Development of Stikine River Coho Salmon Stock Assessment Options

(Year 1)

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Executive Summary

To evaluate stock assessment options for coho salmon the Stikine River, three discrete projects were completed in 2019. These projects included a feasibility assessment of conducting a mark-recapture experiment on the Iskut River, and feasibility assessments of the use of sonar technology on the Chutine River and on the Katete River.

Mark-recapture of coho salmon in the Iskut River may be an effective stock assessment tool, but will require further evaluation and refinement. Almost 400 coho salmon were tagged in 2019 and options to improve future marking efforts were identified. Additional effort will be required in both the marking and recapture components of the experiment. For example, additional effort (i.e., a second crew) in Event 1 (marking) could allow sites to be assessed simultaneously and could increase the number of mark applications. Furthermore, in-river recapture (e.g., set net) can be tested, boat-based access to spawning sites to recover tags can be tested, and additional helicopter supported recapture effort (i.e., more days) to visit sites that are not accessible by boat can be completed.

Implementation of a sonar enumeration program on the Chutine River would be challenging. As the river is large, braided, and undergoes significant water level fluctuations in the fall (despite being lake-headed), it would be a formidable task to install a weir that could withstand the flows on this system. Also, turbidity is high which could reduce the effectiveness of sonar. Construction of a camp and supporting infrastructure would be required to support a future sonar program on the Chutine River. As a result of the remote location, a significant investment would be required.

The use of sonar technology to enumerate coho salmon on the Katete River may be feasible. River flows, however, can be dynamic due in part to a lack of storage in the system. Consequently, any in-river infrastructure needs to be able to withstand significant fluctuations in water level and flow, or be easily removed. A sonar project designed to allow equipment and associated infrastructure to be quickly removed at high flows may be successful.

It is evident that without Northern Endowment Fund (NEF) augmentation to the Departmental budget, completion this feasibility assessment work would not have been possible. The initial year of the work allowed exploration and testing of several approaches that could contribute to the development an abundance-based management regime for coho salmon in the Stikine River. Further refinement of the approaches tested in 2019 will be required and additional tools could also be considered. It is recommended that NEF augmentation to Departmental budgets continue such that further evaluation of the proposed approaches can be completed.

Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 Introduction

The Pacific Salmon Treaty (2019) requires development of an abundance-based management regime for Stikine River coho salmon. A central requirement of an abundance-based management program is the development of defensible abundance estimates; ideally stock specific abundance and run timing.

Total in-river escapement prior to 2000 (1986-1999) was approximated based on the performance of a coho test fishery augmented with annual aerial surveys of eight index sites. However, there has not been any confirmation that the test fishery is a reliable indicator of coho abundance. From 2000 to 2003, a joint Canada/U.S. coho mark-recapture study was conducted as a pilot experiment; however, because the numbers of tags applied and recovered were both low, the estimates of run size were relatively weak and therefore did not provide a reliable measure of abundance. Since then, assessment methodology has not progressed.

Radio telemetry work completed in 2005 and 2006 provided information on stock-specific run timing and distribution (Smith et al 2007, 2012). Averaged over the two years, of the fish that successfully migrated above the border (n=188 in 2005 and n=288 in 2006), 36% terminated in the Iskut River, 12% in the Chutine River, and 10% in the Katete River. As such, these three systems accounted for 58% of the above-border recoveries, and included both lower river and upper river stocks. This work identified key coho salmon spawning locations which guided the 2019 feasibility assessment of stock assessment options for coho.

2.0 Objectives

The specific objectives of this project were to:

1. test the feasibility of using mark-recapture to estimate abundance of coho salmon on the Iskut River;
2. conduct reconnaissance for appropriate sites to test sonar enumeration of coho salmon on the Katete and Chutine Rivers;
3. subject to the successful outcome of (2), test the feasibility of conducting sonar enumeration of coho salmon in the Katete and Chutine Rivers.

The intent of the first year of this work was to test the feasibility of the proposed methodologies and evaluate resource requirements and limitations. These are preliminary steps towards derivation of drainage-wide population abundance estimates and enumeration of specific stocks.

3.0 Methods

The mark-recapture and Katete sonar projects were based out of the DFO field facility near the Canada/U.S. border on the lower Stikine River, approximately 50 km upstream from the river mouth (Figure 1). Field operations involved two crews of DFO and Tahltan Iskut First Nation (TIFN) staff: one crew focused on the netting and marking work on the Iskut River, and the other crew focused on the Katete River sonar. Additional personnel, including project leads, were deployed on the Chutine River sonar assessment and the recapture portion of the mark-recapture study.

Event I (tagging) of the mark-recapture project on the Iskut River began in early September after a few days of testing, and continued until mid-October. Event II (recapture) occurred in late October. Following site selection, the Katete River sonar project began in early September and ended later that month. The Chutine River reconnaissance occurred in early September. Staff, equipment, and supplies mobilized through Telegraph Creek, B.C., Dease Lake, B.C., and Atlin, B.C. Fixed and rotary wing aircraft chartered out of Dease Lake and Atlin, B.C. were used to support the project. Boat support was provided out of Telegraph Creek/Glenora, B.C.

Iskut River Mark-Recapture

Marking (Event 1)

Live-capture gillnetting sites were located and tested on the lower Iskut River to mark coho salmon as part of Event I of the mark-recapture study. These sites were located more than 5 kilometers (3 miles) up the Iskut River to avoid other Stikine River coho salmon stocks. Event I (tagging) was initiated on September 2 and continued until October 16; timing was based on historical Rock Island Eddy test fishery timing shifted by a week to account for the anticipated salmon travel time to the lower Iskut River (refer to Smith et al. 2007, 2012 for guiding data and discussion).

Effort consisted of 5 hours (approximately 10:00 am to 3:00 pm) per day set net soak time. The 5 3/8" mesh green monofilament nets (Redden Nets) were 100 ft long, 15 ft deep, with a 3:1 hanging ratio. Only one net was deployed at a time. It was monitored continuously so that captured fish could be removed and processed immediately. Processing included: length measurement (fork length, mid-eye fork length, post-orbital hypural fork length); sex identification; scale removal (5) for ageing; checking for adipose clips; marking by insertion of an individually-numbered orange spaghetti tag through the dorsal musculature 2 to 3 cm below the posterior end of the dorsal fin; and a hole punch through the operculum as a secondary mark to assess primary tag loss. Lastly, any observations relevant to fish health or morphological irregularities were recorded.

Recapture (Event II)

The recapture portion of the work was scheduled in two stages, between October 13 and 21 and then between October 22 and 25. The plan was to sample spawning locations on

the Iskut River and its tributaries (Figure 1) that were boat accessible during the first stage, and use a helicopter in the second stage to access isolated locations. Fish capture using beach seines and hook and line was planned. In addition to processing as per Event I (except that mark application was replaced by mark inspection), an axillary appendage would also be collected for coho genetic baseline development if the fish appeared to be on their spawning grounds (i.e. in a terminal location). Any genetic material collected would be split in half and shared between the Molecular Genetics Lab at the Pacific Biological Station (Nanaimo, B.C.) and the Alaska Department of Fish and Game Genetic Lab in Anchorage, AK.

Chutine River Sonar Feasibility Assessment

The objective of the assessment work planned for 2019 was to evaluate the potential for using sonar technology to enumerate coho salmon in the Chutine River. Although this river is lake-headed (Chutine Lake) which should result in buffered flows following precipitation events, the river undergoes large fluctuations in water level. The river is large, turbid. and braided with a floodplain comprising many side/back channels. These qualities could limit the utility of sonar technology. In the spring (May 16) a helicopter overflight was conducted opportunistically and a video recording of the river obtained. A directed helicopter overflight was completed on August 29 which focused on the section of river downstream of Triumph Creek. Based on available information, this was the cut-off for enumerating the majority of the Chutine River coho salmon run (Figure 1). The late August aerial survey identified a number of potential sites which were further evaluated through helicopter-supported on-the-ground site evaluations in early September.

Adaptive resolution imaging sonar (ARIS 1800) (Sound Metrics Corporation) was deployed in sonar site assessments within the Chutine River.

Katete River Sonar Feasibility Assessment

Google Earth imagery was used to locate potential sonar locations that were downstream of the known primary spawning sites (Figure 1) and were within a single channel (<1 km section) where east and west forks of the river converged before splitting again. Following the helicopter reconnaissance completed on August 29, only one suitable site was identified for *in situ* sonar testing in the river.

Adaptive resolution imaging sonar (ARIS 1800) (Sound Metrics Corporation) was deployed in sonar site assessment within the Katete River.

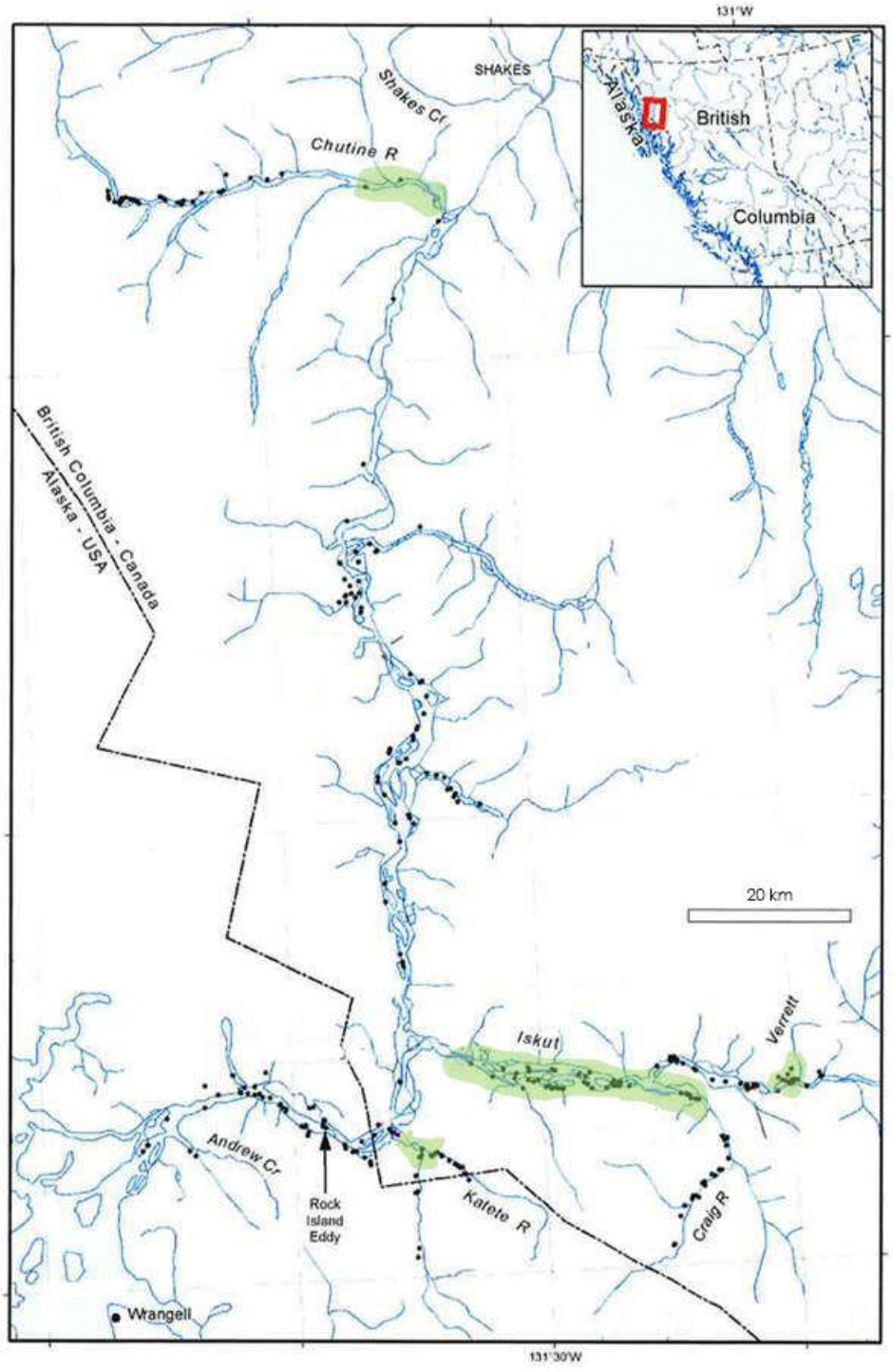

Figure 1. Map of the Stikine River drainage showing radio tag fates observed in the 2006 radio tagging study (Smith et al, 2007). Study areas are highlighted in green.

4.0 Results and Discussion

Iskut River Mark-Recapture

Marking (Event 1)

Spaghetti tag application was conducted over 38 days of the scheduled 45 days between September 2 and October 16. No fish capture occurred September 4-6, September 11, and October 8 as staff were deployed to other projects or involved in crew changes. Flood events interfered with fishing on 3 occasions. For example, on September 21 only 3 hours of fishing occurred, and no fishing occurred on September 22 and October 7. In the Iskut River, high water events typically lead to excessive woody debris and detritus accumulation in the nets, thus making fishing both challenging and inefficient.

Two locations were fished over the course of the project: the first was in close proximity to the water survey station (Russell site) and the second (Kia site) was slightly upstream (Figure 2). The Kia site appeared to be the better location during low water, and was the most productive overall. At the Russell site, the eddy was not setting the net as anticipated and the net was not fishing effectively. A second lead line was added to the net in an attempt to resolve the issue, but did not result in an obvious improvement. Crews returned to using the single lead line net.

Figure 2. Set net locations for 2019 Event I (marking) in the Iskut River.

Unfortunately, since the two net sites were not fished simultaneously (i.e., crews fishing each site at the same time) it was not possible to determine their relative productivity; it is not known whether the second site was indeed superior to the first or if there were simply more fish present when the second site was fished. The first location was fished exclusively for the first 16 days, then staff alternated between the locations for approximately 4 days, and subsequently fished the second site exclusively for the remainder of the project (20 days) (Table 1).

Table 1. Daily tagging, effort, and location for Event I (marking) of the Mark-Recapture project on the Iskut River, 2019.

Date	Start Time	Stop time	Total Time - Hours	Daily Tags	Cum. Tags	Location/ Description	Water Level High/ Medium/ low	Set Net Description
2-Sep	1130	1630	5	6	6	Russell Set	Medium	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
3-Sep	1000	1500	5	5	11	Russell Set	Medium	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
4-Sep					11			
5-Sep					11			
6-Sep					11			
7-Sep	1030	1530	5	7	18	Russell Set	low	5 3/8 Mesh - 100' long - 15' Deep? (double lead line)
8-Sep	1200	1700	5	5	23	Russell Set	low	5 3/8 Mesh - 100' long - 15' Deep? (double lead line)
9-Sep	920	1420	5	10	33	Russell Set	low	5 3/8 Mesh - 100' long - 15' Deep? (double lead line)
10-Sep	945	1455	5	10	43	Russell Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
11-Sep					43			
12-Sep	1036	1533	5	15	58	Russell Set	High	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
13-Sep	1000	1500	5	8	66	Russell Set	High	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
14-Sep	940	1537	5	9	75	Russell Set	High	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
15-Sep	930	1530	5	4	79	Russell Set	Medium	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
16-Sep	920	1424	5	5	84	Russell Set	Medium	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
17-Sep	1010	1505	5	28	112	Kia Set	Medium	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
18-Sep	1025	1531	5	18	130	Kia Set	Medium	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
19-Sep	1005	1500	5	11	141	Kia Set	Medium	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
20-Sep	940	1500	5	6	147	Kia; 4 hours Russell Set		5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
21-Sep	935	1230	3	0	147		Flood	
22-Sep					147		Flood	
23-Sep	942	1450	5	3	150	Russell Set	High	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
24-Sep	949	1442	5	2	152	Russell Set	High	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
25-Sep	940	1446	5	8	160	Kia Set	Medium	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
26-Sep	942	1504	5	18	178	Kia Set	Medium	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
27-Sep	1030	1530	5	10	188	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
28-Sep	1030	1530	5	22	210	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
29-Sep	1015	1515	5	43	253	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
30-Sep	1045	1545	5	33	286	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
1-Oct	1015	1515	5	49	335	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
2-Oct	1000	1500	5	11	346	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
3-Oct	1030	1530	5	10	356	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
4-Oct	945	1445	5	26	382	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
5-Oct	915	1415	5	5	387	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
6-Oct	945	1445	5	0	387	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
7-Oct					387	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
8-Oct					387	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
9-Oct	1030	1530	5	2	389	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
10-Oct	1030	1530	5	0	389	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
11-Oct	1130	1630	5	2	391	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
12-Oct	1030	1530	5	2	393	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
13-Oct	1020	1520	5	0	393	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
14-Oct	1030	1530	5	0	393	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
15-Oct	1030	1530	5	0	393	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)
16-Oct	1100	1600	5	3	396	Kia Set	low	5 3/8 Mesh - 100' long - 15' Deep? (single lead line)

In total, 396 coho salmon were tagged (Table 1). Although scale samples were taken from these fish, results were not available at the time of report preparation. Captures peaked in late September (Statistical Week (SW) 40; September 29 to October 5; refer to Appendix 1), and were very low by the end of the first week in October (Figure 2). Chum salmon were also captured, particularly in the first half of September, and Sockeye salmon were captured, particularly in the latter part of September. A few pink salmon (3), Steelhead (2), and 16 Dolly Varden (16) were also captured.

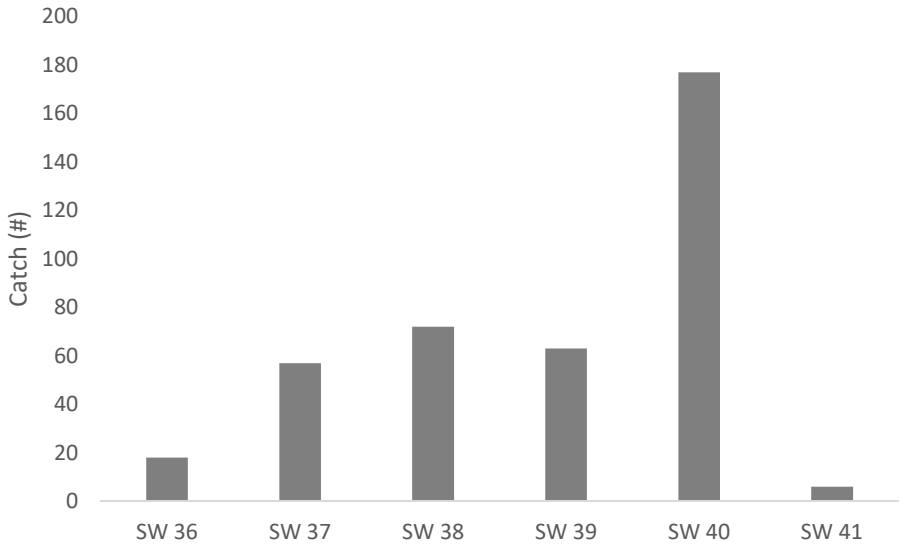

Figure 3. Coho salmon capture and tagging in set nets on the Iskut River between September 2 and October 16, 2019.

Five adipose-clipped coho salmon were observed and sampled during the Event I of the mark-recapture experiment. The heads were sent to the contracted DFO lab (J.O. Thomas) in Vancouver, B.C. for CWT extraction, and data will be uploaded into the Regional Mark Processing Centre website database (www.rmpc.org).

Recapture (Event II)

As a result of equipment failure (damaged fishing rods) and availability of staff, the recapture portion of the project was essentially restricted to 1.5 days (October 25: ½ day; October 26: full day). Recapture was attempted at the locations where the highest densities of coho salmon were anticipated. These included Verrett Creek, the upper Craig River, and side channels of the Iskut River.

On Verrett Creek (Figure 3), a crew of three people caught 32 coho salmon (Appendix 1; mean fork length: 696 mm; SE±13.3) by hook and line. None of the fish caught were spaghetti-tagged, and one adipose-clipped coho salmon was retained. All fish captured were sampled, and an axillary appendage was retained in anhydrous ethyl alcohol for genetic stock identification.

On the Craig River, a crew of three people attempted seine netting in the mainstem (site 1 WPT 508 56°32.224' 131°14.667'; Figure 3). At this location, however, the current was fairly strong, the water was > 1m deep, and there was woody debris near the bank that affected netting success. Although an estimated 30+ coho salmon were observed spawning in this location, no fish were captured, and no tags were observed despite reasonably good visibility.

On a small side channel of the Iskut River (site 2: WPT 511: 56°41.923' 131°24.541'; Figure 3), 3 coho salmon (mean fork length: 735 mm; SE±47.7) were caught using a dip net and sampled. No spaghetti-tagged salmon were caught or observed, and no adipose-clipped salmon were captured or observed. Coho salmon were observed on redds in this clear-water, low flow side channel, but were difficult to capture as they sought refuge under stumps and other woody debris in the channel.

On a larger side channel of the Iskut River (site 3: WPT 512: 56°42.169' 131°28.976'; Figure 3), the crew of three successfully seined and sampled 22 coho salmon (mean fork length: 663 mm; SE±24.1). Although no spaghetti-tagged fish were captured or observed, one adipose-clipped (CWT) female was captured and sacrificed. Fish were observed on redds in this location also. Although the water was quite deep at this location (> 1m), the flow was conducive to seining, and woody debris within the channel and along the banks did not negatively affect seining activities. This location was very productive and many other spawning congregations of coho salmon on redds were observed in the vicinity and within this particular side channel.

In the absence of sufficient time to conduct sampling on the day of departure (October 27), three staff completed an aerial survey of the Iskut River and its tributaries and side channels, to locate redds and spawning congregations of coho salmon. In excess of 30 active (salmon observed on redds) or recently used (redds visible, but no fish observed) spawning sites were identified. The locations were geo-referenced, and will be used to guide future recapture events.

Since no marked fish were recaptured, it was not possible to generate a population estimate.

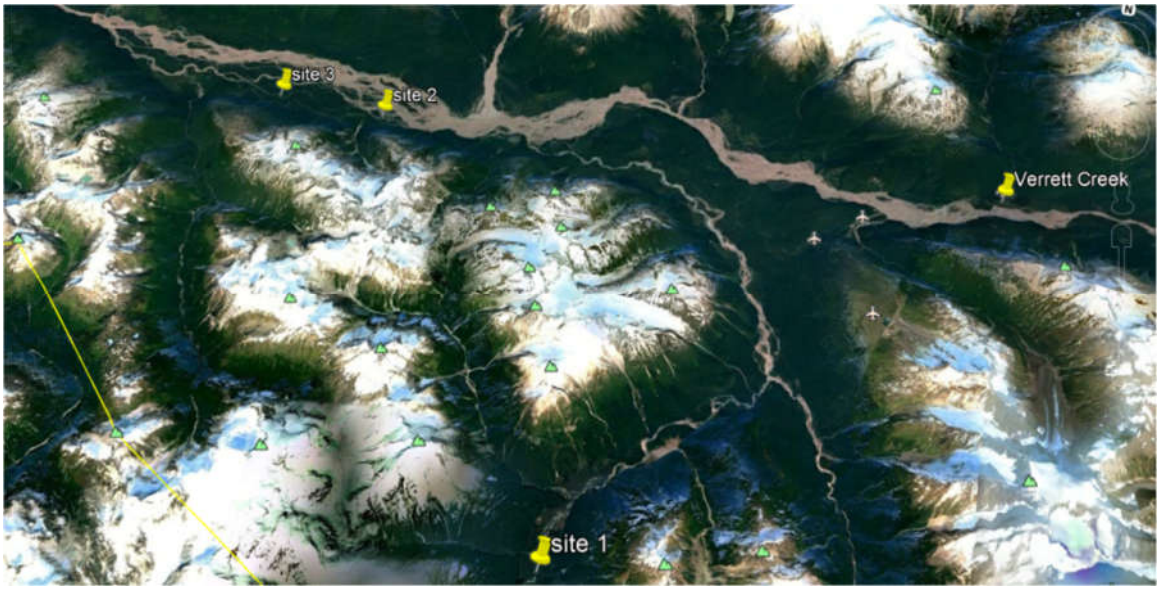

Figure 4. Coho salmon recapture sites within the Iskut River drainage included: Verrett Creek, the upper Craig River (site 1), and two side channels of the Iskut River (sites 1&2) (Google Earth imagery).

Chutine River Sonar Feasibility Assessment

The helicopter survey completed on August 29 identified approximately six sites that appeared to have potential for supporting sonar enumeration (Figure 4). At these sites, the river was in one channel (i.e., there were not numerous side channels that could be accessible to fish such that they could bypass the sonar), the bottom profile was relatively uniform (i.e., no shadows from sand/gravel bars), the flow was relatively uniform across the width of the cross section (e.g., the sonar unit installation could withstand the flows), and there was minimal debris within the channel cross section (e.g., no large stumps/woody debris that could hide fish).

These sites were re-visited on September 4-5 to conduct a ground-based assessment. This involved measuring channel width (m), and visually assessing flow conditions (i.e., at this relatively low flow period, could a sonar unit be safely installed within the channel in such a way that it could withstand water level fluctuations?), channel morphology, and bottom substrate (i.e., adequately firm/gravelly, such that bars would not form and disappear) to the extent possible. The feasibility of weir and camp construction were also evaluated.

Figure 5. Potential sonar sites assessed in the Chutine River in late August and early September, 2019.

At the short-listed sites (n=3), the sonar was deployed for 20 to 60 minutes. With the sonar *in situ*, the bottom profile and substrate were further assessed to confirm that there were no shadows (dips/holes) where fish would not be visible, and that there were no targets (e.g., large rocks) that could hide fish from view of the sonar. The detailed assessment of each potential site is described below.

Site #1 - Barrington River

The first location assessed on the Chutine River on September 4, was approximately 200 meters upstream of the Barrington River confluence (WPT 492 57°41.760' 131°44.312'; Figure 4). At this site, the Chutine River was 51 m wide (wetted width), the water temperature was 5.8°C, and the air temperature was 9.4°C at approximately 10:00 am. The river level was approximately 6 inches higher than it was the previous week during the aerial survey.

The main channel of the river was on the opposite side (i.e., river right). The sonar was deployed for approximately 20 minutes. After some initial fine tuning with the positioning of the unit, the visual range was approximately 20 m. The size of the cobble increased with distance from the sonar (i.e., further in the channel), and there appeared to be a dip in the bottom profile (i.e., channel) where fish could potentially pass undetected. At the location the view was almost perpendicular to the flow. Overall, the view from this site was good, but the dip in the bottom profile would need to be investigated further. A weir could be installed on river left (i.e., the side assessed).

The sonar unit was subsequently shifted about 10 m downstream to a second location to get another view of the river. The visual range was 22-24 m and the view was perpendicular to the river. The view was slightly better than at the first site; the bottom profile was fairly uniform and there did not appear to be any significant blind spots where fish could pass undetected. A 20 minute sonar trial confirmed initial observations. Overall, the view from this location was good, however weir installation and subsequent installation of the sonar may be challenging in higher flows.

Site #2

The second site was upstream of the first site (WPT 493 57°42.696' 131°51.467'; WPT 494 57°42.694' 131°51.188'; Figure 4) and was one of the secondary sites identified in the aerial survey. The river exhibited laminar flow at this site and wetted width was approximately 86 m. There was a large gravel bar in the vicinity of the site which had been recently under water. The current was very fast on river left (site assessment was conducted on river right). This site did not appear to be suitable as the substrate was very soft, there appeared to be a few gravel bars in the area, there were side channels in the vicinity of the site which would be difficult to manage, and it would be difficult to install a weir at this location.

Sites #3 & 4

Secondary Sites 3 & 4 were upstream of site 2 (in the vicinity of WPT 480 57°41.678' 132°04.311'; Figure 4) but they did not warrant further assessment as the channel was too braided and it would be impractical to weir off the secondary channels.

Site #5

Site 5 was further upstream than the other sites assessed and on river left. (WPT 478 57°42.667' 131°55.302'; Figure 4). The wetted width was 71 m and the site looked promising. The sonar installation revealed a shadow which could hide fish. As a result, the unit was moved upstream about 50 m (WPT 495 57°42.654' 131°55.378') for another view of the river. The turbulence in the middle of the river between the two sites appeared to be a stump under the water. The wetted width at this location was 80 m. The sonar recorded for approximately 20 minutes and several fish (65+cm in length) passed within 10 m of the sonar unit. The visual range was approximately 22 m. A large boulder or gravel bar was just out of view of the sonar, however minor adjustments to sonar unit placement could resolve the issue. The second location at site 5 appeared to be slightly better than the first (fewer shadows) but the view from site 1 (Barrington River) was slightly better.

Site #6

Site 6 (WPT 496 57°42.625' 131°54.979'; Figure 4) was approximately 500 m downstream of site 5 and on river right. The best sonar location at this site was approximately 100 m downstream from a large stump. Channel morphology was gradual on river right and most of the flow was on river left. The wetted width was 70 m where the sonar unit was installed.

The visual range was approximately 23 m from the sonar. There did appear to be a shadow between 14 and 16 m from the sonar unit, however large cobble was visible in this location, so fish should be visible as well. Although the view from this location was favorable, further assessment of channel morphology *in situ* could be useful at this site. It appeared as though a weir could be built on river right.

Katete River sonar feasibility assessment

There was only one suitable site identified on the Katete River (Figure 5), and under the water conditions at the time, the site was nearly ideal: wetted channel width was approximately 50 m, channel morphology was relatively uniform, and bottom substrate was firm and composed of gravels. Maximum depth encountered was approximately 1.2 m. The sonar was deployed on September 10 to assess the location *in situ* and finalize sonar unit placement. The location was 0.5 hours by boat from the DFO camp.

Figure 6. Location of weir installation and sonar deployment on the Katete River in 2019.

The weir materials began to arrive September 7 and weir construction occurred September 10 and 11. The final gap between the two end weir tripods on either side of the river was 26 m which was the target gap width. The sonar unit was installed and left in place on September 11. The unit was working well and the entire gap width was visible. There did not appear to be any shadows which could obstruct the unit's view of the fish.

The Operational Plan for the project included daily visits (minimum) to the site to monitor the weir and sonar infrastructure and download files. The ARISFish software was used to review files and measure fish. Based on historical data, and for the purposes of this project, it was assumed that any fish greater than 600 mm was a coho salmon and was counted as

such. If file review indicated that adjustments were necessary to the sonar unit or its settings, those were completed the following day.

The sonar installation crew departed the site on September 12. After overnight rain, water level increased about 0.3 to 0.4 m by September 13. Continued rain required removal of the sonar unit late in the day on September 13 as the water level was almost above the top of the end tripods. At this water level, the sonar stand was unstable, the sonar computer tent was at risk of flooding, and trees and large woody debris were being transported downstream.

By September 15, 2019, water level had receded to the extent that re-installation of the sonar was possible. Although damage had been done to the weir (Figure 5), it was repaired to the extent possible. The sonar recorded effectively between September 15 and 21.

Figure 7: The comparatively minor flooding that occurred on the Katete in mid- September required the sonar unit to be removed on September 13, 2019. These photos depict conditions during the high water event (left side) and the significant debris accumulation (right side) apparent once the water began to recede.

As a result of heavy rains on September 19/20, water level in the Katete River increased by about 1.4 m overnight. Catastrophic damage to the sonar and associated infrastructure (e.g., cables, computer) had occurred by September 21, 2019 and the unit and associated infrastructure were disabled. This flood also caused catastrophic damage to the weir. As

a result, we terminated the project for the season. As the water level receded, the weir and other materials were removed from the river as conditions allowed.

The dynamic nature of the Katete River is not surprising as it is not lake-headed and there is little storage. Although the September 2019 high-water event seemed significant, there have been much larger flooding events in the recent past. Using the gauging station at the Iskut River (Water Survey of Canada station 08CG001) as a proxy for conditions on the Katete, maximum discharge (m^3/s) was much higher in September of 2014 and 2011 than it was in September of 2019 (Figure 4). Future project plans should consider the likelihood of large flood events.

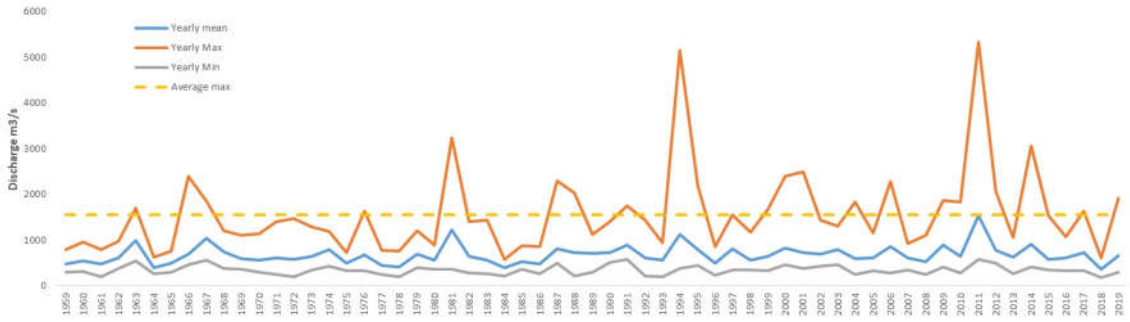

Figure 8. Yearly mean, maximum, and minimum September discharge in the Iskut River between 1959 and 2019.

In total, 395 coho salmon were enumerated in the Katete River in the 10 days that the sonar unit operated between September 11 and September 21. It was not possible to complete any species composition sampling in 2019.

5.0 Budget Summary

The Northern Endowment Fund awarded $121,001.70 to Fisheries and Oceans Canada for completion of the project, and the 90 % advance of $108,901 was fully expended. The 10% holdback is not required from the PSC. A budget summary of expenditures can be referenced in Appendix 5.

6.0 Conclusions

The project objectives were largely met and the outcome of each discrete component of this work will inform future years of the project.

<u>Iskut River Mark-Recapture</u>

Although no marked fish were recaptured in 2019, methodologies were tested and strategies to improve future operations were developed. Although the time available to

complete the recapture portion of the work was extremely limited, fish capture strategies were tested, capture locations were evaluated, and future potential capture locations were identified. Adjustments to future recapture efforts could involve upriver, in-river recapture using drift nets, boat based recapture on the spawning grounds (conditions permitting), and a longer period of helicopter-assisted sampling on the spawning grounds. With additional resources to allow increased recapture effort, defensible recapture numbers can be achieved.

Likewise, additional effort to increase mark applications should increase the probability of fish recapture. Productivity of one capture location over another could not be assessed conclusively in 2019 as only one crew was working at any given time. With two crews, relative productivity of multiple netting sites could be assessed, and additional fish could be captured and marked.

It is recommended that the mark-recapture feasibility studies on Iskut River coho salmon continue.

Chutine River Sonar Feasibility Assessment

There are one or two locations on the Chutine River which may be suitable for sonar enumeration of coho salmon. It may be challenging, however, to construct required infrastructure to withstand the dynamic flows of this large river.

Katete River Sonar Feasibility Assessment

As the Katete River system lacks lake storage and is in a mountainous area with high precipitation, it exhibits extreme fluctuations in flow. Although the sonar system performed well during low flows, the infrastructure was unable to withstand high flows. The next phase of the feasibility study will deploy two sonar units, one on each fork of the river. It is anticipated that flooding should not be as destructive if flow is divided between the two channels. Furthermore, attempts will be made to locate sites that do not require a weir for channel ensonification. Four sites that warrant further investigation have been identified. Finally a 'grab-and-go' system will be tested, using less infrastructure (i.e., no weir) to facilitate prompt removal of the sonar unit when water levels increase rapidly.

7.0 Acknowledgements

Set netting and marking was completed by Adam Brennan, Shawn McFarland, Mark McFarland, Ross Wilcox, Jared Dennis, and Sheldon Dennis under the direction of Johnny Sembsmoen. All crew members relayed helpful advice to consistently improve netting and marking practices for the project. Russell Sampson provided insight and advice as it related to netting practices in the Iskut.

Recapture efforts were completed by Ian Boyce, Michael Folkes, Sheldon Dennis, Kerry Carlick, Jared Dennis, and Jody Mackenzie-Grieve.

Chutine assessment work was completed by Jody Mackenzie-Grieve, Kerry Carlick, and Austin Schroeder (Metla Environmental).

The Katete sonar assessment and weir installation was completed by Shawn McFarland, Mark McFarland, Kerry Carlick, Johnny Sembsmoen, Jody Mackenzie-Grieve, and Austin Schroeder (Metla Environmental) with conceptual advice provided by Brian Mercer (Metla Environmental). The sonar program was completed by Kerry Carlick and Ross Wilcox with the assistance of Jared Dennis and Sheldon Dennis.

Helicopter support for the project was provided by Tundra Helicopters (Steve Harrison, Jaime Tait, Jeremiah MacDonald, and Jim Reed. Fixed wing support was provided by BC Yukon Air Service. Transport of materials and logistical support was provided by Myles and Russell Sampson.

8.0 Literature Cited

Smith, J., Robichaud, D., Etherton, P., Waugh, B., Stark, S., and K. Jensen. 2012. Run Timing and Distribution of Coho Salmon (*Oncorhynchus kisutch*) in the Stikine River, 2006.

Smith, J., Robichaud, D., Mathews, M., Etheron, P., Waugh, B. and K. Jensen. 2007. Mark Recapture and Radiotelemetry Studies of Stikine River Adult Salmon, 2000 – 2005. Pacific Salmon Commission Technical Report No. X., August 2007. Pp. 115.

9.0 Appendices

Appendix 1 – Date ranges of Statistical Weeks relevant to 2019 project

Statistical Week (SW)	Date Range
36	September 1 -7, 2019
37	September 8 -14, 2019
38	September 15 -21, 2019
39	September 22 -28, 2019
40	September 28 - October 5, 2019
41	October 6 - 12, 2019
42	October 13 - 19, 2019
43	October 20 - 26, 2020

Appendix 2 – Recapture sampling on Verrett Creek (October 25-26, 2019).

		Scale	Scale	Fork	Mid-eye fork	Post-orbital Hypural	Gender	Spawning	Secondary	Adipose	CWT
	Date	Book #	Column #	Length (mm)	Length (mm)	Length (mm)	(M/F)	Condition	Mark (Y/N)	Clip (Y/N)	Label #
1	25-Oct	23961	1	720	650	560	M		N	N	
2	25-Oct	23961	2	545	485	425	M	post	N	N	
3	25-Oct	23961	3	715	655	555	M	pre	N	N	
4	25-Oct	23961	4	760	650	560	M		N	N	
5	25-Oct	23961	5	675	595	510	M	pre	N	N	
6	26-Oct	23961	6	710	620	540	M	post	N	N	
7	26-Oct	23961	7	625	560	470	M	pre	N	N	
8	26-Oct	23961	8	760	665	570	M	post	N	N	
9	26-Oct	23961	9	645	570	495	M	pre	N	N	
10	26-Oct	23961	10	740	655	555	M	pre	N	N	
11	26-Oct	23962	10	725	645	555	M	pre	N	N	
12	26-Oct	23962	9	750	665	580	M	mid	N	N	
13	26-Oct	23962	8	730	630	535	M	mid	N	N	
14	26-Oct	23962	7	795	675	590	M	pre	N	N	
15	26-Oct	23962	6	810	690	585	M	mid	N	N	
16	26-Oct	23962	5	635	555	475	M	mid	N	N	
17	26-Oct	23962	4	770	670	555	F	pre	N	N	
18	26-Oct	23962	3	695	610	520	M	pre	N	N	
19	26-Oct	23962	2	760	655	565	M	mid	N	N	
20	26-Oct	23962	1	630	550	490	M	mid	N	N	
21	26-Oct	23963	10	600	525	440	M	pre	N	N	
22	26-Oct	23963	9	660	590	510	F	mid	N	N	
23	26-Oct	23963	8	570	500	425	M	mid	N	N	
24	26-Oct	23963	7	705	605	515	M	mid	N	N	
25	26-Oct	23963	6	705	615	525	M	mid	N	N	
26	26-Oct	23963	5	735	650	575	M	mid	N	N	
27	26-Oct	23963	4	755	675	590	M	mid	N	N	
28	26-Oct	23963	3	485	415	370	M	post	N	N	
29	26-Oct	23963	2	735	640	525	M	mid	N	N	
30	25-Oct	10651	10	635	565	490	M	pre	N	N	
31	25-Oct	10651	9	710	645	545	F	mid	N	N	
32	25-Oct	10651	8	770	660	570	M	pre	N	N	

Appendix 3 – Recapture sampling at the site 1 side channel of the Iskut River (October 25-26, 2019).

		Scale	Scale	Fork	Mid-eye fork	Post-orbital Hypural	Gender	Spawning	Secondary	Adipose	CWT
	Date	Book #	Column #	Length (mm)	Length (mm)	Length (mm)	(M/F)	Condition	Mark (Y/N)	Clip (Y/N)	Label #
1	26-Oct	23951	10-6	680	610	530	M	post	N	N	
2	26-Oct	23951	20-16	695	600	510	M	post	N	N	
3	26-Oct	23951	30-26	830	740	600	F	mid	N	N	

Appendix 4 – Recapture sampling at the site 2 side channel of the Iskut River (October 25-26, 2019).

		Scale	Scale	Fork	Mid-eye fork	Post-orbital Hypural	Gender	Spawning	Secondary	Adipose	CWT
	Date	Book #	Column #	Length (mm)	Length (mm)	Length (mm)	(M/F)	Condition	Mark (Y/N)	Clip (Y/N)	Label #
1	26-Oct	23952	10-6	745	670	560	M	mid	N	N	
2	26-Oct	23952	20-16	640	580	520	M	mid	N	N	
3	26-Oct	23952	30-26	545	490	410	M	mid	N	N	
4	26-Oct	23952	40-36	835	730	640	M	mid	N	N	
5	26-Oct	23952	50-46	760	655	560	M	mid	N	N	
6	26-Oct	23953	10-6	510	445	385	M	mid	N	N	
7	26-Oct	23953	20-16	570	490	410	M	mid	N	N	
8	26-Oct	23953	30-26	780	680	570	M	mid	N	N	
9	26-Oct	23953	40-36	755	665	565	F	mid	N	N	
10	26-Oct	23953	50-46	750	660	550	F	mid	N	N	
11	26-Oct	23954	10-6	525	465	405	M	mid	N	N	
12	26-Oct	23954	20-16	610	540	450	M	mid	N	N	
13	26-Oct	23954	30-26	730	650	565	M	mid	N	N	
14	26-Oct	23954	40-36	550	480	405	M	mid	N	N	
15	26-Oct	23954	50-46	745	650	560	M	mid	N	N	
16	26-Oct	23955	10-6	750	660	570	F	mid	N	N	
17	26-Oct	23955	20-16	740	640	550	M	mid	N	N	
18	26-Oct	23955	30-26	790	680	585	F	mid	Y	Y	1070891
19	26-Oct	23955	40-36	675	595	500	M	mid	N	N	
20	26-Oct	23955	50-46	610	535	440	M	mid	N	N	
21	26-Oct	23956	10-6	505	455	385	M	mid	N	N	
22	26-Oct	23956	20-16	455	400	320	M	mid	N	N	

Appendix 5 – Budget Summary

Fisheries and Oceans Canada - PSC Project Budget Financial Report

Name of Project and PSC#:

Development of Stikine River Stock Assessment Options (I-23)

EXPENDITURES

Labour
DFO Employee Salaries and Benefits

Position		Expenditures (DFO Inkind + PSC)	DFO-Inkind	PSC funding (expences)		Approved Budget (PSC Funding)	Total PSC Funded Expenditure	Variance
Manager	Salary	$ -						
	Benefits	$ -				$ -		
Biologist	Salary	$ 8,100.00	$ 8,100.00					
	Benefits	$ 2,187.00	$ 2,187.00			$ -		
Technician	Salary	$ 32,919.98	$ 16,621.00	$ 16,299		$ 15,758		
	Benefits	$ 8,827.62	$ 4,487.67	$ 4,340		$ 4,255		
Total Expended		$ 52,034.80	$ 31,395.67	$ 20,638.93		$ 20,013.00	$ 20,638.93	$ (625.93)

Subcontractors & Consultants

Contract	Contract Amount Expended	Inkind	PSC funding (expences)		Approved Budget	Total PSC Funded Expenditure	Variance
Tahltan First Nations (TFN)	$ 15,916.63		$ 15,917		15,136		
Fuel Delivery	$ 4,310.00		$ 4,310		4,100		
Air charter	$ 23,300.00		$ 23,300		38,775		
SONAR contract	$ 17,510.00		$ 17,510		18,408		
	$ -						
Total Expended	$ 61,036.63	$ -	$ 61,036.63		$ 76,419.00	$ 61,036.63	$ 15,382.37
		$ 31,395.67		Total	$ 96,432.00	$ 81,675.56	$ 14,756.44

Site / Project Costs

Item	Amount Expended	Inkind	PSC funding (expences)		Approved Budget	Total PSC Funded Expenditure	Variance
Travel	$ 8,138.37		8,138		6,036		
Small Tools & Equipment	$ 1,579.21		1,579		1,500		
Site Supplies & Materials	$ 6,258.83		6,259		6,365		
Equipment Rental	$ -						
Work & Safety Gear	$ 3,061.74		3,062		2,200		
Repairs & Maintenance	$ 2,800.47		2,800		2,659		
Permits	$ -						
Other costs	$ 5,387.00		5,387		5,810		
Total Expended	$ 27,226.62	$ -	$ 27,226.62		$ 24,569.70	$ 27,226.62	$ (2,656.92)
		$ -			$ 24,569.70	$ 27,225.62	$ (2,655.92)

Training Costs

Item	Amount Expended	Inkind	PSC funding (expences)		Approved Budget	Total PSC Funded Expenditure	Variance
Firearms	$ 600.00	$ 600.00					
	$ -						
Total Expended	$ 600.00	$ 600.00	$ -		$ -	$ -	$ -
		$ 600.00			$ -	$ -	$ -

Fisheries and Oceans Canada - PSC Project Budget Financial Report

Name of Project and PSC#:

Development of Stikine River Stock Assessment Options (I-23)

Overhead / Indirect Costs

Item	Amount Expended	Inkind	PSC funding (expenses)	Approved Budget	Total PSC Funded Expenditure	Variance
Office space; including utilities, etc.	$ -					
Insurance	$ -					
Office supplies	$ 250.00	250				
Telephone & long Distance	$ 1,600.00	1600				
Photocopies & printing	$ -					
Indirect/overhead costs	$ -					
Administration and financial management	$ -					
(If the PSC contribution to indirect costs exceeds 20% of the total PSC grant submission of back-up documentation justifying the expense is required).						
Total Expended	$ 1,850.00	$ 1,850.00	$ -	$ -	$ -	$ -
		$ 1,850.00		$ -	$ -	$ -

Capital Costs / Assets (Value > $250.00)

Item	Amount Expended		PSC funding (expenses)	Approved Budget	Total PSC Funded Expenditure	Variance
	$ -					
	$ -					
	$ -					
	$ -					
Total Expended	$ -	$ -	$ -	$ -	$ -	$ -
		$ -		$ -	$ -	$ -

Financial Report

Categories	DFO InKind		Approved Budget (PSC Grant)	Project Expenditures (PSC$)	Variance
Labour	$ 31,395.67		$ 96,432.00	$ 81,675.56	$ 14,756.44
Site / Project Costs	$ -		$ 24,569.70	$ 27,225.62	$ (2,655.92)
Training	$ 600.00		$ -	$ -	$ -
Overhead / Indirect Costs	$ 1,850.00		$ -	$ -	$ -
Capital Costs / Assets	$ -		$ -	$ -	$ -
TOTAL			$ 121,001.70	$108,901.18	$ 12,100.52

PSC Project Funding Grant Advance Amount Received	$ (108,901.00)	(funds rec enter as negative)
PSC Project Funding Grant Amount Remaining to be Paid		(positive refundable to PSC)
Difference Between Grant Amount and Project Expenditures	$ (0.18)	

Fisheries and Oceans Canada - PSC Project Budget Financial Report

Name of Project and PSC#:

Development of Stikine River Stock Assessment Options (I-23)

Justification if Variance

90$ of allocated budget paid to DFO; overspent by $0.18

Project Manager Name	Jody Mackenzie-Grieve
Project Manager Signature	MackenzieGrieve, Jody Digitally signed by MackenzieGrieve, Jody Date: 2020.03.31 09:12:21 -07'00'
Date	31-Mar-20
DFO Responsibility Center Manager Name	Bill Waugh
DFO Responsibility Center Manager Signature	Waugh, William Digitally signed by Waugh, William Date: 2020.03.31 16:31:52 -07'00'
Date	31-Mar-20