitat that define its suitability as juvenile sturgeon habitat?	Juvenile White Sturgeon use deeper (>10 m), lower velocity (<0.5 m/s) habitats with fine substrates (sand/silt/clay). To date, this knowledge has been based primarily on movements of acoustically tagged juveniles (n=250).
3. What is the quantity of available habitat meeting these conditions in the Mid-Columbia?	Both REV discharges and Arrow Lakes Reservoir operations influence habitat quality and quantity. Discharge from REV influences the quality and quantity of habitat in riverine sections; however the effects diminish with downstream distance. Higher reservoir elevations result in greater availability of deeper, lower velocity habitats further upstream. Recruitment does not appear to be limited by juvenile habitat quality and quantity; however, this hypothesis cannot be rejected at this time.
4. How do hydraulic conditions resulting from dam and reservoir operations relate to habitat suitability for juvenile White Sturgeon in the Mid-Columbia?	The main areas of habitat use are downstream from REV (>25 km) where it is considered unlikely that significant improvements can be made.
5. What are the survival rates of juvenile white sturgeon in the mid-Columbia River?	Though direct captures have been extremely low and preclude survival estimates, a few of the captured individuals have survived to age-3 or older and exhibit growth rates of approximately 13.3 cm/year in length. Additional capture data are required to adequately address this question. Larval releases were conducted in 2010 and 2011 and survival of those fish is yet to be detected through this program.
6. Can modifications be made to the operations of Revelstoke Dam and/or Arrow Lakes Reservoir to protect or enhance juvenile white sturgeon habitat?	Uncertainty remains about what an enhancement would entail. Detecting a response of operational modifications would be difficult as the main effects (benefits) would accrue in riverine areas that are not preferred juvenile rearing areas (e.g. from Revelstoke to Greenslide Creek).

ACKNOWLEDGEMENTS

The Okanagan Nation Alliance would like to acknowledge **BC Hydro** as the funding source for this project and for the opportunity to increase our skills and capacity through the award of this project. Thank you to Dr. James Crossman (Senior Environmental Coordinator) for your assistance in all aspects of this project. We would also like to acknowledge Golder Associates Ltd. for their mentorship, technical and logistical support in previous years of CLBMON21.

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2013	Larry Hildebrand, B.Sc, R.P. Bio	Senior Fisheries Scientist, Project Advisor
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1.0 BACKGROUND AND INTRODUCTION

White sturgeon (*Acipenser transmontanus*) are the largest and longest lived freshwater fish species in North America, and are native to the Columbia River drainage flowing from British Columbia, Canada through the United States. The population of White Sturgeon in the upper Columbia River was listed as Endangered under the Canadian Species at Risk Act (SARA) in 2006 as the population is undergoing recruitment failure (Fisheries and Oceans 2014). A small segment of the population occurs within the Arrow Lakes, a section of the mid-Columbia River (MCR) spanning from the Revelstoke Dam (REV) to the Hugh L. Keenleyside Dam (HLK). It is estimated there are approximately 52 adult White Sturgeon remaining in the Arrow Lakes (37 - 92 individuals at 95% confidence level; Golder 2006), all of which are assumed to have been present prior to the completion of HLK Dam in 1969. There have been no younger age classes detected in this section of river, suggesting that natural recruitment has not occurred.

During the development of the Columbia River Water Use Plan, BC Hydro's Consultative Committee identified knowledge gaps for juvenile White Sturgeon habitat capabilities in the mid-Columbia River (BC Hydro 2007). Since 2007, BC Hydro has been releasing hatchery-origin juvenile White Sturgeon into the mid-Columbia River. A 10-year juvenile monitoring program was initiated to investigate habitat use, habitat availability and the potential for building a self-sustaining or failsafe population in this section of the Columbia River. One important aspect of the program is to evaluate juvenile growth and survival after release from the hatchery, as well as describe the availability and suitability of habitat for juvenile White Sturgeon in the Arrow Lakes Reservoir. These questions have largely been addressed through monitoring of juveniles following release, either through passive methods (e.g. telemetry) or direct capture (e.g. setlines and gill net effort).

From 2007-2010 over 43,000 juvenile White Sturgeon were released, only 10 of which were recaptured (Golder 2010) which made addressing the objectives of this program challenging. While habitat use was described through tracking of acoustically tagged juveniles (n=50 per year from 2008-2011) in the early years of this program (Golder 2012), it was determined that understanding growth and survival of juveniles following release was critical to determining the potential for building a self-sustaining or failsafe population. In an attempt to increase capture efficiency, a Vemco Positioning System (VPS) was developed and implemented in 2012 and 2013 in order to provide fine scale movement data. The results of the VPS study indicated juvenile White Sturgeon most commonly used the thalweg portion of the Columbia River, regardless of reservoir elevations (Golder and ONA 2013), which guided the study design of the sampling program in subsequent years.

The objective of the juvenile White Sturgeon monitoring program since 2013 has been to maximize efforts in capturing juveniles to describe distribution, growth and general survival of fish released from the conservation aquaculture program. The study design for these sampling years was guided by the experiences and successes of previous efforts in this program (Golder

2010, 2011, Golder and ONA 2013, ONA 2016). Sampling efforts were increased by year from 2013 to 2016, and incorporated the skills and knowledge of a number of Okanagan Nation Alliance Fisheries Technicians and Biologists. This report outlines the results of Implementation Year 10 of CLBMON 21 (2016), and provides a summary of captures in all years of this program (2007-2016).

1.1 Management Questions & Hypotheses

The management questions defined by the Consultative Committee and associated with CLBMON-21 as per the Terms of Reference and Scope of Services (BC Hydro 2007) are:

- Where are the habitat locations utilized by juvenile sturgeon in the Mid-Columbia?
- What are the physical and hydraulic properties of this habitat that define its suitability as juvenile sturgeon habitat?
- What is the quantity of available habitat meeting these conditions in the mid-Columbia?
- How do hydraulic conditions resulting from dam and reservoir operations relate to habitat suitability for juvenile White Sturgeon in the mid-Columbia?
- What are the survival rates of juvenile White Sturgeon in the Middle Columbia River?
- Can modifications be made to the operations of Revelstoke Dam and/or Arrow Lakes Reservoir to protect or enhance juvenile White Sturgeon habitat?

Hypotheses for the above management questions have been developed to guide the juvenile sturgeon study, and are as follows:

- H_1: The recruitment of White Sturgeon in Arrow Lakes Reservoir is limited by the quality and quantity of juvenile habitat below Revelstoke Dam.
    - H_{1A}: Quality and quantity of White Sturgeon juvenile habitat in the mid-Columbia River is directly related to discharge from the dam.
    - H_{1B}: Quality and quantity of White Sturgeon juvenile habitat in the mid-Columbia River is directly related to water elevation in Arrow Lakes Reservoir.
    - H_{1C}: Quality and quantity of White Sturgeon juvenile habitat in the mid-Columbia River is directly related to the interaction between discharge from the dam and water elevation in Arrow Lakes Reservoir.
- H_2: Quality and quantity of White Sturgeon juvenile habitat in the mid-Columbia River can be significantly improved through changes in dam and reservoir operations.
- H_{3A}: Juvenile White Sturgeon do not survive in the mid-Columbia River in significant numbers from release as post-hatch larvae to year 1.
- H_{3B}: Juvenile White Sturgeon do not survive in the mid-Columbia River in significant numbers from release as late sub-yearling stage to year 2+ or older.

2.0 METHODS

2.1 Study Area

The mid-Columbia River is a portion of the Columbia River spanning 230 km from the Revelstoke Dam south to the Hugh L. Keenleyside Dam near Castlegar, BC. This portion of the Columbia River encompasses both the Upper and Lower Arrow Lakes within the Arrow Lakes Reservoir. The juvenile White Sturgeon study area spanned from south of Nakusp, BC near McDonald Creek Provincial Park north to Greenslide Creek (Figure 1). The entire study area is approximately 90 km in length.

2.2 Study Design

Field sampling was designed to optimize chances of catching juvenile White Sturgeon using previous years' successes and failures as guidelines. Previous work has shown that juvenile White Sturgeon within the Columbia River prefer calm (<0.5 m/s), deep (>10 m) areas with fine substrates (Golder 2009b). Additionally, the 2012 acoustic positioning study showed that juvenile White Sturgeon movement is concentrated within the thalweg or in floodplain areas associated with the thalweg, and that movement of juvenile White Sturgeon is greatest early to mid-September (Golder and ONA 2013).

Two hundred gillnet and two hundred set line sites were established randomly using the general random tessellation stratified (GRTS; Stevens and Olsen 2004) design in R (R Development Core Team). This method provides spatially balanced randomly chosen sample locations. Sites were randomly distributed along the center line of the mid-Columbia River and distinguished as setline or gill net sites. Over sample sites were also created to replace sites that were rejected during sampling due to logistical concerns (depth, velocity, obstructions) to ensure that randomness and spatial segregation were maintained within the study design. The generated GRTS sites were used as a guideline, and once in the field, sample locations were selected based on targeted water depths (10 – 30 m).

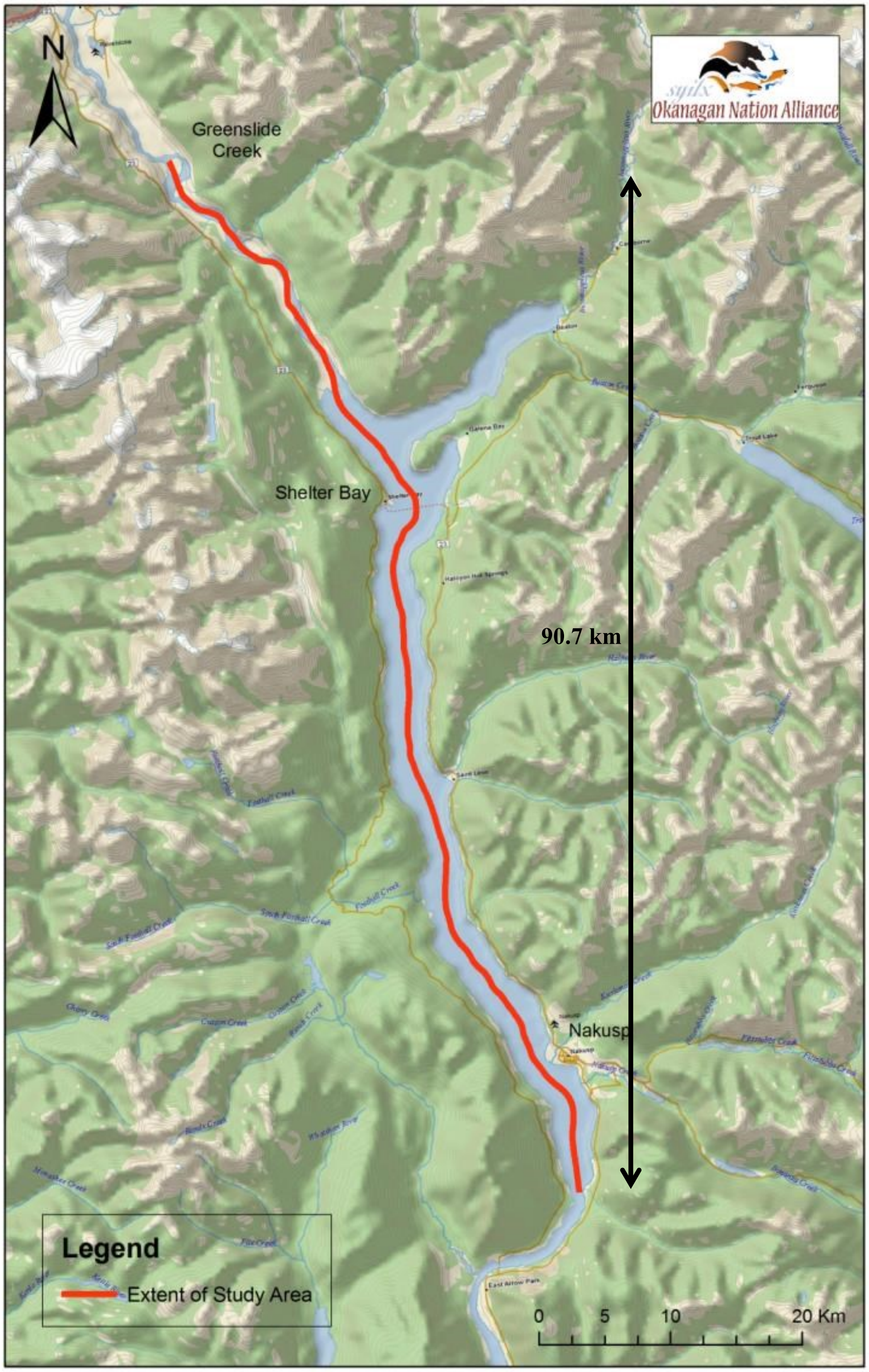

Figure 1: Study location on Upper Arrow Lake near Revelstoke, BC. Red line approximates length of study area.

2.3 Field Sampling

2.3.1 Study Period

In 2016, seven field sampling sessions were conducted from May 31 – September 28 using GRTS sites. Specific dates and corresponding sampling locations and times can be found in Appendix B.

2.3.2 Physical Habitat Parameters

Surface water temperatures were measured at each sampling site using an onboard depth sounder or handheld thermometer and measured to the nearest 0.1˚C. Water depths were also recorded from the onboard depth sounder. We used Hobo Tidbit temperature loggers to record water temperatures throughout the study area. Temperature loggers were deployed at three locations: one near Greenslide Creek (UTMs: 11 U 422522 5636776; the northern-most extent of the study area; deployment depth: 8 m), a second near Shelter Bay (UTMs: 11 U 434547 5610465; deployment depth: 15.4 m) and a third on the river-right bank adjacent to the town of Nakusp (UTMs: 11 U 439110 5565171; deployment depth: 17.5 m). Loggers were tied to a rope and anchor and were secured approximately 1 meter from the river bottom. Loggers were deployed at the beginning of the field season (June 28, 2016) and retrieved on September 27, 2016. Reservoir levels were recorded at the Fauquier station and discharge data were retrieved from BC Hydro's historic hydrometric data recorded from the Revelstoke Dam.

2.3.3 Capture Methods

A number of different equipment types have been used to sample for juvenile White Sturgeon, including angling, tangle nets, trawling, beach seines, set lines and gillnets, among others (McCabe 1994, Courtier 2010, Glova *et al*. 2010, BC Hydro 2015). This study used gill nets and set lines due to the hydraulic and physical properties of the sites along the Arrow Lakes Reservoir. Both sampling methods have been utilized previously for juvenile White Sturgeon with success in the mid- and lower-Columbia River (Golder 2009, 2010, 2011, 2012, Golder and ONA 2013, BC Hydro 2015, ONA 2016).

Gill net sets consisted of a 5.1 cm multi-strand net measuring 1.8 m deep by 91.5 m wide. Few nets were shorter in length measuring 30.5 m long. The ONA acquired three new gillnets in 2016 measuring 3.05 m by 91.45 m. Gill nets were set for a targeted duration of 4 hours to minimize impacts on bycatch. Gill nets were deployed at the bottom of the water column with a float and float line and anchors attached to each end of the net. Nets were weighted using steel railway plates on either end. Set and pull times, surface water temperatures, minimum and maximum net depths and orientation to flow were recorded during each set.

Setlines measured 120 m in length were set with 20 size 6-0 hooks per line. The mainline was marked at 4 m intervals to ensure hooks were evenly spaced on the line. Setlines were set in the afternoon and left to sample overnight. An anchor, float line and LD-2 float were attached to either end of the setline. Barbless 'J' hooks were baited with worms (nightcrawlers). Setlines were oriented perpendicular to the flow whenever possible to increase downstream scent dispersal. As with the gill net sets, set and pull times, hook sizes, bait types, UTM coordinates, surface water temperatures, minimum and maximum depths of the set line, fouled and baitless hooks, and any other catch details were recorded.

2.3.4 Fish Handling

Upon capture, sturgeon were weighed (g) and measured for fork length (mm), photographed, examined for health and external markings (missing scutes) and scanned for the presence of a passive integrated transponder (PIT) tag. Handling methods were consistent with those set by the Upper Columbia White Sturgeon Recovery Initiative (UCWSRI) in the Upper Columbia River Adult White Sturgeon Capture, Transport and Handling Manual (2006). All bycatch were noted for species, measured for length and then released to reduce negative impact. Bycatch resulting in mortality were sunk by puncturing the swim bladder.

Gastric lavage was attempted on two of the captured sturgeon with the objective of flushing the Sturgeon's stomach to identify prey items. Gastric lavage was conducted using a Chapin SureSpray Select 8.0 L pump/bladder and a VWR size 8 standard testing sieve (#140). Samples were collected in glass jars and labelled with the following information: date of collection, collection site, UTM's of site, sturgeon weight (kg) and fork length (cm).

2.3.5 Substrate Collection and Analysis

Benthic substrates were collected at a subsample of sturgeon capture sites from 2014, 2015 and 2016 using a Ponar Grab with a grab capacity of 145 cubic inches (2,376 cm^3). Grabs at sites from previous captures years were taken at the location referenced via GPS. Grab samples were stored in glass containers with ethanol preservative until processing. Samples were collected in September 2016. Sorting of samples was completed by ONA staff in December 2016 and January 2017. Substrate volume was recorded prior to sorting. Samples were sorted using size 105 or 500 micron stainless steel screening depending on sample type. Samples were differentiated by dominant and secondary substrate types (fine-medium-coarse sand/clay/granule/pebbles) and recorded for contents. All sorted invertebrates were stored in micro-centrifuge tubes with ethanol preservative. Invertebrates were identified to Order using a dissecting microscope (Motic SMZ-143 Series) and the Guide to Common Freshwater Invertebrates of North America (Voshell 2002).

2.4 Data Analysis

Data management and descriptive statistics were completed using Microsoft Excel. Physical parameters (water temperature, reservoir elevation) were averaged daily for comparison between years. Catch per unit effort (CPUE) was calculated for each year as total juvenile White Sturgeon captures per effort hour. Biological data collected and analyzed in this report included fork length (mm) and weight (g). Fish were aged by scanning for a PIT tag and determining year class. Total and annual growth was calculated for each individual and compared by year class.

Total growth was calculated by subtracting the size at release (length and weight) from the capture size. Annual growth was calculated by dividing the total growth by the number of days at large and multiplying by 365. Incidental bycatch counts were represented graphically by gear type and mortality/survival. Spatial distribution of juvenile White Sturgeon in the MCR was recorded in the field using a GPS and plotted on a map using ArcMap (Version 9.3.1, ArcGIS by ESRI).

2.5 Gear Efficacy Testing

In 2016, the ONA conducted an additional gear testing sampling period from May 2 – 6. The objective of this additional sampling was to test the efficacy of the gear we used due to low capture rates in previous study years. The timing of the gear efficacy sampling was concurrent with the juvenile Sturgeon release at Shelter Bay (Mar 3 and 5) to optimize the chances of capture.

Gear efficacy testing was conducted using 4-hour gillnets sets and overnight setline sets. Different size hooks (4-0, 5-0 and 6-0) and bait types (shrimp, Kokanee and worms) were tested on setlines to assess preference in prey items and recruitment to different sizes of gear. Hook sizes and bait types were differentiated on each setline clip using colored electrical tape. Two lines of electrical tape were placed on each setline clip to differentiate between hook sizes and bait types, for example, green tape indicated 4-0 hook size and also shrimp bait type, so if the setline clip had two lines of green electrical tape, it was a size 4-0 hook baited with shrimp. Hook sizes and bait types were also randomized on each set line.

3.0 RESULTS

3.1 Physical Habitat Parameters

Water temperatures at tidbit locations averaged 11.4°C (range 5.3 – 18.8°C) from June 28 to September 27, 2016 in the mid-Columbia River (Figure 2). Temperatures were stable at both the Shelter Bay (average 10.9°C, range 9.4-13.5°C) and Greenslide Creek (average 12.5, range 6.0 – 15.8°C) stations and most variable near Nakusp (average 10.8°C, range 5.3 – 18.8°C). The Shelter Bay station was consistently warmer compared to the other two stations. The depths of the temperature loggers at Nakusp, Shelter Bay and Greenslide Creek upon collection measured at 28 m, 7 m and 0.8 m, respectively.

Reservoir elevations (meters above sea level, MASL) varied in 2016 compared to the average for all previous years of this study (2007 – 2015) (Figure 3). The general trend of reservoir elevations at Fauquier in previous years showed a decrease from May into late July/early August, increasing thereafter into the winter months. In 2016, reservoir elevations peaked in early June and decreased thereafter. Mean daily discharge levels (cubic meters per second, cms) recorded at BC Hydro's Revelstoke Dam also showed a different trend in comparison to the mean from

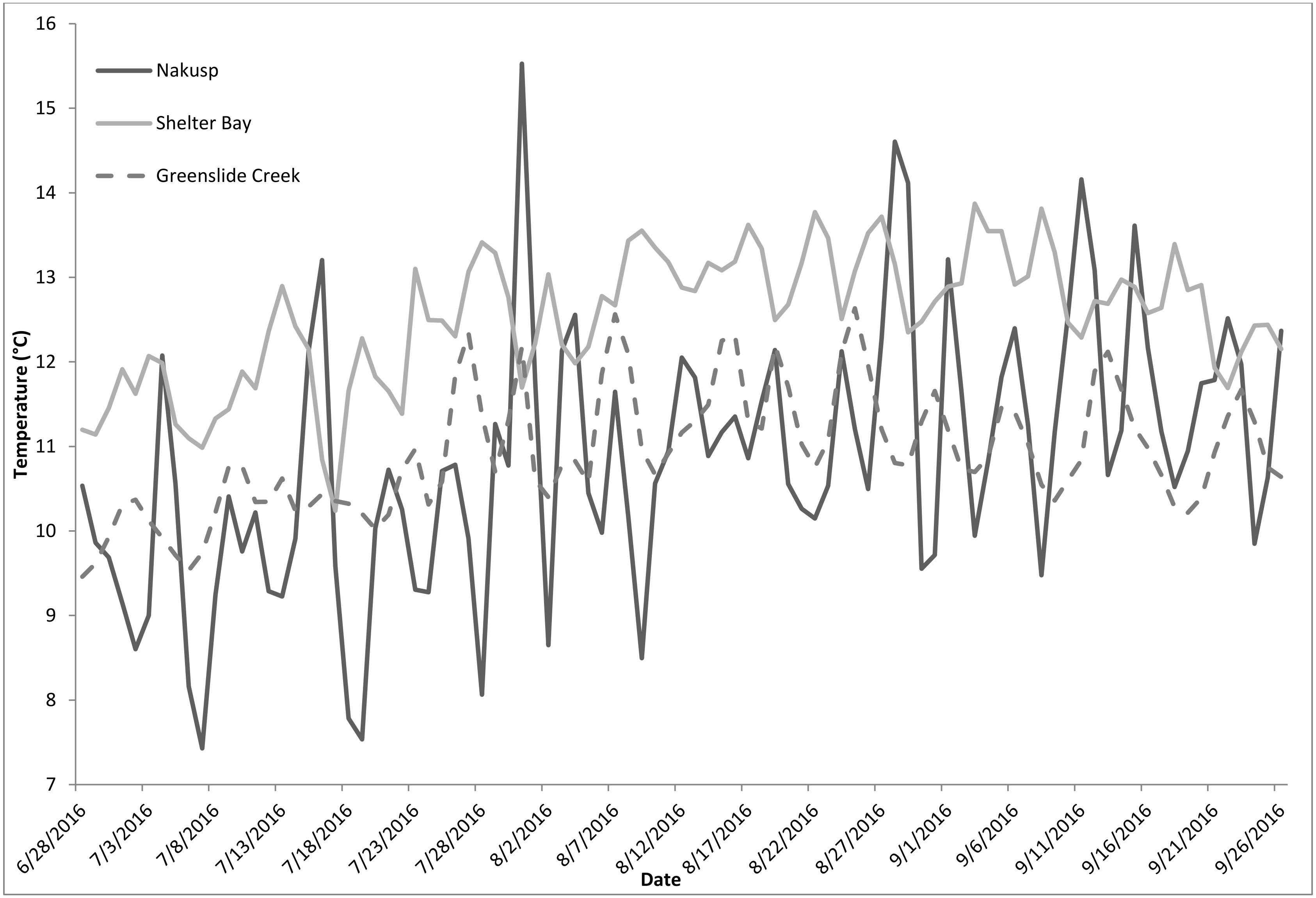

Figure 2: Mean daily water temperature data (˚C) from June 28 – September 26, 2016 recorded at Nakusp, Shelter Bay and Greenslide Creek in the mid-Columbia River.

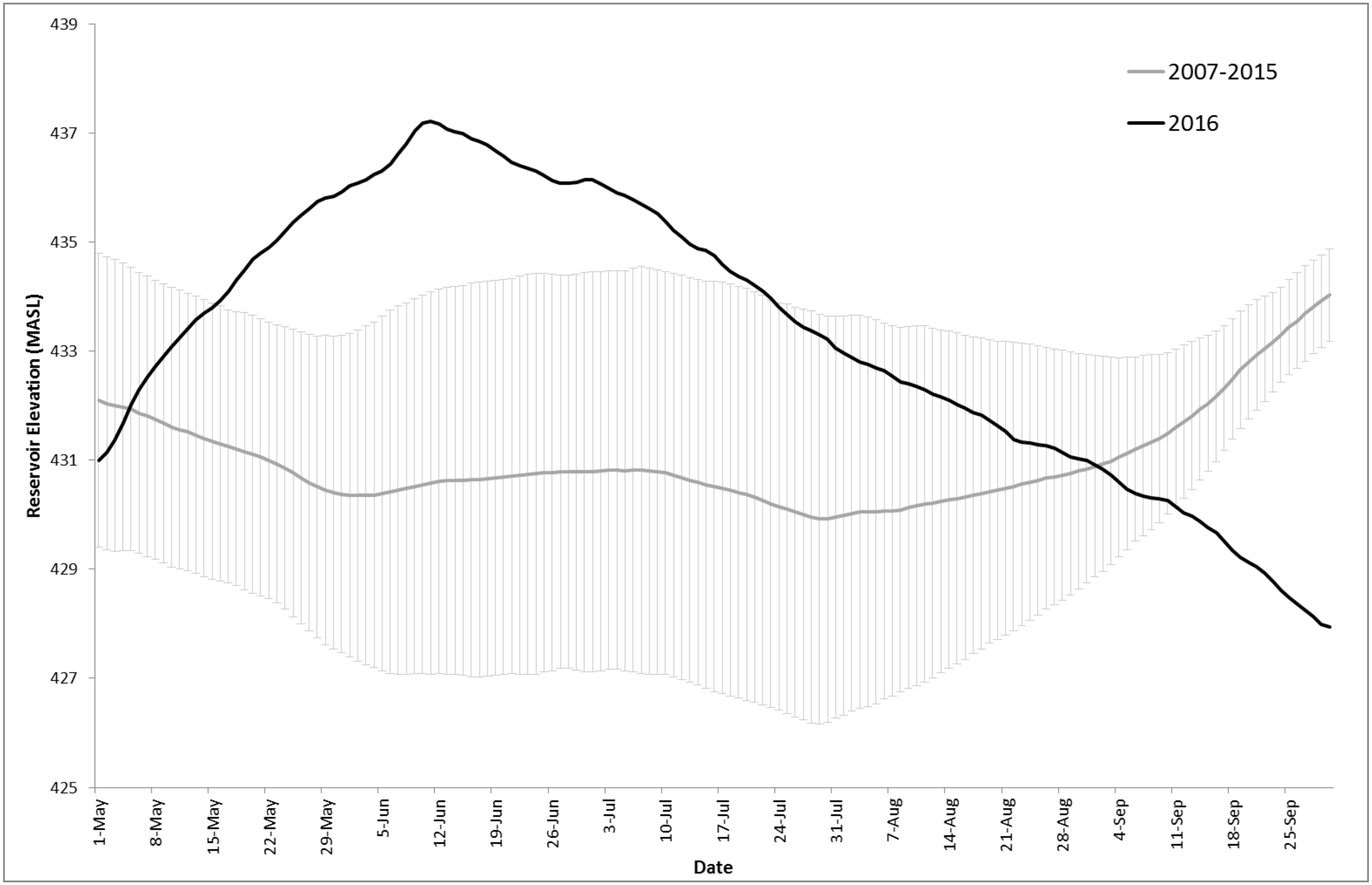

Figure 3: Mean daily reservoir elevation (MASL) recorded at Fauquier, BC from May 1st through September 30th comparing 2016 elevations to the average from 2007-2015 ± SD (data provided by BC Hydro 2016).

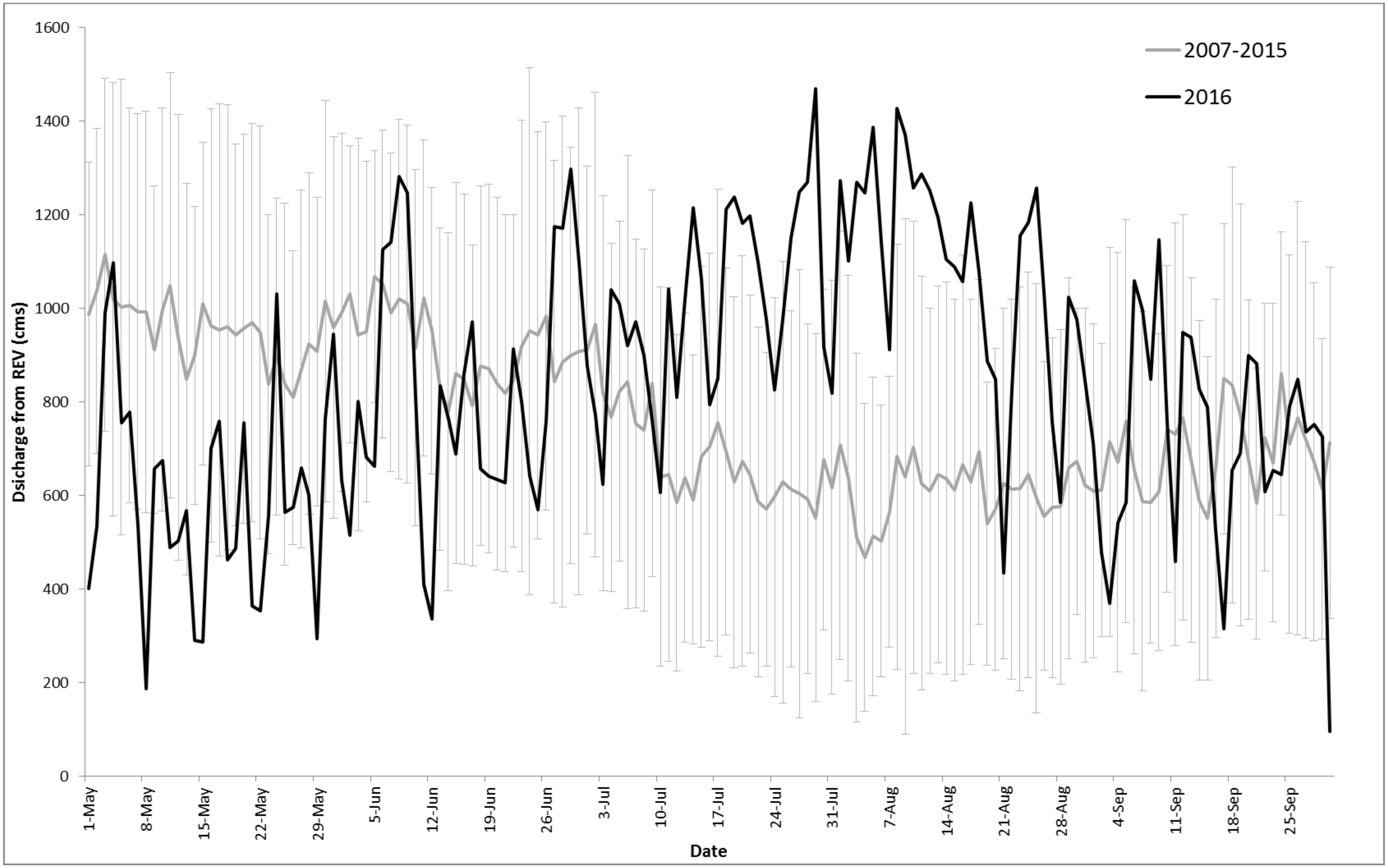

Figure 4: Mean daily discharge (cms) recorded at the Revelstoke Dam for May 1st through September 30th comparing 2016 to the average from 2007-2015 ± SD (data provided by BC Hydro 2016).

2007-2015 (Figure 4). Discharge was lower than average in the spring and then increased through the summer reaching peak levels during this time period in mid-August. Generally, discharge levels are higher in the spring and decrease throughout the summer.

3.2 Field Sampling Effort

In 2016, 64 days were spent in the field sampling a total of 453 sites (214 set lines, 239 gill nets) (Figure 8). All of the generated GRTS sites were sampled with the exception of the gillnet sites in the northern sections of the study area near Greenslide Creek due to high velocities moving nets downstream. For this reason, setlines were used exclusively in the upper sites of the study area. Opportunistic gill net sites were sampled instead in the Beaton Arm and additional sites added near Shelter Bay.

The amount of sampling effort expended in this project has increased annually from 2013 to 2016 (Table 2). Of all study years inclusive in this report, 2014 was the most successful in juvenile White Sturgeon captures. CPUE was very low in all study years.

Table 1: Sampling effort by year and gear type inclusive of Golder, ONA and BC Hydro efforts and including juvenile Sturgeon releases at Shelter Bay since 2007.

Study Year	No. Sturgeon Released	Cumulative Total Released	Gill Net Effort		Set Line Effort		CPUE
			Hours*	Captures	Hours	Capture	
2007	4,206	4,206	2.1	0	0	0	0
2008	6,534	10,740	22.3	4	0	0	< 0.1
2009	8,168	18,908	36.3	2	1,085	0	< 0.1
2010	9,625	28,533	72.5	4	14,101	0	< 0.1
2011	8,078	36,611	0**	0	0	0	0
2012	6,567	43,178	0	0	0	0	0
2013	5,944	49,122	122	0	484	0	0
2014	3,288	52,410	368	7	2,398	4	< 0.1
2015	6,013	58,423	699	1	3,268	0	< 0.1
2016	1,301	59,724	914	0	4,810	8	< 0.1

*Gillnet sampling from 2007 – 2010 was recorded as net units by Golder (2013). One net unit = 100 m^2 of net sampled for 24 hours.

**Note: the VPS feasibility study was conducted in 2011 and 2012 therefore no capture effort was expended in these years.

3.3 Capture Results

3.3.1 Gear Efficacy Testing

Gillnets and setlines were used to sample juvenile White Sturgeon concurrent to the release at Shelter Bay from May 2 – 6, 2016. A total of ten gillnet sets and five overnight setline sets were sampled during this time (Figure 5). Gillnets were set for an average duration of 4 hours, except for 3 gillnet sets that were left for 24 hours due to emergency boat issues. Those 3 gillnets that sampled overnight were successful in capturing 16 juvenile White Sturgeon, with no mortalities (Table 2). Setlines did not capture any White Sturgeon during the gear efficacy testing.

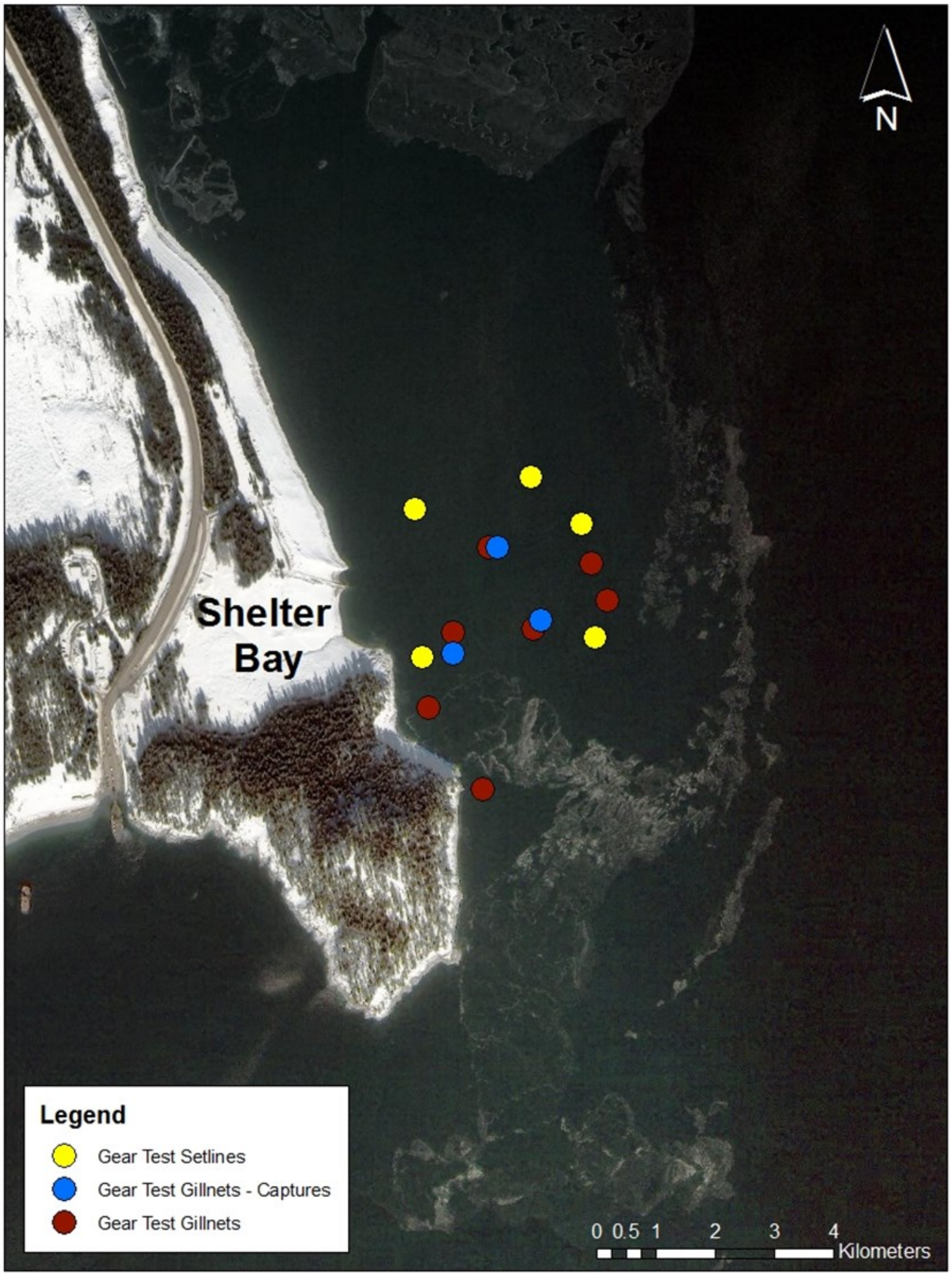

Figure 5: Location of setlines, gillnets and captures in gillnets during Gear Testing at Shelter Bay, May, 2016.

Table 2: Juvenile White Sturgeon captures in gillnets during Gear Efficacy Testing at Shelter Bay, May 2016.

#	Point	Easting	Northing	Length (cm)	Weight (g)	Method	Date of Capture	Time of Capture	Water Temp. °C	Water Depth (m)	PIT Tag Number
1	GT2016-09	435026	5609820	35.0	43	gillnet	16-05-05	11:45	10.6	13.6	900254000139627
2	GT2016-09	435026	5609820	30.5	40	gillnet	16-05-05	11:45	10.6	13.6	900254000099624
3	GT2016-08	434882	5609767	36	29	gillnet	16-05-05	11:05	10.5	13.5	900254000130630
4	GT2016-08	434882	5609767	37.5	34	gillnet	16-05-05	11:05	10.5	13.5	900254000137815
5	GT2016-08	434882	5609767	39.5	42	gillnet	16-05-05	11:05	10.5	13.5	142773261A*
6	GT2016-08	434882	5609767	34	24	gillnet	16-05-05	11:05	10.5	13.5	900254000143072
7	GT2016-08	434882	5609767	39	44	gillnet	16-05-05	11:05	10.5	13.5	900254000118277
8	GT2016-08	434882	5609767	37	37	gillnet	16-05-05	11:05	10.5	13.5	900254000090989
9	GT2016-08	434882	5609767	34.5	22	gillnet	16-05-05	11:05	10.5	13.5	900254000105272
10	GT2016-10	434958	5609939	38	42	gillnet	16-05-05	12:15	11	13.9	900254000181348
11	GT2016-10	434958	5609939	38	43	gillnet	16-05-05	12:15	11	13.9	900254000093707
12	GT2016-10	434958	5609939	32	21	gillnet	16-05-05	12:15	11	13.9	900254000115731
13	GT2016-10	434958	5609939	40.5	50	gillnet	16-05-05	12:15	11	13.9	900254000156429
14	GT2016-10	434958	5609939	44	57	gillnet	16-05-05	12:15	11	13.9	90025400011952
15	GT2016-10	434958	5609939	39.5	48	gillnet	16-05-05	12:15	11	13.9	900254000093176
16	GT2016-10	434958	5609939	42	59	gillnet	16-05-05	12:15	11	13.9	900254000125069

Bycatch during the gear efficacy testing is shown in Figure 6. Of the 87 individual fish captured as bycatch in this week, 38 died (44%). The most common bycatch species captured in gillnets were Peamouth Chub (*Mylocheilus caurinus*) and Northern Pikeminnow (*Ptychocheilus oregonensis*); setlines were most efficient at capturing Burbot (*Lota lota*). Burbot mortality on setlines was high (45%) due to the depth of setline sets and resultant swim bladder ruptures when the lines were pulled in. Following this, setlines were not set at depths > 25 m and were also pulled in at a slower rate to avoid further Burbot mortality.

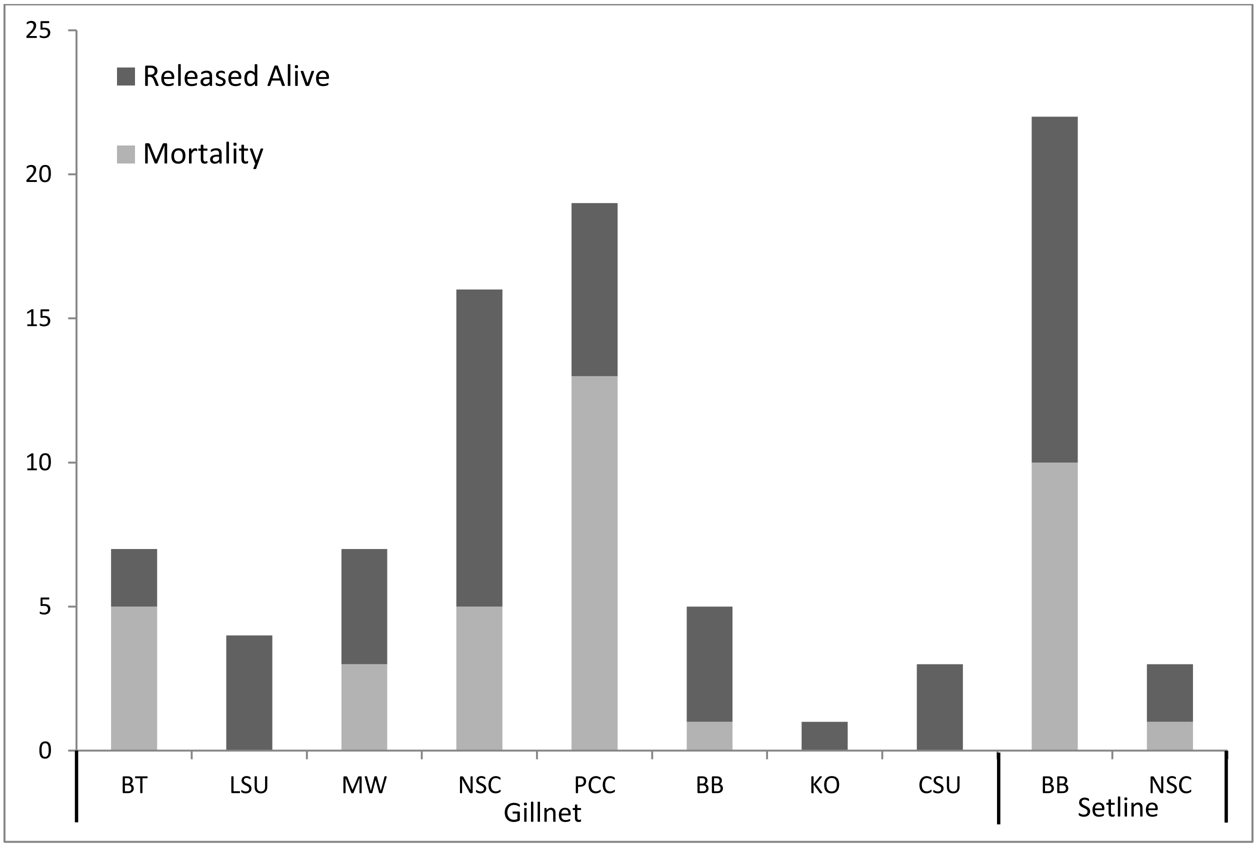

Figure 6: Bycatch by equipment type showing species and number captured during gear efficacy with associated mortality of each species. BT = Bull Trout (*Salvelinus confluentus*), LSU = Largescale Sucker (*Catostomus macrocheilus*), KO = Kokanee (*Onchorynchus nerka*), CSU = Longnose Sucker (*Catostomus catostomus*), MW = Mountain Whitefish (*Prosopium williamsoni*), NSC = Northern Pikeminnow, PCC = Peamouth Chub, BU = Burbot.

3.3.2 Capture Results

A total of 8 juvenile White Sturgeon were captured in 2016 (Table 3, Figure 7). All Sturgeon were captured on setlines in the northern section of the study area closer to Greenslide Creek (Figure 9). Only five locations are shown in Figure 7 because in two instances, two Sturgeon were captured on one setline, and another two captures were at nearly overlapping sites. All of the sturgeon captured possessed PIT tags indicating they were of hatchery origin (Table 3).

Table 3: Juvenile White Sturgeon capture data from 2016 GRTS sites.

ID	Capture Location	Capture Date	Easting	Nothing	Fork Length (cm)	Weight (kg)	Year Class	PIT Tag Number
2016-1	S004	9/12/2016	423284	5633071	39.00	0.37	2014	900254000087058
2016-2	S020	9/13/2016	421360	5634454	40.50	0.38	2013	985121021043135
2016-3	S119	9/18/2016	429033	5626890	54.00	1.01	2012	985121021549005
2016-4	S119	9/18/2016	429033	5626890	44.50	0.64	2014	900254000107183
2016-5	S8A	9/23/2016	423245	5633120	43.00	0.53	2014	900254000120023
2016-6	S8A	9/24/2016	423245	5633120	38.00	0.39	2014	900254000161446
2016-7	S19A	9/25/2016	425657	5630059	33.00	0.14	2014	900254000101924
2016-8	S16A	9/25/2016	425251	5631080	48.00	0.44	2014	900254000114457

Figure 7: Juvenile White Sturgeon captured on September 25, 2016.

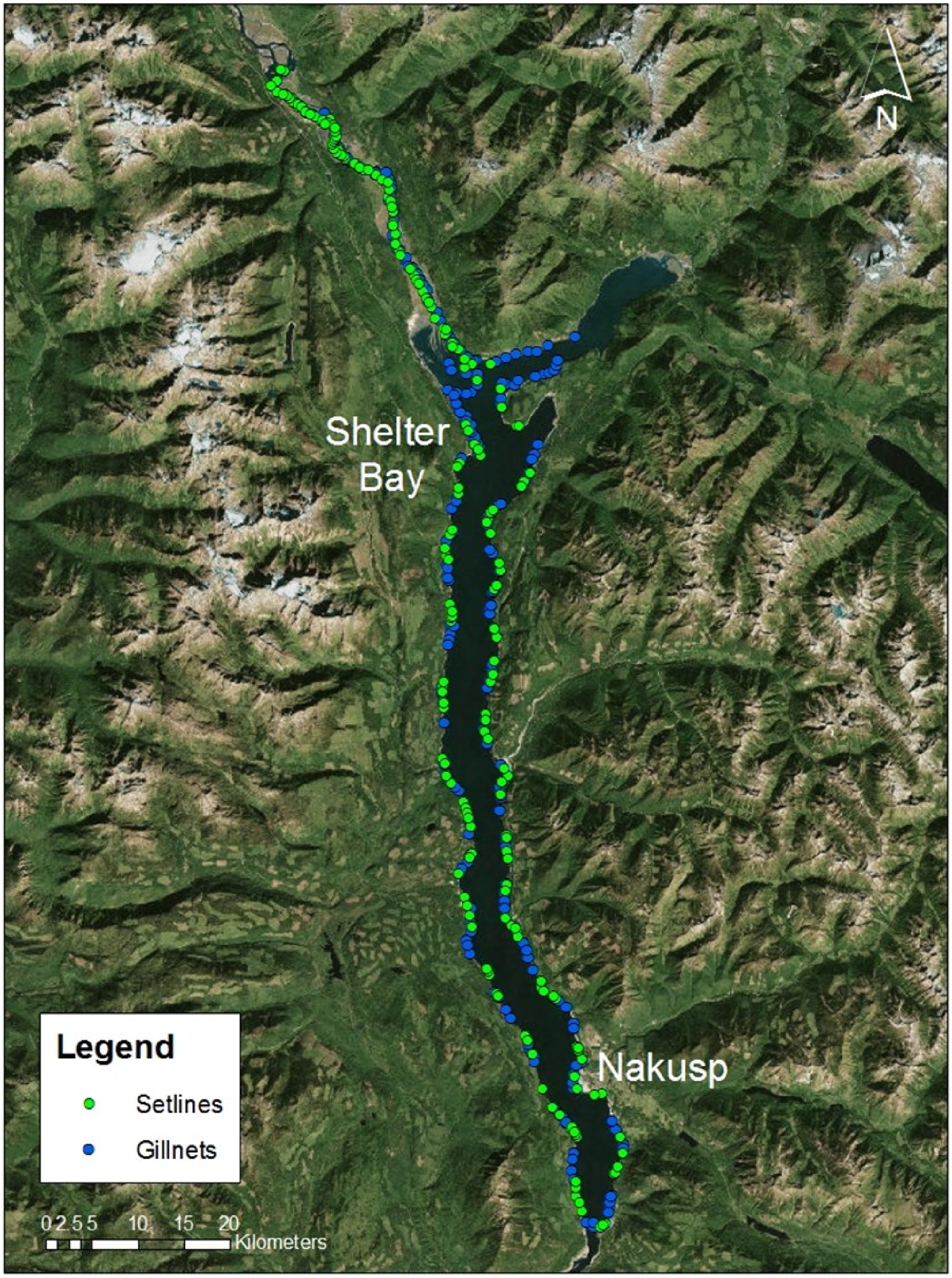

Figure 8: Gillnet and setline sites sampled in 2016.

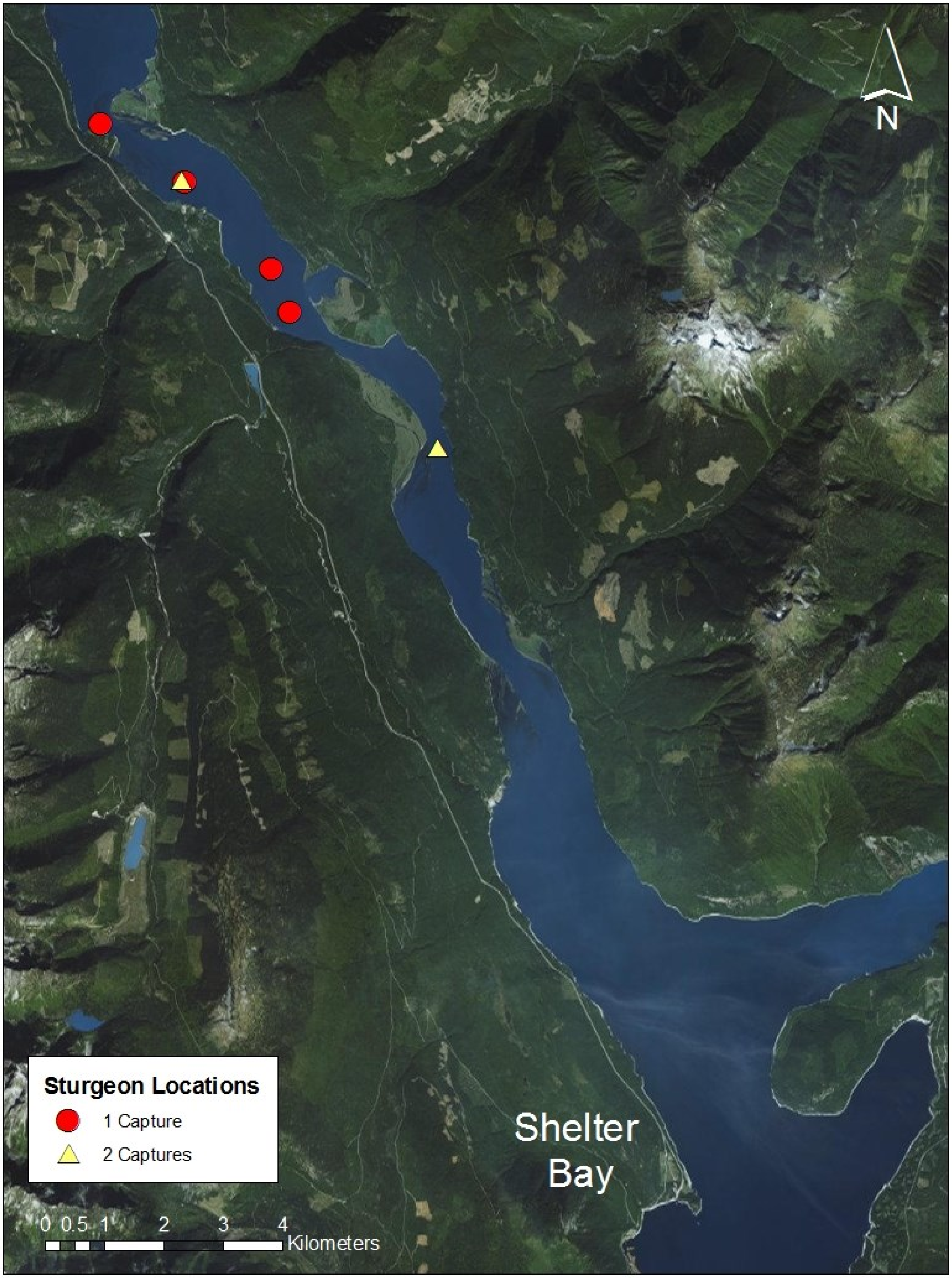

Figure 9: Location of juvenile White Sturgeon captures in 2016.

Bycatch from GRTS sites in 2016 is shown in Figure 10. Of the 541 individual fish captured as bycatch, 156 died (29%). Bull Trout (*Salvelinus confluentus*) mortality in 2016 was 35%. The most common bycatch species captured in gillnets were Mountain Whitefish (*Prosopium williamsoni*) and Northern Pikeminnow; setlines were most efficient at capturing Burbot.

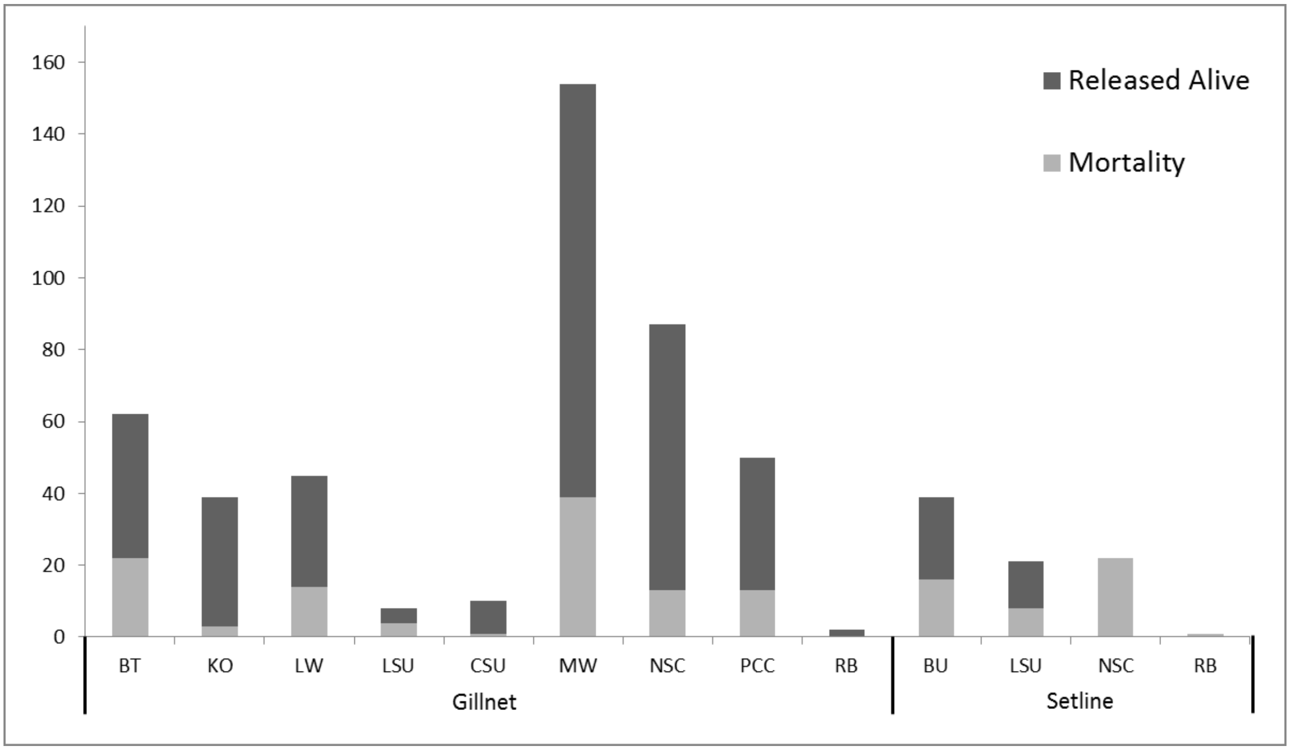

Figure 10: Bycatch by equipment type showing species and number captured in 2016 with associated mortality of each species. BT = Bull Trout, KO = Kokanee, LW = Lake Whitefish (*Coregonus clupaeformis*), LSU = Largescale Sucker, CSU = Longnose Sucker, MW = Mountain Whitefish, NSC = Northern Pikeminnow, PCC = Peamouth Chub, RB = Rainbow Trout (*Onchorynchus mykiss*), BU = Burbot.

3.4 Juvenile Sturgeon Size and Growth

Body size measurements of all sturgeon captured during CLBMON-21 to date (2008-2016) are shown in Tables 4 (for fish captured in the same year of release) and Table 5 (for fish captured at least one year following release). Most (75%) of the Sturgeon captured in 2016 had been released in spring of the same year (Table 4), except for two Sturgeon who had survived at least 2 years at large (Table 5). The mean annual growth in length for sturgeon captured after at least one year at large is 8.78 cm ± 3.6 (range: 3.70 – 14.56 cm) and mean annual increase in weight is 0.21 kg ± 0.19 (range: 0.02 – 0.70 kg). Figure 11 shows the weight-length relationship based on capture results for all juvenile White Sturgeon captures from 2008-2016. There have been no captures from the 2010 or 2011 year classes to date.

Table 4: Capture information including number of days at large and total growth (length and weight) since release for fish captured the same year after release (<365 days at large) from 2008-2016.

	ID	Fork Length at Capture (cm)	Weight at Capture (kg)	Capture Method	Capture Date	Fork Length at Release (cm)	Weight at Release (kg)	Year Class	Days at Large	Years at Large	Total Growth Since Release		Percent of Growth	
											Length (cm)	Weight (kg)	Length (%)	Weight (%)
Fish captured the same year after release	2008-1	25.10	0.08	gillnet	9/9/2008	21.00	0.07	2007	134	0.37	4.10	0.01	20	21
	2008-2	35.60	0.22	gillnet	9/12/2008	31.00	0.23	2007	137	0.38	4.60	0.00	15	-1
	2009-1	38.50	0.35	gillnet	8/21/2009	32.00	0.25	2008	121	0.33	6.50	0.10	20	40
	2010-3	27.50	0.11	gillnet	10/6/2010	22.00	0.08	2009	167	0.46	5.50	0.02	25	29
	2014-10	39.00	0.33	setline	10/9/2014	29.00	0.22	2013	155	0.42	10.00	0.11	34	50
	2014-6	34.00	0.22	gillnet	9/23/2014	28.00	0.20	2013	139	0.38	6.00	0.02	21	10
	2014-7	32.10	0.18	setline	9/23/2014	28.00	0.20	2013	139	0.38	4.10	-0.02	15	-10
	2014-8	39.00	0.38	setline	10/2/2014	29.00	0.22	2013	148	0.41	10.00	0.16	34	73
	2014-9	28.00	0.13	gillnet	10/8/2014	28.00	0.20	2013	154	0.42	0.00	-0.07	0	-35
	2015-1	30.50	0.24	gillnet	9/1/2015	29.00	0.19	2014	117	0.32	1.50	0.05	5	26
	2016-1	39.00	0.37	setline	9/12/2016	27.00	0.15	2014	128	0.35	12.00	0.22	44	151
	2016-4	44.50	0.64	setline	9/18/2016	41.00	0.55	2014	136	0.37	3.50	0.10	9	18
	2016-5	43.00	0.53	setline	9/23/2016	42.00	0.54	2014	141	0.39	1.00	-0.01	2	-2
	2016-6	38.00	0.39	setline	9/24/2016	29.00	0.22	2014	140	0.38	9.00	0.17	31	76
	2016-7	33.00	0.14	setline	9/25/2016	26.50	0.14	2014	141	0.39	6.50	0.00	25	2
	2016-8	48.00	0.44	setline	9/25/2016	27.00	0.14	2014	141	0.39	21.00	0.31	78	226
Average									**140**	**0.38**	**6.58**	**0.07**	**24**	**42**

Table 5: Capture information including number of days at large and total growth (length and weight) since release for fish captured at least one year after release (>365 days at large) from 2008-2016.

	ID	Fork Length at Capture (cm)	Weight at Capture (kg)	Capture Method	Capture Date	Fork Length at Release (cm)	Weight at Release (kg)	Year Class	Days at Large	Years at Large	Total Growth Since Release		Growth/Year	
											Length (cm)	Weight (kg)	Length (cm)	Weight (kg)
Fish captured at least one year after release	2008-3	26.80	0.11	gillnet	9/17/2008	19.00	0.04	2006	504	1.38	7.80	0.07	5.65	0.05
	2008-4	25.30	0.08	gillnet	9/17/2008	18.00	0.04	2006	504	1.38	7.30	0.03	5.29	0.02
	2009-2	38.00	0.28	gillnet	8/22/2009	19.00	0.04	2006	843	2.31	19.00	0.24	8.23	0.10
	2010-1	54.00	0.89	gillnet	9/15/2010	34.00	0.25	2008	511	1.40	20.00	0.63	14.29	0.45
	2010-2	42.60	0.43	gillnet	10/4/2010	25.00	0.12	2008	530	1.45	17.60	0.31	12.12	0.22
	2010-4	62.30	1.42	gillnet	10/8/2010	41.00	0.39	2008	534	1.46	21.30	1.03	14.56	0.70
	2014-1	41.00	0.43	gillnet	8/18/2014	30.00	0.22	2012	466	1.28	11.00	0.21	8.60	0.16
	2014-11	46.50	0.63	gillnet	10/10/2014	29.00	0.18	2012	519	1.42	17.50	0.45	12.30	0.31
	2014-2	36.00	0.29	gillnet	9/19/2014	31.00	0.21	2012	498	1.36	5.00	0.08	3.70	0.06
	2014-3	44.50	-	gillnet	9/20/2014	29.00	0.18	2012	499	1.37	15.50	N/A	11.34	N/A
	2014-4	41.50	0.52	setline	9/21/2014	30.00	0.20	2012	500	1.37	11.50	0.34	8.40	0.25
	2014-5	36.80	0.30	gillnet	9/22/2014	28.00	0.17	2012	501	1.37	8.80	0.13	6.40	0.09
	2016-2	40.50	0.38	setline	9/13/2016	29.00	0.22	2013	860	2.36	11.50	0.16	4.88	0.07
	2016-3	54.00	1.01	setline	9/18/2016	30.00	0.21	2012	1228	3.36	24.00	0.81	7.13	0.24
	Average								**607**	**1.66**	**14.13**	**0.35**	**8.78**	**0.21**

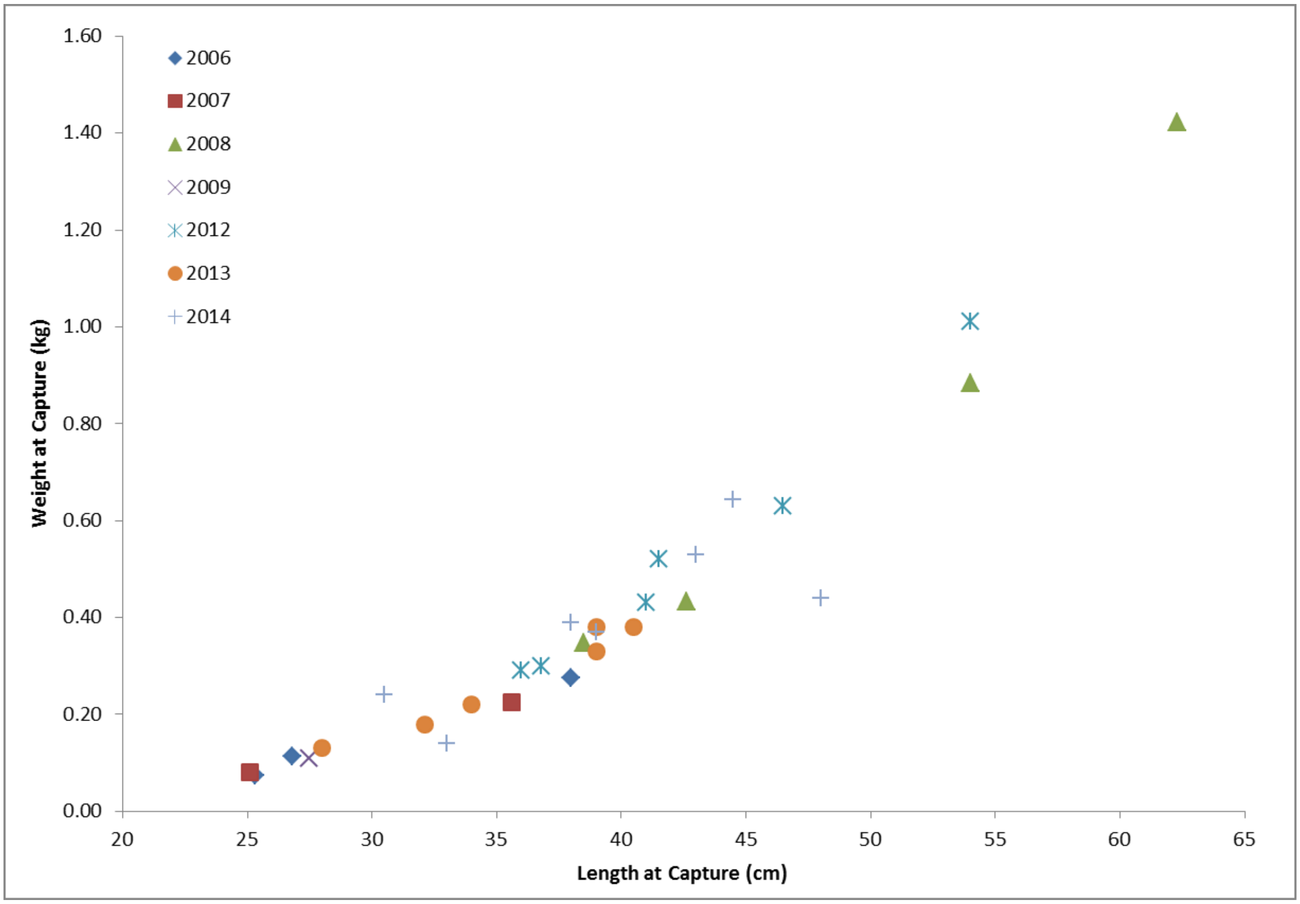

Figure 11: Weight (kg) - length (cm) relationship based on capture results for all juvenile White Sturgeon captures from 2008 – 2016.

3.5 Habitat Use

All of the juvenile White Sturgeon were captured in the riverine section of the mid-Columbia River extending from Greenslide Creek to the Shelter Bay boat launch. The mean depth and water temperature data for sites where juvenile White Sturgeon were captured are listed in Table 6. Targeting shallow depths (8.3-13 m) with cool water temperatures (10-11˚C) was most successful for capturing juvenile Sturgeon. From 2013-2016, the mean depth for setline captures was 10.85 m and for gillnets 10.15 m. Mean water temperature at captures averaged 10.25 – 10.75°C inclusive of both capture methods.

Table 6: Mean set depth (m) and temperature (°C) of set line and gill net sites from 2013-2016 separated by capture success.

Capture Year	Capture?	Mean Setline Depth (m)	Mean Setline Water Temp (°C)	Mean Gillnet Depth (m)	Mean Gillnet Water Temp (°C)
2013	No	20.1	12.1	16.2	12.1
2014	*Yes*	*13.4*	*10.1*	*11.3*	*10.3*
2014	No	8.9	13.6	13.4	13.7
2015	*Yes*	*n/a*	*n/a*	*9*	*11.2*
2015	No	13.8	13.8	14.4	13.3
2016	*Yes*	8.3	10.4	*n/a*	*n/a*
2016	No	11	13.5	12.3	13.5

3.5.1 Substrate Analysis and Gastric Lavage

A total of 15 bottom substrate samples were collected in September 2016 from a subsample of sturgeon capture locations from 2014-2016 (Appendix C). Six of the 15 samples had invertebrates, all from the Order Diptera. Biting and non-biting midges were the primary suspected species (see photos in Appendix C). The density of prey per sample ranged from 0.001-0.11. The dominant substrate was sand (medium/coarse) with some samples consisting of pebbles/granules, clay and fine sand. Many of the samples also contained driftwood or vegetation.

Gastric lavage samples were collected from two fish captured in 2016. There were no contents in either of the samples.

4.0 DISCUSSION

The objective of CLBMON-21 since 2013 has been to maximize juvenile White Sturgeon captures in the Upper Arrow Lakes section of the Columbia River in order to address the management questions posed within the Terms of Reference (BC Hydro 2007). Despite low capture rates of juvenile White Sturgeon to date in this monitoring program, results contribute to the current state of knowledge on habitat use and growth rates.

Where are the habitat locations utilized by juvenile sturgeon in the mid-Columbia?

All juvenile White Sturgeon captured to date have been within the riverine section of the mid-Columbia River between Greenslide Creek and Shelter Bay. This habitat most closely represents the historical habitat that would have been available in the Columbia River prior to impoundment. To date, juvenile White Sturgeon have not been captured within the Upper Arrow Lakes section of the mid-Columbia River between McDonald Creek and Galena Bay.

Previous efforts aimed at capturing juvenile White Sturgeon between 2007 and 2010 resulted in 10 captures using the same methods employed in the current study (Golder 2011). In addition, an array of telemetry receivers were used to record movement and microhabitat use for juvenile Sturgeon implanted with acoustic tags which were released annually from 2007-2012. Analysis of post-release data showed that juvenile Sturgeon released at upstream sites (in the vicinity of Revelstoke) made rapid movements downstream into deeper habitat providing lower water velocities. Those fish released at downstream sites exhibited variable movements with no trend being evident (Golder 2011).

The resulting low capture rates spurred the initiation of a program in 2012 aimed at documenting fine-scale movements in relation to environmental parameters (e.g., water levels) using acoustic receivers to provide more detailed information on the habitat use of juvenile White Sturgeon (Golder and ONA 2013). In 2012, 50 juvenile White Sturgeon tagged with acoustic transmitters were released into a 3 km section of the mid-Columbia River where an array of 29 acoustic receivers were positioned with the intent of collecting more detailed movement and habitat use information. The study found that both habitat use and movements appear to change seasonally, and that juvenile Sturgeon use a range of water depths throughout the year but most commonly used the thalweg portion of the river. Juvenile White Sturgeon were found to use shallow and floodplain areas in summer and fall but rarely throughout the spring; juveniles were also found to use shallow water in all reservoir elevations. Daily movements also varied between seasons and were more frequent, faster and longer in summer compared to spring and fall (Golder and ONA 2013). Habitat use and capture locations from the 2013 – 2016 study sessions were consistent with the results of the telemetry study and with previous capture results.

What are the physical and hydraulic properties of this habitat that define its suitability as juvenile sturgeon habitat?

Sturgeon captures in 2014-2016 occurred when water temperatures were < 11.5˚C at set depths between 8.3-13.5 m. Substrate samples taken at capture locations contained primarily sand (medium/coarse) with some pebbles and granules; it appears juvenile White Sturgeon prefer habitats with fine substrates. The primary objective of field sampling in 2016, however, was to expend maximum effort capturing juvenile White Sturgeon and therefore data is limited on the hydraulic properties of capture locations. Additional substrate samples from un-sampled capture locations as well as water stage and velocity data could provide more information on the physical and hydraulic conditions at capture locations.

What is the quantity of available habitat meeting these conditions in the mid-Columbia?

Insufficient data is available to accurately address this question at this time. Bathymetry data and hydraulic modelling could be used to determine the amount of suitable habitat for juvenile White Sturgeon in the mid-Columbia River including the Upper and Lower Arrow Lakes, which could vary based on reservoir operations. Capture data to date indicate juvenile White Sturgeon primarily use transitional riverine habitats north of their release site (Shelter Bay), spanning approximately 45 km straight line distance up to Drimmie Creek just south of Greenslide Creek.

Physical and hydraulic modelling based on reservoir elevation would provide better insight to the amount and availability of habitat suitable for juvenile White Sturgeon in the mid-Columbia River.

How do hydraulic conditions resulting from dam and reservoir operations relate to habitat suitability for juvenile White Sturgeon in the mid-Columbia?

The results from these study years did not provide the information required to answer this question. However, previous studies (Golder 2008, 2009, 2010, 2011, 2012 and Golder and ONA 2013) identified the habitat use and movements of juvenile White Sturgeon appear to be dependent upon season, and that they are most commonly found within deep, slow-moving environments (i.e., the thalweg portion of the river). Shallow and flood-plain habitats were also used to some degree depending on season; however long distance movements were often recorded from these habitats into thalweg areas during the reservoirs emptying phase. Intuitively, dam and reservoir operations influence the amount of thalweg, floodplain and shallow habitats available seasonally for juvenile White Sturgeon, which may consequently affect movements. However, juvenile White Sturgeon tended to use the deeper habitats which are available under most operating regimes.

What are the survival rates of juvenile White Sturgeon in the Middle Columbia River?

Insufficient data is available to address this question at this time. However, since 2013 the Conservation Aquaculture Program has been increasing the size of juvenile White Sturgeon being released in an attempt to address overwinter survival (evaluated through this program). Prior to 2013 Sturgeon were released at weights ranging between 55 – 81 g, however the average size at release was nearly doubled between 2013-2015, and increased again in 2016 (Table 6). Consistent with 2016, the target size at release for 2017-2018 is 300 g with the hope that this increased size will reduce predation and provide sufficient resources to survive overwinter.

Table 7: Release information by year for the Conservation Aquaculture Program on the ALR showing number of juvenile White Sturgeon released by year and the mean size at release.

Year	Number Released	Cumulative	Number Recaptured	Size at Release
2007	4,206	4,206	0	58.6
2008	6,534	10,740	4	60.9
2009	8,168	18,908	2	66.3
2010	9,625	28,533	4	80.7
2011	8,078	36,611	No sampling	55.0
2012	6,567	43,178	No sampling	81.0
2013	5,944	49,122	0	154.0
2014	3,288	52,410	11	147.8
2015	6,013	58,423	1	202.0
2016	1,301	59,724	8	400.0

Capture rates of juveniles in the mid-Columbia River have been low in all years of sampling (total captures = 30, 2007-2016) with no fish recaptured in subsequent sampling events. The lack of recaptures precludes estimating survival at this point.

Compared to similar juvenile White Sturgeon monitoring programs (including those supplemented by hatchery releases), the recapture rate in the mid-Columbia is low. For example, efforts on the Lower Columbia River using similar methods resulted in recapture rates of 0.84 and 1.12 CPUE in 2011 and 2012, respectively (BC Hydro 2015). Trawling and tangle netting efforts in the Fraser River resulted in 35 juvenile White Sturgeon captures in 2009 and 2010 however effort data was not reported therefore CPUE comparisons cannot be made (Glova *et al.* 2010). Comparative to the results of this report, few juvenile White Sturgeon were captured in the Nechako River in 2009 using set line and angling methods resulting in a CPUE of 0.02 (Courtier 2010).

In order to address survival in this program, increased captures and/or identification of sources of mortality are required. Increasing sampling effort and targeting areas of previous capture in all seasons may aid in capturing more juvenile Sturgeon. Efforts to reduce bycatch mortality, especially for Bull Trout (*Salvelinus confluentus*), however, limit the duration of sets and sampling locations depending on time of year (see Golder 2011). However, setlines can be easily used in the riverine section between Shelter Bay and Greenslide Creek and are less likely to capture Bull Trout.

Can modifications be made to the operations of Revelstoke Dam and/or Arrow Lakes Reservoir to protect or enhance juvenile White Sturgeon habitat?

Capture results to date have primarily been successful in the riverine section of the Columbia River between Greenslide Creek and Shelter Bay. This section of river is sensitive to daily fluctuations in water levels resulting from discharge rates from the Revelstoke Dam, especially during very low Arrow Lakes Reservoir levels. However, based on the results of the last nine years of sampling and research, juvenile White Sturgeon appear to prefer deep, slow moving environments found within the thalweg portion of the Columbia River. These habitats are available between Shelter Bay and Greenslide Creek and downstream of Shelter Bay. Sampling in the riverine section becomes challenging when Arrow Reservoir elevations are below 430 MASL due to shallow water.

5.0 RECOMMENDATIONS

Based on the results of the 2016 sampling year and previous years, the ONA recommends the following:

- Based on the low capture rates to date, we propose sampling areas of previous capture earlier in the year (spring). This sampling will be conducted using only setlines since gillnets are prone to drifting in the upper riverine section and to reduce the risk of Bull Trout mortality;
- Sampling below Beaton Flats and into the Lower Arrow Lakes would also provide insight as to whether Sturgeon are able to travel long distances to meet habitat requirements;
- Additional substrate samples taken from Sturgeon capture locations will provide more data on habitat use and prey availability. To date, samples have been collected from capture locations in 2014, 2015 and 4 from 2016. We recommended collecting substrate from capture locations from 2008-2011 as well as remaining locations from 2016;
- Install a Levelogger® or similar water stage logger in Reach 1 of the mid-Columbia River where all captures have been located. This will provide information on water levels in the riverine section relative to discharge from REV;
- Record velocity at the bottom of the water column at capture locations to provide further information on the hydraulic conditions at capture locations; and,
- Extending the sampling period further into the fall (September-October) when the majority of captures have occurred previously may increase capture success.

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7.0 CLOSURE

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APPENDIX A: ONA-BC HYDRO FIELD DATA SHEET – JUVENILE STURGEON SAMPLING

2016 Middle Columbia River Juvenile White Sturgeon Sampling Session

CREW: ______________________ **WEATHER:** ______________________ **No. HOOKS SET/LO:** ______________________
SITE DESCRIPTION: ______________________
SET COMMENTS: ______________________ **PICK COMMENTS:** ______________________

LOCATION	GRTS SAMPLE #	LOCATION			SET DEPTH (m)		SET			PICK		
		rKm	UTM (NAD 83)				DATE	TIME	TEMP	DATE	TIME	TEMP
			Easting	Northing			Y Y M M D D	h h m m	°C	Y Y M M D D	h h m m	°C
MCR					MIN		1 6			1 6		
					MAX							

WP: ______________ Bait Type: ______________ Substrate: ______________ most to least dominant Cover: ______________
Orientation to flow: parallel oblique perpendicular Location in water colu upper mid lower

WSG Catch Summary:

FORK LENGTH (cm)	WEIGHT (kg)	DISP	AT CAPTURE					APPLIED			DNA ID	PIT NUMBER	PHOTOS	COMMENTS
			PECT	SCUTE SCARS	PIT	EXTAG	DEFOM	SCUTE S REMOV	PIT	DNA				
											MCR-WS-2016-			
											MCR-WS-2016-			
											MCR-WS-2016-			
											MCR-WS-2016-			

Incidental Catch Summary

Species	Life Stage	Number	look Size/Ba	# Live	# Dead	Comments

KEY TO FIELDS
SPECIE WSG = white sturgeon; BB = burbot; NSC = Northern Pikeminnow; BT = Bull Trout; LSU = Longnose Sucker; CSU = Largescale Sucker; MW = Mountain Whitefish
DISP (disposition) R = alive and released S = sacrificed D = dead at captur **PIT** Y = present/applied (record number in provided box) N = not present/not applied
PECT (pectoral fi L = left ray R = right ray B = both rays N = neither ray **EXTAG (extern** Y = present S = scar N = none

Appendix B: Raw Field Data 2016

Gillnets

Set Number	Site	Location			Set Date	Set Time	Water Temp. (Celsius)	Pull Date	Pull Time	Water Depth (m)		Orientation to Flow	Location in water Column	Soak Time	WSG Catch Summary
		Zone	Easting	Northing						Min	Max				
1	G112B	11	443433	5557460	6/1/2016	10:15	13.9	6/1/2016	14:56	6.4	13.6	parallel	lower	4:41	0
2	G064B	11	441723	5556443	6/1/2016	9:50	13.8	6/1/2016	14:30	19.2	21.7	perpendicular	lower	4:40	0
3	G152B	11	443341	5557050	6/1/2016	10:04	13.8	6/1/2016	14:45	16.0	16.2	perpendicular	lower	4:41	0
4	G048B	11	442273	5556081	6/1/2016	9:28	13.5	6/1/2016	13:50	13.0	22.3	perpendicular	lower	4:22	0
5	G096B	11	442268	5556360	6/1/2016	9:40	13.5	6/1/2016	14:06	28.6	30.4	perpendicular	lower	4:26	0
6	G144B	11	440961	5559441	6/2/2016	10:00	13.0	6/2/2016	14:30	9.8	16.4	parallel	lower	4:30	0
7	G160B	11	443368	5557743	6/2/2016	9:20	13.9	6/2/2016	13:40	26.3	16.3	parallel	lower	4:20	0
8	G200B	11	443462	5558143	6/2/2016	9:27	13.9	6/2/2016	13:55	7.2	10.7	parallel	lower	4:28	0
9	G080B	11	441036	5559095	6/2/2016	9:50	13.2	6/2/2016	14:16	10.6	14.3	parallel	lower	4:26	0
10	G032B	11	443611	5558230	6/2/2016	9:36	13.3	6/2/2016	14:05	12.3	13.2	oblique	lower	4:29	0
11	G128B	11	440791	5560012	6/3/2016	9:10	13.7	6/3/2016	13:30	14.4	19.6	parallel	lower	4:20	0
12	G072B	11	440826	5550782	6/3/2016	9:20	14.0	6/3/2016	13:44	13.0	14.7	perpendicular	lower	4:24	0
13	G161B	11	444376	5561508	6/3/2016	9:45	13.9	6/3/2016	14:20	13.2	24.0	oblique	lower	4:35	0
14	G016B	11	440957	5551204	6/3/2016	9:30	13.9	6/3/2016	13:55	9.6	26.1	oblique	lower	4:25	0
15	G113B	11	444376	5561740	6/3/2016	9:55	14.1	6/3/2016	14:30	9.4	15.4	parallel	lower	4:35	0
16	G033B	11	443877	5562777	6/5/2016	10:25	15.2	6/5/2016	14:35	9.2	12.3	parallel	lower	4:10	0
17	G017B	11	443950	5562596	6/5/2016	10:15	15.6	6/5/2016	14:20	9.0	15.6	parallel	lower	4:05	0
18	G129B	11	440476	5563324	6/5/2016	11:00	17.7	6/5/2016	15:16	7.2	12.4	parallel	lower	4:16	0
19	G169B	11	443630	5563401	6/5/2016	10:37	16.4	6/5/2016	14:45	9.3	16.4	parallel	lower	4:08	0
20	G081B	11	448481	5563244	6/5/2016	10:51	17.7	6/5/2016	15:00	8.6	48.7	perpendicular	lower	4:09	0
21	G179B	11	440902	5566126	6/6/2016	8:30	16.3	6/6/2016	13:12	11.0	14.0	parallel	lower	4:42	0
22	G035B	11	439585	5564332	6/6/2016	8:00	16.2	6/6/2016	12:45	7.0	18.0	parallel	lower	4:45	0
23	G051B	11	441022	5565683	6/6/2016	8:20	16.5	6/6/2016	13:00	10.0	13.0	perpendicular	lower	4:40	0
24	G083B	11	439930	5563923	6/6/2016	7:50	15.5	6/6/2016	12:21	13.0	24.0	parallel	lower	4:31	0
25	G001B	11	440218	5563674	6/6/2016	7:43	15.1	6/6/2016	12:10	22.0	31.0	parallel	lower	4:27	0
26	G003B	11	438275	5567947	6/7/2016	8:20	16.3	6/7/2016	12:42	18.0	25.0	parallel	lower	4:22	0
27	G187B	11	441192	5567254	6/7/2016	7:50	16.3	6/7/2016	12:04	14.0	34.0	perpendicular	lower	4:14	0
28	G099B	11	440997	5566699	6/7/2016	7:40	16.5	6/7/2016	11:50	15.0	24.0	oblique	lower	4:10	0
29	G198B	11	438278	5567580	6/7/2016	8:09	16.7	6/7/2016	12:30	8.0	12.0	parallel	lower	4:21	0
30	G115B	11	441540	5567455	6/7/2016	8:00	16.0	6/7/2016	12:14	17.0	28.0	parallel	lower	4:14	0
31	G131B	11	441018	5569773	6/8/2016	9:30	16.7	6/8/2016	12:14	7.0	18.0	parallel	lower	2:44	0
32	G171B	11	437879	5568760	6/8/2016	9:20	17.2	6/8/2016	11:56	10.0	14.5	parallel	lower	2:36	0
33	G019B	11	437979	5568415	6/8/2016	9:12	17.4	6/8/2016	11:50	9.0	16.0	parallel	lower	2:38	0

34	G163B	11	438082	5568194	6/8/2016	9:04	17.5	6/8/2016	11:40	9.0	13.0	parallel	lower	2:36	0
35	G062B	11	441081	5570235	6/8/2016	9:40	16.4	6/8/2016	12:25	9.0	16.0	parallel	lower	2:45	0
36	G046B	11	436623	5570716	6/21/2016	9:45	12.4	6/21/2016	13:15	12.3	13.4	parallel	lower	3:30	0
37	G142B	11	436677	5570573	6/21/2016	9:36	12.5	6/21/2016	13:05	12.3	10.7	parallel	lower	3:29	0
38	G150B	11	439762	5571921	6/21/2016	9:20	13.1	6/21/2016	12:50	11.5	14.5	perpendicular	lower	3:30	0
39	G110B	11	439999	5571780	6/21/2016	9:05	13.4	6/21/2016	12:40	8.5	16.9	perpendicular	lower	3:35	0
40	G158B	11	440542	5571332	6/21/2016	8:56	13.8	6/21/2016	12:30	16.5	24.6	parallel	lower	3:34	0
41	G135B	11	435590	5572372	6/22/2016	9:20	12.9	6/22/2016	13:18	13.0	22.0	parallel	lower	3:58	0
42	G039B	11	438262	55739911	6/22/2016	9:40	13.5	6/22/2016	13:38	8.0	20.0	parallel	lower	3:58	0
43	G087B	11	435822	5572033	6/22/2016	9:14	13.0	6/22/2016	13:09	10.5	16.0	parallel	lower	3:55	0
44	G094B	11	436310	5571208	6/22/2016	9:04	13.0	6/22/2016	12:55	7.0	17.0	parallel	lower	3:51	0
45	G075B	11	437933	5574765	6/22/2016	9:54	13.6	6/22/2016	13:50	7.5	22.5	oblique	lower	3:56	0
46	G191B	11	433740	5575632	6/23/2016	9:46	13.7	6/23/2016	13:17	12.0	17.0	parallel	lower	3:31	0
47	G007B	11	433936	5575037	6/23/2016	9:36	13.7	6/23/2016	13:06	12.0	18.0	parallel	lower	3:30	0
48	G067B	11	437580	5575749	6/23/2016	9:15	12.8	6/23/2016	12:53	11.0	17.0	parallel	lower	3:38	0
49	G119B	11	437810	5575247	6/23/2016	9:05	12.9	6/23/2016	12:47	6.0	10.0	parallel	lower	3:42	0
50	G023B	11	437908	5574757	6/23/2016	9:00	13.0	6/23/2016	12:31	11.0	15.0	parallel	lower	3:31	0
51	G147B	11	434027	5576604	6/24/2016	9:05	14.0	6/24/2016	11:55	10.8	21.3	perpendicular	lower	2:50	0
52	G155B	11	433661	5575969	6/24/2016	9:00	13.8	6/24/2016	11:45	13.1	13.9	oblique	lower	2:45	0
53	G015B	11	434051	5578198	6/25/2016	9:15	11.4	6/25/2016	13:35	4.5	13.3	parallel	lower	4:20	0
54	G055B	11	434047	5576628	6/25/2016	9:56	11.9	6/25/2016	14:00	12.5	30.5	oblique	lower	4:04	0
55	G103B	11	433906	5577354	6/25/2016	9:05	11.4	6/25/2016	13:50	18.8	23.1	perpendicular	lower	4:45	0
56	G107B	11	436316	5578682	6/25/2016	9:35	12.7	6/25/2016	12:58	19.6	17.4	parallel	lower	3:23	0
57	G195B	11	436374	5578225	6/25/2016	9:25	12.6	6/25/2016	13:15	7.6	12.0	oblique	lower	3:50	0
58	G183B	11	433398	5580956	6/26/2016	9:57	13.7	6/26/2016	13:40	9.0	13.0	parallel	lower	3:43	0
59	G043B	11	436447	5579876	6/26/2016	9:38	12.8	6/26/2016	13:25	9.0	12.0	parallel	lower	3:47	0
60	G091B	11	436415	5519593	6/26/2016	9:30	13.2	6/26/2016	13:19	10.0	17.0	perpendicular	lower	3:49	0
61	G059B	11	436367	5579184	6/26/2016	9:22	13.0	6/26/2016	13:09	8.0	16.0	perpendicular	lower	3:47	0
62	G139B	11	433840	5581429	6/26/2016	10:07	13.3	6/26/2016	13:52	9.0	14.0	parallel	lower	3:45	0
63	G175B	11	434008	5581889	6/27/2016	10:15	14.3	6/27/2016	13:04	6.1	6.5	parallel	lower	2:49	0
64	G027B	11	433884	5581600	6/27/2016	10:08	14.4	6/27/2016	12:50	21.0	38.0	parallel	middle	2:42	0
65	G011B	11	436465	5592885	6/27/2016	10:35	13.6	6/27/2016	13:35	11.2	16.0	parallel	lower	3:00	0
66	G167B	11	436503	5582444	6/27/2016	10:27	13.6	6/27/2016	13:20	12.1	16.2	parallel	lower	2:53	0
67	G123B	11	436469	5583173	6/27/2016	10:43	13.1	6/27/2016	13:40	9.2	12.1	parallel	lower	2:57	0
68	G008B	11	436200	5585754	7/5/2016	11:15	13.5	7/5/2016	14:20	11.7	21.7	parallel	lower	3:05	0
69	G180B	11	433961	5583379	7/5/2016	10:20	13.3	7/5/2016	13:20	10.6	11.5	parallel	lower	3:00	0
70	G036B	11	433977	5584036	7/5/2016	10:31	13.6	7/5/2016	13:30	17.3	17.6	parallel	lower	2:59	0

71	G084B	11	433932	5584329	7/5/2016	10:45	17.0	7/5/2016	13:40	13.6	24.9	parallel	lower	2:55	0
72	G188B	11	436045	5584965	7/5/2016	11:00	13.9	7/5/2016	14:00	9.0	25.0	oblique	lower	3:00	0
73	G052B	11	436073	5586348	7/6/2016	10:15	14.6	7/6/2016	13:15	16.4	17.4	parallel	lower	3:00	0
74	G100B	11	436140	5585960	7/6/2016	10:03	14.5	7/6/2016	13:00	12.7	13.3	parallel	lower	2:57	0
75	G020B	11	433235	5586365	7/6/2016	10:35	14.2	7/6/2016	13:40	14.3	16.4	parallel	lower	3:05	0
76	G132B	11	436073	5586535	7/6/2016	10:24	14.7	7/6/2016	13:25	14.1	19.3	parallel	lower	3:01	0
77	G164B	11	433016	5586618	7/6/2016	10:42	14.3	7/6/2016	13:55	18.1	24.2	parallel	lower	3:13	0
78	G004B	11	432366	5587540	7/7/2016	9:46	14.2	7/7/2016	13:14	10.4	15.2	perpendicular	lower	3:28	0
79	G172B	11	432526	5587120	7/7/2016	9:35	14.2	7/7/2016	13:03	13.4	14.2	parallel	lower	3:28	0
80	G116B	11	432313	5588178	7/7/2016	9:55	13.7	7/7/2016	13:25	15.2	15.9	parallel	lower	3:30	0
81	G063B	11	436178	5588124	7/7/2016	10:10	15.2	7/7/2016	13:50	7.3	7.5	perpendicular	lower	3:40	0
82	G151B	11	435300	5589529	7/7/2016	10:24	15.3	7/7/2016	14:05	14.2	23.0	parallel	lower	3:41	0
83	G095B	11	435303	5589688	7/8/2016	9:15	15.2	7/8/2016	12:20	11.8	12.4	parallel	lower	3:05	0
84	G159B	11	435046	5590575	7/8/2016	9:26	15.1	7/8/2016	12:35	13.2	16.2	parallel	lower	3:09	0
85	G111B	11	432303	5991015	7/8/2016	9:47	13.9	7/8/2016	13:00	15.5	15.5	parallel	lower	3:13	0
86	G199B	11	435127	5591175	7/8/2016	9:36	15.1	7/8/2016	12:50	12.5	15.0	parallel	lower	3:14	0
87	G071B	11	432208	5592350	7/8/2016	9:56	13.8	7/8/2016	13:10	7.0	16.0	parallel	lower	3:14	0
88	G031B	11	432124	5592969	7/9/2016	9:55	14.0	7/9/2016	13:05	20.0	20.7	parallel	lower	3:10	0
89	G127B	11	432143	5593185	7/9/2016	10:01	14.0	7/9/2016	13:15	9.0	11.3	parallel	lower	3:14	0
90	G143B	11	432185	5593512	7/9/2016	10:10	14.0	7/9/2016	13:20	9.0	13.7	parallel	lower	3:10	0
91	G047B	11	435370	5593419	7/9/2016	10:24	15.2	7/9/2016	13:42	11.8	12.3	parallel	lower	3:18	0
92	G079B	11	435512	5593873	7/9/2016	10:31	15.3	7/9/2016	13:55	15.6	20.7	parallel	lower	3:24	0
93	G060B	11	435595	5594166	7/10/2016	9:54	15.5	7/10/2016	13:45	8.0	25.0	parallel	lower	3:51	0
94	G108B	11	435658	5594569	7/10/2016	10:00	15.4	7/10/2016	14:00	14.0	15.2	parallel	lower	4:00	0
95	G196B	11	435680	5595027	7/10/2016	10:15	16.1	7/10/2016	14:12	8.4	24.0	parallel	lower	3:57	0
96	G184B	11	432603	5596428	7/10/2016	10:29	15.4	7/10/2016	14:20	10.4	15.0	parallel	lower	3:51	0
97	G092B	11	432755	5596718	7/10/2016	10:35	15.2	7/10/2016	14:30	10.4	15.6	parallel	lower	3:55	0
98	G140B	11	432865	5597866	7/11/2016	10:20	15.4	7/11/2016	13:50	12.4	12.8	parallel	lower	3:30	0
99	G028B	11	435586	5598492	7/11/2016	10:33	16.8	7/11/2016	13:10	14.2	16.8	parallel	lower	2:37	0
100	G044B	11	432803	5597179	7/11/2016	10:02	15.4	7/11/2016	14:08	10.9	12.7	parallel	lower	4:06	0
101	G176B	11	433037	5597654	7/11/2016	10:05	15.3	7/11/2016	13:56	11.5	14.9	parallel	lower	3:51	0
102	G012B	11	435591	5598856	7/11/2016	10:41	17.1	7/11/2016	13:20	16.4	17.7	parallel	lower	2:39	0
103	G168B	11	435680	5599135	7/12/2016	9:39	16.1	7/12/2016	12:45	9.8	20.0	parallel	lower	3:06	0
104	G124B	11	435755	5599929	7/12/2016	9:53	16.4	7/12/2016	12:54	17.1	18.5	parallel	lower	3:01	0
105	G024B	11	432776	5600831	7/12/2016	10:06	16.2	7/12/2016	13:15	8.0	11.2	parallel	lower	3:09	0

106	G136B	11	435814	5600052	7/12/2016	10:00	16.5	7/12/2016	13:04	12.2	13.8	parallel	lower	3:04	0
107	G076B	11	432695	5600988	7/12/2016	10:15	16.0	7/12/2016	13:20	11.8	12.7	parallel	lower	3:05	0
108	G040B	11	435772	5602682	8/3/2016	11:20	13.3	8/3/2016	14:00	15.8	15.6	parallel	lower	2:40	0
109	G104B	11	435639	5602953	8/3/2016	11:40	13.5	8/3/2016	14:15	15.5	8.0	parallel	lower	2:35	0
110	G068B	11	432610	5601809	8/3/2016	11:03	14.4	8/3/2016	13:50	10.0	15.5	perpendicular	lower	2:47	0
111	G120B	11	432666	5601677	8/3/2016	10:54	14.3	8/3/2016	13:38	15.2	23.0	perpendicular	lower	2:44	0
112	G192B	11	432675	5603543	8/4/2016	9:45	15.1	8/4/2016	13:20	9.0	15.0	perpendicular	lower	3:35	0
113	G148B	11	433056	5604166	8/4/2016	9:56	14.2	8/4/2016	13:55	7.0	27.0	perpendicular	lower	3:59	0
114	G156B	11	435895	5603994	8/4/2016	9:50	14.7	8/4/2016	13:40	6.0	14.0	perpendicular	lower	3:50	0
115	G056B	11	435470	5604633	8/4/2016	10:05	13.8	8/4/2016	14:10	9.5	13.0	parallel	lower	4:05	0
116	G088B	11	435570	5605188	8/4/2016	10:15	13.9	8/4/2016	14:25	7.0	26.0	parallel	lower	4:10	0
117	G138B	11	432976	5605724	8/5/2016	9:46	16.6	8/5/2016	12:55	7.3	9.0	parallel	lower	3:09	0
118	G026B	11	433321	5606439	8/5/2016	10:15	16.8	8/5/2016	12:29	9.9	20.0	parallel	lower	2:14	0
119	G174B	11	433349	5606271	8/5/2016	9:55	16.7	8/5/2016	13:15	10.5	15.0	parallel	lower	3:20	0
120	G042B	11	435239	5606001	8/5/2016	10:30	14.5	8/5/2016	13:55	9.9	20.4	parallel	lower	3:25	0
121	G166B	11	436433	5606055	8/5/2016	10:25	14.8	8/5/2016	13:40	12.4	20.2	parallel	lower	3:15	0
122	G078B	11	433727	5609197	8/6/2016	9:55	16.8	8/6/2016	14:38	6.5	12.0	parallel	lower	4:43	0
123	G030B	11	433522	5608908	8/6/2016	9:49	16.7	8/6/2016	14:32	7.0	14.0	parallel	lower	4:43	0
124	G090B	11	433488	5608704	8/6/2016	9:43	17.0	8/6/2016	14:23	9.0	15.5	parallel	lower	4:40	0
125	G014B	11	438161	5607723	8/6/2016	10:07	15.9	8/6/2016	13:52	9.5	12.5	parallel	lower	3:45	0
126	G126B	11	438419	5608218	8/6/2016	10:14	16.1	8/6/2016	14:04	9.5	12.0	parallel	lower	3:50	0
127	G058B	11	438726	5609415	8/7/2016	9:47	14.4	8/7/2016	12:48	10.1	11.2	parallel	lower	3:01	0
128	G070B	11	438625	5609120	8/7/2016	9:41	14.2	8/7/2016	12:35	9.1	10.1	parallel	lower	2:54	0
129	G182B	11	439032	5610065	8/7/2016	9:57	13.9	8/7/2016	12:57	10.5	8.5	parallel	lower	3:00	0
130	G106B	11	434852	5609649	8/7/2016	10:12	14.4	8/7/2016	13:25	10.0	11.7	parallel	lower	3:13	0
131	G194B	11	434916	5609511	8/7/2016	10:08	14.3	8/7/2016	13:15	12.5	13.5	parallel	lower	3:07	0
132	G146B	11	434252	5611166	8/8/2016	9:53	12.9	8/8/2016	13:23	6.5	12.5	perpendicular	lower	3:30	0
133	G054B	11	433947	5611814	8/8/2016	10:02	13.1	8/8/2016	13:34	6.0	10.9	perpendicular	lower	3:32	0
134	G086B	11	434476	5610679	8/8/2016	9:47	13.0	8/8/2016	13:03	7.0	12.0	perpendicular	lower	3:16	0
135	G102B	11	436535	5612883	8/8/2016	10:10	13.5	8/8/2016	13:45	8.5	12.0	parallel	lower	3:35	0
136	G154B	11	436540	5613264	8/8/2016	10:17	13.6	8/8/2016	14:07	1.5	13.0	perpendicular	lower	3:50	0
137	G038B	11	433429	5613012	8/9/2016	9:26	13.1	8/9/2016	13:36	6.2	9.4	perpendicular	lower	4:10	0
138	G190B	11	433572	5612478	8/9/2016	9:18	13.2	8/9/2016	13:27	8.1	9.2	parallel	lower	4:09	0
139	G118B	11	434672	5615946	8/9/2016	9:49	14.6	8/9/2016	13:18	10.5	10.8	perpendicular	lower	3:29	0
140	G074B	11	434814	5615918	8/9/2016	9:45	14.7	8/9/2016	13:15	7.5	10.5	perpendicular	lower	3:30	0

141	G022B	11	436163	5615792	8/9/2016	9:36	14.6	8/9/2016	12:50	N/A	N/A	parallel	lower	3:14	0
142	G149B	11	432822	5617794	8/16/2016	10:20	17.3	8/16/2016	12:55	6.5	10.5	perpendicular	lower	2:35	0
143	G122B	11	432978	5615792	8/16/2016	9:58	17.9	8/16/2016	12:35	5.8	6.1	perpendicular	lower	2:37	0
144	G134B	11	433170	5615225	8/16/2016	9:50	17.8	8/16/2016	12:30	5.6	6.3	perpendicular	lower	2:40	0
145	G061B	11	432981	5617589	8/16/2016	10:22	17.5	8/16/2016	13:00	7.5	11.5	perpendicular	lower	2:38	0
146	G010B	11	433195	5616972	8/16/2016	10:13	17.7	8/16/2016	12:50	8.0	9.5	perpendicular	lower	2:37	0
147	G093B	11	432122	5619233	8/17/2016	11:10	14.7	8/17/2016	15:08	9.1	9.9	parallel	lower	3:58	0
148	G198B	11	432110	5619100	8/17/2016	11:49	11.9	8/17/2016	15:00	7.9	10.0	perpendicular	lower	3:11	0
149	G197B	11	432408	5618622	8/17/2016	11:37	11.9	8/17/2016	14:46	6.1	11.9	perpendicular	lower	3:09	0
150	G109B	11	432826	5617845	8/17/2016	11:17	13.4	8/17/2016	14:29	4.5	9.9	parallel	lower	3:12	0
151	G157B	11	432717	5618036	8/17/2016	11:28	12.6	8/17/2016	14:35	8.1	8.8	parallel	lower	3:07	0
152	G045B	11	431520	5620745	8/18/2016	10:20	11.0	8/18/2016	12:55	5.0	7.0	perpendicular	lower	2:35	0
153	G125B	11	431293	5621162	8/18/2016	10:30	11.2	8/18/2016	13:00	8.5	10.0	parallel	lower	2:30	0
154	G077B	11	431544	5620023	8/18/2016	10:05	11.8	8/18/2016	12:40	6.5	10.5	perpendicular	lower	2:35	0
155	G141B	11	431493	5620179	8/18/2016	10:15	11.2	8/18/2016	12:45	7.0	10.0	perpendicular	lower	2:30	0
156	G069B	11	430974	5621459	8/18/2016	10:35	11.0	8/18/2016	13:10	7.0	12.0	perpendicular	lower	2:35	0
157	G029B	11	430798	5621878	8/19/2016	9:55	11.2	8/19/2016	12:50	9.0	12.3	perpendicular	lower	2:55	0
158	G013B	11	431038	5621559	8/19/2016	9:46	11.7	8/19/2016	12:35	9.7	12.1	parallel	lower	2:49	0
159	G162B	11	430277	5622455	8/19/2016	10:10	11.1	8/19/2016	13:05	7.0	12.1	perpendicular	lower	2:55	0
160	G114B	11	430501	5622304	8/19/2016	10:05	11.0	8/19/2016	13:00	7.0	10.0	parallel	lower	2:55	0
161	G002B	11	430030	5622823	8/19/2016	10:30	11.1	8/19/2016	13:24	7.0	10.0	perpendicular	lower	2:54	0
162	G050B	11	430057	5623043	8/20/2016	9:45	12.4	8/20/2016	12:25	6.5	9.0	parallel	lower	2:40	0
163	G006B	11	429666	5623529	8/20/2016	9:50	12.3	8/20/2016	12:30	7.2	7.5	parallel	lower	2:40	0
164	G066B	11	429469	5623588	8/20/2016	10:00	12.2	8/20/2016	12:40	9.5	12.5	perpendicular	lower	2:40	0
165	G186B	11	429205	5624528	8/20/2016	10:16	12.4	8/20/2016	13:00	9.5	12.0	parallel	lower	2:44	0
166	G098B	11	429221	5624219	8/20/2016	10:07	12.3	8/20/2016	12:50	8.0	11.0	parallel	lower	2:43	0
167	G034B	11	429248	5626125	8/21/2016	10:12	11.1	8/21/2016	13:22	8.8	9.7	perpendicular	lower	3:10	0
168	G082B	11	429313	5625645	8/21/2016	10:05	11.2	8/21/2016	13:11	9.7	11.1	perpendicular	lower	3:06	0
169	G018B	11	429267	5626360	8/21/2016	10:20	11.1	8/21/2016	13:30	7.4	7.5	perpendicular	lower	3:10	0
170	G130B	11	428970	5626843	8/21/2016	10:30	11.1	8/21/2016	13:42	9.4	11.7	perpendicular	lower	3:12	0
171	G178B	11	429195	5625213	8/21/2016	11:00	11.4	8/21/2016	15:05	8.4	8.8	parallel	lower	4:05	0
172	G185B	11	428788	5628874	8/22/2016	10:24	7.4	8/22/2016	11:20	6.5	13.0	parallel	lower	0:56	0
173	G049B	11	429133	5628034	8/22/2016	10:19	10.4	8/22/2016	11:05	8	13.5	parallel	lower	0:46	0
174	G005B	11	428967	5628440	8/22/2016	10:15	10.4	8/22/2016	11:10	7.0	9.5	perpendicular	lower	0:55	0
175	G170B	11	429020	5627355	8/22/2016	9:55	10.7	8/22/2016	11:45	7.0	10.5	perpendicular	lower	1:50	0

176	G097B	11	429109	5627732	8/22/2016	10:00	10.5	8/22/2016	11:55	4.0	8.0	parallel	lower	1:55	0
177	G021B	11	426226	5629751	9/7/2016	12:15	10.2	9/7/2016	15:43	13.8	15.2	parallel	lower	3:28	0
178	G133B	11	427405	5629061	9/7/2016	11:56	10.3	9/7/2016	15:20	16.1	17.4	parallel	lower	3:24	0
179	G037B	11	427143	5629159	9/7/2016	12:03	10.3	9/7/2016	15:25	11.3	12.4	parallel	lower	3:22	0
180	G065B	11	428024	5628701	9/7/2016	11:37	10.5	9/7/2016	14:37	9.8	10.4	parallel	lower	3:00	0
181	G117B	11	428064	5628851	9/7/2016	11:55	10.2	9/7/2016	15:00	3.0	12.0	oblique	lower	3:05	0
182	G053B	11	425162	5630808	9/8/2016	10:31	9.5	9/8/2016	14:50	7.4	8.3	parallel	lower	4:19	0
183	G101B	11	425277	5631417	9/8/2016	10:40	9.4	9/8/2016	15:06	8.8	9.5	parallel	lower	4:26	0
184	G189B	11	425168	5630606	9/8/2016	10:26	9.6	9/8/2016	14:37	6.5	5.6	parallel	lower	4:11	0
185	G153B	11	425578	5630172	9/8/2016	10:16	9.6	9/8/2016	14:26	8.9	10.5	parallel	lower	4:10	0
186	G073B	11	426147	5629927	9/8/2016	10:06	9.7	9/8/2016	14:07	4.7	6.5	perpendicular	lower	4:01	0
187	G089B	11	423405	5633032	9/9/2016	10:56	9.0	9/10/2016	11:30	10.8	12.3	parallel	lower	24:34:00	0
188	G177B	11	424598	5632966	9/9/2016	10:30	9.1	9/9/2016	14:40	4.3	8.0	parallel	lower	4:10	0
189	G041B	11	423813	5632881	9/9/2016	10:43	9.0	9/9/2016	14:50	7.8	9.9	perpendicular	lower	4:07	0
190	G085B	11	425271	5631919	9/9/2016	10:06	9.5	9/9/2016	14:10	7.4	8.6	perpendicular	lower	4:04	0
191	G145B	11	425035	5632296	9/9/2016	10:20	9.0	9/9/2016	14:22	6.0	6.3	parallel	lower	4:02	0
192	G3a	11	437743	5614520	9/10/2016	10:34	14.0	9/10/2016	15:05	14.2	30.0	perpendicular	lower	4:31	0
193	G4a	11	436622	5614389	9/10/2016	10:50	14.1	9/10/2016	15:15	10.4	15.7	perpendicular	lower	4:25	0
194	G1a	11	436875	5614258	9/10/2016	10:15	13.9	9/10/2016	14:36	9.2	10.8	perpendicular	lower	4:21	0
195	G2a	11	437459	5614184	9/10/2016	10:30	14.0	9/10/2016	14:53	14.9	17.2	perpendicular	lower	4:23	0
196	G8a	11	438986	5616488	9/11/2016	10:05	14.3	9/11/2016	14:30	7.0	13.0	parallel	lower	4:25	0
197	G7a	11	438403	5616443	9/11/2016	9:55	14.3	9/11/2016	14:20	12.3	12.9	parallel	lower	4:25	0
198	G6a	11	437527	5616264	9/11/2016	9:50	14.4	9/11/2016	14:11	8.0	16.0	parallel	lower	4:21	0
199	G5a	11	436912	5616027	9/11/2016	9:40	14.4	9/11/2016	14:04	18.0	20.1	parallel	lower	4:24	0
200	G10a	11	439469	5614904	9/12/2016	10:05	13.5	9/12/2016	14:54	11.6	13.0	parallel	lower	4:49	0
201	G9a	11	438896	5614777	9/12/2016	9:55	12.9	9/12/2016	14:45	11.0	12.0	parallel	lower	4:50	0
202	G12a	11	440174	5615203	9/12/2016	10:20	13.6	9/12/2016	15:15	11.0	12.0	parallel	lower	4:55	0
203	G11a	11	439858	5615035	9/12/2016	10:12	13.7	9/12/2016	15:05	10.4	16.9	parallel	lower	4:53	0
204	G14a	11	434097	5613657	9/13/2016	9:55	13.3	9/13/2016	14:36	8.0	8.9	parallel	lower	4:41	0
205	G13a	11	434499	5613723	9/13/2016	9:45	13.1	9/13/2016	14:25	7.0	8.2	oblique	lower	4:40	0
206	G15a	11	433493	5613768	9/13/2016	10:00	11.2	9/13/2016	14:50	8.8	10.0	perpendicular	lower	4:50	0
207	G16a	11	432897	5613907	9/13/2016	10:05	10.9	9/13/2016	15:00	3.9	3.5	perpendicular	lower	4:55	0
208	G17a	11	434868	5614197	9/21/2016	10:09	12.6	9/21/2016	14:09	6.4	6.9	perpendicular	lower	4:00	0
209	G18a	11	434879	5614924	9/21/2016	10:20	13.2	9/21/2016	14:25	2.3	2.5	perpendicular	lower	4:05	0
210	G19a	11	434169	5615023	9/21/2016	10:30	13.2	9/21/2016	14:40	7.6	8.4	parallel	lower	4:10	0

211	G20a	11	434047	5615544	9/21/2016	10:44	11.8	9/21/2016	14:50	8.4	8.4	perpendicular	lower	4:06	0
212	G21a	11	434077	5615885	9/21/2016	10:47	11.1	9/21/2016	15:00	6.6	7.4	parallel	lower	4:13	0
213	G22a	11	434428	5615878	9/22/2016	9:22	13.0	9/22/2016	14:24	6.8	7.8	perpendicular	lower	5:02	0
214	G23a	11	434167	5616143	9/22/2016	10:00	13.2	9/22/2016	14:40	7.7	8.3	perpendicular	lower	4:40	0
215	G24a	11	433769	5616618	9/22/2016	10:06	12.6	9/22/2016	14:50	3.6	8.2	perpendicular	lower	4:44	0
216	G25a	11	433440	5616801	9/22/2016	10:15	10.8	9/22/2016	15:03	7.1	12.0	perpendicular	lower	4:48	0
217	G26a	11	433316	5617140	9/22/2016	10:21	10.4	9/22/2016	15:26	8.2	8.8	parallel	lower	5:05	0
218	G31a	11	434116	5612109	9/23/2016	10:20	11.8	9/23/2016	15:23	7.8	9.7	perpendicular	lower	5:03	0
219	G29a	11	434190	5611615	9/23/2016	10:06	11.9	9/23/2016	15:05	8.9	12.2	perpendicular	lower	4:59	0
220	G30a	11	434136	5611935	9/23/2016	10:14	11.9	9/23/2016	15:16	UNKN	UNKN	perpendicular	lower	5:02	0
221	G28a	11	434237	5611329	9/23/2016	10:02	11.9	9/23/2016	14:55	8.6	10.4	perpendicular	lower	4:53	0
222	G27a	11	434413	5611174	9/23/2016	9:56	12.2	9/23/2016	14:50	13.3	11.4	oblique	lower	4:54	0
223	G32a	11	434987	5609958	9/24/2016	9:44	11.9	9/24/2016	14:13	9.2	15.4	perpendicular	lower	4:29	0
224	G33a	11	434855	5610077	9/24/2016	9:48	11.9	9/24/2016	14:26	8.6	9.1	perpendicular	lower	4:38	0
225	G34a	11	434840	5610246	9/24/2016	9:54	11.9	9/24/2016	14:32	9.0	14.3	perpendicular	lower	4:38	0
226	G35a	11	434724	5610510	9/24/2016	10:00	11.9	9/24/2016	14:43	9.3	20.7	perpendicular	lower	4:43	0
227	G36a	11	434663	5610698	9/24/2016	10:04	11.9	9/24/2016	15:00	10.7	15.0	perpendicular	lower	4:56	0
228	G37a	11	440157	5615197	9/25/2016	10:46	12.3	9/25/2016	15:28	8.9	12.2	parallel	lower	4:42	0
229	G38a	11	440360	5615534	9/25/2016	10:54	12.4	9/25/2016	15:40	9.8	23.0	parallel	lower	4:46	0
230	G39a	11	440450	5615877	9/25/2016	11:05	12.4	9/25/2016	15:50	25.0	40.0	unrecorded	lower	4:45	0
231	G40a	11	439799	5616884	9/25/2016	11:20	12.9	9/25/2016	16:03	5.8	11.0	unrecorded	lower	4:43	0
232	G41b	11	441699	5617407	9/25/2016	9:25	13.0	9/25/2016	16:20	9.0	16.5	parallel	lower	6:55	0
233	G44a	11	433446	5612940	9/26/2016	9:56	11.0	9/26/2016	14:01	5.4	5.9	perpendicular	lower	4:05	0
234	G43a	11	433682	5612380	9/26/2016	9:51	11.5	9/26/2016	13:52	5.3	5.7	oblique	lower	4:01	0
235	G42a	11	434028	5611582	9/26/2016	9:43	11.5	9/26/2016	13:44	6.7	7.0	parallel	lower	4:01	0
236	G41a	11	434285	5611182	9/26/2016	9:35	11.6	9/26/2016	13:29	6.7	8.1	perpendicular	lower	3:54	0
237	G45b	11	433311	5613549	9/26/2016	10:04	10.5	9/26/2016	14:06	5.6	6.3	perpendicular	lower	4:02	0
238	G49a	11	434069	5611796	9/27/2016	10:33	11.4	9/27/2016	14:42	7.7	8.0	perpendicular	lower	4:09	0
239	G48a	11	434423	5611472	9/27/2016	10:28	11.6	9/27/2016	14:30	9.5	16.0	oblique	lower	4:02	0
240	G47a	11	434388	5611148	9/27/2016	10:21	11.3	9/27/2016	13:55	9.1	9.4	oblique	lower	3:34	0
241	G46a	11	434477	5611009	9/27/2016	10:16	11.4	9/27/2016	13:47	9.5	17.2	oblique	lower	3:31	0
242	G45a	11	434581	5610805	9/27/2016	10:10	11.5	9/27/2016	13:29	11.5	15.0	parallel	lower	3:19	0

Setlines

Set Number	Site	Location			Set Date	Set Time	Water Temp. (Celsius)	Pull Date	Pull Time	Water Depth (m)		Orientation to Flow	Location in water column	Soak Time	# Hooks	Retrieved Hooks				WSG Catch Summary
		Zone	Easting	Northing						Min	Max					Baited	Baitless	Fouled	Lost	
1	S080B	11	441384	5557164	6/1/2016	13:17	14.0	6/2/2016	11:15	21.9	23.7	parallel	lower	21:58	20	3	17	0	0	0
2	S144B	11	441210	5557738	6/1/2016	13:40	14.2	6/2/2016	11:00	22.5	27.6	parallel	lower	21:20	20	2	18	0	0	0
3	S032B	11	443048	5556277	6/1/2016	13:00	13.5	6/2/2016	10:50	7.2	8.5	parallel	lower	21:50	20	3	17	0	0	0
4	S128B	11	442855	5556210	6/1/2016	12:50	13.5	6/2/2016	10:35	6.0	7.4	parallel	lower	21:45	20	7	13	0	0	0
5	S072B	11	442705	5556083	6/1/2016	12:40	13.6	6/2/2016	10:20	5.7	12.8	parallel	lower	21:40	20	1	19	0	0	0
6	S160B	11	443745	5559849	6/2/2016	13:24	13.9	6/3/2016	11:00	8.8	16.5	parallel	lower	21:36	20	0	20	0	0	0
7	S112B	11	443687	5559683	6/2/2016	13:30	13.8	6/3/2016	11:15	17.4	18.3	parallel	lower	21:45	20	0	20	0	0	0
8	S064B	11	440971	5558803	6/2/2016	12:55	13.9	6/3/2016	10:28	15.4	24.6	parallel	lower	21:33	20	0	20	0	0	0
9	S096B	11	441015	5559256	6/2/2016	13:07	13.6	6/3/2016	10:40	8.5	32.4	perpendicular	lower	21:33	20	3	17	0	0	0
10	S048B	11	440975	5558217	6/2/2016	12:43	13.6	6/3/2016	10:11	7.5	10.2	parallel	lower	21:28	20	0	20	0	0	0
11	S140B	11	441015	5562527	6/3/2016	13:20	14.3	6/4/2016	9:25	13.5	19.7	parallel	lower	20:05	20	14	6	0	0	0
12	S108B	11	441113	5562282	6/3/2016	13:10	15.2	6/4/2016	9:00	5.2	12.9	parallel	lower	19:50	20	1	19	0	0	0
13	S060B	11	444135	5562261	6/3/2016	12:55	16.7	6/4/2016	8:56	11.2	10.0	parallel	lower	20:01	20	0	20	0	0	0
14	S184B	11	444298	5561143	6/3/2016	12:43	14.2	6/4/2016	8:45	10.0	11.3	parallel	lower	20:02	20	0	20	0	0	0
15	S200B	11	443904	5560231	6/3/2016	12:30	14.5	6/4/2016	8:30	6.0	14.5	parallel	lower	20:00	20	0	20	0	0	0
16	S176B	11	440954	5562634	6/5/2016	14:10	21.3	6/6/2016	8:45	15.0	26.0	parallel	lower	18:35	20	2	18	0	0	0
17	S044B	11	440734	5562963	6/6/2016	9:50	17.4	6/7/2016	8:35	13.0	17.0	parallel	lower	22:45	20	9	11	0	0	0
18	S092B	11	440766	5563001	6/6/2016	10:00	16.8	6/7/2016	8:40	12.0	27.0	oblique	lower	22:40	20	3	17	1	0	0
19	S016B	11	442865	5565280	6/6/2016	10:15	16.4	6/7/2016	8:50	11.0	16.0	parallel	lower	22:35	20	0	20	0	0	0
20	S196B	11	442408	5565226	6/6/2016	10:26	17.1	6/7/2016	9:10	22.0	28.0	oblique	lower	22:44	20	5	15	0	0	0
21	S133B	11	441178	5565619	6/6/2016	10:33	17.0	6/7/2016	9:20	8.0	13.0	perpendicular	lower	22:47	20	2	15	0	0	0
22	S049B	11	441544	5567676	6/7/2016	11:45	17.4	6/8/2016	9:45	7.5	13.5	parallel	lower	22:00	20	5	15	0	0	0
23	S037B	11	439929	5563904	6/7/2016	11:03	18.3	6/8/2016	10:20	14.0	22.0	parallel	lower	23:17	19	5	14	0	0	0
24	S073B	11	439453	5564376	6/7/2016	11:12	18.5	6/8/2016	10:10	7.0	14.0	parallel	lower	22:58	20	7	13	0	0	0
25	S117B	11	440999	5566557	6/7/2016	11:35	18.7	6/8/2016	9:50	12.0	27.0	perpendicular	lower	22:15	20	0	20	0	0	0
26	S021B	11	438753	5565708	6/7/2016	11:25	18.5	6/8/2016	10:02	13.5	23.0	parallel	lower	22:37	20	11	9	0	0	0
27	S169B	11	438026	5568372	6/20/2016	17:28	14.4	6/21/2016	10:40	16.4	17.0	parallel	lower	17:12	20	0	20	0	0	0
28	S033B	11	441183	5568590	6/20/2016	17:10	15.4	6/21/2016	10:14	17.6	18.1	parallel	lower	17:04	20	0	20	0	0	0
29	S081B	11	438130	5568122	6/20/2016	17:20	14.4	6/21/2016	10:31	14.4	15.9	parallel	lower	17:11	20	0	19	0	1	0
30	S097B	11	441273	5568283	6/20/2016	17:00	15.4	6/21/2016	9:58	12.3	17.6	oblique	lower	16:58	20	9	11	0	0	0
31	S177B	11	441257	5568462	6/20/2016	17:05	15.9	6/21/2016	10:05	8.3	15.8	perpendicular	lower	17:00	20	8	12	0	0	0
32	S017B	11	437735	5569143	6/21/2016	11:48	12.5	6/22/2016	10:15	26.5	13.6	oblique	lower	22:27	20	0	20	0	0	0
33	S129B	11	437810	5569013	6/21/2016	11:40	12.5	6/22/2016	10:05	17.9	26.5	parallel	lower	22:25	19	1	18	0	0	0

34	S001B	11	439754	5571940	6/21/2016	12:10	13.4	6/22/2016	10:35	10.8	15.2	perpendicular	lower	22:25	20	2	18	0	0	0
35	S113B	11	437571	5569345	6/21/2016	11:57	12.6	6/22/2016	10:24	11.1	11.8	parallel	lower	22:27	20	4	16	0	0	0
36	S161B	11	439610	5572074	6/21/2016	12:20	13.6	6/22/2016	10:47	7.8	15.2	perpendicular	lower	22:27	20	0	20	0	0	0
37	S065B	11	438947	5572407	6/22/2016	12:10	14.2	6/23/2016	10:00	10.0	15.0	perpendicular	lower	21:50	20	5	15	0	0	0
38	S005B	11	438745	5572733	6/22/2016	12:20	13.7	6/23/2016	10:11	5.5	11.0	parallel	lower	21:51	20	2	18	0	0	0
39	S181B	11	435706	5572270	6/22/2016	12:50	13.7	6/23/2016	10:44	12.0	22.0	parallel	lower	21:54	20	1	19	0	0	0
40	S193B	11	435795	5572123	6/22/2016	12:42	14.1	6/23/2016	10:35	9.0	17.0	parallel	lower	21:53	20	1	19	0	0	0
41	S105B	11	438770	5573102	6/22/2016	12:27	14.5	6/23/2016	10:22	8.0	15.5	perpendicular	lower	21:55	20	3	17	0	0	0
42	S069B	11	435101	5573872	6/23/2016	11:57	13.9	6/24/2016	9:30	9.0	13.0	parallel	lower	21:33	20	0	20	0	0	0
43	S013B	11	435213	5573604	6/23/2016	11:47	14.1	6/24/2016	9:15	10.0	18.0	parallel	lower	21:28	20	1	19	0	0	0
44	S089B	11	437211	5576264	6/23/2016	12:17	12.7	6/24/2016	10:00	8.0	12.0	parallel	lower	21:43	20	3	17	0	0	0
45	S125B	11	434967	5573990	6/23/2016	12:05	14.0	6/24/2016	9:45	9.0	17.0	parallel	lower	21:40	20	0	20	0	0	0
46	S041B	11	437063	5576605	6/23/2016	12:28	12.5	6/24/2016	10:10	6.0	17.0	parallel	lower	21:42	20	1	19	0	0	0
47	S077B	11	436354	5577506	6/24/2016	11:15	13.0	6/25/2016	10:05	7.5	11.0	parallel	lower	22:50	20	0	20	0	0	0
48	S045B	11	433976	5576974	6/24/2016	11:25	14.0	6/25/2016	10:20	11.6	12.0	parallel	lower	22:55	20	0	20	0	0	0
49	S093B	11	436992	5576841	6/24/2016	10:56	12.4	6/25/2016	9:44	6.8	16.7	perpendicular	lower	22:48	20	2	18	0	0	0
50	S029B	11	436772	5576979	6/24/2016	11:05	12.4	6/25/2016	9:55	2.8	6.8	oblique	lower	22:50	20	0	20	0	0	0
51	S141B	11	433874	5577744	6/24/2016	11:36	14.0	6/25/2016	10:30	12.0	32.6	oblique	lower	22:54	20	0	20	0	0	0
52	S173B	11	433697	5578370	6/25/2016	12:05	10.7	6/26/2016	10:49	14.1	18.0	oblique	lower	22:44	20	0	20	0	0	0
53	S137B	11	433957	5577967	6/25/2016	12:16	11.0	6/26/2016	10:42	9.3	16.0	oblique	lower	22:26	20	0	20	0	0	0
54	S025B	11	433498	5578959	6/25/2016	12:30	10.5	6/26/2016	10:58	7.1	14.6	parallel	lower	22:28	20	0	20	0	0	0
55	S121B	11	436466	5579817	6/25/2016	12:51	12.9	6/26/2016	10:20	5.5	7.4	parallel	lower	21:29	20	0	20	0	0	0
56	S165B	11	436359	5579394	6/25/2016	12:43	12.4	6/26/2016	10:28	17.4	27.5	parallel	lower	21:45	20	2	18	1	0	0
57	S053B	11	436493	5582113	6/26/2016	12:47	13.1	6/27/2016	11:05	9.0	13.0	parallel	lower	22:18	20	4	16	0	0	0
58	S153B	11	436554	5581581	6/26/2016	12:36	14.3	6/27/2016	10:57	6.5	10.0	parallel	lower	22:21	20	0	20	0	0	0
59	S009B	11	433135	5580633	6/26/2016	11:58	14.6	6/27/2016	11:16	11.0	11.5	parallel	lower	23:18	20	1	19	1	0	0
60	S101B	11	434057	5518981	6/26/2016	12:21	13.1	6/27/2016	11:50	7.5	10.0	parallel	lower	23:29	20	0	20	0	0	0
61	S189B	11	433894	5581748	6/26/2016	12:11	13.6	6/27/2016	11:27	13.0	28.0	parallel	lower	23:16	20	0	20	0	0	0
62	S145B	11	436453	5583036	6/26/2016	12:32	14.2	6/27/2016	10:55	5.1	11.4	parallel	lower	22:23	20	0	20	0	0	0
63	S085B	11	436464	5583190	6/26/2016	12:40	14.1	6/27/2016	11:05	19.6	24.0	parallel	lower	22:25	20	1	19	0	0	0
64	S145B	11	436453	5583036	7/5/2016	12:32	14.2	7/6/2016	10:55	5.1	11.4	parallel	lower	22:23	20	0	20	0	0	0
65	S038B	11	436459	5583471	7/5/2016	12:53	14.2	7/6/2016	11:15	7.8	8.1	parallel	lower	22:22	20	1	19	0	0	0
66	S086B	11	433979	5583831	7/5/2016	13:05	14.0	7/6/2016	11:26	14.8	16.1	parallel	lower	22:21	20	1	17	2	0	0
67	S134B	11	433814	5584463	7/5/2016	13:15	13.8	7/6/2016	11:34	16.2	16.3	parallel	lower	22:19	20	2	18	1	0	0
68	S118B	11	433778	5584759	7/6/2016	12:15	15.4	7/7/2016	10:35	4.2	6.2	perpendicular	lower	22:20	20	0	20	0	0	0
69	S074B	11	433697	5585119	7/6/2016	12:22	16.0	7/7/2016	10:45	15.9	24.2	parallel	lower	22:23	20	6	14	0	0	0
70	S050B	11	436115	5586045	7/6/2016	12:44	16.2	7/7/2016	11:05	14.7	14.9	parallel	lower	22:21	20	1	19	0	0	0

71	S022B	11	433534	5585582	7/6/2016	12:35	16.0	7/7/2016	10:55	15.4	29.0	parallel	lower	22:20	20	11	9	0	0	0
72	S006B	11	436589	5587350	7/7/2016	12:04	16.5	7/8/2016	10:25	6.0	15.4	parallel	lower	22:21	20	0	20	0	0	0
73	S186B	11	436399	5587857	7/7/2016	12:11	16.2	7/8/2016	10:10	9.0	9.2	parallel	lower	21:59	20	0	20	0	0	0
74	S082B	11	432724	5586834	7/7/2016	12:41	15.1	7/8/2016	10:35	9.0	13.4	parallel	lower	21:54	20	0	20	0	0	0
75	S178B	11	432388	5587352	7/7/2016	12:51	14.8	7/8/2016	10:40	10.9	14.2	parallel	lower	21:49	20	0	20	0	0	0
76	S002B	11	432072	5588600	7/8/2016	11:40	15.3	7/9/2016	11:02	14.1	15.1	parallel	lower	23:22	20	0	20	0	0	0
77	S066B	11	432294	5588208	7/8/2016	11:32	14.9	7/9/2016	10:54	9.6	10.4	parallel	lower	23:22	20	4	16	0	0	0
78	S157B	11	435027	5590402	7/8/2016	12:05	16.0	7/9/2016	11:30	9.1	28.0	parallel	lower	23:25	20	6	14	0	0	0
79	S197B	11	435244	5589904	7/8/2016	11:55	15.9	7/9/2016	11:20	15.6	25.0	parallel	lower	23:25	20	15	5	0	0	0
80	S149B	11	435129	5591151	7/9/2016	12:10	15.3	7/10/2016	10:53	10.8	11.3	parallel	lower	22:43	20	1	19	0	0	0
81	S109B	11	435170	5591636	7/9/2016	12:20	15.4	7/10/2016	11:00	14.7	19.5	parallel	lower	22:40	20	2	18	0	0	0
82	S034B	11	432200	5592025	7/9/2016	12:40	13.6	7/10/2016	11:10	9.7	14.8	parallel	lower	22:30	20	0	20	0	0	0
83	S170B	11	432243	5592401	7/9/2016	12:45	13.4	7/10/2016	11:16	12.8	16.1	parallel	lower	22:31	20	0	20	0	0	0
84	S102B	11	435643	5594361	7/10/2016	13:16	17.6	7/11/2016	11:35	13.1	15.0	parallel	lower	22:19	20	2	18	0	0	0
85	S162B	11	432245	5593847	7/10/2016	12:54	16.2	7/11/2016	10:55	8.0	14.3	parallel	lower	22:01	20	0	20	0	0	0
86	S018B	11	435498	5593803	7/10/2016	13:06	16.9	7/11/2016	11:25	14.2	16.4	parallel	lower	22:19	20	0	20	0	0	0
87	S114B	11	432194	5593547	7/10/2016	12:46	15.4	7/11/2016	11:05	26.0	35.7	parallel	lower	22:19	19	3	16	0	0	0
88	S130B	11	432145	5593170	7/10/2016	12:30	16.3	7/11/2016	11:14	7.0	12.2	parallel	lower	22:44	20	0	20	0	0	0
89	S190B	11	435769	5597515	7/11/2016	13:00	17.2	7/12/2016	11:00	12.1	18.5	parallel	lower	22:00	20	0	20	0	0	0
90	S026B	11	432866	5597996	7/11/2016	13:30	16.6	7/12/2016	11:20	11.2	14.8	parallel	lower	21:50	20	0	20	0	0	0
91	S122B	11	432844	5598277	7/11/2016	13:40	16.7	7/12/2016	11:15	10.3	14.2	parallel	lower	21:35	20	0	20	0	0	0
92	S010B	11	435794	5595239	7/11/2016	12:32	17.1	7/12/2016	10:36	4.0	6.0	parallel	lower	22:04	20	3	17	0	0	0
93	S154B	11	436003	5596851	7/11/2016	12:50	17.2	7/12/2016	10:55	4.2	4.8	parallel	lower	22:05	20	0	20	0	0	0
94	S042B	11	432775	5599171	7/12/2016	12:10	16.3	7/13/2016	9:50	11.0	18.0	parallel	lower	21:40	20	0	20	0	0	0
95	S058B	11	435855	5600150	7/12/2016	12:24	17.2	7/13/2016	10:30	17.5	19.4	parallel	lower	22:06	20	0	20	0	0	0
96	S174B	11	432942	5598659	7/12/2016	12:00	16.1	7/13/2016	10:00	14.1	20.0	parallel	lower	22:00	20	0	20	0	0	0
97	S138B	11	432952	5598388	7/12/2016	11:54	15.8	7/13/2016	10:10	16.0	21.4	parallel	lower	22:16	20	1	19	0	0	0
98	S182B	11	435980	5600402	7/12/2016	12:30	17.3	7/13/2016	10:44	6.0	7.2	parallel	lower	22:14	20	0	20	0	0	0
99	S106B	11	432700	5602265	8/3/2016	13:20	15.0	8/4/2016	11:05	8.4	13.4	parallel	lower	21:45	20	0	20	0	0	0
100	S194B	11	436170	5601979	8/3/2016	13:04	13.6	8/4/2016	10:50	8.6	13.6	parallel	lower	21:46	20	5	15	0	0	0
101	S090B	11	436264	5601342	8/3/2016	12:45	13.6	8/4/2016	10:28	8.8	11.2	parallel	lower	21:43	20	1	19	0	0	0
102	S014B	11	435263	5601445	8/3/2016	12:54	13.7	8/4/2016	10:40	8.9	13.7	parallel	lower	21:46	20	4	16	0	0	0
103	S030B	11	432579	5602492	8/3/2016	13:30	15.4	8/4/2016	11:10	8.7	11.0	parallel	lower	21:40	20	0	20	0	0	0
104	S070B	11	432779	5603932	8/4/2016	12:34	16.4	8/5/2016	10:49	7.0	12.0	parallel	lower	22:15	20	0	20	0	0	0
105	S078B	11	432486	5603054	8/4/2016	12:25	16.5	8/5/2016	10:40	6.5	11.5	parallel	lower	22:15	20	0	20	0	0	0

106	S126B	11	432988	5604290	8/4/2016	12:40	16.0	8/5/2016	10:56	5.0	16.0	parallel	lower	22:16	20	0	20	0	0	0
107	S094B	11	435640	5604005	8/4/2016	12:55	15.0	8/5/2016	11:10	6.0	11.0	parallel	lower	22:15	20	0	20	0	0	0
108	S142B	11	435318	5604811	8/4/2016	13:05	14.5	8/5/2016	11:30	8.0	13.0	parallel	lower	22:25	20	0	20	0	0	0
109	S151B	11	433467	5606777	8/5/2016	12:40	17.6	8/6/2016	11:06	7.7	20.4	parallel	lower	22:26	20	5	14	0	1	0
110	S111B	11	435816	5605652	8/5/2016	12:30	14.6	8/6/2016	10:53	14.2	18.4	parallel	lower	22:23	20	1	19	0	0	0
111	S063B	11	435650	5605477	8/5/2016	12:20	14.6	8/6/2016	10:40	10.0	20.4	parallel	lower	22:20	20	2	18	0	0	0
112	S046B	11	435467	5604990	8/5/2016	12:10	15.1	8/6/2016	10:31	15.0	17.8	parallel	lower	22:21	20	3	17	0	0	0
113	S199B	11	433474	5607207	8/5/2016	12:50	18.3	8/6/2016	11:15	8.3	12.4	parallel	lower	22:25	20	0	20	0	0	0
114	S015B	11	437766	5607137	8/6/2016	13:36	17.6	8/7/2016	10:50	10.5	15.0	parallel	lower	21:14	20	2	18	0	0	0
115	S195B	11	437818	5607215	8/6/2016	13:27	17.6	8/7/2016	10:47	9.0	15.0	parallel	lower	21:20	20	7	13	0	0	0
116	S107B	11	433594	5608872	8/6/2016	12:34	17.1	8/7/2016	10:31	13.0	16.5	parallel	lower	21:57	21	0	21	0	0	0
117	S159B	11	433382	5608674	8/6/2016	12:26	16.9	8/7/2016	10:19	8.0	11.5	parallel	lower	21:53	20	0	20	0	0	0
118	S095B	11	438003	5607561	8/6/2016	11:49	14.8	8/7/2016	10:32	11.2	11.8	parallel	lower	22:43	20	0	20	0	0	0
119	S047B	11	438369	5608133	8/7/2016	11:58	14.8	8/8/2016	10:45	10.1	13.0	parallel	lower	22:47	20	0	20	6	0	0
120	S143B	11	434834	5609788	8/7/2016	12:18	15.1	8/8/2016	11:03	12.6	13.2	parallel	lower	22:45	20	0	20	0	0	0
121	S079B	11	434979	5609368	8/7/2016	12:10	15.0	8/8/2016	10:56	13.5	14.2	parallel	lower	22:46	20	0	20	0	0	0
122	S059B	11	437686	5611412	8/8/2016	12:42	14.3	8/9/2016	10:25	7.0	12.0	parallel	lower	21:43	20	0	19	0	1	0
123	S031B	11	437493	5611425	8/8/2016	12:32	14.1	8/9/2016	10:13	4.5	10.0	parallel	lower	21:41	20	0	20	0	0	0
124	S127B	11	434633	5610176	8/8/2016	12:21	13.4	8/9/2016	10:42	6.5	10.0	parallel	lower	22:21	20	0	20	0	0	0
125	S071B	11	434771	5610083	8/8/2016	12:13	13.4	8/9/2016	10:35	10.0	12.5	parallel	lower	22:22	20	0	20	0	0	0
126	S167B	11	436518	5612693	8/9/2016	12:21	15.8	8/10/2016	10:09	9.9	11.5	parallel	lower	21:48	20	0	20	0	0	0
127	S011B	11	436461	5613921	8/9/2016	12:31	15.5	8/10/2016	10:17	9.6	10.0	parallel	lower	21:46	20	0	20	0	0	0
128	S191B	11	434177	5611095	8/9/2016	12:04	14.0	8/10/2016	9:49	6.6	11.0	perpendicular	lower	21:45	20	0	20	0	0	0
129	S155B	11	433978	5611552	8/9/2016	12:11	14.2	8/10/2016	9:57	9.6	9.9	parallel	lower	21:46	20	0	20	0	0	0
130	S139B	11	433958	5615421	8/16/2016	13:48	19.7	8/17/2016	10:50	5.0	5.1	perpendicular	lower	21:02	20	0	20	0	0	0
131	S091B	11	434471	5615689	8/16/2016	12:15	20.4	8/17/2016	12:30	6.8	10.5	perpendicular	lower	24:15:00	20	0	20	1	0	0
132	S123B	11	435791	5615635	8/16/2016	11:45	19.9	8/17/2016	12:12	8.5	10.5	perpendicular	lower	24:27:00	20	0	20	1	0	0
133	S183B	11	434433	5615097	8/16/2016	12:05	19.9	8/17/2016	12:38	4.0	5.5	perpendicular	lower	24:38:00	20	0	20	1	0	0
134	S043B	11	434799	5614562	8/16/2016	12:55	19.6	8/17/2016	12:48	6.5	8.5	perpendicular	lower	23:53	20	0	20	0	0	0
135	S103B	11	433122	5617113	8/17/2016	14:15	18.0	8/18/2016	11:10	8.7	9.9	perpendicular	lower	20:55	20	0	20	0	0	0
136	S027B	11	433584	5616676	8/17/2016	14:06	20.0	8/18/2016	11:00	9.7	12.1	perpendicular	lower	20:54	20	0	20	0	0	0
137	S175B	11	434008	5615984	8/17/2016	13:56	20.3	8/18/2016	10:55	10.0	10.4	perpendicular	lower	20:59	20	0	20	0	0	0
138	S062B	11	432630	5617696	8/18/2016	12:09	15.2	8/19/2016	10:50	10.0	12.0	parallel	lower	22:41	20	0	20	0	0	0
139	S150B	11	433181	5616860	8/18/2016	12:00	16.0	8/19/2016	10:40	8.5	10.0	parallel	lower	22:40	20	0	20	0	0	0
140	S003B	11	432606	5618156	8/18/2016	12:25	16.0	8/19/2016	11:10	8.0	10.0	parallel	lower	22:45	20	0	20	0	0	0

141	S110B	11	432724	5618034	8/18/2016	12:15	16.3	8/19/2016	11:00	7.0	9.5	parallel	lower	22:45	20	0	20	0	0	0
142	S163B	11	431605	5619975	8/19/2016	12:15	11.6	8/20/2016	10:50	8.9	10.6	perpendicular	lower	22:35	20	0	20	0	0	0
143	S115B	11	431394	5620237	8/19/2016	12:20	11.5	8/20/2016	11:00	9.1	9.2	parallel	lower	22:40	20	0	20	0	0	0
144	S019B	11	431714	5619589	8/19/2016	12:06	11.8	8/20/2016	10:42	9.4	11.1	perpendicular	lower	22:36	20	0	20	0	0	0
145	S158B	11	432014	5618820	8/19/2016	12:00	11.5	8/20/2016	10:30	9.5	13.8	perpendicular	lower	22:30	20	0	20	0	0	0
146	S051B	11	430587	5621804	8/20/2016	12:15	12.3	8/21/2016	11:20	7.0	8.0	parallel	lower	23:05	20	1	19	0	0	0
147	S171B	11	430932	5621208	8/20/2016	11:45	12.8	8/21/2016	10:55	7.0	9.5	parallel	lower	23:10	20	0	20	0	0	0
148	S035B	11	431127	5620722	8/20/2016	11:40	12.6	8/21/2016	10:50	7.0	8.5	parallel	lower	23:10	20	0	20	0	0	0
149	S083B	11	430939	5621277	8/20/2016	12:00	12.5	8/21/2016	11:02	7.0	8.5	oblique	lower	23:02	20	2	18	0	0	0
150	S131B	11	430765	5621493	8/20/2016	12:06	12.4	8/21/2016	11:10	7.0	9.0	parallel	lower	23:04	20	0	20	0	0	0
151	S067B	11	429576	5623439	8/21/2016	12:40	11.6	8/22/2016	10:50	7.3	9.0	perpendicular	lower	22:10	20	0	20	0	0	0
152	S187B	11	429313	5623954	8/21/2016	12:46	11.7	8/22/2016	10:56	10.4	11.0	parallel	lower	22:10	20	0	20	0	0	0
153	S099B	11	430329	5622241	8/21/2016	12:20	11.7	8/22/2016	10:36	7.0	9.4	perpendicular	lower	22:16	19	0	19	0	0	0
154	S179B	11	429693	5623159	8/21/2016	12:28	11.7	8/22/2016	10:45	7.0	10.3	perpendicular	lower	22:17	20	3	17	0	0	0
155	S007B	11	429313	5624600	8/21/2016	12:55	11.7	8/22/2016	11:05	10.1	10.1	parallel	lower	22:10	20	0	20	0	0	0
156	S039B	11	429215	5625411	9/7/2016	13:55	10.4	9/8/2016	11:05	11.3	14.4	oblique	lower	21:10	20	0	20	0	0	0
157	S075B	11	429209	5626174	9/7/2016	14:06	10.4	9/8/2016	11:15	10.8	11.8	perpendicular	lower	21:09	20	2	18	0	0	0
158	S147B	11	429166	5625188	9/7/2016	13:46	10.5	9/8/2016	10:56	7.3	14.7	perpendicular	lower	21:10	20	0	20	0	0	0
159	S135B	11	429143	5626459	9/7/2016	14:16	10.3	9/8/2016	11:25	6.4	8.6	perpendicular	lower	21:09	20	5	15	0	0	0
160	S119B	11	429033	5626890	9/7/2016	14:25	10.3	9/8/2016	11:50	10.0	10.0	parallel	lower	21:25	20	0	20	0	0	2
161	S012B	11	428081	5628720	9/8/2016	13:46	9.6	9/9/2016	11:58	5.5	8.8	parallel	lower	22:12	20	0	20	0	0	0
162	S168B	11	428851	5628178	9/8/2016	13:26	9.6	9/9/2016	11:31	7.4	11.2	parallel	lower	22:05	20	0	20	0	0	0
163	S124B	11	428500	5628404	9/8/2016	13:36	9.6	9/9/2016	11:40	7.2	7.8	parallel	lower	22:04	20	0	20	0	0	0
164	S023B	11	428907	5627136	9/8/2016	13:05	9.7	9/9/2016	11:15	9.6	10.4	parallel	lower	22:10	20	0	20	0	0	0
165	S028B	11	428969	5627682	9/8/2016	13:16	9.7	9/9/2016	11:24	10.1	11.7	parallel	lower	22:08	20	0	20	0	0	0
166	S076B	11	426639	5629469	9/9/2016	13:26	9.2	9/10/2016	11:55	10.0	10.8	parallel	lower	22:29	20	6	14	0	0	0
167	S024B	11	425872	5629994	9/9/2016	13:36	9.4	9/10/2016	12:10	7.1	8.1	perpendicular	lower	22:34	20	0	20	0	0	0
168	S068B	11	427162	5629035	9/9/2016	13:10	9.1	9/10/2016	11:30	11.9	12.2	parallel	lower	22:20	20	5	15	0	0	0
169	S120B	11	426906	5629241	9/9/2016	13:20	9.3	9/10/2016	11:40	7.3	8.2	perpendicular	lower	22:20	20	5	15	0	0	0
170	S192B	11	427565	5629079	9/9/2016	13:00	9.1	9/10/2016	11:15	7.9	10.1	perpendicular	lower	22:15	20	2	18	0	0	0
171	S056B	11	424981	5632515	9/10/2016	13:40	9.5	9/11/2016	11:30	8.0	7.0	parallel	lower	21:50	20	0	20	0	0	0
172	S104B	11	425293	5631948	9/10/2016	13:26	9.5	9/11/2016	11:16	7.1	11.1	parallel	lower	21:50	20	1	19	0	0	0
173	S148B	11	425374	5631609	9/10/2016	13:20	9.6	9/11/2016	11:06	5.5	7.1	parallel	lower	21:46	20	7	13	0	0	0
174	S040B	11	425761	5630124	9/10/2016	13:00	9.5	9/11/2016	10:45	6.3	7.2	parallel	lower	21:45	20	0	20	0	0	0
175	S088B	11	425071	5630629	9/10/2016	13:10	9.9	9/11/2016	10:55	5.9	6.4	parallel	lower	21:45	20	0	20	0	0	0

176	S156B	11	424594	5632252	9/11/2016	12:50	9.6	9/12/2016	11:00	4.0	6.3	oblique	lower	22:10	20	1	19	0	0	0
177	S008B	11	424281	5632444	9/11/2016	12:40	9.7	9/12/2016	11:10	5.0	8.6	perpendicular	lower	22:30	20	1	19	0	0	0
178	S004B	11	423284	5633071	9/11/2016	13:06	9.7	9/12/2016	11:35	10.8	10.8	parallel	lower	22:29	20	10	10	0	0	1
179	S116B	11	423979	5632701	9/11/2016	12:57	9.6	9/12/2016	11:17	7.0	8.4	perpendicular	lower	22:20	20	0	20	0	0	0
180	S036B	11	422780	5633441	9/11/2016	13:16	9.7	9/12/2016	11:50	6.8	11.0	parallel	lower	22:34	20	7	13	0	0	0
181	S172B	11	422381	5634022	9/12/2016	13:10	10.9	9/13/2016	10:52	5.6	8.0	parallel	lower	21:42	20	0	20	0	0	0
182	S132B	11	422678	5633709	9/12/2016	13:04	10.9	9/13/2016	10:42	7.0	7.2	parallel	lower	21:38	20	1	19	0	0	0
183	S020B	11	421360	5634454	9/12/2016	13:30	11.1	9/13/2016	11:30	8.0	10.5	perpendicular	lower	22:00	20	3	17	0	0	1
184	S164B	11	421962	5634294	9/12/2016	13:20	11.0	9/13/2016	11:06	8.5	10.5	parallel	lower	21:46	20	0	20	0	0	0
185	S188B	11	420923	5634862	9/12/2016	13:40	11.3	9/13/2016	11:40	6.8	11.6	perpendicular	lower	22:00	20	0	20	0	0	0
186	S180B	11	421658	5635972	9/13/2016	13:09	11.3	9/14/2016	10:20	2.0	2.2	oblique	lower	21:11	20	2	18	0	0	0
187	S084B	11	421343	5635251	9/13/2016	12:55	11.1	9/14/2016	10:10	4.7	5.4	parallel	lower	21:15	20	3	17	0	0	0
188	S100B	11	421854	5635895	9/13/2016	13:20	11.3	9/14/2016	10:30	2.8	3.4	perpendicular	lower	21:10	20	0	20	0	0	0
189	S1a	11	422582	5633711	9/21/2016	12:30	9.6	9/22/2016	11:00	8.0	8.2	parallel	lower	22:30	20	9	11	0	0	0
190	S2a	11	422416	5633789	9/21/2016	12:40	9.6	9/22/2016	11:10	7.2	7.8	parallel	lower	22:30	20	9	11	0	0	0
191	S3a	11	422192	5634029	9/21/2016	12:46	9.7	9/22/2016	11:17	5.7	5.8	parallel	lower	22:31	20	0	20	0	0	0
192	S4a	11	422016	5634181	9/21/2016	12:50	9.7	9/22/2016	11:25	5.4	7.6	oblique	lower	22:35	20	1	19	0	0	0
193	S5a	11	421724	5634289	9/21/2016	13:01	9.8	9/22/2016	11:40	3.7	11.2	oblique	lower	22:39	20	0	20	0	0	0
194	S9a	11	423586	5632926	9/22/2016	13:14	10.3	9/23/2016	12:01	6.4	8.8	parallel	lower	22:47	20	11	9	0	0	0
195	S10a	11	423980	5632711	9/22/2016	13:20	10.3	9/23/2016	12:11	4.7	6.7	oblique	lower	22:51	20	0	20	0	0	0
196	S6a	11	422780	5633578	9/22/2016	12:54	10.3	9/23/2016	11:00	7.1	8.7	parallel	lower	22:06	20	5	15	0	0	0
197	S7a	11	422988	5633390	9/22/2016	13:00	10.3	9/23/2016	11:10	UNKN	UNKN	parallel	lower	22:10	20	11	9	0	0	0
198	S8a	11	423245	5633120	9/22/2016	13:06	10.3	9/23/2016	11:25	8.0	8.5	oblique	lower	22:19	20	10	10	0	0	2
199	S12a	11	424814	5632302	9/23/2016	13:13	10.6	9/24/2016	11:05	3.5	5.6	parallel	lower	21:52	20	5	15	0	0	0
200	S13a	11	425175	5632140	9/23/2016	13:20	10.6	9/24/2016	11:14	8.1	9.4	parallel	lower	21:54	20	11	9	0	0	0
201	S11a	11	424476	5632462	9/23/2016	13:05	10.6	9/24/2016	10:54	2.6	4.4	parallel	lower	21:49	20	0	20	0	0	0
202	S14a	11	425320	5631751	9/23/2016	13:25	10.6	9/24/2016	11:24	5.2	4.6	parallel	lower	21:59	20	2	18	0	0	0
203	S15a	11	425314	5631381	9/23/2016	13:34	10.6	9/24/2016	11:34	6.4	6.6	parallel	lower	22:00	20	1	19	0	0	0
204	S18a	11	425487	5630434	9/24/2016	12:43	10.4	9/25/2016	12:36	4.9	6.1	parallel	lower	23:53	20	3	17	0	0	0
205	S17a	11	425245	5630719	9/24/2016	12:36	10.4	9/25/2016	12:25	4.8	7.3	oblique	lower	23:49	20	4	16	0	0	0
206	S20a	11	425977	5629849	9/24/2016	12:55	10.4	9/25/2016	13:09	6.1	8.0	parallel	lower	24:14:00	20	3	17	0	0	0
207	S19a	11	425657	5630059	9/24/2016	12:49	10.5	9/25/2016	12:45	6.3	8.1	parallel	lower	23:56	20	1	19	0	0	1
208	S16a	11	425251	5631080	9/24/2016	12:30	10.4	9/25/2016	12:16	5.8	6.5	parallel	lower	23:46	20	7	13	0	0	1
209	S21a	11	425877	5629976	9/25/2016	14:27	9.4	9/26/2016	10:30	4.3	6.8	parallel	lower	20:03	20	5	15	0	0	0
210	S22a	11	425717	5630106	9/25/2016	14:34	9.5	9/26/2016	10:42	3.3	4.5	perpendicular	lower	20:08	20	1	19	0	0	0
211	S23a	11	425351	5630298	9/25/2016	14:41	9.6	9/26/2016	10:53	3.4	6.0	oblique	lower	20:12	20	0	20	0	0	0
212	S25a	11	425138	5630829	9/25/2016	14:56	9.5	9/26/2016	11:16	3.9	4.7	perpendicular	lower	20:20	20	0	20	0	0	0
213	S24a	11	425174	5630558	9/25/2016	14:48	9.6	9/26/2016	11:06	3.0	3.5	perpendicular	lower	20:18	20	0	20	0	0	0
214	S26a	11	425244	5630757	9/26/2016	12:27	9.4	9/27/2016	11:29	3.7	7.2	perpendicular	lower	23:02	20	0	20	0	0	0
215	S27a	11	425264	5631215	9/26/2016	12:35	9.5	9/27/2016	11:42	4.5	6.5	perpendicular	lower	23:07	20	0	20	0	0	0
216	S28a	11	425338	5631378	9/26/2016	12:44	9.5	9/27/2016	11:55	3.5	5.4	perpendicular	lower	23:11	20	12	8	0	0	0
217	S29a	11	425309	5631694	9/26/2016	12:52	9.5	9/27/2016	12:04	5.4	6.0	perpendicular	lower	23:12	20	5	15	0	0	0
218	S30a	11	425257	5631930	9/26/2016	12:58	9.5	9/27/2016	12:14	5.8	6.2	perpendicular	lower	23:16	20	10	10	0	0	0

APPENDIX C: SUBSTRATE ANALYSIS

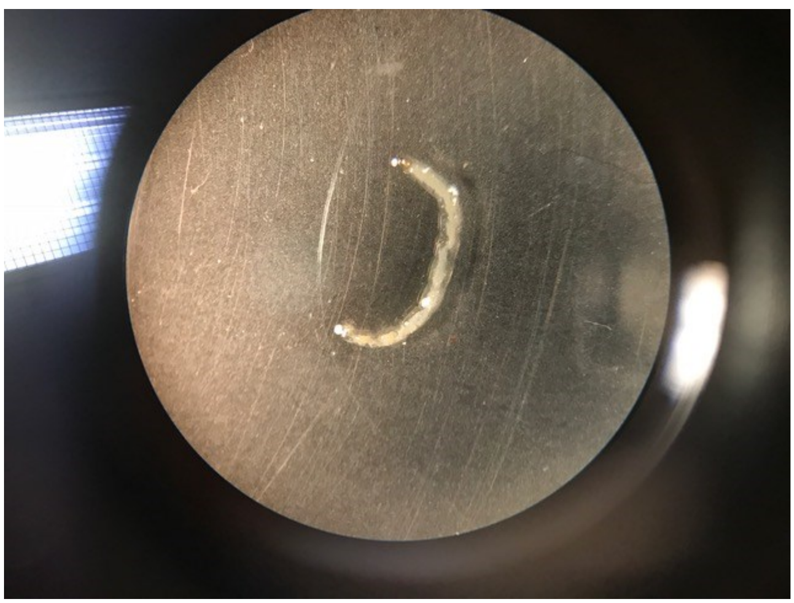
Site #	Date of Collection	Date of Analysis	Easting	Northing	Dominant Substrate	Secondary Substrate	Volume (cm3)	Screen Size	Contents	Genus	Density of Prey Type	Comments
2014-5	9/24/2016	12/20/2016	427916	5628873	Pebbles	Granule	na	500	None			small amount of detritus
S020B	9/22/2016	12/20/2016	421360	5634454	Pebbles	Granule	568.575	None - substrate large	biting midge	Diptera	0.002	kept for further analysis; note volume estimated
2014-09	9/22/2016	12/20/2016	423988	5632651	Granule	Pebble	568.575	105	non-biting midge / larvae	Diptera	0.002	kept for further analysis; note volume estimated
2014-1	9/21/2016	12/20/2016	430861	5621730	coarse sand	medium sand	na	105	None			some small vegetation
2014-7	9/24/2016	12/20/2016	422473	5633700	medium sand	fine sand	568.575	106	6 non biting midges	Diptera	0.011	kept for further analysis; note volume estimated
2014-2	9/21/2016	12/20/2016	429284	5624793	coarse sand	medium sand	568.575	106	biting midge	Diptera	0.002	kept for further analysis; note volume estimated
2014-10	9/22/2016	1/4/2017	422703	5633760	fine sand	fine sand	433.20	106	3 red non biting midges	Diptera	0.007	kept for further analysis
2014-3	9/23/2016	1/4/2017	429211	5625355	clay	fine sand	667.85	106	1 biting midge	Diptera	0.001	2 pieces of driftwood in sample
2014-8	9/23/2016	1/4/2017	429039	5625211	fine sand	clay	731.03	106	none			lots of vegetative debris in sample
2014-6	9/24/2016	1/5/2017	422278	5634246	medium sand	fine sand	1083.00	106	none			sample was dry upon collection
S9A	9/23/2016	1/6/2017	423586	5632926	coarse sand	pebble	992.75	106	none			lots of driftwood in sample
2014-4	9/23/2016	1/6/2017	428745	5628885	coarse sand	medium sand	1137.15	106	none			not in ethanol
S119A	9/23/2016	1/6/2017	429033	5626890	coarse sand	medium sand	1159.57	106	none			not in ethanol
S004B	9/22/2016	1/12/2017	423284	5633071	coarse sand	medium sand	1210.35	106	none			some small rocks in sample
2015-1	9/24/2016	1/17/2017	434805	5609954	clay	clay	1046.90	106	none			wood in sample

Site ID: 2014-2

Suspected Biting Midge (Diptera)

Site ID: 2014-3

Suspected Biting Midge (Diptera)

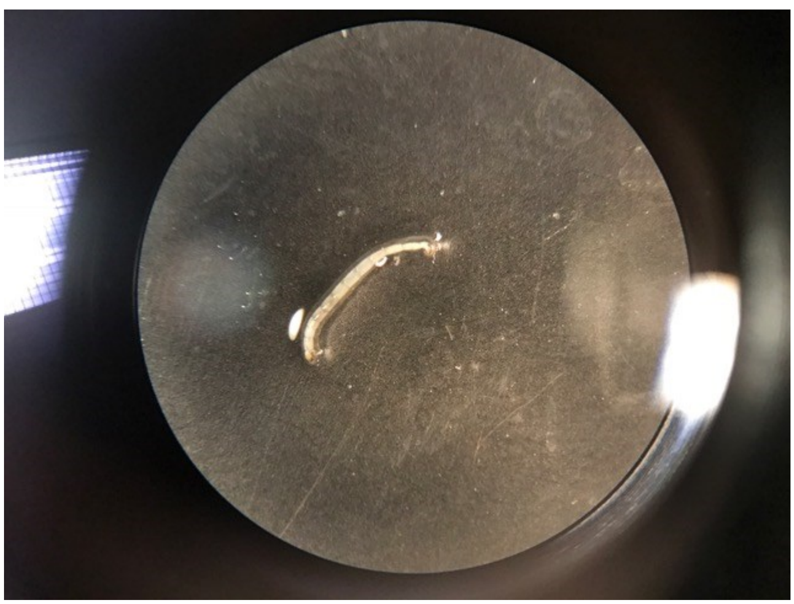


Site ID: 2014-7

Suspected 6 Non-Biting Midges (Diptera)

Site ID: 2014-9

Suspected Non-Biting Midge (Diptera)



Site ID: 2014-10

Suspected 3 Non-Biting Midges (Diptera)

Site ID: S020B

Suspected Biting Midge (Diptera)