

# **Joint US and CA Juan de Fuca Chum Sampling Program 2017**

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## **Abstract**

Through the initial work on the ChumGEM reconstruction model, it was very apparent that the diversion of Chum salmon stocks through the southern route (Strait of Juan de Fuca) was a significant gap in our information needed to populate the model. Currently the model structure is available to incorporate this information but the assumptions on the migration pathways being used require investigation and validation.

The purpose of this project was to work towards addressing that data gap by sampling this migration route in both US and Canadian waters to determine:

- The spatial and temporal stock composition of Chum salmon migrating through the Southern Diversion route,
- Provide sampling platform for stock identification, migration rate studies etc.
- Develop time series of Catch per Unit effort data to pair with the Johnstone Strait Test Fishery to determine diversion rate of various Chum populations.

The first year of this multi-year program was initiated in 2016. The success of that season moved to continue the program in 2017 with a few modifications. The program began as planned on September 25<sup>th</sup> and ran until November 7<sup>th</sup>. A total of 131 sets were completed (68 in Canadian waters and 63 in US waters). A total of 9,577 Chum were encountered and 1,538 were sampled for stock id and other biologicals. There was a significantly higher Catch per Unit Effort (CPUE) in the Canadian side of the Strait compared to what was encountered in the US. This was the complete opposite as to what was encountered in 2016. The catch information demonstrated an earlier timing on the Canadian side of the Strait with a peak CPUE during week 42 and a later peak CPUE in the US waters during week 44. Over the period of the program, Chum CPUE was higher in Canadian waters than in US waters except in week 44.

Stock composition information demonstrated that Canadian stocks dominated the samples throughout the program in Canadian waters and only during the first week in US waters. US stocks in Canadian waters varied in composition but increased later in the program. In US waters, US stocks dominated the mixtures throughout the program except during the first week. Stock timing and distribution differences were observed and this new information has improved our understanding of stock composition and timing through the Strait of Juan de Fuca

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Without the support of staff from the Molecular Genetics Laboratory of the Pacific Biological Station in Nanaimo and the Sclerochronology Laboratories of the Pacific Biological Station in Nanaimo and the A-Tlegay Fisheries Society in Campbell River many of the samples would not have been analyzed.

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## Introduction

The Chum Technical Committee (TCChum), in consideration of the requirements of the latest version of Annex IV, Chapter 6 (Chum Annex) of the Pacific Salmon Treaty, has determined that a significant amount of stock assessment work should be undertaken by the parties, in order to provide the level of information necessary for the successful implementation of the Annex. Annex IV of the Pacific Salmon Treaty states that both parties will submit annual reports on fishing practices from the year previous. As well as a plan for the coming year, this would include run size, total allowable catch, fishery plans for management of the stock for the respective party and estimates of how many fish will be migrating in international waters.

Part of implementing the strategic plan, the TCChum submitted various proposals over the last few years to target key components of the plan. In 2014 the first phase of the Chum Genetic and Environmental Management model (ChumGEM) was initiated to develop a run reconstruction model for Southern BC and Washington Chum salmon. Through the initial work on ChumGEM, it was very apparent that the diversion of Chum salmon stocks through the southern route (Strait of Juan de Fuca) was a significant gap in our information needed to populate the model. Currently the model structure is available to incorporate this information but the assumptions on the migration pathways being used required investigation and validation. The purpose of this project was to continue working towards addressing that data gap by sampling this migration route in both US and Canadian waters to determine:

- The spatial and temporal stock composition of Chum salmon migrating through the Southern Diversion route,
- Provide sampling platform for stock identification, migration rate studies etc.



- Develop time series of Catch per Unit effort data to pair with the Johnstone Strait Test Fishery to determine diversion rate of various Chum populations.

## **Study Area**

Juan de Fuca Strait is a partially mixed tidal channel connecting the freshwater catchment basins of the Strait of Georgia and Puget Sound to the continental margins of British Columbia and Washington State (Figure 1). The strait has a maximum depth of 200 m, a width of 25–40 km, a length of 160 km, a surface area of 4068 km<sup>2</sup>, and a volume of 417 km<sup>3</sup> (Thomson, Mihály and Kulikov 2007). In order to evaluate the migration of Chum moving through this Southern Diversion pathway, the area was broken into 4 quadrants (Figure 2) to sample over the duration of the program. Juan de Fuca Strait has a shared border off the coast of the United States and Canada. To simplify set locations, the area to be fished was split into four quadrants (A, B, C and D). The set location was recorded on the set log which started with the quadrant, followed by the GPS coordinates, taken when the net commenced going out.

## Materials and Methods

This program entailed 3 components: Vessel operation, catch sampling including locations and sample processing.

### *Charter Vessel Operations and Fish Capture:*

In order to reduce catch selectivity, a Purse Seine vessel was chartered to conduct the sampling to cover the main fall Chum migration time period (typically September through November). As recommended in 2016, the seine net was modified in depth from 675 meshes deep to 475 to allow better access to shallower locations primarily on the Canadian side of the Strait. The dimensions of the seine net used were 225 fathom (1,350 feet; 411m) long and 21 fathoms (475 meshes) deep. The vessel was monitored with a satellite Vessel Monitoring System (VMS) for real time monitoring of vessel positioning every 15 minutes. That data is available but not included in this report due to the size of the file (link).

[http://www-ops2.pac.dfo-mpo.gc.ca/fos2\\_Internet/Testfish/rptdtfdparm.cfm?fsub\\_id=228](http://www-ops2.pac.dfo-mpo.gc.ca/fos2_Internet/Testfish/rptdtfdparm.cfm?fsub_id=228).

### Study Design

To understand chum salmon migration patterns and abundance, the test fishery was designed to provide equal coverage in U.S. and Canadian territorial waters. The vessel fished a total of 24 days between September 25<sup>th</sup>, and November 7<sup>th</sup> 2017, targeting the peak migration periods. Trip length varied between three and five days of fishing, with up to four days between trips. We targeted a sample rate of 100 Chum per day, to a maximum of 400 over the course of a trip. The seine vessel, was to perform 6 sets a day, with each set requiring approximately 1-1.5 hours from commencement to completion

The Juan de Fuca Straits can be quite rough with winds coming off the Pacific Ocean, creating large swell. The skipper and crew did their best to follow the schedule although they took advantage of favorable weather conditions.

#### Vessel Operation

For the Juan de Fuca test fishery, a drum seiner was used, and each seine was conducted as follows. The set commenced when a power skiff pulled the running line, causing the net to unwind from the drum. The power skiff towed the running line into the current creating a taut line and net in a crescent shape, the line is towed between 20-40 minutes, after which the power skiff circles back to the seiner and starts closing the net. As the net is in a circular shape off the port or starboard side, the purse line is pulled up with the rings sealing the bottom of the net, once the rings are on deck they are threaded with a hairpin to hold them together. At the same time, the drum is bringing in the excess net, the rings are pulled off the hair pin tightening up the net, the net is tied off and lifted with the boom until the net creates a bunt gathering all the fish together, the crew would roll and pull the net over the side and into the vessel bringing the fish closer to the surface. The fish would be dip netted to bring them on board as random samples and all other fish released. To release the fish the cork line was dropped and the purse line loosened, the fish were counted as they swam out over the purse line. The boom was brought back down to loosen the rope allowing the net to fall free and be pulled in by the drum, the purse line and skiff were brought to the stern of the boat, tied up, to be ready for the next set.

#### Fish Capture.

A total of 100 random samples were targeted daily. Every attempt was made to sample the catch across sets proportionate to the CPUE, that is to say, we attempted to collect samples proportional to the number of fish captured in each set. Fish to be sampled were removed from the seine using a dip net and processed as soon as possible. When the sample fish were onboard for a given set, the crew would release the cork line, drop the purse line slightly and allow the remaining fish to swim out. Lowering and raising the purse line controlled the speed at which the fish swam out. It was the observer's responsibility to communicate if the fish were swimming too quickly/ slowly. A tally counter was held in hand, for every 10 fish that swam out, it would be pressed once. All species of fish swimming out of the net were identified and counted to make sure all catch were being recorded properly. The skipper and his crew ensured the observer knew all the fish they had found caught in the net and released if the observer was not able to be present on the back deck for safety reasons.

#### Observer Roles

Prior to setting the net, the observer would be in the wheel house communicating with the skipper about when and where was best to set. It was the observer's responsibility to fill out the set log. The set log included which quadrant the set was being performed, GPS coordinates when the net started, time the net started going out and when the rings were up. Weather and the tide were also recorded; documenting percentage of cloud coverage and fog, amount of rain, wind direction and speed, water temperature and the sea surface condition. All species of all fish caught and released were documented and how successful the assessment set was (examples in Appendix A and B). After the set log was completed the information was entered into an electronic logbook program on the DFO computer, this allowed for real-time data transmission using a satellite system. All data collected from the program is available on the DFO website.

Other responsibilities included:

- Looking for signs of fish, taking note and documenting any other wildlife in the area was another key activity of the observer.
- Watching the entirety of the set, if something happened making sure it was documented.
- When the fish were being brought in it was the observer's duty to tell the crew how many fish were required for sampling, counting how many were on board, and accurately counting the fish as they swam out of the net. +
- Once the fish were on board it was then time to perform all sampling tasks required.

### *Catch Sampling:*

#### Sampling

An onboard observer trained by DFO was responsible for collecting all biological data and samples. The following samples were collected from each fish:

- Length: measured using a hypural stick, the post orbital fork length
- Scale Sample: two scale samples were taken from the left side of the fish drawing a diagonal line from the dorsal fin to the anal fin, approximately 3 scales above or below the lateral line. It was focused on to only take scale samples that were taken from flesh that had not been healed over and in a cycloid shape. Scale samples were used to determine age based on protocols laid out in (MacLellan et al. 2004).
- DNA: a sample from the adipose fin is taken with a hold punch (if damaged the sample was taken from the caudal fin), having a thin tissue sample is beneficial, allowing it to dry quickly on the Whatman sheet reducing the chance of it falling off and being lost

<http://www.pac.dfo-mpo.gc.ca/science/facilities-installations/pbs-sbp/mgl-lgm/samp-echant/index-eng.html>.

- Sex: the chum salmon were cut just passed their pectoral fin on its belly, 1-2 inches in length, one finger was inserted to feel either a smooth sperm sack or eggs

### *Sample processing:*

#### **Scale samples:**

Scale samples were sent to the Sclerochronology Laboratory of both the Pacific Biological Station in Nanaimo and the A-Tlegay Fisheries Society in Campbell River for age analysis. Sample preparation and scale age evaluation were completed following methods described in (MacLellan et al. 2015) and (Hudson et al. 2010). Results by fish were provided back and compiled within the database for this program.

#### **Tissue samples for DNA:**

##### Sample preparation

All tissue samples were sent to the Molecular Genetic Laboratory of the Pacific Biological Station for DNA extraction and analysis. The sample size (200/strata) was derived from past genetic studies. Simulations from previous Puget Sound Chum genetic stock studies in the 1980s and 1990s using less accurate electrophoresis genetic analyses methods demonstrated large increases in precision when sample size increased from 100 to 200 and a small increase in precision for sample size above 200.

Once Chum salmon genomic DNA was available, surveys of variation at the following 14 microsatellite loci were conducted: Ots3 (Banks et al. 1999), Oke3 (Buchholz et al. 2001), Oki2 (Smith et al. 1998), Oki100 (Beacham et al. 2008b), Ots103 (Nelson and Beacham 1999), Omm1070 (Rexroad et al. 2001), Omy 1011 (Spies et al. 2005), One101, One102, One104, One111, and One114 (Olsen et al. 2000), Ssa419 (Cairney et al. 2000), and OtsG68

(Williamson et al. 2002). Microsatellites were size fractionated in an Applied Biosystems (ABI) 3730 capillary DNA sequencer, and genotypes were scored by GeneMapper software 3.0 (Applied Biosystems, Foster City, CA) using an internal lane sizing standard.

In general, polymerase chain (PCR) reactions were conducted in 10 µl volumes consisting of 0.06 units of Taq polymerase, 1µl of 30ng DNA, 1.5-2.5mM MgCl<sub>2</sub>, 1mM 10x buffer, 0.8mM dNTP's, 0.006-0.065µM of labeled forward primer (depending on the locus), 0.4µM unlabeled forward primer, 0.4µM unlabeled reverse primer, and deionized H<sub>2</sub>O. PCR was completed on an MJResearch™ DNA Engine™ PCT-200 or a DNA Engine Tetrad™ PCT-225. The amplification profile involved one cycle of 2 min @ 92°C, 30 cycles of 15 sec @ 92°C, 15 sec @ 52-60°C (depending on the locus) and 30 sec @ 72°C, and a final extension for 10 min @ 72°C. Specific PCR conditions for a particular locus could vary from this general outline. Further information on laboratory equipment and techniques is available at the Molecular Genetics Laboratory website at <http://www.pac.dfo-mpo.gc.ca/science/facilities-installations/pbs-sbp/mgl-lgm>.

### Baseline Populations

The baseline survey consisted of microsatellite analysis of Chum salmon from 130 locations within Canada and the southern US (Table 1). Thirteen regional groupings of populations were identified based on genetic stock structure and the ability to accurately estimate known mixtures on of these groupings (DFO unpublished data). All annual baseline samples available for a specific sample location were combined to estimate population allele frequencies, as was recommended by Waples (1990).

### Estimation of Stock Composition

Analysis of fishery samples was conducted with a Bayesian procedure (BAYES) as outlined by Pella and Masuda (2001). Each locus was assumed to be in Hardy-Weinberg equilibrium, and expected genotypic frequencies were determined from the observed allele frequencies and used as model inputs. For BAYES, the initial FORTRAN-based computer program as outlined by (Pella and Masuda 2001) required large amounts of computer analytical time when applied to stock identification problems with a baseline as comprehensive as employed in the current study. Given this limitation, a new version of the program was developed by our laboratory as a C-based program which is available from the Molecular Genetics Laboratory website (Neaves et al. 2005). In the analysis, ten 20,000-iteration Monte Carlo Markov chains of estimated stock compositions were produced, with initial starting values for each chain set at 0.90 for a particular population which was different for each chain. Estimated stock compositions were estimated when all Monte Carlo Markov chains had converged producing a Gelman-Rubin coefficient  $< 1.2$  (Pella and Masuda 2001). The last 1,000 iterations from each of the 10 chains were combined, and for each fish the probability of originating from each population in the baseline was determined. These individual probabilities were summed over all fish in the sample, and divided by the number of fish sampled to provide the point estimate of stock composition. Standard deviations of estimated stock compositions were also determined from the last 1,000 iterations from each of the 10 Monte Carlo Markov chains incorporated in the analysis.

## **Results and Discussion**

The program initiated as planned on September 25<sup>th</sup> and ran until November 7<sup>th</sup>. Data has been stratified over each week and by fishing area (see Table 2 for the week assignments). A total of 131 sets were completed (67 in Canadian fishing areas and 63 in US fishing areas). A total of 9,577 (compared to 2016:1,471 encountered) Chum were encountered and 1,538 were sampled for stock id and other biologicals. The majority of fish in 2017 were caught in



quadrants A on the Canadian side and D on the United States side. Over the last two years, setting locations has been refined to areas mainly within those 2 quadrants.

### *Set distribution*

Sets were conducted throughout the study area during the duration of the program. As this was the second year of this type of survey in this location, flexibility on set location was provided within a defined area to determine fish utilization and behavior (Figure 2). Set locations were collected on the data sheets as well as through VMS. The GPS coordinates of each of these set locations (Appendix C) were then incorporated into Google Earth and provided in Figures 3-9.

Of the 131 sets conducted only one set was deemed a “non-assessment” set due to a setting malfunction and not included in the analysis. For the 130 assessment sets 51% were within the Canadian fishing areas and 49% were conducted in US waters over the duration of the program. The original plan was to set weekly in both Canadian and US fishing areas, but due to the participation of the sampling platform in commercial fisheries, some weekly coverage in both fishing areas was not achieved.

### *Catch and Effort information*

Catch and effort data is provided in Table 3 for the program. A total of 9,577 Chum, 120 adult Coho and 249 Coho jacks were encountered during the program. Of the catch only 1,538 Chum were retained for sampling and all the other Chum and Coho were released. Chum CPUE peaked during week 42 in both the US and Canadian waters. Unlike 2016, Chum CPUE tended to be higher in Canadian waters over the duration of the program (Figure 10). As this was the second year of this type of sampling it is difficult to draw any conclusions as to what the CPUE encountered reflects on abundance of Chum salmon moving through this area over the time of the program.

## *Biological Information*

All Chum retained during the project were sampled for a variety of biologicals. 1,538 Chum were sampled over the duration of the project.

### **Sex composition**

The sex composition varied across weeks (Table 4). Male Chum dominated in the first weeks with female Chum composition increasing through the weeks and then dominating in week 42 (Figure 11). This pattern is indicative of chum migration seen in other areas such as the Johnstone Strait Test fishery.

### **Age composition**

Age composition was dominated by 4<sub>1</sub> Chum during the entire program (Table 5) but unlike 2016 the 4<sub>1</sub> composition declined dramatically after week 41. The contribution of Age 3<sub>1</sub> fish was much higher with both sexes than was observed in 2016 (Figure 12). This result is similar to what was encountered in the 2017 Johnstone Strait test fishery samples for chum moving through the northern approach.

### **Length data**

Fish size range from 510mm to 782mm with the average Male Chum = 650mm and females = 638mm (Table 6). The size distribution overlapped for both species with male Chum tending to be skewed a bit more to larger fish (Figure 13). Fish size tended to decline over time for both sexes with some stability between males and females from week 42 to 44 (Figure 14) which coincides with a strong Age 3 female composition during that period (Figure 14).

### **Stock Composition**

Stock composition of the Chum catch by week and fishing area is provided in Table 7 and 8 to the regional and country of origin level. Keep in mind when evaluating the assignment

of stock to the samples that sample size targets were not achieved in all weeks and fishing areas.

The samples collected in the Canadian fishing areas tended to be dominated by Canadian stocks with an increase in prevalence of US stocks into the later weeks (Table 7). In US waters, the Canadian stocks only dominated the samples during the first weeks with US stocks taking over in week 40 through week 45 (Table 8). Based on this information it appeared that spatially, US stocks tended to favor the “US waters” or the Southern portion of the Study Area similar to what was observed in 2016. Temporally, US stocks increased their prevalence throughout October and into November in both US and Canadian fishing areas (Figure 15) but unlike in 2016 the US composition in US water dominated in the 2<sup>nd</sup> week and continued through the rest of the program.

In regards to Canadian composition, Southern BC populations tended to dominate spatially in Canadian waters over the duration of the program. Fraser populations only made up a small portion of the composition in both CDN and US waters over the entire season (Figure 15). The Southern BC populations were made up primarily of West Coast Vancouver Island stock early in the season which then transitioned to a Strait of Georgia West and East stock composition (Figure 16). West Coast Vancouver Island composition tended to close to 50% or greater in Canadian waters for week 39 through 43 and in US waters in weeks 39-40. .

The composition of US stocks saw Hood Canal Fall stocks dominating most weeks in both Canadian and US waters except weeks 39 and 45 (Figure 17). Hood Canal Fall stock dominated in US waters from week 41 till the end and in Canadian waters in weeks 44 and 45. Puget Sound North stock appeared to migrate spatially more in Canadian waters over the entire time period sampled.

## Conclusion

The program in 2017 continued to be an effective platform to sample Chum migration moving through the Strait of Juan de Fuca similar to 2016 (Van Will et al., 2017). The program collected valuable stock specific information on spatial distribution and migration timing. The CPUE in 2017 was much higher than 2016 with a shift to higher CPUEs in Canadian waters than in the US waters (Figure 18). Strong differences were observed in the stock composition over weeks and between US and CDN waters. Canadian populations dominated samples on the Canadian side of the Strait and US populations dominated in US waters. In both years, US stocks increased in prevalence later in the season. Unlike 2016 which saw Canadian stocks dominate in US waters for the first few weeks of the survey, in 2017 Canadian stocks only dominated in the first week of sampling in US waters.

Mark Recalma (skipper) from the Pentlatch and Kwagwiltz Nation used information he'd gathered from his elders to better understand the waters in Juan de Fuca Strait. Two interviews were taken while on board with Mark Recalma and Wiley Roberts (skiff man, deckhand) from the Weiwaikum nation, it gave insight into the experience of the crew and the knowledge that had been passed down from generations previous.

During observation, video footage was taken over the entirety of the program. It showed the surrounding environment, set from beginning to end. Roles of the deckhands, dip netting and releasing the fish as well Department of Fisheries and Oceans Canada took a drone video showcasing the Seine boat set from beginning to end. This allowed for an optimal aerial view of all of the processes from beginning to the end of the project. It engaged the viewers with a visual tool, demonstrating the role each crew member played in effectively catching the chum salmon. It also demonstrated the difference between seining in the United States vs Canada. This was an excellent opportunity working with the United States fishery demonstrating the set on board the vessel and from an aerial vantage point.

The link has been included.

<https://www.youtube.com/watch?v=JAn-Uj6H1Fg>

## **Recommendations**

In planning for subsequent years, it is important that sample sizes by strata (week and fishing area) be achieved in order to draw appropriate conclusions regarding temporal and spatial compositions moving through the Strait of Juan de Fuca. It is imperative that we sample on both sides of the border during the same week in order to compare the catch information. It is important to gain more area familiarization to better understand the stocks migratory path through the channel. We recommend maintaining the commencement and duration of the program as in 2017. As the program requires permitting on both sides of the border it will be key to initiate that process well in advance of the start date to ensure all required permits are approved for the fishing activities.

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## Tables

**Table 1.** Baseline of 130 sample sites/populations by regional genetic groups used to estimate stock composition of Chum salmon from southern British Columbia and Washington State in 2017 fisheries

Region	Populations
Johnstone Strait	Heydon Cr, Klinaklini R, Ahta R, Viner Sound, Waump Cr, Nimpkish R, Kakweiken R, Glendale Cr, Ahnuhati Cr, Mackenzie Sound, Phillips R, Viner/Scott Cove
Strait of Georgia East	Tzoonie Cr, Cheakamus R, Sliammon R, Mamquam R, Wortley Cr, Squamish R, Indian R, Theodosia R, Southgate R, Algard Cr, Orford R, Shovelnose R, Mashiter Cr, Stawamus R, Homathko R, Kwalate Cr, Lang Cr, Deserted Cr, Myrtle Cr, Snake Cr, Anderson Cr
Strait of Georgia West	Goldstream R, Cowichan R, Nanaimo R, Chemainus R, Puntledge R, Qualicum R, Little Qualicum R, Campbell R, Cold Cr, Englishman R
West Coast Vancouver Island	Smith Cr, Kirby Cr, Demaniel R, Nitinat R, Hathaway Cr, Petattum Cr, Goodspeed, R, Cayeghle Cr, Colonial R, Sugsaw, Cr, Nahmint R, Hoiss Cr, Black Cr, Parks R, Tsowwin_R, Kaouk R, Sucwoa R, Canton R, Little Toquart R, Tranquil Cr, Salmon Cr, Bedwell R, Warner Bay, Burman Cr, Sooke R
Fraser River	Silverdale Cr, Squakum Cr, Wahleach Cr, Chilliwack R, Chehalis R, Stave R, Alouette R, Vedder R, Harrison R, Inch Cr, Lower Lillooet R, Norrish-Worth Cr, North Alouette R, Widgeon Slough, Kawkawa Cr, Blaney Cr, Chilqua Cr, Serpentine R, Kanaka Cr, Worth Cr, Hopedale Cr, Hicks Cr, Harrison Lake, Peach Cr, Sweltzer Cr, Nathan Cr, McIntyre Cr, Street Cr, Railroad, Cr, Collum Cr
North Puget Sound	Skagit R, County Line Cr, Grant Cr, Siberia Cr, Skykomish R, Snohomish R, Stillaguamish R, Sauk R
South Puget Sound	Kennedy Cr, Minter Cr, Nisqually R, Mill Cr, Skookum Cr, Puyallup R, South Prairie Cr
Juan de Fuca/ Hood Canal Summer	Salmon R, Big Quilcene R
Coastal Washington	Ellsworth Cr, Bitter Cr, Quinault R, Satsop R
Nooksack	Nooksack R
Tulalip	Tulalip R
Central Puget Sound	Green R, Grovers Cr
Juan de Fuca/ Hood Canal Fall	Elwha R, Hoodsport, Spencer Cr, Big Mission Cr, Dewatto R, Hamma Hamma R, Big Beef Cr

**Table 2.** 2017 Date ranges and assigned week numbers

<b>Date Range</b>	<b>Week Number</b>
September 23 - September 29	39
September 30 - October 6	40
October 7 - October 13	41
October 14 - October 20	42
October 21 - October 27	43
October 28 - November 3	44
November 4 - November 10	45

**Table 3.** Catch and Effort information for the program in 2017

<b>Week Number/ Fishing Area</b>	<b>Number of Sets</b>	<b>Chum Kept</b>	<b>Chum Released</b>	<b>Coho adult released</b>	<b>Coho Jack released</b>
<b>39</b>					
Canada	15	56	16	24	54
US	6	10	0	5	5
<b>40</b>					
Canada	6	150	1107	7	12
US	10	84	44	45	29
<b>41</b>					
Canada	13	244	3700	15	11
US	12	110	34	2	1
<b>42</b>					
Canada	6	106	2761	1	0
US	10	165	0	9	5
<b>43</b>					
Canada	6	105	233	0	0
US	12	75	3	3	0
<b>44</b>					
Canada	19	267	135	0	33
US	7	115	1	4	0
<b>45</b>					
Canada	2	39	5	0	0
US	6	12	0	5	99
<b>Grand Total</b>	<b>130</b>	<b>1538</b>	<b>8039</b>	<b>120</b>	<b>249</b>



**Table 4.** Chum Salmon age composition by sex over time

<b>Week #</b>	<b>Female</b>	<b>Male</b>	<b>Sample Size</b>
39	41%	59%	66
40	43%	57%	234
41	47%	53%	354
42	53%	47%	271
43	63%	37%	180
44	60%	40%	382
45	76%	24%	51
<b>Combined</b>	<b>53%</b>	<b>47%</b>	<b>1538</b>

**Table 5.** Chum Salmon age composition by sex over time

<b>Sex/ Week #</b>	<b>Female</b>				<b>Male</b>			
	<b>Age 3</b>	<b>Age 4</b>	<b>Age 5</b>	<b>Total</b>	<b>Age 3</b>	<b>Age 4</b>	<b>Age 5</b>	<b>Total</b>
39	5%	29%	8%	<b>42%</b>	2%	45%	12%	<b>58%</b>
40	4%	34%	5%	<b>43%</b>	10%	37%	10%	<b>57%</b>
41	8%	34%	5%	<b>47%</b>	9%	36%	8%	<b>53%</b>
42	17%	32%	3%	<b>53%</b>	14%	30%	4%	<b>47%</b>
43	20%	38%	4%	<b>63%</b>	16%	19%	3%	<b>37%</b>
44	22%	35%	3%	<b>60%</b>	18%	19%	3%	<b>40%</b>
45	26%	44%	6%	<b>76%</b>	16%	6%	2%	<b>24%</b>
<b>Combined</b>	<b>14%</b>	<b>35%</b>	<b>4%</b>	<b>53%</b>	<b>13%</b>	<b>28%</b>	<b>6%</b>	<b>47%</b>

**Table 6.** *Chum salmon length by sex over time*

<b>Sex/ Week#</b>	<b>Average Length (mm)</b>	<b>Standard deviation (mm)</b>	<b>Maximum (mm)</b>	<b>Minimum (mm)</b>	<b>Sample Size</b>
<b>Female</b>	<b>638</b>	<b>41</b>	<b>782</b>	<b>516</b>	<b>819</b>
39	657	38	782	582	27
40	657	34	721	569	101
41	649	36	749	539	167
42	626	43	709	516	143
43	635	37	736	531	113
44	627	44	719	521	229
45	639	40	701	537	39
<b>Male</b>	<b>650</b>	<b>45</b>	<b>750</b>	<b>510</b>	<b>719</b>
39	677	38	750	565	39
40	666	35	747	544	133
41	662	38	749	551	187
42	632	46	735	534	128
43	635	42	731	520	67
44	638	48	745	520	153
45	615	62	730	510	12
<b>Combined</b>	<b>643</b>	<b>43</b>	<b>782</b>	<b>510</b>	<b>1538</b>

**Table 7.** Estimated percentage stock composition of Chum salmon caught in the Juan de Fuca sampling program by week and Area (CDN: Canadian waters) in 2017. Stock compositions were estimated using 14 microsatellite loci and the baseline outlined in Table 1. Number of fish excluded because of their inability to provide sufficient information for genetic stock identification in parentheses beside the sample size. Standard deviation (SD) of the estimated stock composition is in parentheses.

Year	2017		2017		2017		2017		2017		2017		2017	
Julian Date	268-269		280-281		284-285		292		296-302		305-307		311	
Gear	seine		seine		seine		seine		seine		seine		seine	
Area	JdFucatest-CDN		JdFucatest-CDN		JdFucatest-CDN		JdFucatest-CDN		JdFucatest-CDN		JdFucatest-CDN		JdFucatest-CDN	
Week #	Week39		Week40		Week41		Week42		Week43		Week44		Week45	
Sample Dates	Sep25-Sep26		Oct07-Oct08		Oct11-Oct12		Oct19		Oct23-Oct29		Nov01-Nov03		Nov07	
Sample Size	52(0)		250(0)		138(0)		105(0)		210(0)		161(0)		39(0)	
Region	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD
Johnstone Strait (F)	4.0%	(9.6%)	0.2%	(0.7%)	7.0%	(9.7%)	2.9%	(5.7%)	1.9%	(4.5%)	11.5%	(5.5%)	8.1%	(9.0%)
Strait of Georgia East (F)	24.0%	(17.9%)	13.1%	(5.3%)	2.2%	(4.1%)	18.7%	(15.8%)	5.5%	(6.6%)	6.3%	(5.0%)	16.9%	(14.4%)
Strait of Georgia West (F)	15.5%	(15.7%)	17.7%	(8.2%)	27.7%	(8.8%)	23.4%	(8.2%)	34.7%	(8.7%)	33.0%	(7.8%)	41.3%	(16.2%)
Fraser River (F)	9.8%	(8.4%)	3.8%	(2.1%)	17.9%	(4.9%)	15.4%	(8.1%)	8.9%	(4.6%)	8.7%	(4.4%)	1.5%	(4.0%)
West Coast Vancouver I (F)	44.6%	(15.5%)	61.5%	(7.8%)	32.4%	(8.2%)	38.1%	(11.8%)	44.5%	(6.9%)	20.5%	(5.7%)	11.7%	(7.3%)
North Puget Sound (F)	0.6%	(3.9%)	0.6%	(1.4%)	0.9%	(2.2%)	0.5%	(1.6%)	1.5%	(3.2%)	3.2%	(4.2%)	17.7%	(10.1%)
Central Puget Sound (F)	0.0%	(1.9%)	0.1%	(0.4%)	0.0%	(0.2%)	0.1%	(0.5%)	0.0%	(0.4%)	0.3%	(0.7%)	0.4%	(1.4%)
South Puget Sound (F-W)	0.0%	(2.3%)	0.2%	(0.6%)	1.1%	(1.7%)	0.2%	(0.8%)	0.1%	(0.5%)	3.5%	(2.2%)	1.3%	(3.6%)
Hood Canal (S)	0.0%	(1.1%)	0.0%	(0.1%)	0.0%	(0.1%)	0.0%	(0.1%)	0.0%	(0.1%)	0.0%	(0.1%)	0.0%	(0.3%)
Hood Canal (F)	0.8%	(4.2%)	2.8%	(1.8%)	10.7%	(3.2%)	0.7%	(1.9%)	2.9%	(2.9%)	13.1%	(3.9%)	0.8%	(2.6%)
Juan de Fuca (F)	0.3%	(2.2%)	0.1%	(0.4%)	0.1%	(0.5%)	0.0%	(0.1%)	0.0%	(0.1%)	0.0%	(0.3%)	0.2%	(1.3%)
Coastal Washington (F)	0.2%	(2.4%)	0.0%	(0.1%)	0.0%	(0.2%)	0.0%	(0.3%)	0.0%	(0.2%)	0.0%	(0.3%)	0.0%	(0.4%)
Country														
Canada	98.0%	(7.3%)	96.3%	(2.4%)	87.2%	(4.0%)	98.5%	(2.7%)	95.5%	(4.1%)	79.9%	(5.7%)	79.6%	(9.7%)
US	2.0%	(7.3%)	3.7%	(2.4%)	12.8%	(4.0%)	1.5%	(2.7%)	4.5%	(4.1%)	20.1%	(5.7%)	20.4%	(9.7%)

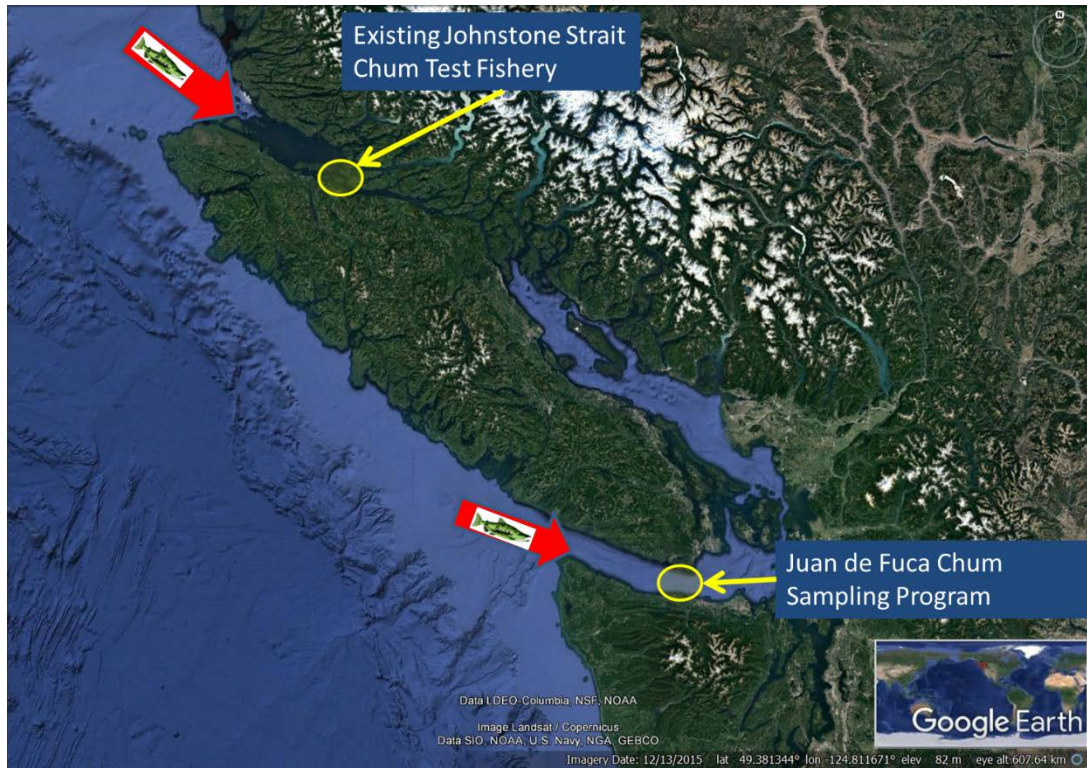
\*(F)=Fall run Chum, (S)=Summer run Chum, (F-W)= Fall and winter run Chum

**Table 8.** Estimated percentage stock composition of Chum salmon caught in the Juan de Fuca sampling program by week and Area (US: United States waters) in 2017. Stock compositions were estimated using 14 microsatellite loci and the baseline outlined in Table 1. Number of fish excluded because of their inability to provide sufficient information for genetic stock identification in parentheses beside the sample size. Standard deviation (SD) of the estimated stock composition is in parentheses.

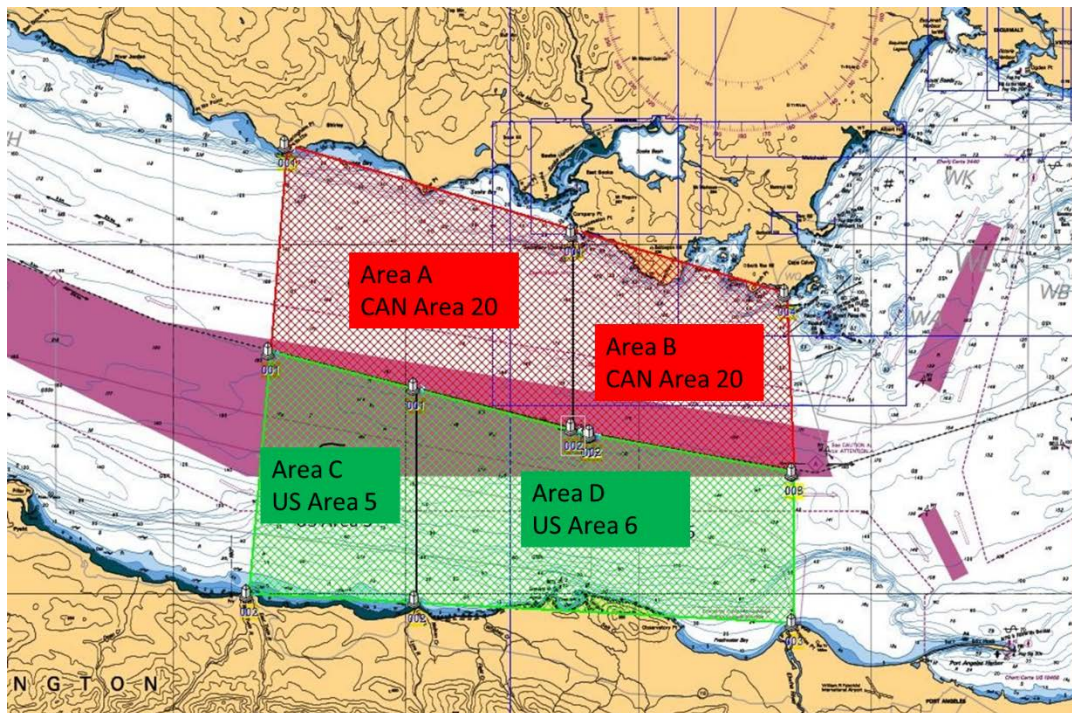
Year	2017		2017		2017		2017		2017		2017		2017	
Julian Date	270-271		278-279		284-286		293-294		297-301		304-305		310	
Gear	seine		seine		seine		seine		seine		seine		seine	
Area	JdFucatest-US		JdFucatest-US		JdFucatest-US		JdFucatest-US		JdFucatest-US		JdFucatest-US		JdFucatest-US	
Week #	Week39		Week40		Week41		Week42		Week43		Week44		Week45	
Sample Dates	Sep27-Sep28		Oct05-Oct06		Oct11-Oct13		Oct20-Oct21		Oct24-Oct28		Oct31-Nov01		Nov06	
Sample Size	14(0)		84(0)		116(0)		164(2)		73(1)		116(0)		12(0)	
Region	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD	Estimate	SD
Johnstone Strait (F)	0.8%	(4.5%)	0.1%	(0.6%)	0.3%	(1.0%)	0.5%	(1.3%)	0.3%	(1.2%)	0.6%	(1.8%)	0.8%	(3.7%)
Strait of Georgia East (F)	49.6%	(24.4%)	2.0%	(3.1%)	4.6%	(4.1%)	2.2%	(2.6%)	1.9%	(3.4%)	7.1%	(4.4%)	14.7%	(10.8%)
Strait of Georgia West (F)	8.6%	(17.5%)	0.3%	(1.1%)	5.5%	(5.2%)	9.4%	(4.1%)	16.9%	(5.9%)	6.6%	(3.9%)	0.1%	(2.1%)
Fraser River (F)	20.1%	(17.9%)	16.8%	(5.1%)	12.2%	(4.4%)	5.5%	(3.7%)	0.8%	(2.1%)	2.4%	(1.9%)	0.4%	(4.3%)
West Coast Vancouver I (F)	4.1%	(9.4%)	12.8%	(5.4%)	6.2%	(2.7%)	0.3%	(0.9%)	0.1%	(0.8%)	0.1%	(0.7%)	1.6%	(5.5%)
North Puget Sound (F)	2.1%	(7.7%)	0.5%	(1.6%)	0.8%	(1.8%)	1.5%	(2.6%)	12.7%	(5.6%)	0.3%	(1.4%)	2.4%	(6.3%)
Central Puget Sound (F)	5.8%	(9.3%)	9.8%	(4.0%)	6.4%	(3.4%)	11.0%	(3.6%)	20.1%	(6.4%)	13.5%	(4.5%)	43.9%	(14.9%)
South Puget Sound (F-W)	4.3%	(7.2%)	9.4%	(3.8%)	11.9%	(3.7%)	8.4%	(3.6%)	6.1%	(5.5%)	30.0%	(5.8%)	2.8%	(7.8%)
Hood Canal (S)	0.0%	(0.8%)	0.0%	(0.1%)	0.0%	(0.1%)	0.0%	(0.1%)	0.0%	(0.2%)	0.0%	(0.1%)	0.0%	(1.0%)
Hood Canal (F)	0.9%	(5.0%)	48.4%	(6.8%)	52.0%	(5.5%)	60.4%	(4.9%)	41.0%	(6.9%)	39.5%	(5.7%)	33.3%	(14.3%)
Juan de Fuca (F)	0.0%	(1.4%)	0.0%	(0.3%)	0.1%	(0.5%)	0.0%	(0.1%)	0.0%	(0.1%)	0.0%	(0.3%)	0.0%	(0.4%)
Coastal Washington (F)	3.7%	(7.7%)	0.0%	(0.3%)	0.1%	(0.4%)	0.7%	(0.8%)	0.1%	(0.5%)	0.0%	(0.2%)	0.1%	(1.4%)
Country														
Canada	83.3%	(14.9%)	32.0%	(6.2%)	28.8%	(5.0%)	17.9%	(4.1%)	20.0%	(6.2%)	16.8%	(4.3%)	17.5%	(12.1%)
US	16.7%	(14.9%)	68.0%	(6.2%)	71.2%	(5.0%)	82.1%	(4.1%)	80.0%	(6.2%)	83.2%	(4.3%)	82.6%	(12.1%)

\*(F)=Fall run Chum, (S)=Summer run Chum, (F-W)= Fall and winter run Chum

## Figures

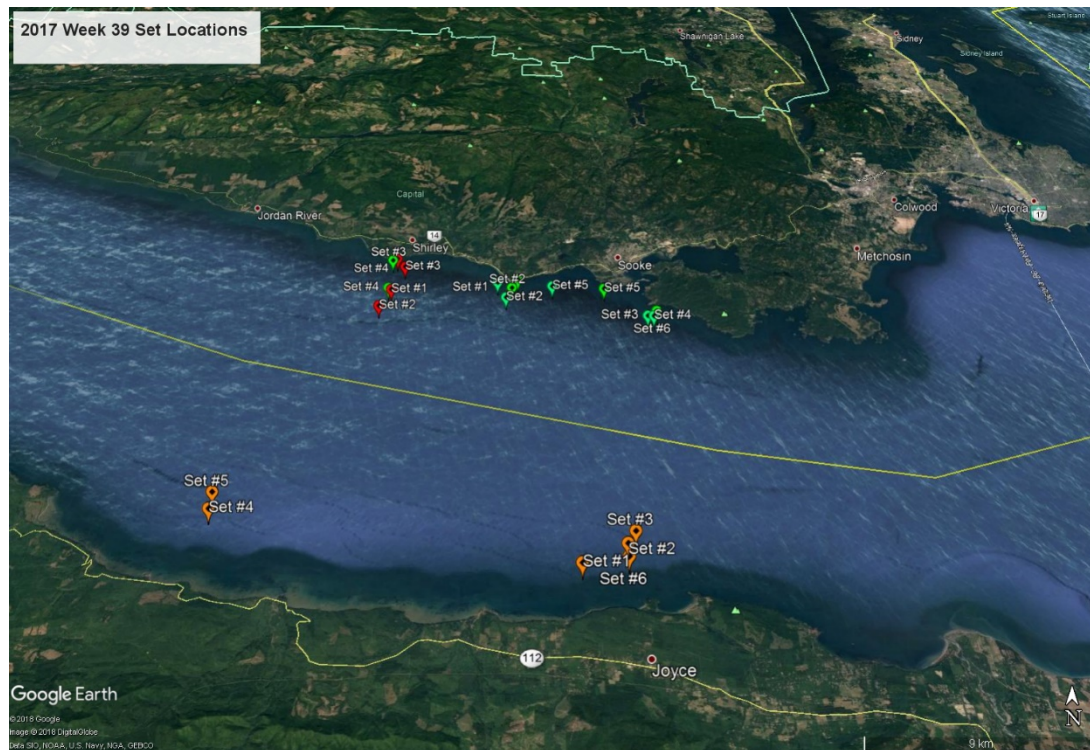


**Figure 1.** Map of migration pathways for Fall Chum returning to Southern BC and Washington State

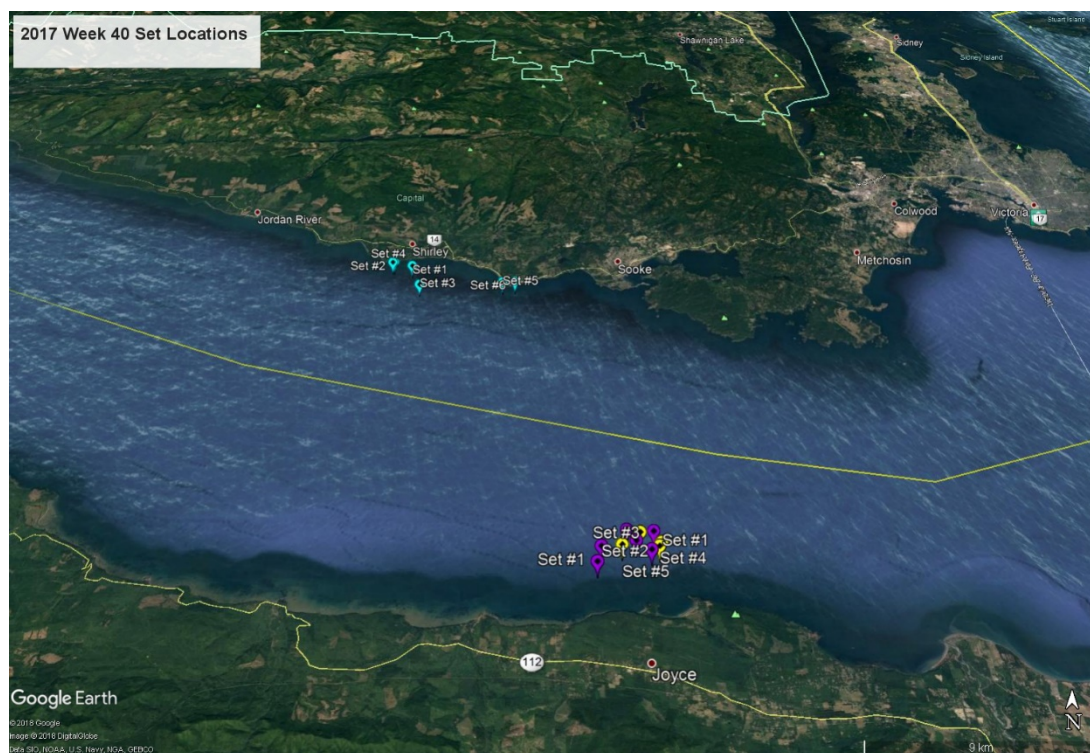




**Figure 2.** Map of fishing quadrants in Juan de Fuca Strait

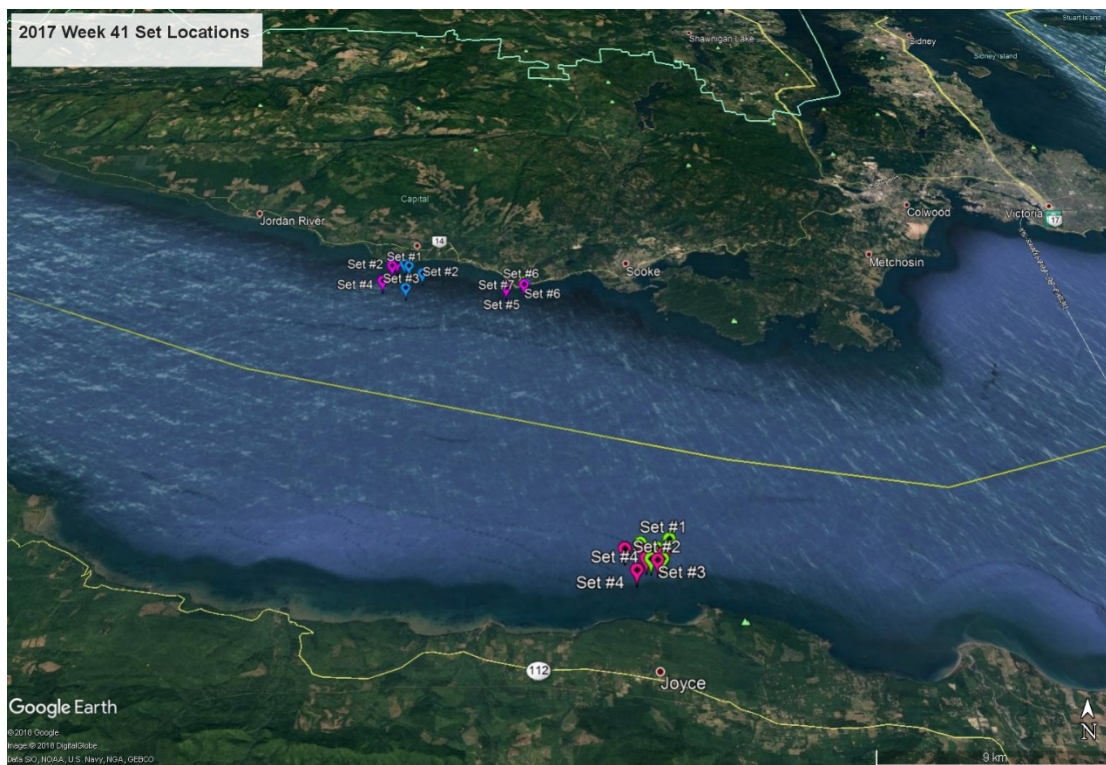


**Figure 3.** Set locations Week 39 (Sept 23-29)

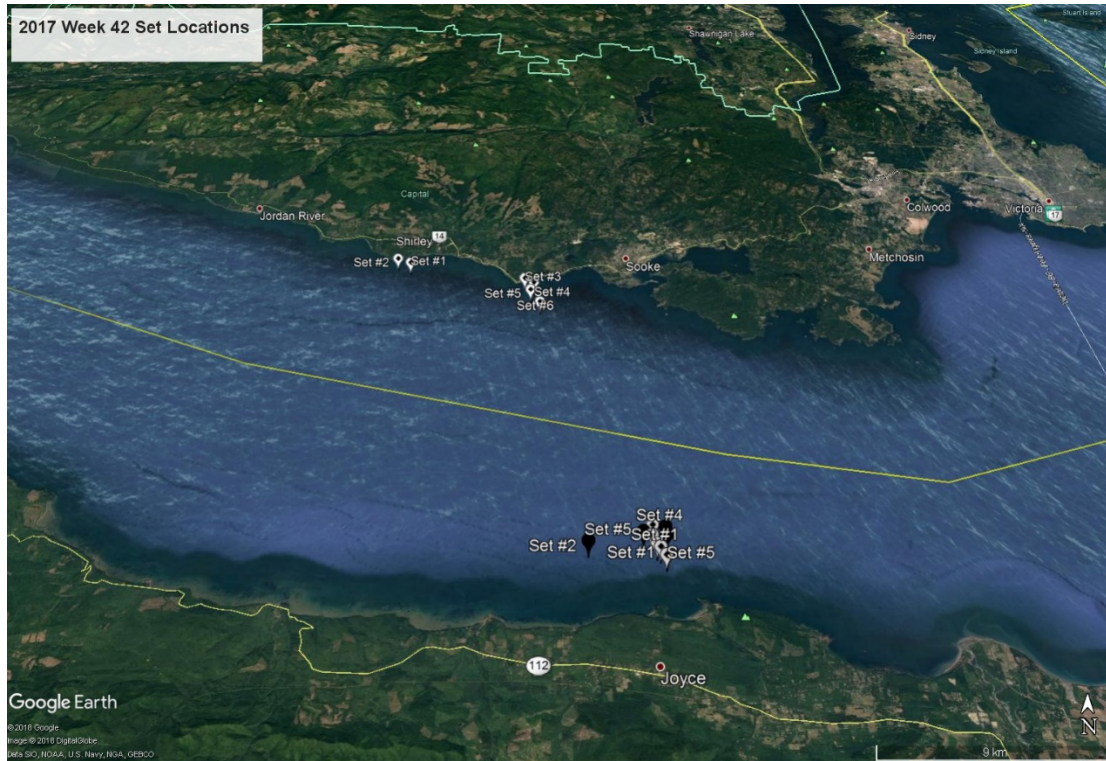


**Figure 4.** Set locations Week 40 (Sept 30-Oct 6)



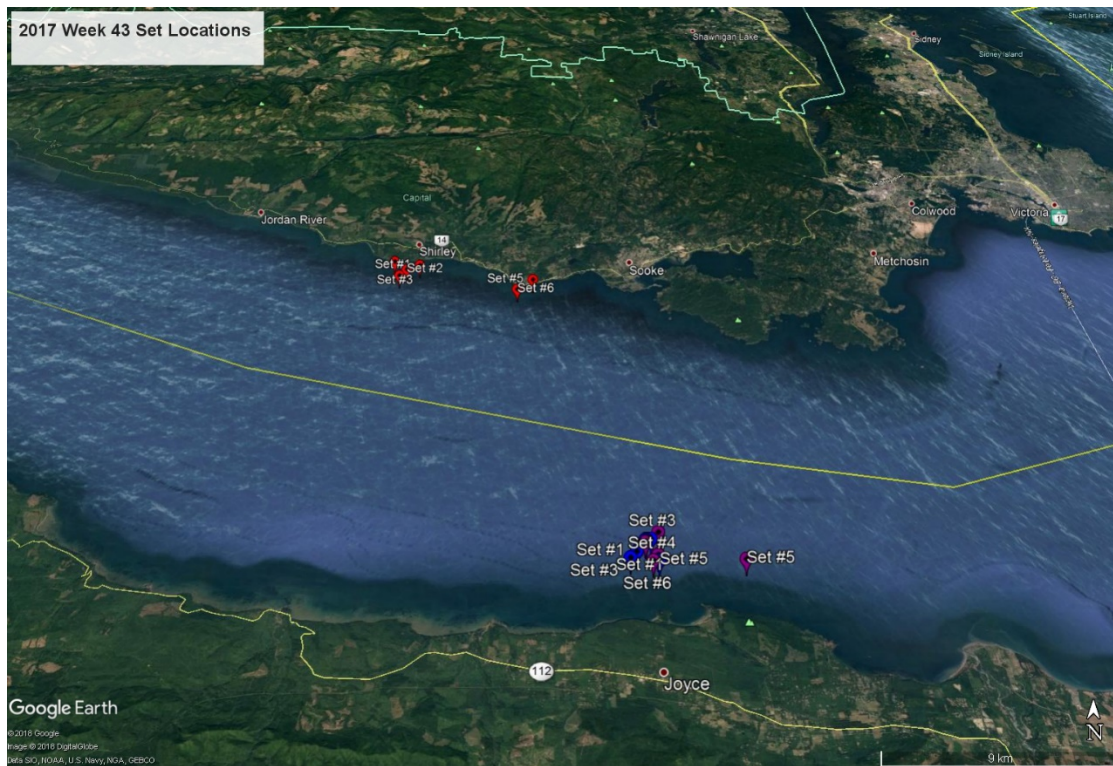


**Figure 5.** Set locations Week 41 (Oct 7-13)

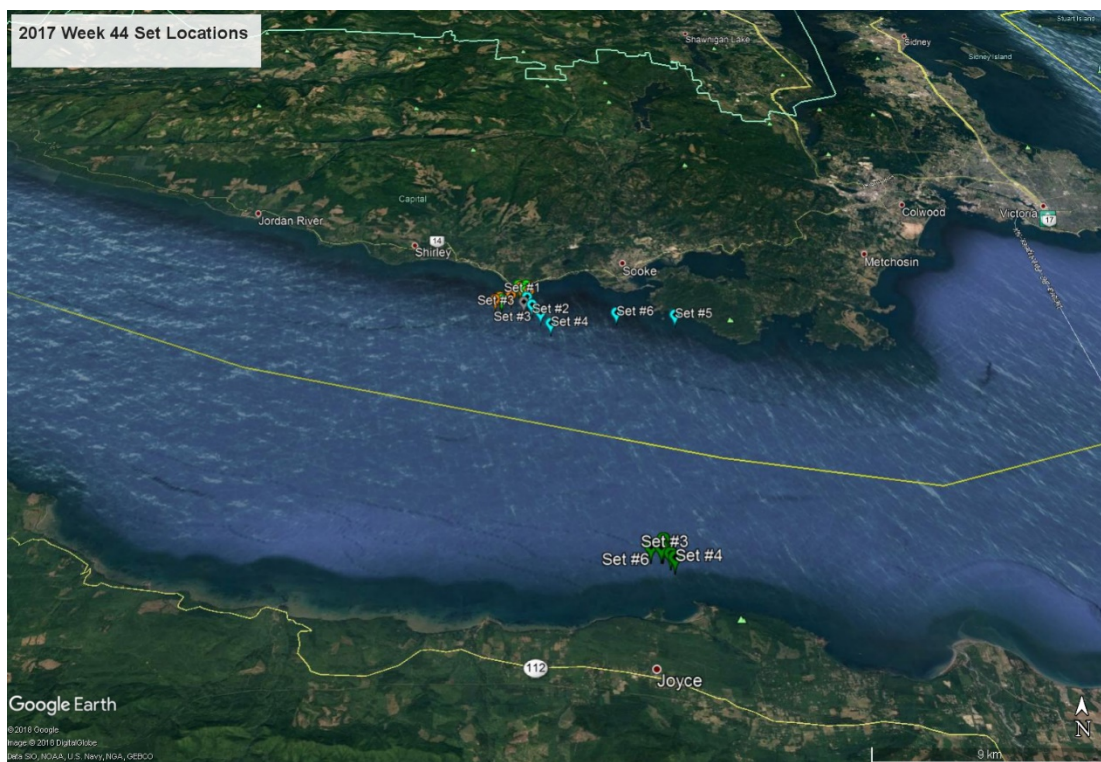


**Figure 6.** Set locations Week 42 (Oct 14-20)



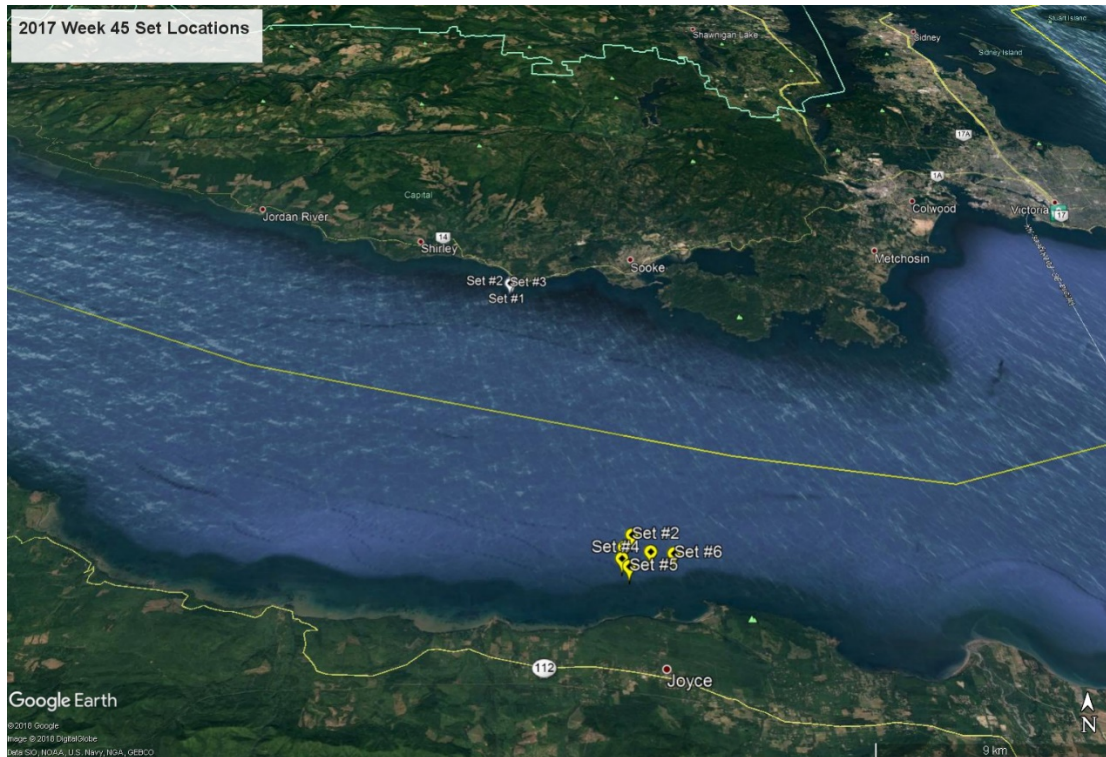


**Figure 7.** Set locations Week 43 (Oct 21-27)

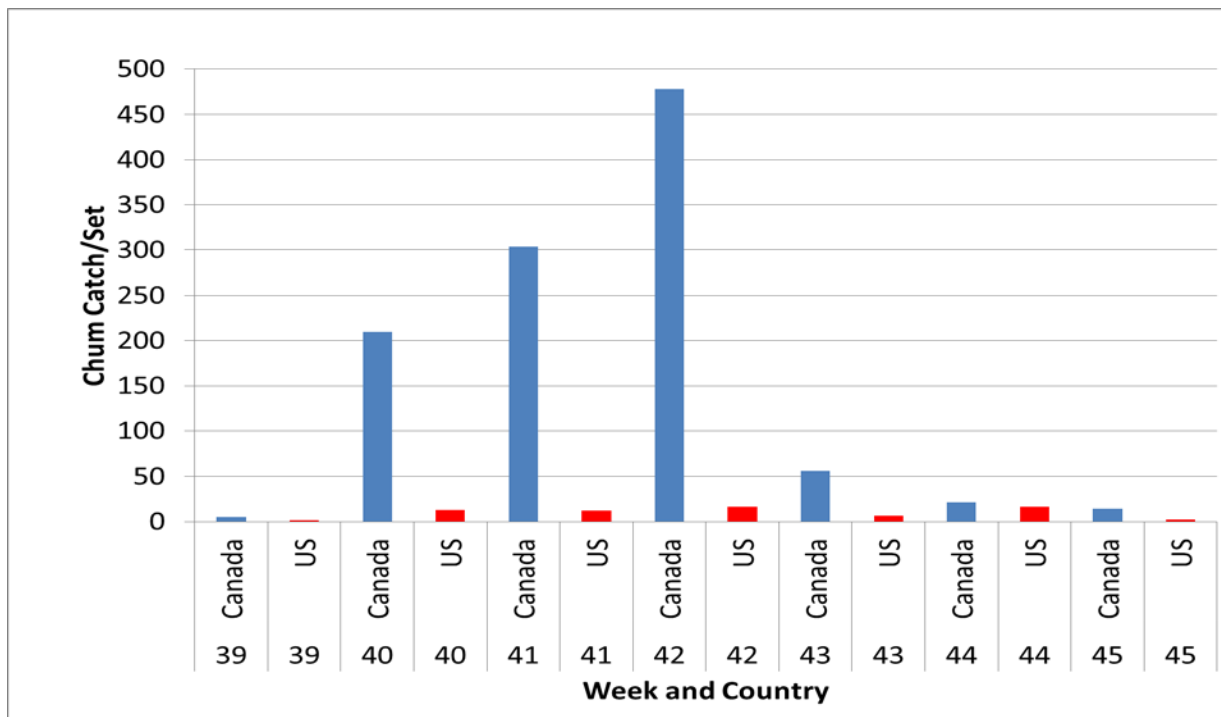


**Figure 8.** Set locations Week 44 (Oct 28-Nov 3)

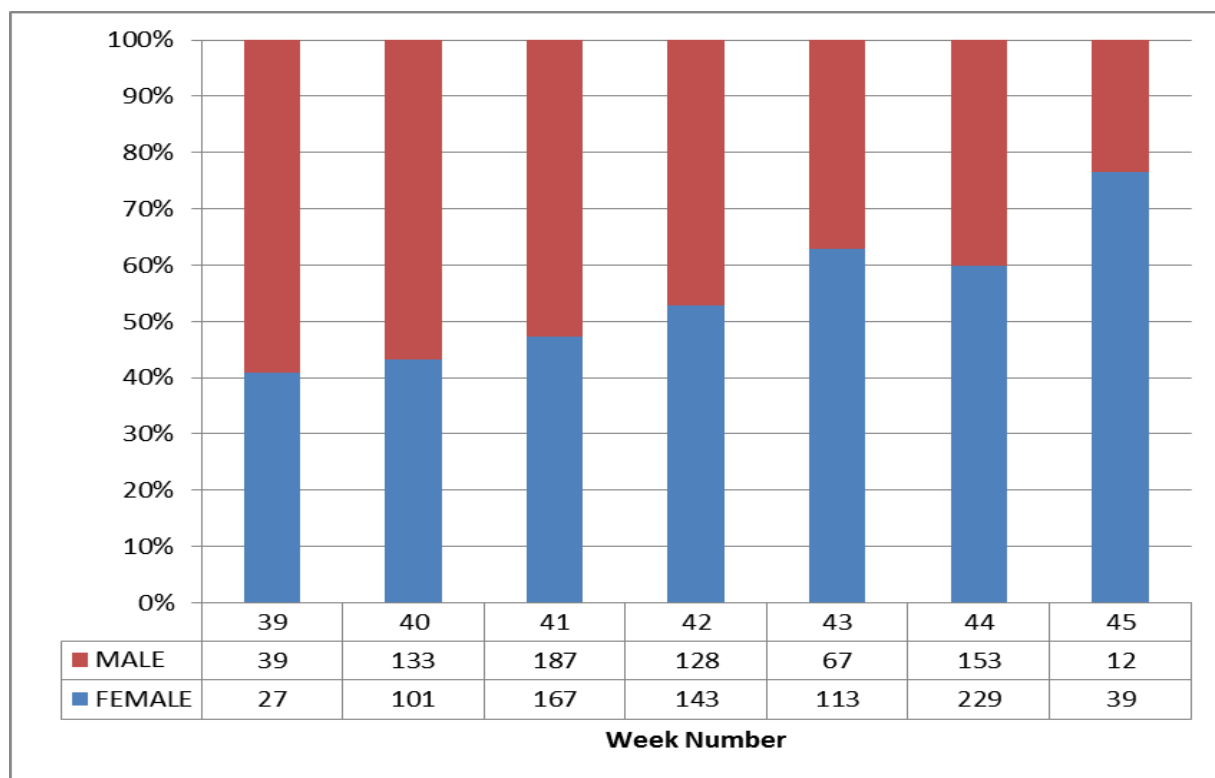




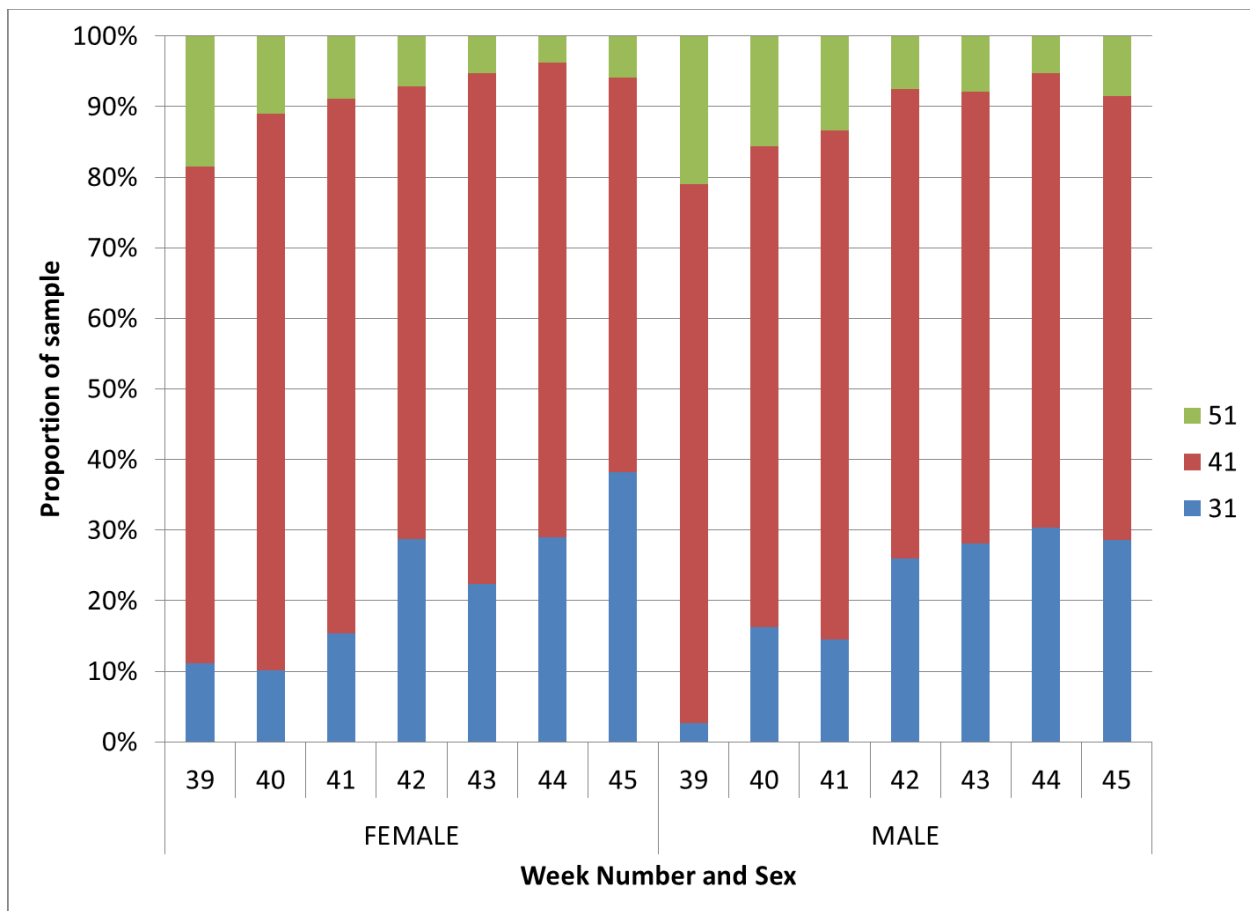
**Figure 9.** Set locations Week 45 (Nov 4-10)



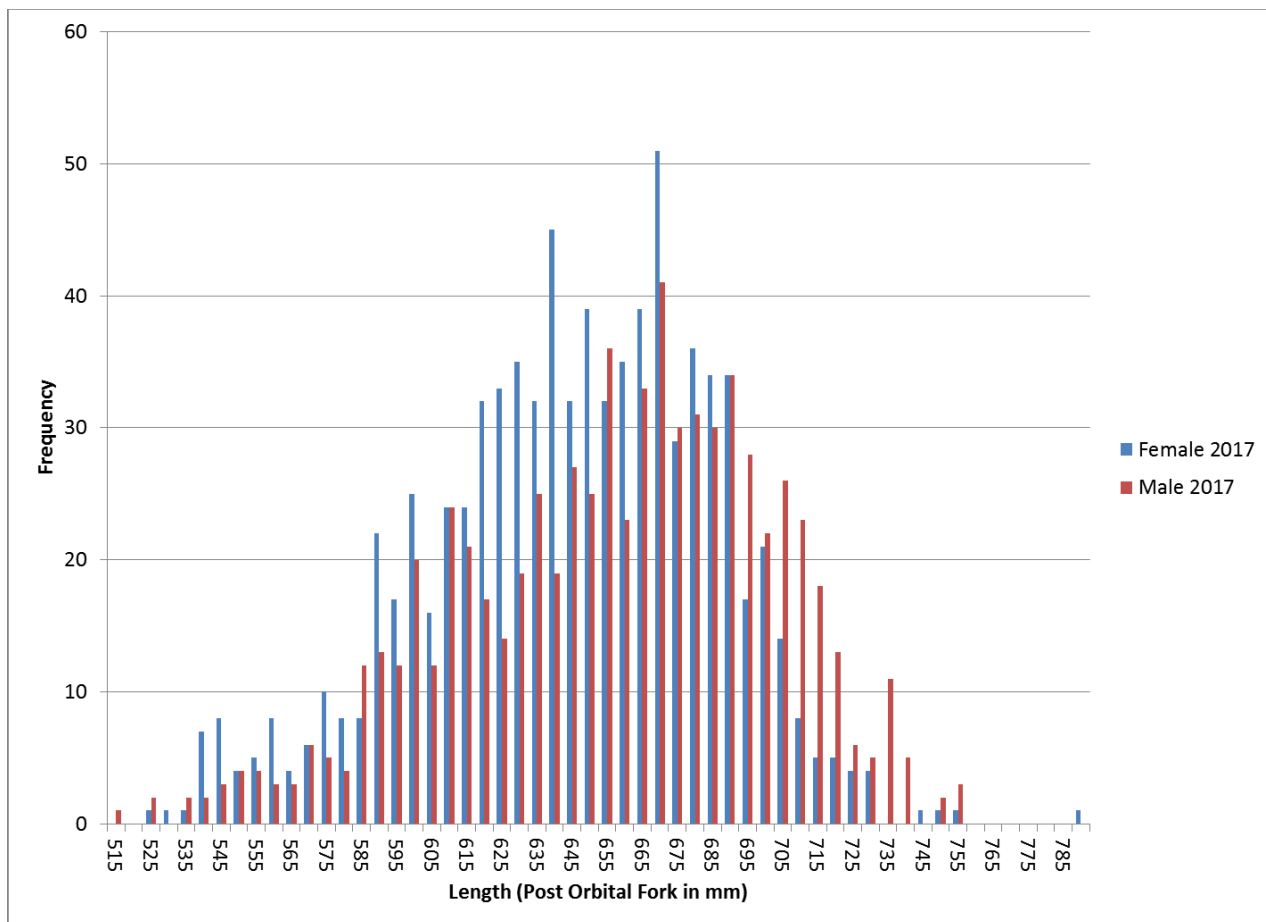
**Figure 10.** CPUE by time and area



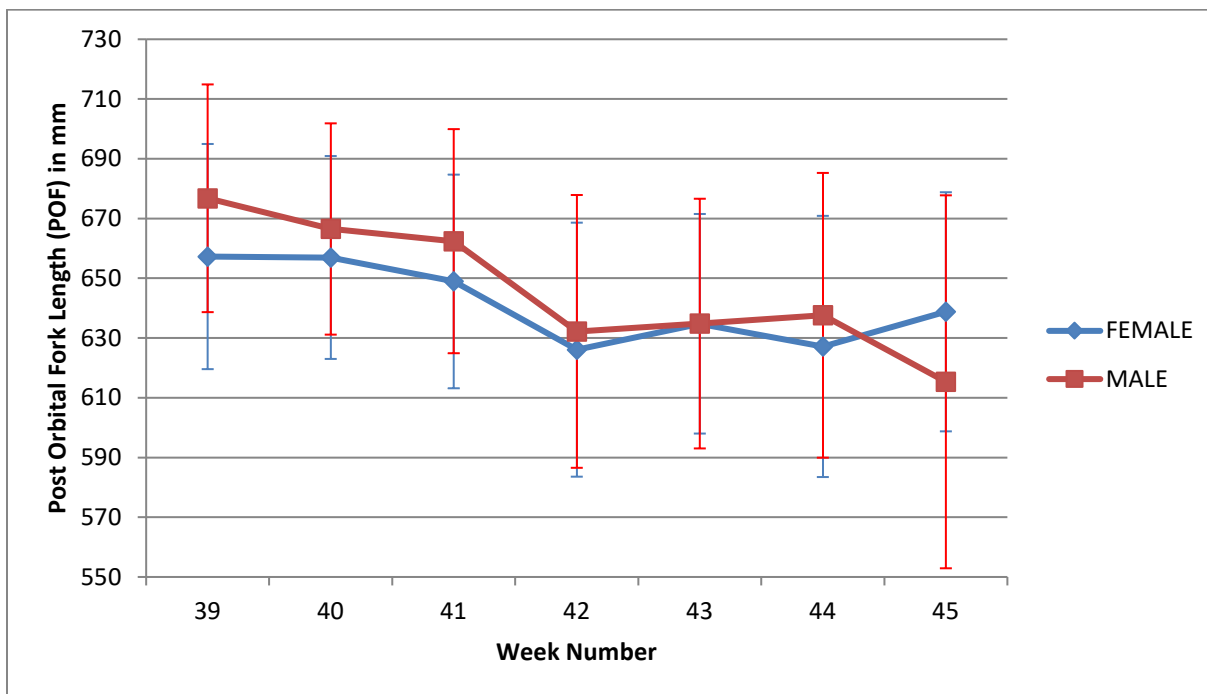
**Figure 11.** Chum salmon sex composition over time (sample size below week #)



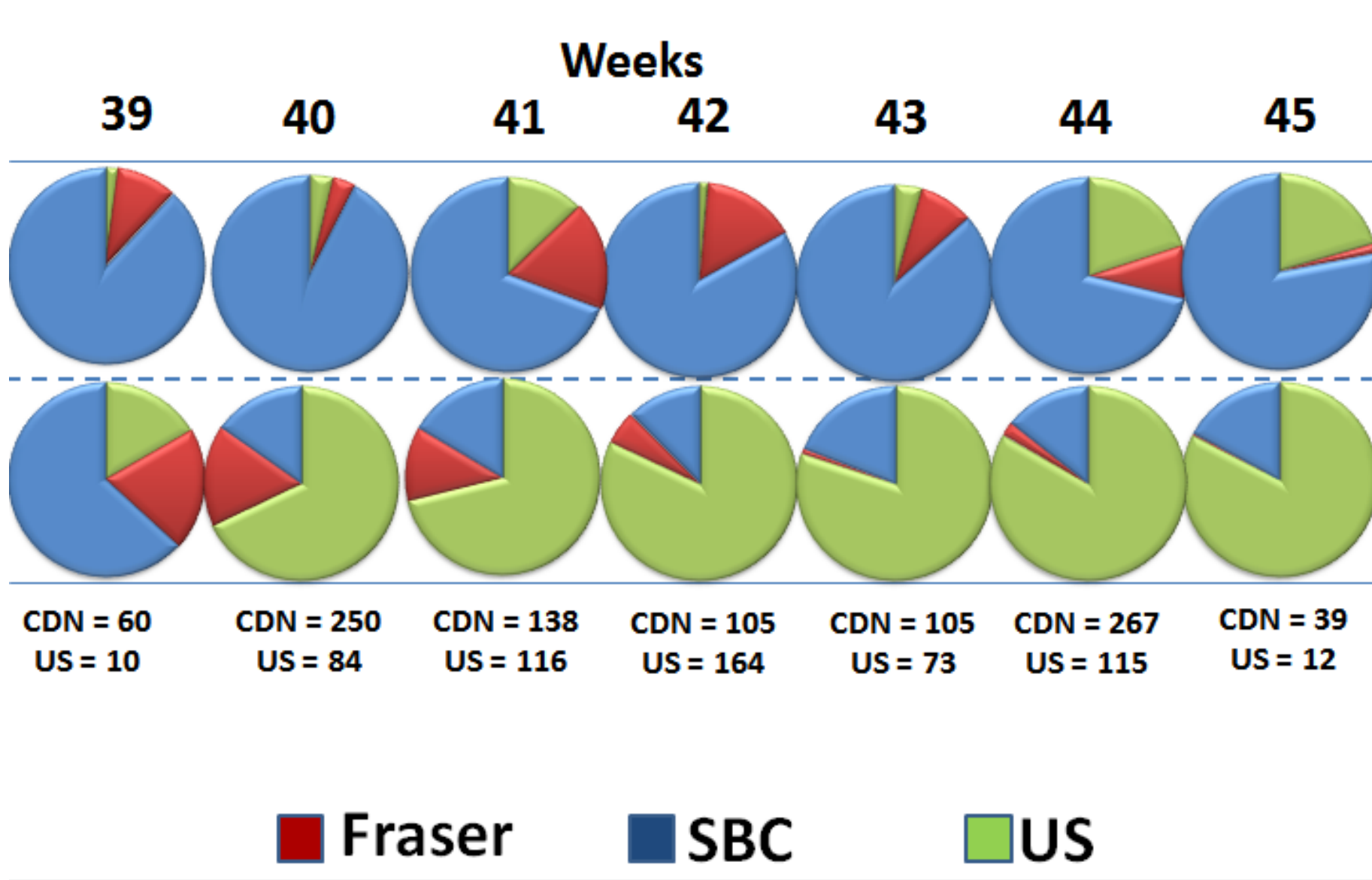
**Figure 12.** Chum salmon age composition over time



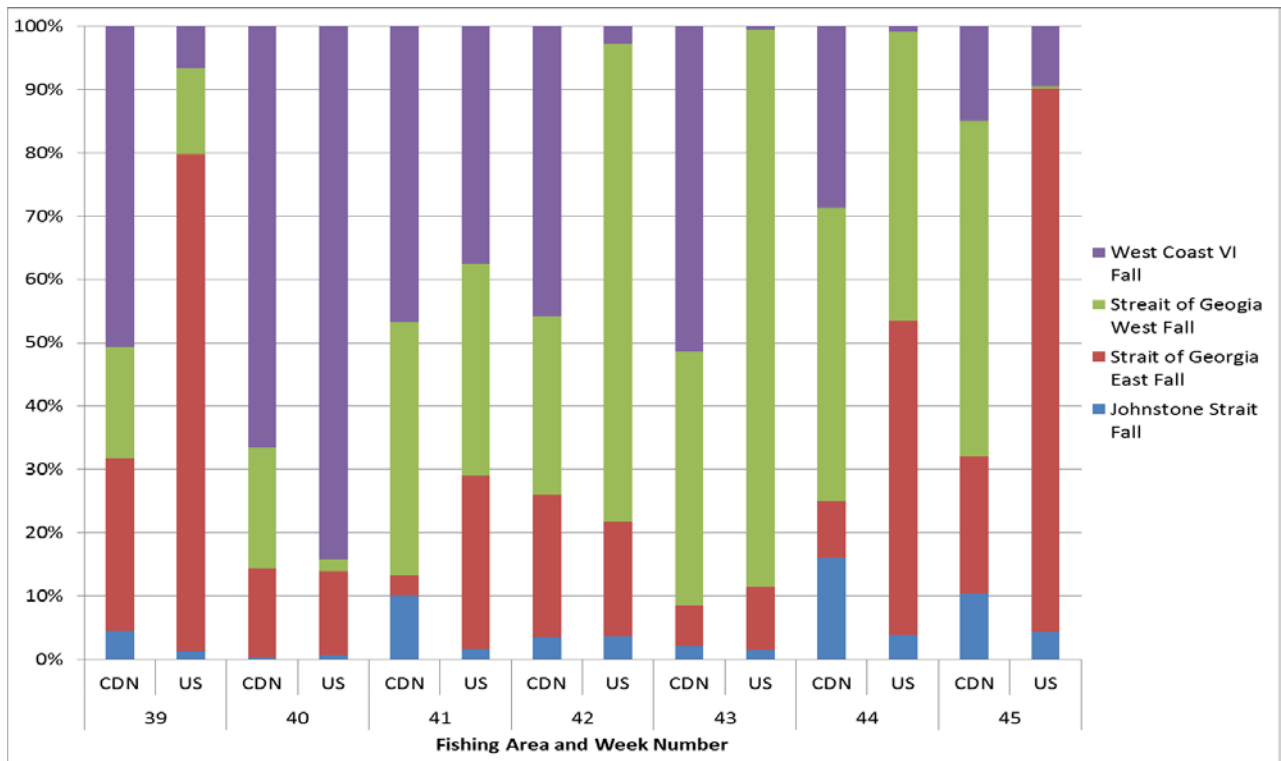
**Figure 13.** Length distribution of chum sampled in 2017



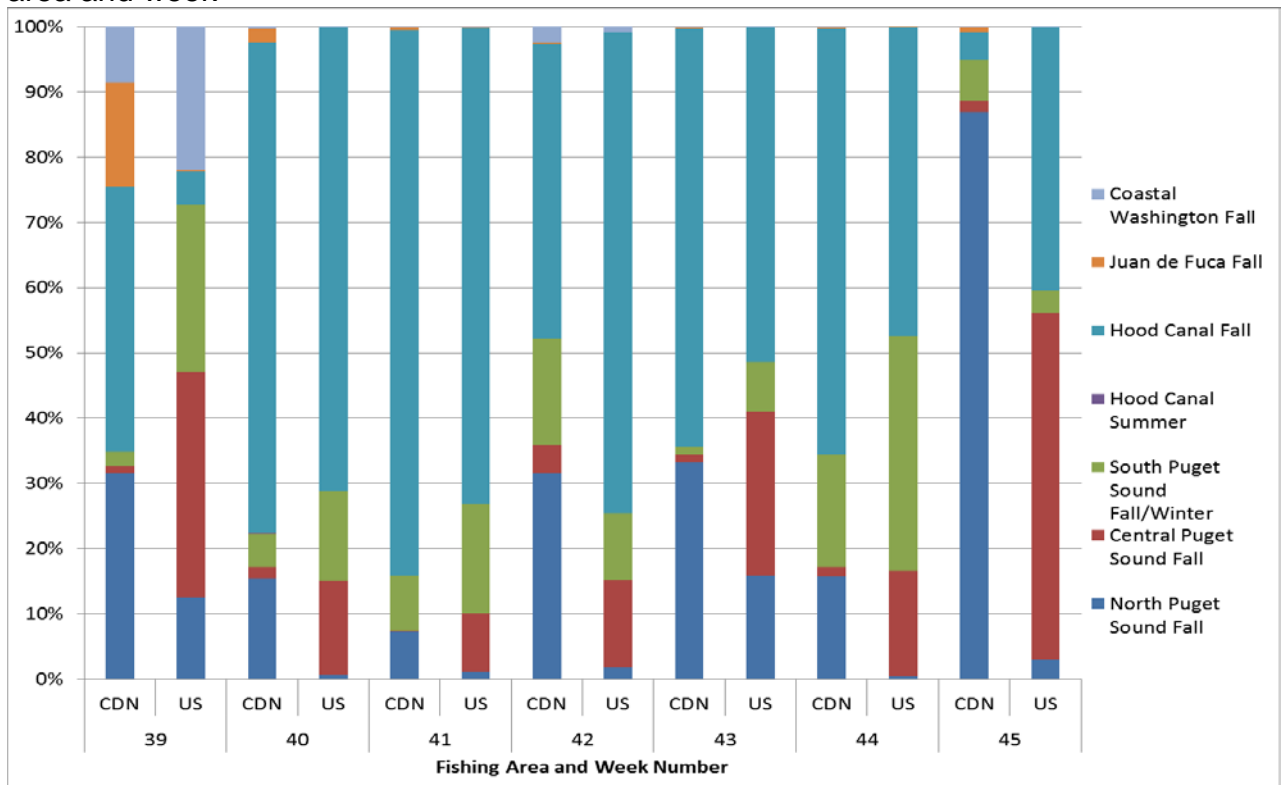
**Figure 14.** Chum salmon length by sex over time (error bars= 1 S.D.)



**Figure 15.** Fraser, Southern BC (SBC) and US Composition of samples across time and between in US and Canadian waters (Sample size is provided below the pie graphs for each week). Week 39 = Sept 23 - 29



**Figure 16.** Stock composition of the Southern BC (SBC) component in the samples by area and week



**Figure 17.** Stock composition of the US component in the samples by area and week

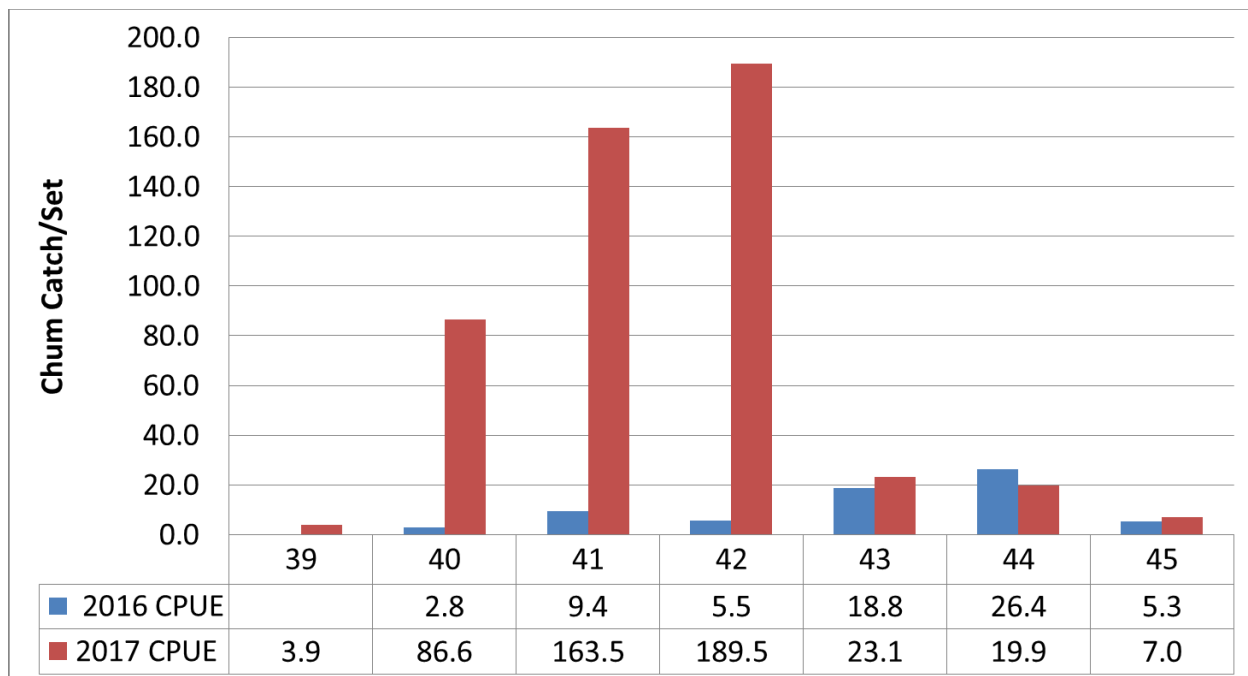


Figure 18. Comparison between 2016 and 2017 CPUE

## *Appendices*



## Appendix A: Set log example

Chum Seine Test Fishery		Juan de Fuca Strait Area 20										Date (dd/mm/yyyy): ____ / ____ / ____		Page ____ of ____								
Mark Recalma MV "Qualicum Producer"		Blinkhorn - Vessel # 2										Observer: _____		FOS Trip ID (office use only): _____								
Set #	Location Name	Time (PST 1845) Start	Close	Tide	Weather		Sockeye (118) Adult	Jack	Coho (115) Adult	Jack/Juv	Pink (108)	Chum (112)	Chinook (124) Adult	Jack	Stlhd (128) (specify)	Other	Set Cond.	Set Type	Bio Data & Set Comments (# of jumpers and finners, problems with set, ect...)			
					Rain: 0 1 2 3	Kept														Book #	Scale #	to
					% Overcast:															Book #	Scale #	to
					Wind (Dir/kn):															DNA Sheet #	DNA #	to
					Sea Cond:															Water Temp °C		
					Rain: 0 1 2 3	Kept														Book #	Scale #	to
					% Cloud:															Book #	Scale #	to
					Wind (Dir/kn):															DNA Sheet #	DNA #	to
					Sea Cond:															Water Temp °C		
					Rain: 0 1 2 3	Kept														Book #	Scale #	to
					% Cloud:															Book #	Scale #	to
					Wind (Dir/kn):															DNA Sheet #	DNA #	to
					Sea Cond:															Water Temp °C		
					Rain: 0 1 2 3	Kept														Book #	Scale #	to
					% Cloud:															Book #	Scale #	to
					Wind (Dir/kn):															DNA Sheet #	DNA #	to
					Sea Cond:															Water Temp °C		
					Rain: 0 1 2 3	Kept														Book #	Scale #	to
					% Cloud:															Book #	Scale #	to
					Wind (Dir/kn):															DNA Sheet #	DNA #	to
					Sea Cond:															Water Temp °C		
					Rain: 0 1 2 3	Kept														Book #	Scale #	to
					% Cloud:															Book #	Scale #	to
					Wind (Dir/kn):															DNA Sheet #	DNA #	to
					Sea Cond:															Water Temp °C		
<b>DAILY &amp; SET COMMENTS</b>		Assessment Total (set cond 1 & 2 and/or set type 1)															<b>Set Condition:</b>					
		Non-Assessment Total (set cond 0 and/or set type 2)															0 - Bad set or catch not representative					
																	1 - Problem with set but did not affect catch					
																	2 - Good set no problems					
																	<b>Set Type:</b>					
																	1 - Assessment					
																	2 - Non-Assessment					
																	<b>Weather Codes:</b>					
																	Overcast: 0%, 25%, 50%, 75%, 100%					
																	Rain: 0 - none 1 - light 2 - medium 3 - heavy					
																	Sea Cond: calm rippled chop rough					
Total Daily Samples -																						

**CHUM BIOSAMPLE FORM:**

Date: \_\_\_\_/\_\_\_\_/\_\_\_\_

[illegible]

*Appendix C: Set coordinates and time*

<b>Latitude</b>	<b>Longitude</b>	<b>Set #</b>	<b>Date and time BEGIN</b>	<b>Date and Time END</b>
48°20.43N	123°54.83W	1	09/25/2017 11:40:00	09/25/2017 12:09:00
48°19.65N	123°55.25W	2	09/25/2017 13:03:00	09/25/2017 13:27:00
48°21.56N	123°54.37W	3	09/25/2017 14:26:00	09/25/2017 14:43:00
48°21.97N	123°54.8W	4	09/25/2017 15:32:00	09/25/2017 15:57:00
48°20.92N	123°48.95W	1	09/26/2017 07:17:00	09/26/2017 07:44:00
48°20.51N	123°49.21W	2	09/26/2017 08:24:00	09/26/2017 08:50:00
48°21.89N	123°55.01W	3	09/26/2017 09:49:00	09/26/2017 10:14:00
48°20.51N	123°54.97W	4	09/26/2017 10:51:00	09/26/2017 11:18:00
48°20.47N	123°44.92W	5	09/26/2017 13:21:00	09/26/2017 13:46:00
48°19.4N	123°42.58W	6	09/26/2017 16:21:00	09/26/2017 16:50:00
48°10.4N	123°46.23W	1	09/27/2017 08:07:00	09/27/2017 08:31:00
48°10.95N	123°44.58W	2	09/27/2017 08:52:00	09/27/2017 09:18:00
48°11.31N	123°44.27W	3	09/27/2017 09:47:00	09/27/2017 10:10:00
48°11.97N	124°0.01W	4	09/27/2017 12:25:00	09/27/2017 12:53:00
48°12.49N	124°0.08W	5	09/27/2017 13:18:00	09/27/2017 13:45:00
48°10.58N	123°44.57W	6	09/27/2017 16:14:00	09/27/2017 16:47:00
48°20.77N	123°49.89W	1	09/28/2017 07:36:00	09/28/2017 08:03:00
48°20.05N	123°49.46W	2	09/28/2017 08:49:00	09/28/2017 09:13:00
48°19.2N	123°43.0W	3	09/28/2017 09:59:00	09/28/2017 10:23:00
48°19.19N	123°42.73W	4	09/28/2017 10:45:00	09/28/2017 11:07:00
48°20.59N	123°47.33W	5	09/28/2017 13:19:00	09/28/2017 13:43:00
48°10.55N	123°45.7W	1	10/05/2017 08:14:00	10/05/2017 08:41:00
48°10.99N	123°45.54W	2	10/05/2017 09:23:00	10/05/2017 09:49:00
48°11.15N	123°44.27W	3	10/05/2017 10:49:00	10/05/2017 11:14:00
48°11.46N	123°44.6W	4	10/05/2017 12:34:00	10/05/2017 13:00:00
48°10.89N	123°43.74W	5	10/05/2017 13:53:00	10/05/2017 14:16:00
48°11.42N	123°43.62W	6	10/05/2017 14:48:00	10/05/2017 15:16:00
48°11.1N	123°43.35W	1	10/06/2017 07:34:00	10/06/2017 07:58:00
48°11.39N	123°44.11W	2	10/06/2017 08:52:00	10/06/2017 09:16:00
48°11.03N	123°44.79W	3	10/06/2017 10:03:00	10/06/2017 10:27:00
48°10.99N	123°43.45W	4	10/06/2017 11:37:00	10/06/2017 12:00:00
48°21.82N	123°54.07W	1	10/07/2017 07:19:00	10/07/2017 07:43:00
48°22.01N	123°54.97W	2	10/07/2017 08:08:00	10/07/2017 08:28:00
48°20.87N	123°53.58W	3	10/07/2017 10:12:00	10/07/2017 10:34:00
48°22.0N	123°55.04W	4	10/07/2017 10:56:00	10/07/2017 11:19:00
48°20.99N	123°49.68W	5	10/07/2017 12:40:00	10/07/2017 13:02:00
48°21.03N	123°49.09W	6	10/07/2017 13:38:00	10/07/2017 14:03:00
48°22.08N	123°55.06W	1	10/08/2017 07:27:00	10/08/2017 07:51:00
48°21.93N	123°55.27W	2	10/08/2017 08:08:00	10/08/2017 08:30:00
48°22.28N	123°55.29W	3	10/08/2017 09:17:00	10/08/2017 09:38:00
48°21.17N	123°55.57W	4	10/08/2017 10:09:00	10/08/2017 10:33:00
48°20.83N	123°49.78W	5	10/08/2017 13:00:00	10/08/2017 13:22:00

<b>Latitude</b>	<b>Longitude</b>	<b>Set #</b>	<b>Date and time BEGIN</b>	<b>Date and Time END</b>
48°21.0N	123°48.96W	6	10/08/2017 13:58:00	10/08/2017 14:28:00
48°11.38N	123°43.37W	1	10/11/2017 08:52:00	10/11/2017 09:16:00
48°10.81N	123°43.67W	2	10/11/2017 09:43:00	10/11/2017 10:06:00
48°11.11N	123°43.81W	3	10/11/2017 10:43:00	10/11/2017 11:05:00
48°10.81N	123°44.08W	4	10/11/2017 11:22:00	10/11/2017 11:44:00
48°11.09N	123°44.04W	5	10/11/2017 12:40:00	10/11/2017 13:04:00
48°11.26N	123°44.41W	6	10/11/2017 13:24:00	10/11/2017 13:51:00
48°21.16N	123°48.98W	7	10/11/2017 15:39:00	10/11/2017 16:02:00
48°21.93N	123°54.47W	1	10/12/2017 08:09:00	10/12/2017 08:31:00
48°21.55N	123°53.77W	2	10/12/2017 08:51:00	10/12/2017 09:12:00
48°20.83N	123°54.43W	3	10/12/2017 09:47:00	10/12/2017 10:08:00
48°22.05N	123°54.71W	4	10/12/2017 12:18:00	10/12/2017 12:42:00
48°22.22N	123°55.19W	5	10/12/2017 13:30:00	10/12/2017 13:54:00
48°21.07N	123°48.9W	6	10/12/2017 16:12:00	10/12/2017 16:40:00
48°10.96N	123°43.62W	1	10/13/2017 08:36:00	10/13/2017 08:58:00
48°11.1N	123°44.98W	2	10/13/2017 10:24:00	10/13/2017 10:46:00
48°10.78N	123°43.85W	3	10/13/2017 11:20:00	10/13/2017 11:37:00
48°10.5N	123°44.6W	4	10/13/2017 13:09:00	10/13/2017 13:30:00
48°10.83N	123°44.24W	5	10/13/2017 13:53:00	10/13/2017 14:15:00
48°11.04N	123°44.3W	6	10/13/2017 14:33:00	10/13/2017 14:55:00
48°21.84N	123°54.37W	1	10/19/2017 08:40:00	10/19/2017 09:05:00
48°22.04N	123°55.0W	2	10/19/2017 09:34:00	10/19/2017 09:54:00
48°21.06N	123°48.93W	3	10/19/2017 11:37:00	10/19/2017 12:01:00
48°20.85N	123°48.5W	4	10/19/2017 12:38:00	10/19/2017 13:03:00
48°20.51N	123°48.64W	5	10/19/2017 13:27:00	10/19/2017 13:50:00
48°19.94N	123°48.2W	6	10/19/2017 15:12:00	10/19/2017 15:34:00
48°10.8N	123°43.51W	1	10/20/2017 07:08:00	10/20/2017 07:31:00
48°11.19N	123°46.26W	2	10/20/2017 07:45:00	10/20/2017 08:10:00
48°11.34N	123°43.48W	3	10/20/2017 08:23:00	10/20/2017 08:47:00
48°11.59N	123°43.48W	4	10/20/2017 09:00:00	10/20/2017 09:23:00
48°11.46N	123°44.28W	5	10/20/2017 12:16:00	10/20/2017 12:38:00
48°11.02N	123°43.71W	1	10/21/2017 08:13:00	10/21/2017 08:37:00
48°11.11N	123°43.83W	2	10/21/2017 08:51:00	10/21/2017 09:15:00
48°11.36N	123°43.98W	3	10/21/2017 09:32:00	10/21/2017 09:56:00
48°11.65N	123°43.94W	4	10/21/2017 10:17:00	10/21/2017 10:38:00
48°10.79N	123°43.53W	5	10/21/2017 13:02:00	10/21/2017 13:22:00
48°21.9N	123°54.05W	1	10/23/2017 08:57:00	10/23/2017 09:21:00
48°21.69N	123°54.63W	2	10/23/2017 09:39:00	10/23/2017 09:59:00
48°21.38N	123°54.92W	3	10/23/2017 10:21:00	10/23/2017 10:45:00
48°22.09N	123°55.27W	4	10/23/2017 11:08:00	10/23/2017 11:28:00
48°21.18N	123°48.69W	5	10/23/2017 14:11:00	10/23/2017 14:40:00
48°20.71N	123°49.39W	6	10/23/2017 15:14:00	10/23/2017 15:37:00
48°11.02N	123°44.68W	1	10/24/2017 07:57:00	10/24/2017 08:18:00

<b>Latitude</b>	<b>Longitude</b>	<b>Set #</b>	<b>Date and time BEGIN</b>	<b>Date and Time END</b>
48°11.33N	123°44.36W	2	10/24/2017 08:43:00	10/24/2017 09:10:00
48°10.85N	123°44.91W	3	10/24/2017 09:48:00	10/24/2017 10:09:00
48°11.38N	123°44.15W	4	10/24/2017 10:40:00	10/24/2017 11:00:00
48°10.77N	123°43.91W	5	10/24/2017 13:03:00	10/24/2017 13:25:00
48°11.37N	123°44.33W	6	10/24/2017 13:45:00	10/24/2017 14:06:00
48°11.29N	123°44.34W	1	10/28/2017 08:22:00	10/28/2017 08:45:00
48°11.3N	123°44.34W	2	10/28/2017 09:02:00	10/28/2017 09:22:00
48°11.58N	123°43.87W	3	10/28/2017 09:36:00	10/28/2017 09:58:00
48°10.93N	123°43.94W	4	10/28/2017 10:20:00	10/28/2017 10:42:00
48°10.81N	123°40.87W	5	10/28/2017 11:20:00	10/28/2017 11:42:00
48°10.77N	123°44.12W	6	10/28/2017 12:14:00	10/28/2017 12:34:00
48°20.37N	123°48.67W	1	10/29/2017 07:56:00	10/29/2017 08:16:00
48°20.0N	123°48.43W	2	10/29/2017 08:36:00	10/29/2017 08:56:00
48°19.63N	123°48.03W	3	10/29/2017 09:16:00	10/29/2017 09:38:00
48°19.15N	123°47.57W	4	10/29/2017 10:01:00	10/29/2017 10:19:00
48°19.53N	123°41.98W	5	10/29/2017 12:08:00	10/29/2017 12:30:00
48°19.63N	123°44.61W	6	10/29/2017 13:14:00	10/29/2017 13:36:00
48°11.11N	123°43.93W	1	10/31/2017 07:36:00	10/31/2017 07:55:00
48°11.11N	123°43.5W	2	10/31/2017 08:15:00	10/31/2017 08:52:00
48°10.91N	123°43.25W	3	10/31/2017 09:41:00	10/31/2017 10:02:00
48°10.8N	123°43.11W	4	10/31/2017 10:48:00	10/31/2017 11:09:00
48°11.32N	123°43.46W	5	10/31/2017 11:43:00	10/31/2017 12:03:00
48°11.09N	123°43.56W	6	10/31/2017 12:35:00	10/31/2017 12:55:00
48°10.76N	123°43.29W	1	11/01/2017 11:46:00	11/01/2017 12:08:00
48°20.73N	123°48.58W	2	11/01/2017 14:29:00	11/01/2017 14:48:00
48°20.13N	123°48.81W	3	11/01/2017 15:20:00	11/01/2017 15:40:00
48°20.8N	123°48.85W	1	11/02/2017 09:39:00	11/02/2017 09:58:00
48°20.26N	123°49.83W	2	11/02/2017 11:02:00	11/02/2017 11:24:00
48°20.93N	123°49.08W	3	11/02/2017 11:49:00	11/02/2017 12:09:00
48°20.93N	123°48.73W	4	11/02/2017 13:34:00	11/02/2017 13:53:00
48°20.66N	123°48.74W	5	11/02/2017 14:26:00	11/02/2017 14:46:00
48°20.85N	123°49.0W	1	11/03/2017 10:05:00	11/03/2017 10:25:00
48°20.45N	123°49.41W	2	11/03/2017 10:39:00	11/03/2017 10:57:00
48°20.36N	123°49.91W	3	11/03/2017 11:12:00	11/03/2017 11:31:00
48°20.25N	123°50.12W	4	11/03/2017 11:48:00	11/03/2017 12:10:00
48°20.94N	123°48.67W	5	11/03/2017 12:33:00	11/03/2017 12:52:00
48°20.65N	123°48.58W	6	11/03/2017 13:10:00	11/03/2017 13:31:00
48°10.92N	123°44.29W	1	11/06/2017 08:01:00	11/06/2017 08:22:00
48°11.4N	123°44.91W	2	11/06/2017 08:42:00	11/06/2017 09:02:00
48°11.05N	123°45.21W	3	11/06/2017 09:24:00	11/06/2017 09:43:00
48°10.73N	123°45.31W	4	11/06/2017 10:01:00	11/06/2017 10:20:00
48°10.51N	123°45.07W	5	11/06/2017 10:45:00	11/06/2017 11:07:00
48°10.87N	123°43.48W	6	11/06/2017 11:49:00	11/06/2017 12:09:00

<b>Latitude</b>	<b>Longitude</b>	<b>Set #</b>	<b>Date and time BEGIN</b>	<b>Date and Time END</b>
48°20.94N	123°49.74W	1	11/07/2017 07:34:00	11/07/2017 07:35:00
48°20.91N	123°49.69W	2	11/07/2017 12:05:00	11/07/2017 12:22:00
48°20.85N	123°49.81W	3	11/07/2017 12:45:00	11/07/2017 13:03:00