Sockeye Salmon Juveniles in Chatham Sound 2007

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Introduction

In early 2002 the Government of British Columbia announced the end of a seven year moratorium on new salmon farm sites and the potential expansion of salmon farms to the North Coast. Several salmon farms were proposed in the vicinity of the Skeena River estuary in 2003. We undertook a series of studies of juvenile salmon use of the Skeena and Nass estuaries to help evaluate potential interactions between wild and farmed salmon. We investigated the ecology of caligid sea lice on salmon on the North Coast with field studies in 2004 through 2006. The data from these studies is available in Krkoŝek *et al.* 2007 and Gottesfeld *et al.* (in review).

The 2007 field research was designed to define the distribution of sockeye salmon smolts in the Skeena and Nass estuaries. This is important because of concern about the potential spread of infectious hematopoietic necrosis virus (IHNV). IHN, the disease caused by this virus, is a serious endemic disease of wild and cultured sockeye. Atlantic salmon are particularly sensitive to this disease (Saksida 2003). Most outbreaks of IHN are restricted to eggs, alevins and fry at sockeye spawning areas, but IHNV can be transmitted in sea water as shown by lab tests (Traxler *et al.* 1993), and by the epidemiology of wild (Traxler *et al.* 1997) and cultured fish (Traxler *et al.* 1998, St. Hilaire and Ribble 2002, Saksida 2003).

We made trawl net collections of juvenile salmon in 2004 and 2005 that demonstrated the presence of sockeye juveniles in the Skeena and Nass estuaries. Juvenile sockeye were found in collections between late May and late June and were especially abundant in Ogden Channel (Gottesfeld *et al.* 2006). The significance of Ogden Channel as a migration corridor for juvenile sockeye is also shown by the relatively large catches in Browning Entrance at the outlet of Ogden Channel by the CCGS W.E. Ricker in 2000 and 2001 (Welch *et al.* 2003, Welch *et al.* 2004).

Juvenile sockeye migration routes and habitat use were explored in this study by examining the abundance of sockeye smolts, the timing of collections, the size of smolts and their diet, and by using microsatellite DNA analysis and mixed stock assignment techniques to shown the origin of smolts using the Skeena estuary.

Methods

Study Area

Our study area included the estuaries of the Skeena and Nass Rivers. Trawl sites extended throughout the regions of freshwater influence, from Hogan Island at the east end of Portland Inlet in the north to the middle of Petrel Channel on the south, and from the mouth of the Skeena River westward to the eastern edge of Chatham Sound.

In order to determine the change in sockeye abundance in different locations over time, we grouped catch locations into five generalized areas (Figure 1). Briefly, these areas are: PE for Port Edward, the region of the estuary immediately to the north of the mouth of the Skeena River; K for Kennedy Island which is in the midst of Arthur, Telegraph and Chismore Passages to the south of the mouth of the Skeena River; O for Ogden Channel, the distal portion of the estuary to the south; SC, the southern portion of Chatham Sound, to the west of Prince Rupert; and NC, for North Chatham Sound, the inland section of the North Coast section between Work Channel and Big Bay adjacent to the outflow of Nass river waters.

Sampling and Analysis

Sampling was conducted during a five-week period between May 26 and July 5, 2007. Samples were collected from sites within each generalized area at least once per week except during week 3, when severe weather conditions prevented fishing in areas SC and NC. Fishing was conducted with a surface trawl net that was modified from the OFL Atlantic salmon smolt net design of Holst and McDonald (2000). It was fished by the *M.V. Pacific Coast*, an 11 m ex-commercial gillnet vessel. The trawl net was 18 m long, with an opening 5m wide and 4.6m deep. Trawl times varied in length from 10 to 77 minutes, depending on the abundance of the target species. Most trawl sample durations were less than 40 minutes. The fish were collected into a rigid holding box at the cod end designed for live capture and to minimize the loss of scales and ectoparasites. Samples were transferred into 5-gallon buckets and sorted by species. Temperature and salinity data were recorded at each site using a YSI-30 meter.

Collections were counted and labeled onboard the *Pacific Coast* . Sockeye that were to be tested for IHN (n=200) were shipped fresh on ice to the Pacific Biological Station laboratory within 24 hours of the time they were caught. Most of the remaining salmonids were individually bagged and frozen for further analysis in the lab. A small number of sockeye from larger sets were selected for stomach analysis, and their stomachs excised and preserved in 7% formalin. Tissue samples for DNA analysis were taken from those sockeye not sent for IHN analysis (n= 437). DNA samples were preserved in 99% ethanol.

Juvenile salmonids were weighed, measured, and examined in the laboratory for sea lice using a dissecting microscope. The motile stages of the lice were separated according to morphological characteristics outlined in Kabata 1972 and Johnson & Albright 1991a. Copepodid and chalimus stages of sea lice were mounted on permanent slides and identified to species and stages using a compound microscope.

The contents of the preserved stomachs were examined using a Wild M-7 dissecting microscope. Zooplankton were counted and categorized at least to the level of order, and the relative abundance of each taxon was calculated.

Plankton samples were taken at sites at the start point of each trawl site. Samples were taken using a 1 meter diameter plankton net with 150 um mesh in a vertical pull from a depth of 20 meters.. The filtrate was preserved with 10% formalin. In the laboratory, plankton samples were decanted into sieve stack of 1 mm, 500 μm, and 150 μm, and rinsed under a stream of water to remove formalin. The filtrate was rinsed with ethanol and concentrated in a centrifuge. Subsamples of the concentrated zooplankton were examined with a counting slide under a compound microscope to determine the relative abundance of zooplankton taxa. The zooplankton samples were initially determined to the same level of taxonomic classification as the corresponding stomach contents.

IHN Analysis

Frozen whole juvenile sockeye were submitted to the fish virology laboratory at the Pacific Biological Station for IHNV analysis by tissue culture techniques using two cell lines. Analysis in the DFO fish virology laboratory has been severely delayed because of priority being given to work on the viral hemorrhagic septicemia virus (VHSV) epizootic that is spreading through the Great Lakes region.

DNA Analysis

Juvenile sockeye tissue samples were submitted to the Salmon Genetics Laboratory of the Pacific Biological Station. Collections for analysis were assembled from trawls in each of the six geographic areas shown in Figure 1. Samples were analyzed for polymerase chain reaction products at 15 microsatellite loci (1b, 3dre, beta1, i1, oki10, oki16, oki1a, oki1b, oki29, oki6, omy77, one8, ots103, ots2, and ots3). Individuals were assigned to source populations using mixed stock analysis techniques employing Bayesian mixture modeling (Pella and Masuda 2001, Koljonen *et al.*, 2005). Proportions of collections were determined using the Coastwide 032107 baseline sample of 227 sockeye populations in a fashion similar to that reported by Beacham *et al.* (2005a, 2005b, 2005c). The reported stock compositions for actual fishery samples are the point estimates of each mixture analyzed, presented with variance estimates derived from 1000 bootstrap simulations.

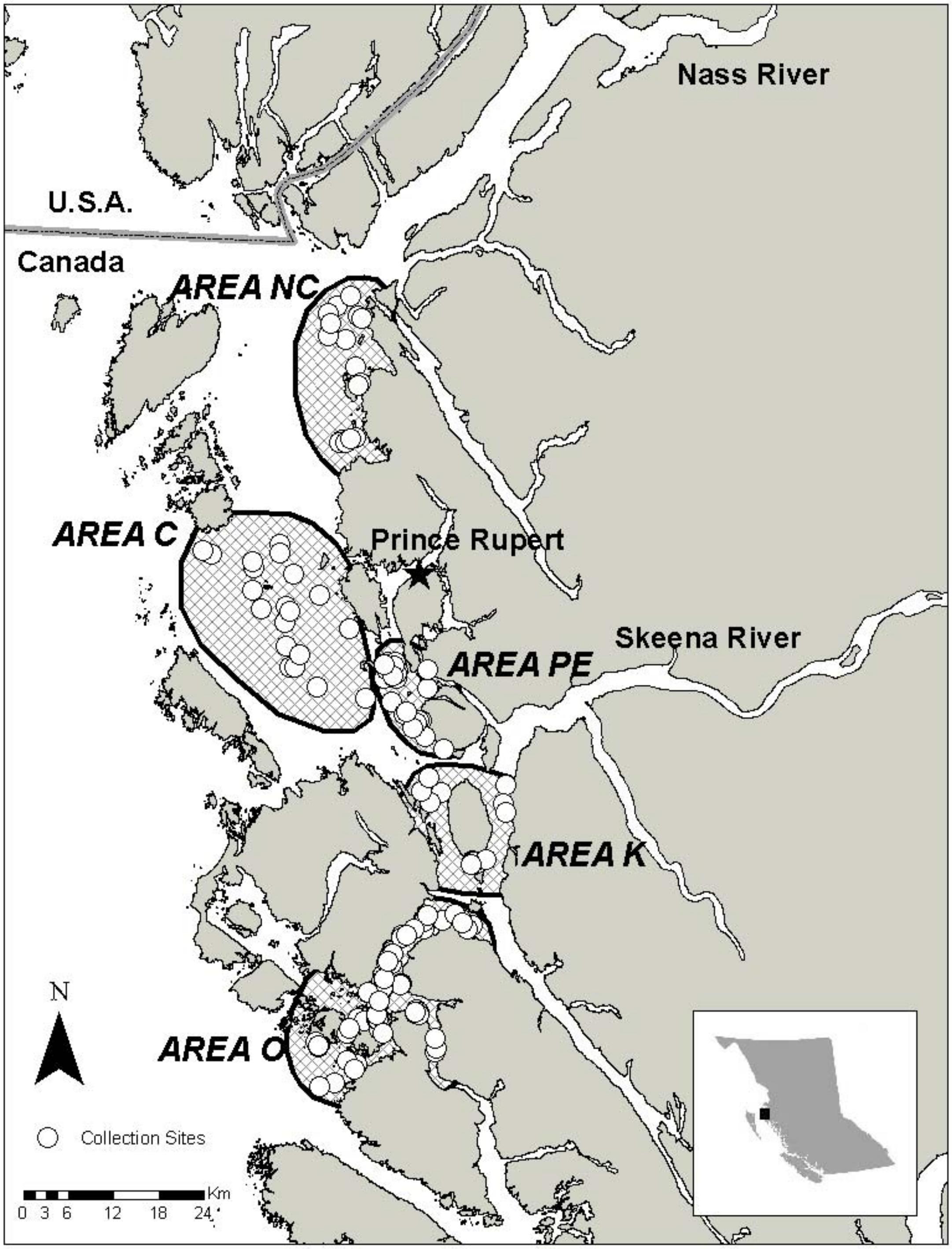

Figure 1. Map of North Coast showing collection sites and defined areas.

Results

The 2007 snowmelt flood resulted from a heavy snow pack followed by a late spring. The peak flow at Usk, the gauging station above Terrace (Figure 2.), was in the first week of June and was the highest since 1974. The peak flows in the estuary occurred about one week later and were about twice as large because they included large contributions from coastal tributary rivers.

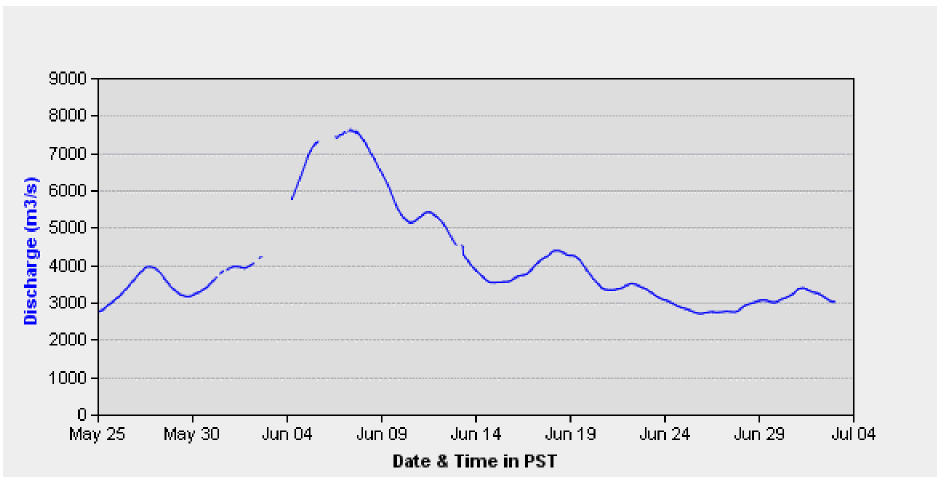

Figure 2. Discharge record at Skeena river at Usk (08EF001) for the 2007 nival flood.

The large flows from the Skeena and the Nass Rivers create brackish conditions along the coast north and south of Prince Rupert. Estuarine flow is conspicuous as far as Dixon Entrance north of Haida Gwaii (Thomson 1981). Defining the estuary is difficult as the Skeena and Nass rivers debouch into a series of coastal fiords. For the purposes of this paper we define the estuary zone as the area where the freshwater component is greater then 10%. Chatham Sound and Ogden Channel, the areas discussed in this paper, had salinities with >30% freshwater component in their most marine portions during the 2007 flood (Figures 3 and 4).

We observed a salinity and current pattern similar to that described by Trites (1952) which first defined the circulation pattern of the Skeena estuary. Early in the sockeye juvenile residence period between late May and early June (Figure 3), the freshwater plume of the Skeena River bifurcates. One branch flows down Ogden Channel and the other turns north along Digby Island. An eddy is formed in southern Ogden Channel with marine waters flowing in through Edye Passage and along the north coast of Porcher Island. Similar flow patterns were observed in 2004 and 2005. Later in the flood season (Figure 4) the flow from the later melting Nass River is predominant in the northern portion of Chatham Sound, blocking much of the estuarine flow from the Skeena River and diverting it southward through Ogden Channel.

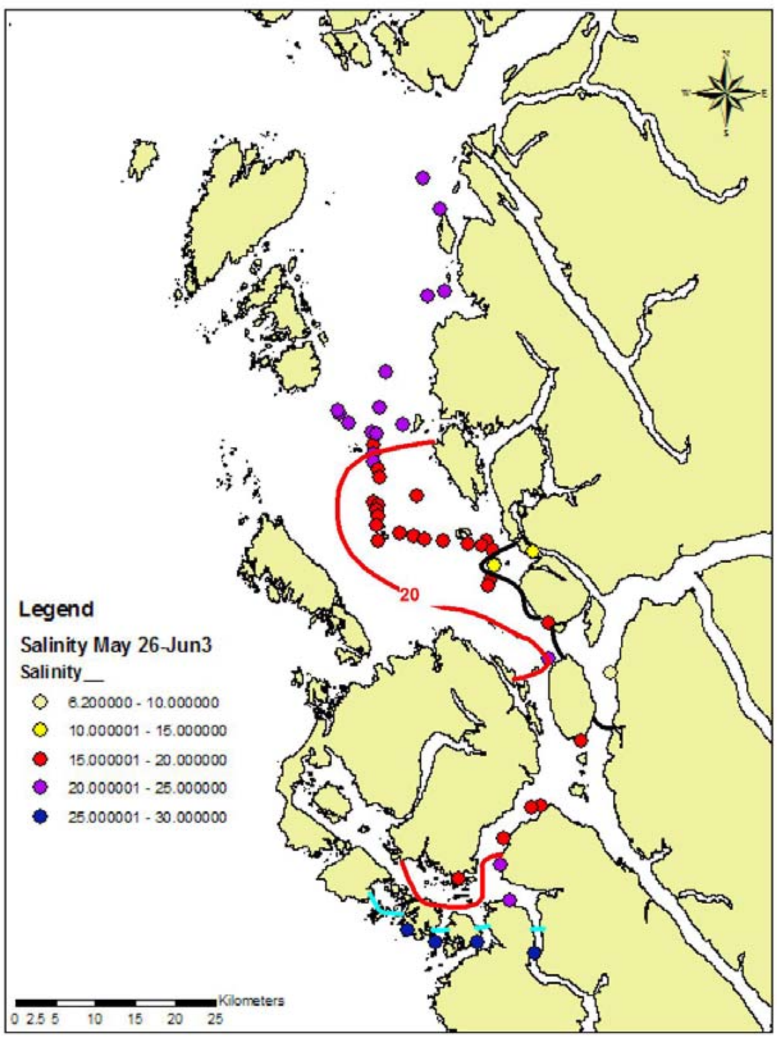

Figure 3. Salinities in the Skeena Estuary early in the nival flood of 2007.

The large volumes of fresh water input and the high tide range on the North Coast result in tidal velocities often greater than 1 knot on inflows and 2 knots on outflows. These velocities are significant in that they probably result in net outward flows of 0.5 to 1 knot (1.7 km/hr) or more. Such velocities are greater than the swimming speed of small fry such as pink and chum salmon, and equivalent to the peak sustained swimming speed of sockeye, chinook and coho salmon smolts (Videler and Wardle 1991).

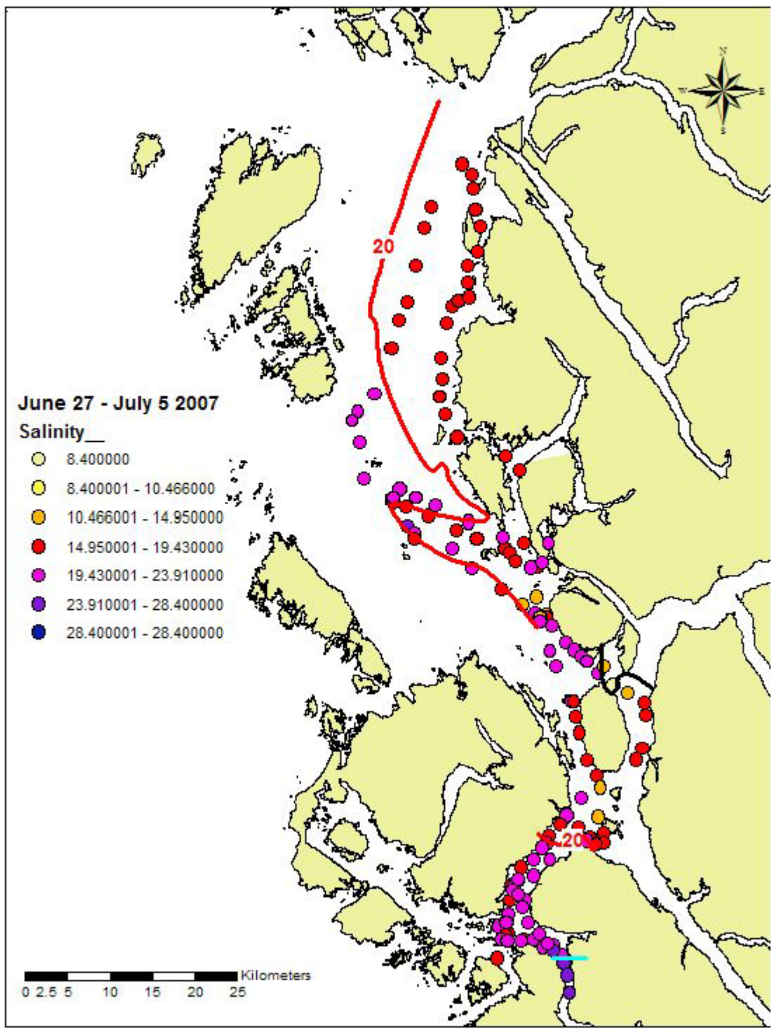

Figure 4. Salinities in the Skeena Estuary late in the nival flood of 2007.

Trawl Catch and CPUE

Trawl catches included many small herring (*Clupea pallasi*), sockeye, coho, pink, chum, steelhead (*Onchorhynchus ssp.)* and Dolly Varden (*Salvelinus malma*) smolts and small numbers of other species. 88% of the 156 trawl sets caught salmonid smolts and 51% caught sockeye. Sockeye were the most abundant salmonid in these collections. A total of 733 sockeye were caught.

The pattern of weekly catches of juvenile sockeye is shown in Figures 5 to 9 and summarized in Table 1 . The largest catches were made early in the season close to the mouth of the Skeena River in areas PE and K. The number of juvenile sockeye caught in areas PE and K declined steadily after the first week. Catch rates were moderately high in Ogden Channel in the first week of June, and remained higher in Ogden Channel than in other portions of the estuary throughout the sampling period. Catch rates in nearly all distal parts of the estuary were relatively low although no samples were collected in areas NC or SC during the second week of June because of poor weather conditions. Many of the trawls in the northern and western portions of Chatham Sound did not catch sockeye. These collection points are shown in Figure 1 but not in the CPUE maps.

These results are comparable to sockeye catches made during previous sampling efforts in 2004 and 2005. While sampling during previous years focused on pink salmon juveniles, some sockeye were taken in both years. We caught 89 sockeye in Area O between June 2 and June 6, 2004. In 2005, we caught 334 sockeye between May 30 and July 18 in areas O, K and PE.

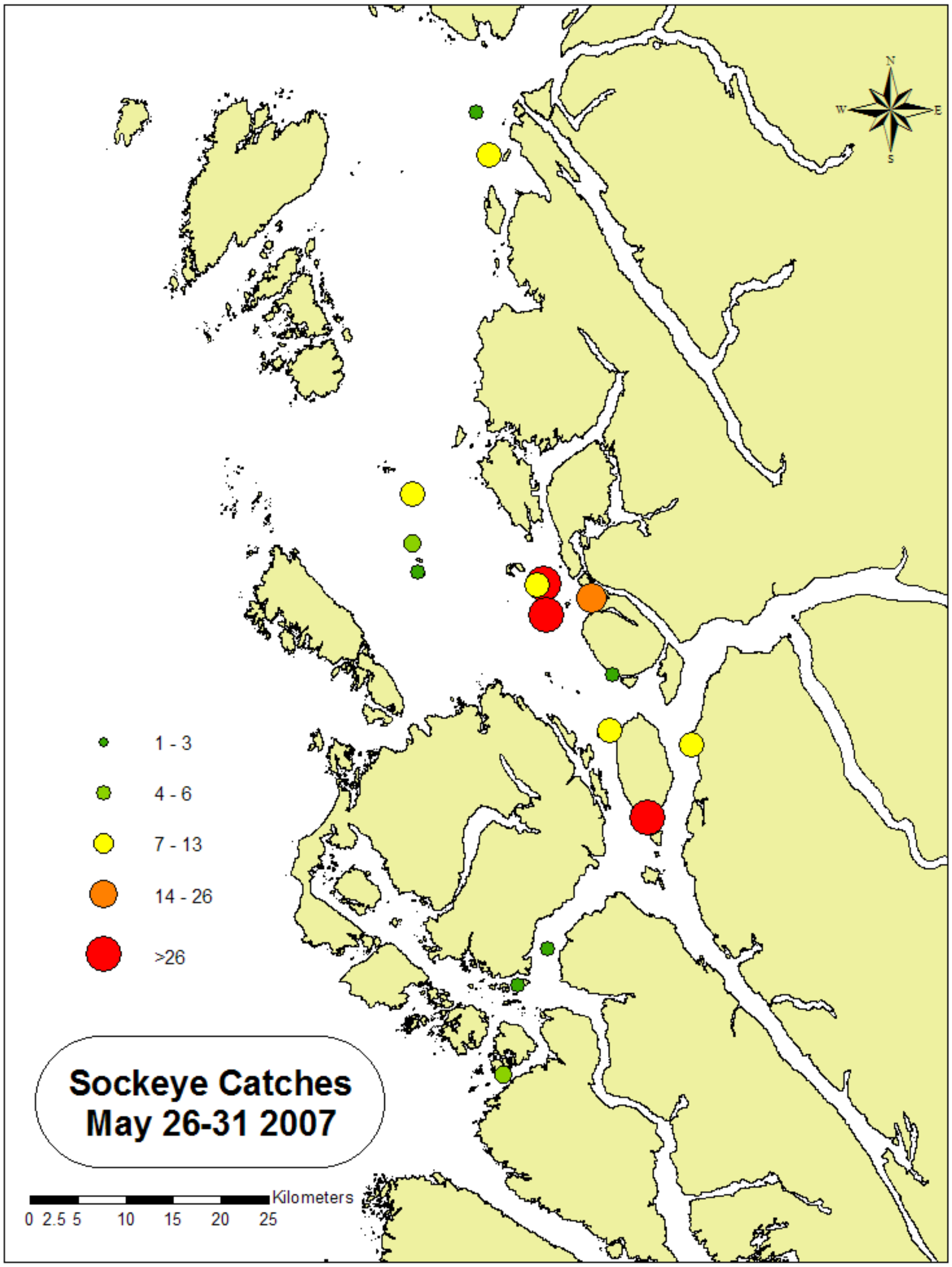

Figure 5. Sockeye trawl catches last week of May 2007.

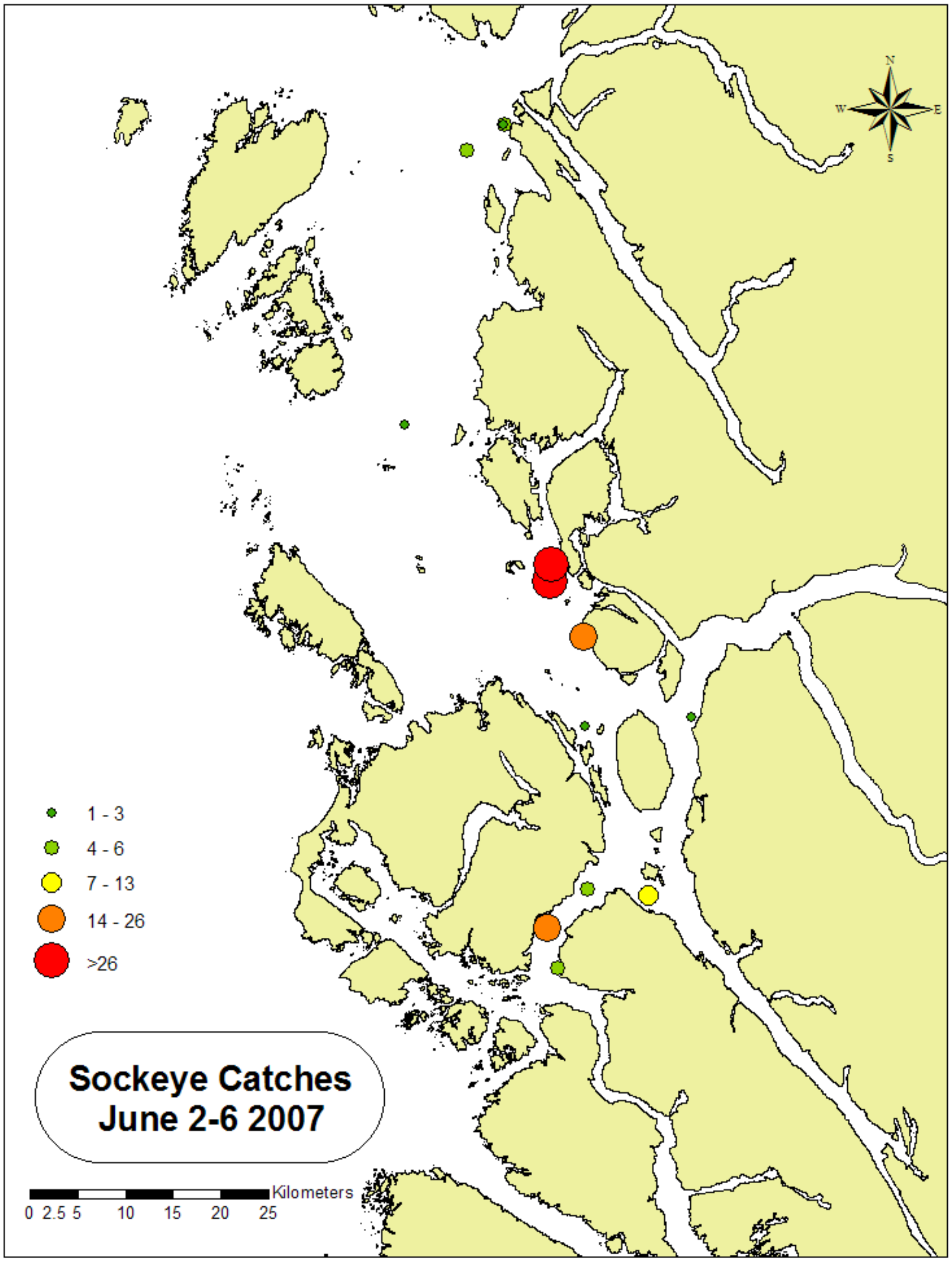

Figure 6. Sockeye trawl catches first week of June 2007.

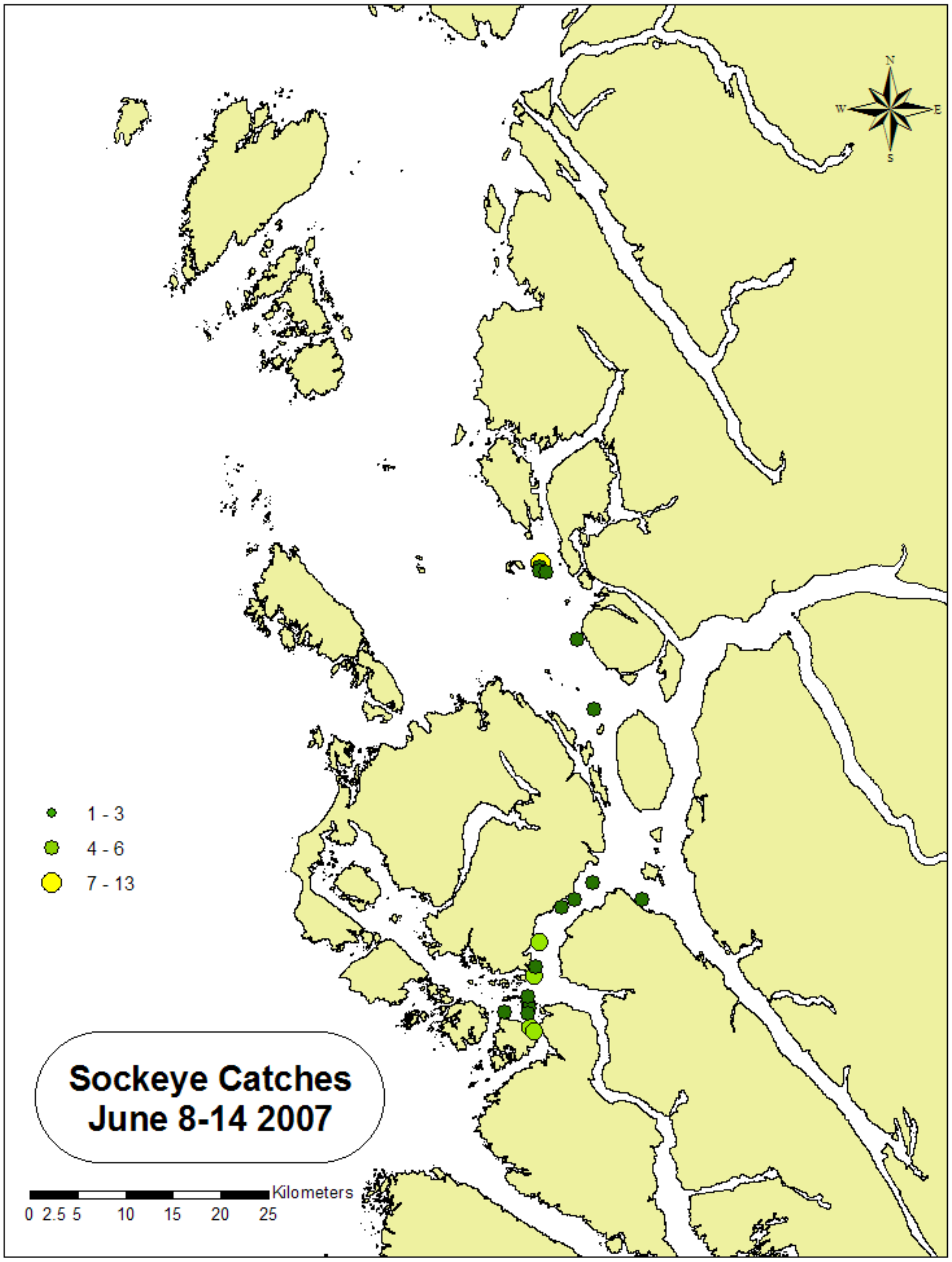

Figure 7. Sockeye trawl catches second week of June 2007.

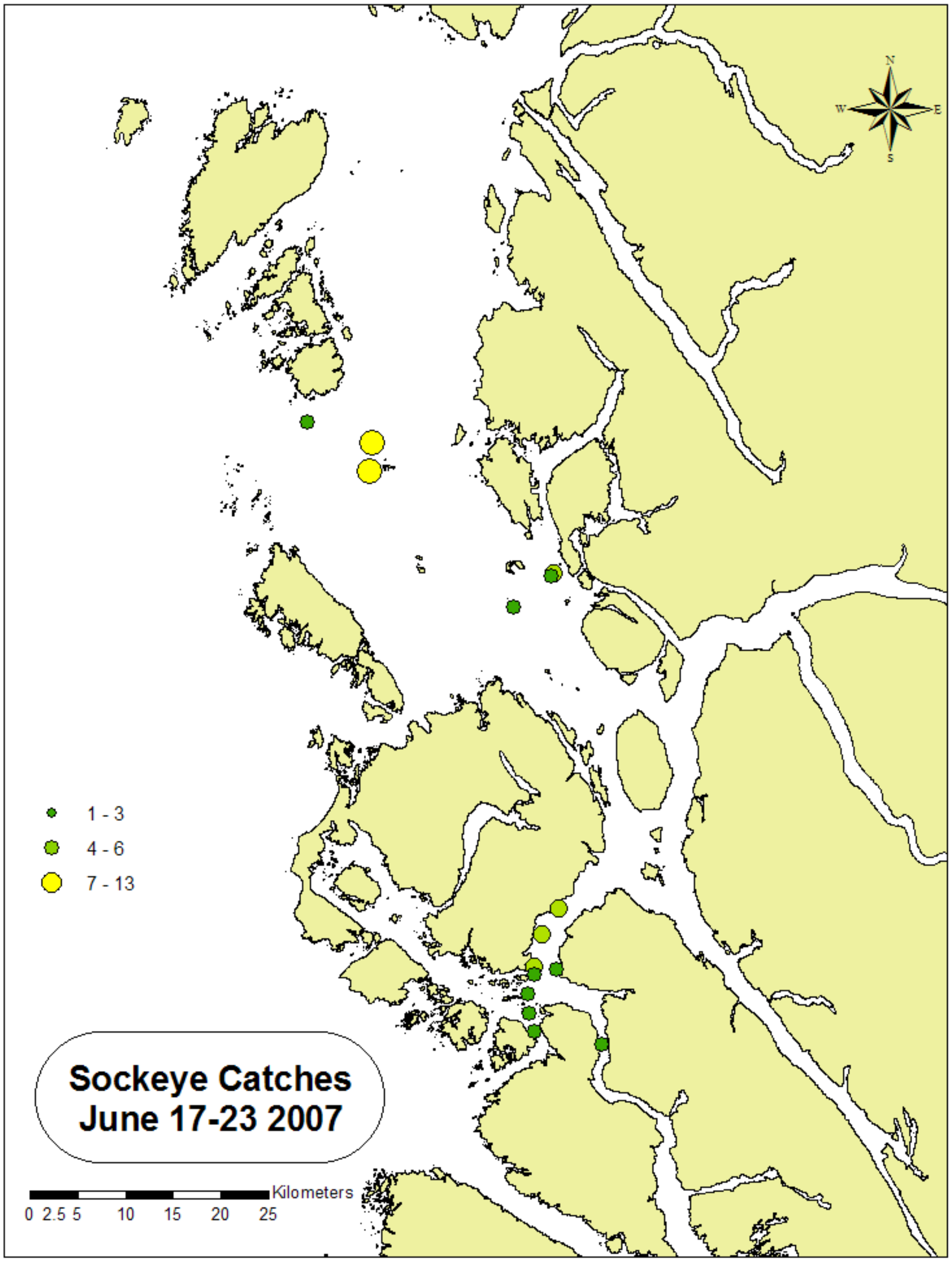

Figure 8. Sockeye trawl catches third week of June 2007.

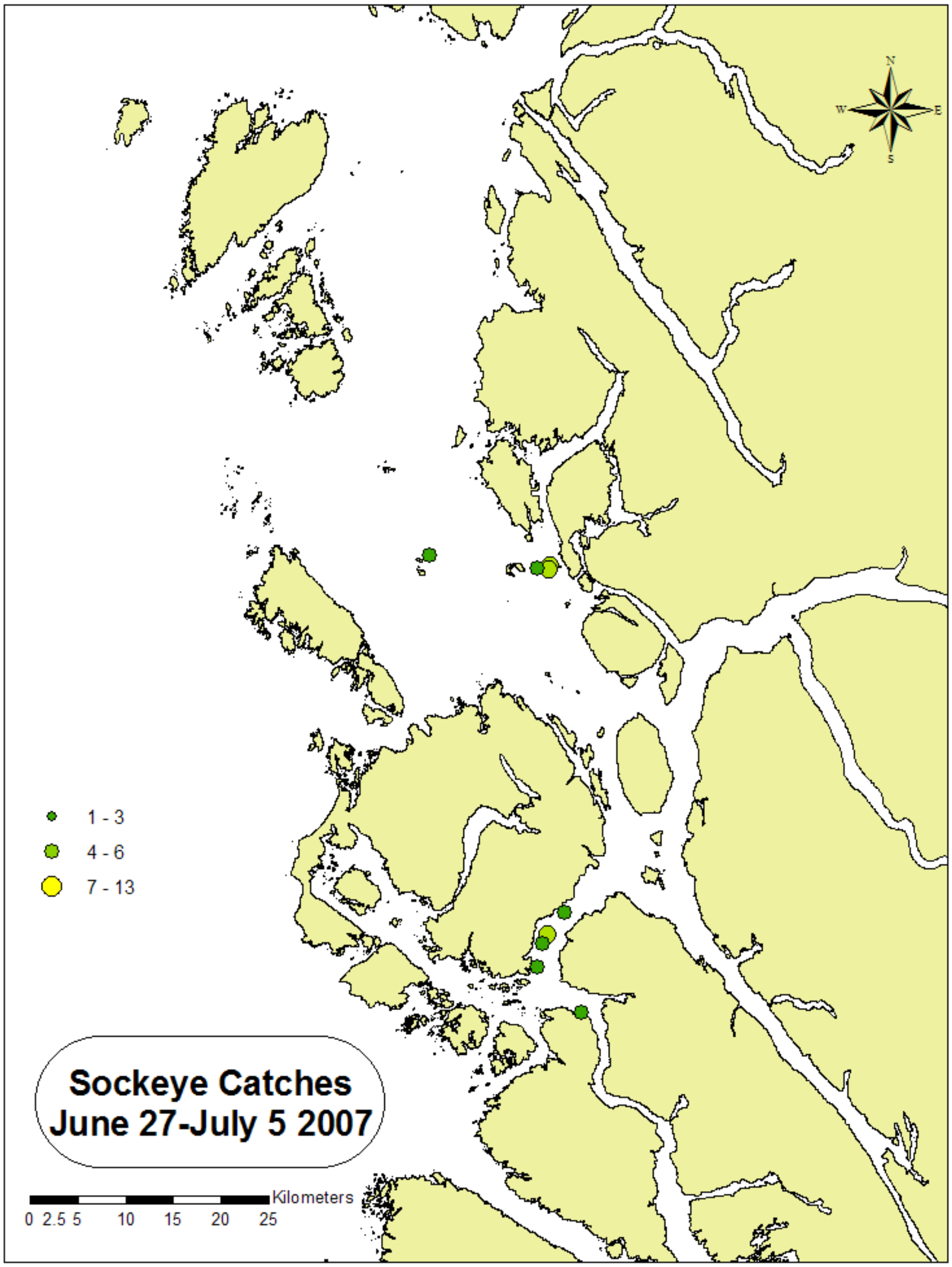

Figure 9. Sockeye trawl catches last week of June and first week of July 2007.

Sockeye length and weight

Sockeye smolts caught ranged in length from 80 mm snout-fork length in the first week to 99 mm in the 5th week. During this period the average weight increased from 4.6 g. to 10.4 g. (Figure 10). For comparison, the average length and weight of sockeye smolts leaving Babine Lake, the predominant sockeye nursery area in the Skeena region, are 83 mm and 5.7 g respectively (Foerster 1968).

Table 1. Sockeye data 2007 Skeena estuary collections.

Area	Week	N	Avg. Ln	Avg Wt
K	1	64	78	4.3
K	2	1	76	4.1
K	3	2	80	4.9
SC	2	3	93	6.8
SC	4	9	87	6.3
SC	5	1	82	4.9
NC	1	11	88	6.5
NC	2	4	81	4.8
O	1	8	82	4.3
O	2	71	78	4.4
O	3	27	86	6.1
O	4	22	87	6.4
O	5	13	113	15.5
PE	1	46	80	4.8
PE	2	60	77	4.1
PE	3	6	80	4.1
PE	4	7	81	5.0
PE	5	14	88	6.0

K = Kennedy Island, Arthur Passage, Telegraph Passage
SC= South Chatham Sound, Digby Island to Stephens Island
NC= North Chatham Sound Melville Island to Big Bay
O= Ogden Channel
PE = Outside Port Edward, Bell Buoy, Kinahan, Flora Bank

DNA Results

The percentage origin of the juvenile sockeye as determined by microsatellite DNA analysis is shown in table 3. Details of the stocks represented in these samples and error estimates by Bayesian mixture modeling are given in Appendix 1.

All of the analyzed sockeye samples taken in the Skeena Estuary were dominated by Skeena sockeye (Table 3), invariably from the large stocks of Babine Lake.
Nass River sockeye were a significant component in northern and western Chatham Sound but a few were collected in the Port Edward area mostly late in the flood season. Sockeye tabulated as Coast area 4,5,6 are predominantly from Area 5 and the Grenville Channel portion of Area 6 with the exception of a single Diana Creek sockeye from the Prince Rupert area (Area 4). The Area 5 and 6 sockeye were captured in the southern part of the estuary from Port Edward to Ogden Channel. The Diana Creek sockeye was caught in the northern part of Chatham Sound.

The late collection from Port Edward is composed mostly of sockeye from the interior inland lakes of the Skeena and Nass watersheds. The Babine sockeye that are present in the late collection almost entirely originate from Pinkut Creek at the south end of Babine Lake, 150 km from the lake outlet. The latest fish that were present in the Ogden Channel area are predominately from Area 5 and 6 coastal lakes to the south. They are conspicuously larger than the earlier sockeye from the Skeena.

Table 2. Calculated percentage origin of sockeye smolts in Skeena/Nass Estuary collections

Sample Area	Outside Port Edward	Kennedy	Ogden Channel	North Chatham Sound	Browns Passage	Outside Pt.Edward Late
N	192	58	156	21	35	16
Region						
Skeena	98.1	94.7	83.7	73.3	94.4	86.4
Nass	0.9	0.1	0.1	22.0	2.7	13.0
Stikine	0.0	0.0	2.7	0.0	0.0	0.0
SE Alaska	0.0	0.0	1.0	0.0	0.2	0.0
Coast Area 4,5,6	1.0	1.8	12.2	4.8	1.3	0.0
Coast Area 10	0.0	3.4	0.2	0.0	0.3	0.3
Other	0.0	0.0	0.1	-0.1	1.1	0.3

Sockeye Diet and Plankton Availability

A preliminary analysis of the diet and feeding selectivity of the juvenile sockeye was conducted. The contents of stomachs removed from a subsample of juvenile sockeye were examined, and revealed a marked difference in preferred food items in different parts of the estuary. Freshwater cladocerans were the predominant component of stomachs removed from sockeye juveniles caught in Zone PE, the area immediately adjacent to the Skeena river. Calanoid copepods and oikopleuran larvaceans were the major dietary components of sockeye juveniles caught in the more distal Area K . Oikopleurans and barnacle cyprids were common food items in Areas O and SC. Small fish began to appear in the stomachs of juvenile sockeye caught in the first week of July in Area O. Table 3 shows the relative proportions of food items by area and week.

A comparison of stomach contents with zooplankton samples collected in areas adjacent to the fish collection sites demonstrated a high degree of selectivity in the diet of juvenile sockeye. For example, the contents of stomachs from Trawl 2 contained 84% cladocerans, 11% cumaceans, and 3% barnacle cyprids, while the most abundant zooplankton taxa in the analogous plankton sample were calanoid copepods, oikopleuran larvaceans, and copepod nauplii. Oikopleuran larvaceans comprised 81% of all stomach contents in Trawl 40, in an area where the relative density of calanoid copepods was nearly eight times that of oikopleurans in the water column. Calanoid copepods, which were by far the most abundant taxon in all zooplankton samples, were significantly underrepresented in most of the stomachs that we examined. However, calanoid copepods were the most common dietary component in Area K, where selectivity was less apparent than in areas PE and O. Table 4 shows the densities of the major groups of zooplankton sampled in areas adjacent to the trawl sites for which sockeye stomachs were collected.

Table 3. Relative proportions of food items contained in sockeye stomachs Skeena Estuary May-July 2007

Trawl #	**1**	**2**	**25**	**53**	**5**	**4**	**34**	**40**	**140**	**150**	**106**
Area	**PE**	**PE**	**PE**	**PE**	**K**	**K**	**O**	**O**	**O**	**O**	**SC**
Date	26-May	26-May	31-May	05-Jun	26-May	26-May	03-Jun	03-Jun	29-Jun	05-Jul	21-Jun
n stomachs	22	12	3	4	6	7	3	5	2	3	8
Barnacle cyprid	18%	3%	5%	2%	3%	3%	45%	8%	0%	0%	57%
Barnacle nauplius	6%	2%	0%	0%	0%	2%	1%	3%	0%	0%	1%
Calanoid	0%	0%	0%	0%	77%	72%	1%	5%	0%	0%	0%
Cladoceran	75%	84%	94%	98%	2%	2%	3%	1%	0%	0%	8%
Cumacean	0%	11%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Crab Zoea	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%
Insect	0%	0%	0%	0%	1%	0%	2%	0%	0%	0%	0%
Fish	0%	0%	0%	0%	0%	0%	0%	0%	49%	30%	0%
Oikopleurans	0%	0%	0%	0%	13%	18%	47%	81%	49%	60%	31%
Other	0%	0%	0%	0%	4%	3%	2%	1%	0%	0%	10%

Table 4. Relative density of important groups of zooplankton present in the water column at selected trawl sites.

Trawl # Area Date	2 PE 26-May	4 K 26-May	40 O 3-Jun	53 PE 5-Jun	106 SC 21-Jun	150 O 5-Jul
Barnacle Cyprid	3	0	2	0	0	13
Barnacle Nauplius	50	56	20	89	4	67
Calanoid	392	341	261	222	620	382
Cladoceran	10	0	3	8	2	16
Copepod nauplius	45	99	40	65	20	121
Crab Zoea	0	0	2	3	0	13
Echinoderm	2	0	2	0	0	16
Euphausids	20	17	2	0	0	3
Insects	0	3	0	0	0	0
Oikopleurans	50	132	31	5	1	188
Polychaetes	11	3	0	0	0	0
Other	25	0	4	3	2	0

Sockeye are actively feeding during the four to six weeks of residence in the Skeena Estuary. Their mass increases two or three fold during this period (Figure 10). The sockeye arrive on the coast sea louse free. As they spend more time on the coast, sea lice copepodids attach to them and start to mature. We observed (Figure 11) that as sea lice (*Caligus clemensi*) advance through their larval stages they are found on larger sockeye juveniles.

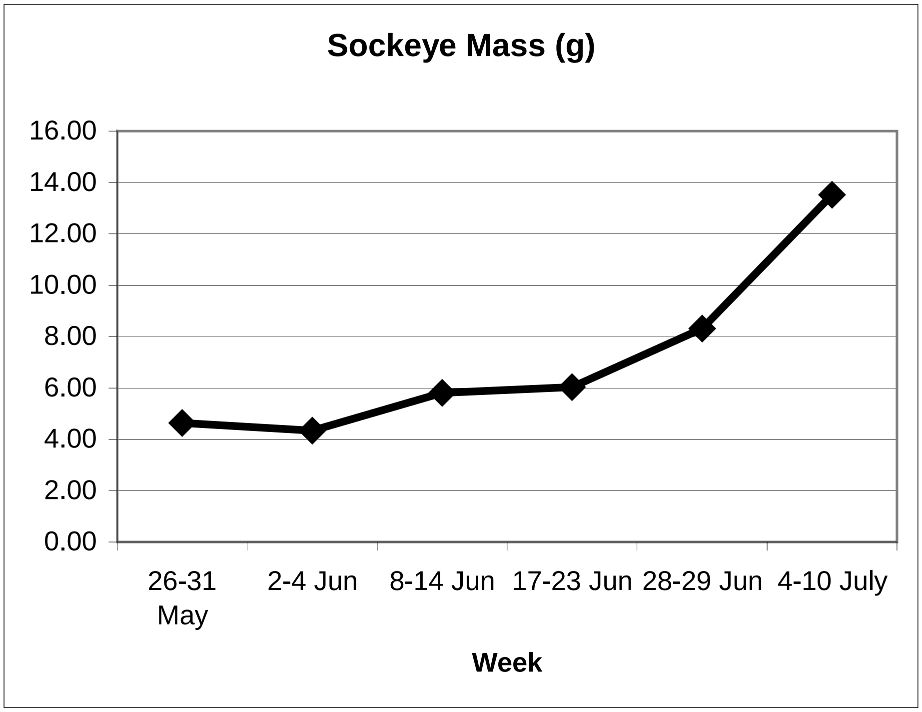

Figure 10. The average weight of sockeye increases during the estuarine residence period.

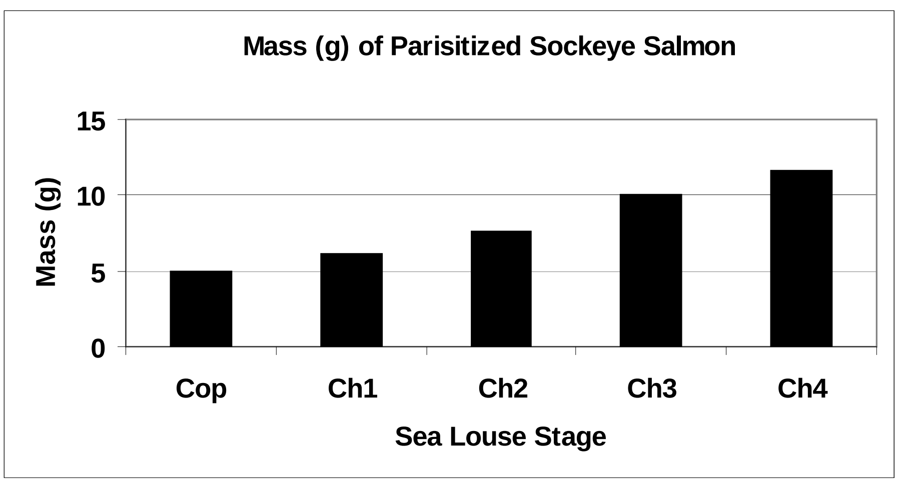

Figure 11. The stage of sea lice parasitizing juvenile sockeye.

Sea Lice Abundance

Sea lice of the two common species *Lepeophtheirus salmonis* and *Caligus clemensi* were observed on captured salmon and sticklebacks. Occurrences are presented in terms of abundance, that is the average number of sea lice on all fish in the population. This value is close to the prevalence rate at low abundances. The abundance levels observed (Table 5) are comparable to those observed in the much better larger collections of 2004 and 2005 (Gottesfeld *et al.* 2006). The relatively low abundance on pink salmon in the 2007 samples is because of the predominance of collections in the proximal portion of the estuary. The relatively high infestation rate of sockeye and chinook salmon is noteworthy. The relative dominance of *C. clemensi* is also similar to that observed in previous collections (Gottesfeld *et al.* 2006, Gottesfeld *et al.* 2008).

Table 5. 2007 Sea lice abundance on various host species

Species	n fish	n lice	Abundance
Sockeye	369	68	0.18
Chinook	145	56	0.39
Coho	162	13	0.08
Chum	41	1	0.02
Pink	158	3	0.02
Stickleback	9	4	0.44
All fish	899	150	0.17

Table 6. Sea lice on Sockeye by stage and species

	Stage	**N lice**
Caligus	Copepod	2
	Chalimus 1	21
	Chalimus 2	11
	Chalimus 3	21
	Chalimus 4	6
	Adult F	2
Lepeophtheirus	Chalimus 1	1
	Chalimus 4	1
Unidentified		3
Total		68

Discussion

The salinity pattern of the Skeena Estuary and its changes during the spring nival flood confirm the pioneering observations of Trites (1952). The biological results of this study are a significant expansion on the early work of Manzer (1956) in Chatham Sound and Higgins and Schouwenberg (1973) on the area near Prince Rupert. The annual migration of juvenile sockeye from the Nass and Skeena Rivers involves several hundred million fish. To the extent that we can define the critical early juvenile habitat of sockeye salmon, we have demonstrated that the areas of high usage are Chatham Sound and Ogden Channel. The eastern and southern portions of Chatham Sound are regularly used by at least some of the Skeena sockeye smolts which leave through passes like Brown Passage on the western margin of Chatham Sound. We cannot exclude the possibility that some of the Chatham Sound rearing sockeye, especially those of Nass origin, leave through Main Passage at the north end of Chatham Sound.

The sockeye collection coverage is best in Ogden Channel which has the most consistent high densities. This is in part because it is easier to find and capture juvenile sockeye in the relatively restricted width of Ogden Channel than in the open waters of Chatham Sound. But the ease of collecting sockeye in Ogden Channel is probably also due to higher abundance. The importance of Ogden Channel as a sockeye migration route is evident in the summer juvenile collections made on the BC and Alaska coast by the CCGS W.E. Ricker. One of the few large catches of juvenile sockeye was a catch of 229 on 3 July 2000 about 30 km west of Browning Entrance, the outlet of Ogden Channel. This catch composed 37% of the total sockeye juveniles collected on a cruise in June and July 2000 from Washington to the southern part of SE Alaska (Welch *et al.* 2003, 2004).

The seasonal pattern of sockeye use in Ogden Channel may be summarized as follows: at the end of May high numbers are found near the mouth of the Skeena River and the first sockeye smolts reach Ogden Channel. The prevailing salinities are 15‰ and 21‰ respectively. In first week of June they become abundant in eastern Ogden Channel. At this time, average salinities are 17‰. From the middle of June onward, sockeye are found only in the seaward half of Ogden Channel and to the south and west along the routes to outside waters such as Beaver Passage, where average salinities are 23‰. As the Skeena origin sockeye thin out at the end of their juvenile residence, larger sockeye from coastal lakes to the south appear. These fish are the same size as those caught in June and July by the Ricker (90-110 mm) in relatively more offshore areas such as Hecate Strait where they are presumed to have started their migration north along the coast to the Gulf of Alaska.

We have been unable so far to obtain fresh assays of whether the migrating smolts carry active IHNV, however analyses of 100 sockeye smolts in 2005 did not demonstrate the presence of IHNV. These last few years have been a time of very low occurrence of IHN in spawning sockeye at the Babine enhancement facilities, the only regular IHN monitoring station on the north coast. The lack of active IHN in migrating smolts is therefore not conclusive.

Sockeye feed selectively and appear to grow rapidly while in the Skeena Estuary. While some of the increase in size as the season progresses may be due to larger smolts arriving later in the estuary, most of it is likely attributable to growth. This pattern is suggested by the increase in maturity of sea lice on larger sockeye. For sockeye to spend several weeks or a month or more in the Skeena Estuary they must actively swim upstream to hold their place against the predominant outflow currents. Alternately and more likely they utilize local variations in flow velocity to keep their chosen place. For example, the surface water layer of Ogden Channel does not reverse with incoming tides during the nival flood season, but only slows. The change in water volume is likely made up by upstream movement at depth. A fish could therefore remain in a favoured portion of Ogden Channel by moving only tens of meters vertically.

There are biogeographic and chronological patterns to smolt usage of the Skeena estuary. Sockeye juveniles from Babine Lake dominate the assemblages throughout the estuarine zone. This is not surprising because Babine Lake produces the majority of sockeye in northern British Columbia. Nass sockeye are found in smaller numbers in the northern part of Chatham Sound, where the Nass inflow occurs, in the passes out of Chatham sound to the west and late in the season in the southern part of Chatham Sound when Nass flood flows dominate the northern part of the combined estuary at least as far south as Big Bay (Trites 1952).

The time separation of juvenile migrants is noteworthy. The late arriving sockeye at Port Edward are predominantly from headwater areas of both the Skeena and the Nass Rivers. The Babine sockeye that are found in this assemblage are almost entirely from the southernmost end of the Lake where they are effectively also headwaters fish. The later timing makes sense because the upriver sockeye do not migrate until the ice melts off their nursery lakes, which is a week or two later than migration timing in warmer, more coastal habitats. Similarly it must take a week or longer for sockeye from the southern basin of Babine lake to reach the outlet of the lake. Once the sockeye smolts reach the Skeena river they have at least an additional week of travel time to the coast..

In general it appears that sockeye smolts tend to move northward upon reaching the marine environment. To some extent this is true even within the estuary, although many or even most sockeye appear to leave the Skeena River via the southern route out of Ogden Channel. It thus appears that few of the Nass sockeye are found in southern Chatham Sound, but some sockeye from further south do appear. Early in the season a few sockeye appear to have moved up Grenville Channel from Area 6 and the central coast. Later in the season southerly derived sockeye are found in the western part of Ogden Channel which they may have entered from Petrel and Principe Channels.

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Appendix:

Sockeye smolt Microsatellite DNA determinations 2007 trawl collections

	Outside Port Edward		Ogden Channel		Kennedy Is		Western Chatham Sound		North Chatham Sound		Outside Port Edward - Late	
N determinations	**192**		**156**		**58**		**35**		**21**		**16**	
Stock	**%**	**SD**	**%**	**SD**	**%**	**SD**	**%**	**SD**	**%**	**SD**	**%**	**SD**
Bivouac	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.5)	0.0	(0.2)
Blackwater	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)
Driftwood Riv	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.5)
Dust	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)	0.0	(0.3)
Felix	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)	0.0	(0.4)
FiveMile	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.4)
Forfar	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)
Gluskie	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)	0.0	(0.3)
Hudson Bay	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)
Kynock	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)	0.0	(0.3)
Narrows	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.3)	0.0	(0.5)	0.0	(0.1)
Paula	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)
Porter Creek	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)
Rossette	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.4)	0.0	(0.2)
Sandpoint	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)
Sinta	0.0	(0.1)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.3)
Bowron	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.3)	0.0	(0.3)	0.0	(0.2)
Cayenne	0.0	(0.1)	0.0	(0.0)	0.0	(0.3)	0.0	(0.1)	0.0	(0.2)	0.0	(0.7)
Chilko south	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.3)
Chilliw lake	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)
Eagle	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.7)
Fennell	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.3)	0.0	(0.1)	0.0	(0.4)
Gates Creek	0.0	(0.1)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.7)
Nadina	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.5)
Nahatlatch	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.4)	0.0	(0.5)
Pitt River	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.4)
Raft	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.3)	0.0	(0.3)	0.0	(0.4)
Scotch	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)
Seymour	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.6)
ThompsonNorth	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)
Upper Adams	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.4)	0.0	(0.1)
Birkenhead	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.4	(1.4)	0.0	(0.1)	0.0	(0.1)
Blue Lead Ck	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)	0.0	(0.3)
Chilko	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)
DollyVarden Cr	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.3)	0.0	(0.6)
Horsefly	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)
Kuzkwa Creek	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.4)
Lower Horsefly	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.5)

McKinley	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.4)	0.0	(0.5)
Mid Horsefly	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)
Middle River	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.5)	0.0	(0.3)
Mitchell	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.8)
Pinchi Creek	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)
QuesnelTrib#1	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)	0.0	(0.2)
QuesnelTrib#2	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.4)
QuesnelTrib#4	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.4)
QuesnelTrib#5	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.3)	0.0	(0.6)	0.0	(0.3)
Roaring River	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)	0.0	(0.4)
Stellako	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.4)	0.0	(0.3)	0.0	(0.2)
Tachie	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)
Upper Horsefly	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.3)	0.0	(0.2)	0.0	(0.5)
Wasko Creek	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)
Big Silver	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.5	(1.6)	0.0	(0.3)	0.0	(0.3)
Cultus Lake	0.0	(0.0)	0.0	(0.1)	0.0	(0.0)	0.0	(0.2)	0.0	(0.7)	0.0	(0.3)
Eagle late	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)
Harrison	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.2	(1.0)	0.0	(0.3)	0.0	(0.1)
Little River	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)
Little Shuswap	0.0	(0.1)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)
Lower Adams	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.4)
Lower Shuswap	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.3)	0.0	(0.1)	0.0	(0.3)
MiddleShuswap	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)	0.0	(0.4)
Portage Creek	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)
Weaver	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)
WidgeonSlough	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)
Baker Lake	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.4)	0.0	(0.4)
LakeWashington	0.0	(0.1)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)
Ozette Lake	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.3)	0.0	(0.3)
Glendale	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)
Heydon	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)
Sakinaw	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.5)
GCL Fawn	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.1)
GCL Forest2	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.3)
GCL McBride	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)
GCL North	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)
Great Central	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)
Henderson	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.4)	0.0	(0.2)
Hobiton	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)
Kennedy	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.6)
Muchalat	0.0	(0.0)	0.0	(0.1)	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.4)
Nahwitti	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.7)
Nimpkish	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)
Quatse	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)
Sproat	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.5)	0.0	(0.3)
Sproat Antler	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)
Sproat Gracie	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.3)
Sproat Snow	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)

Vernon	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)
Woss Lake	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)	0.0	(0.2)
Lake Wenatchee	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.7)
Okanagan River	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)
Rocky Reach	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.6)
Bonney	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.1	(0.5)	0.0	(0.1)	0.0	(0.5)
Bowser	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.1	(0.9)	0.0	(0.2)	0.0	(0.4)
Brown Bear	0.8	(2.3)	0.1	(0.7)	0.1	(0.6)	1.9	(4.5)	12.5	(7.9)	0.0	(0.7)
Damdochax	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.6	(2.1)	0.0	(0.6)	13.0	(8.4)
Gingit	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.5)	0.0	(0.4)
Hanna Creek	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.5)
Kwinageese	0.0	(0.1)	0.0	(0.0)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)	0.0	(0.2)
Meziadin beach	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.4)	0.0	(0.4)
Meziadin weir	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	4.2	(5.8)	0.0	(0.4)
Nass Lates3	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	5.2	(5.6)	0.0	(0.2)
Tintina Creek	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.3)	0.0	(0.5)	0.0	(0.2)
Zolzap juv	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.4)
Alastair	0.5	(0.5)	0.6	(0.6)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)
Kalum	1.6	(0.9)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)
Kitwanga	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.3)	0.0	(0.1)	0.0	(0.2)
McDonnell	0.5	(0.5)	1.3	(0.9)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)
Schulbuckhand	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.6	(1.6)	0.0	(0.2)	0.0	(0.2)
Stephens Kispox	1.0	(0.9)	0.9	(0.9)	0.1	(0.7)	0.0	(0.2)	0.0	(0.2)	0.0	(0.4)
Williams	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	2.3	(2.5)	0.0	(0.2)	0.0	(0.1)
Motase	0.0	(0.0)	0.0	(0.1)	0.0	(0.0)	0.1	(0.6)	0.0	(0.2)	12.8	(8.0)
SalixBear	0.0	(0.0)	3.9	(1.6)	0.3	(1.1)	7.1	(4.8)	0.0	(0.2)	5.4	(6.2)
Sustut	0.0	(0.0)	1.3	(0.9)	0.0	(0.1)	2.9	(2.7)	0.0	(0.3)	12.5	(7.5)
Swan	0.1	(0.4)	0.4	(0.7)	2.6	(2.4)	0.0	(0.2)	0.0	(0.2)	0.0	(0.4)
Nanika	0.3	(0.4)	1.2	(0.9)	0.0	(0.1)	1.3	(2.2)	0.0	(0.3)	0.0	(0.4)
Four Mile	5.2	(6.9)	0.2	(1.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)
FultonLate	59.3	(8.6)	40.0	(7.7)	76.8	(8.7)	78.2	(9.4)	70.0	(12.2)	17.9	(23.0)
Grizzly	0.0	(0.1)	0.3	(1.2)	0.0	(0.2)	0.5	(3.3)	0.0	(0.4)	0.2	(1.4)
Lower Babine	3.8	(2.9)	8.7	(5.2)	0.0	(0.1)	0.1	(1.2)	0.3	(2.2)	0.9	(4.0)
Morrison	18.3	(8.4)	0.1	(0.6)	1.0	(3.2)	0.0	(0.4)	0.3	(2.4)	0.0	(0.1)
Pierre	0.6	(2.0)	0.6	(2.0)	0.1	(0.8)	0.0	(0.4)	0.3	(2.0)	0.3	(2.2)
Pinkut	6.2	(8.3)	23.8	(7.9)	13.7	(8.2)	0.0	(0.3)	2.2	(6.3)	36.3	(24.0)
Tahlo	0.2	(1.0)	0.3	(1.4)	0.0	(0.0)	0.7	(3.1)	0.0	(0.3)	0.1	(1.1)
Twain Cr	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.4)	0.2	(1.8)	0.0	(0.2)
Upper Babine	0.3	(1.4)	0.1	(0.7)	0.0	(0.3)	0.5	(2.5)	0.0	(0.2)	0.0	(0.2)
Bugleg Creek	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.5)	0.0	(0.2)
Christina Lk	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)	0.0	(0.7)
Chutine River	0.0	(0.0)	0.5	(1.4)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)	0.2	(1.5)
Craig River	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)	0.0	(1.0)	0.0	(0.3)
Devils Elbow	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)	0.0	(0.5)
Iskut	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)	0.0	(0.3)
Katete River	0.0	(0.0)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)
PorcupineSloug	0.0	(0.0)	0.0	(0.1)	0.0	(0.0)	0.0	(0.2)	0.0	(0.3)	0.0	(0.3)
Scud	0.0	(0.0)	0.2	(0.7)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.6)

Shakes Creek	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.6)	0.0	(0.2)
Stikine main	0.0	(0.0)	2.0	(1.7)	0.0	(0.2)	0.0	(0.1)	0.0	(0.5)	0.0	(0.3)
Tahltan	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)
Tuya	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.4)	0.0	(0.6)
UpperStikine	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)	0.0	(0.4)
Verrett	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.4)	0.0	(0.5)
Banks	0.0	(0.0)	0.1	(0.4)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.4)
Bella Coola mix	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.7)
Canoe Creek	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.2	(1.0)	0.0	(0.2)	0.0	(0.4)
Canoona	0.0	(0.0)	0.1	(0.4)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.5)
Deer Lake	0.0	(0.0)	2.0	(1.6)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)	0.0	(0.1)
Devon Lake	0.0	(0.0)	3.3	(1.7)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.4)
Diane Creek	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	4.8	(4.5)	0.0	(0.5)
Evelyn Lake	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)
Kadjusdis	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.8)
Kent Lake	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.6)
Kimsquit	0.0	(0.0)	0.0	(0.1)	0.0	(0.0)	0.0	(0.3)	0.0	(0.7)	0.0	(0.3)
Kingkown Sou	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.5)
Kitimat	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)	0.0	(0.2)
Kitkiata Lake	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.1)	0.0	(0.4)
Kitlope	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.5)	0.0	(0.6)
Klinaklini	0.0	(0.1)	0.0	(0.1)	0.0	(0.5)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)
Koeye	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.3)
Kwakwa Lake Lo	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)
Kwakwa Lake Up	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)	0.0	(0.2)
Lagoon Creek	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)
Lonesome	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)	0.0	(0.3)
Long Lake	0.0	(0.0)	0.0	(0.1)	0.0	(0.0)	0.9	(1.8)	0.0	(0.2)	0.0	(0.6)
Lowe	0.0	(0.0)	5.0	(1.8)	1.7	(1.7)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)
Mary Cove	0.0	(0.0)	0.7	(1.2)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)	0.0	(0.2)
Mikado Creek	0.0	(0.0)	0.2	(0.7)	0.0	(0.1)	0.0	(0.0)	0.0	(0.2)	0.0	(0.3)
Namu	0.0	(0.1)	0.7	(1.1)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)
Phillips	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.5)
Shawatlan Lake	1.0	(0.7)	0.0	(0.0)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)
Smokehouse Ck	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.2	(0.8)	0.0	(0.2)	0.0	(0.2)
Tankeeah	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.4)	0.0	(0.4)	0.0	(0.2)
Tenas	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)	0.0	(0.5)
West Arm Creek	0.0	(0.0)	0.0	(0.3)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)
B. Tatsamenie	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)	0.0	(0.9)
Hackett	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.6)
King Salmon	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.3)	0.0	(0.6)	0.0	(0.2)
Kuthai	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.3)
L.Tatsamenie	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)
Little Trapper	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)
Nahlin	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.8)
Takwahoni	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.5)	0.0	(0.2)
Tulsequah	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)
Tuskwa	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)	0.0	(0.4)	0.0	(0.2)

Yonakina	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.3)
Alsek T down	0.0	(0.1)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)
Klukshu Early	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)	0.0	(0.4)
Klukshu Late	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)
Klukshu mix	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.4)	0.0	(0.4)
Kudwat Creek	0.0	(0.0)	0.0	(0.2)	0.0	(0.0)	0.0	(0.1)	0.0	(0.3)	0.0	(0.3)
L.Tatshenshini	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.3)	0.0	(0.2)
Neskataheen	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.6)	0.0	(0.4)
Stinky Creek	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)
Uknown Alsek	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)
Up Tatshensh	0.0	(0.0)	0.0	(0.2)	0.0	(0.3)	0.0	(0.1)	0.0	(0.4)	0.0	(0.4)
Amback	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.4)
Ashlulm	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)	0.0	(0.7)
Dallery	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(1.0)	0.0	(0.7)
Genesee	0.0	(0.0)	0.0	(0.2)	1.6	(2.3)	0.0	(0.2)	0.0	(0.3)	0.0	(0.2)
Inziana	0.0	(0.1)	0.0	(0.0)	0.0	(0.3)	0.0	(0.1)	0.0	(0.5)	0.0	(0.1)
Marble Creek	0.0	(0.0)	0.0	(0.1)	0.0	(0.3)	0.0	(0.3)	0.0	(0.1)	0.1	(1.4)
Neechanz	0.0	(0.0)	0.0	(0.1)	0.1	(0.6)	0.3	(1.3)	0.0	(0.2)	0.3	(1.3)
Sheemahant	0.0	(0.0)	0.0	(0.1)	1.7	(2.4)	0.0	(0.3)	0.0	(0.2)	0.0	(0.2)
Wannock	0.0	(0.0)	0.1	(0.5)	0.0	(0.2)	0.0	(0.3)	0.0	(0.2)	0.0	(0.4)
Washwash	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.3)	0.0	(0.6)
Awun River	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)	0.0	(0.3)
CopperR QCI	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.6)
Mercer Lake	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)
Naden River	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)
Yakoun	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)	0.0	(0.4)
Heckman	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.3)	0.0	(0.3)
Hetta	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)
Hugh Smith	0.0	(0.0)	0.1	(0.5)	0.0	(0.3)	0.2	(1.1)	0.0	(0.2)	0.0	(0.3)
Kah Sheets	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.4)
Karta	0.0	(0.0)	0.0	(0.2)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)	0.0	(0.2)
Kegan	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)
Klakas	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)	0.0	(0.2)
Kunk	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.6)	0.0	(0.4)
Kutlaku Lake	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.4)	0.0	(0.2)
Luck	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)
Mahoney	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.2)	0.0	(0.1)	0.0	(0.1)
McDonald	0.0	(0.0)	0.8	(1.4)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.3)
PetersburgLake	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)
Red Bay Lake	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)
Salmon Bay	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.3)
Sarkar	0.0	(0.0)	0.0	(0.0)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)
Shipley	0.0	(0.1)	0.0	(0.0)	0.0	(0.1)	0.0	(0.3)	0.0	(0.2)	0.0	(0.3)
Sitkoh	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)
Thoms Lake	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.1)	0.0	(0.3)	0.0	(0.3)