BC Centre for Aquatic Health Sciences

2015 Kitasoo Fisheries Wild Juvenile Pacific Salmon Sea Lice Monitoring Program

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Executive Summary

In 2005 the Kitasoo/Xaixais First Nations established a program to monitor sea lice presence and abundance on seaward migrating wild juvenile salmon in selected regions of their traditional territories. The purpose of this action was to determine whether or not salmon farming was having an observable effect on the sea lice infestation rates of wild salmon that might then affect wild salmon populations. This report summarizes data collected in 2015, the 11th year of the program.

The sampling areas used in 2015 were similar to past years and included locations in the region of Mathieson and Finlayson Channel salmon farming sites and to the west in Tolmie Channel where there are no salmon farms. In 2015, a fourth area was added with sites sampled in the Tolmie Channel area. Sampling areas were grouped into five zones as related to migration trends of wild salmon: control (no farms), upstream of salmon farms, near salmon farms and downstream of salmon farms and four new sampling locations in Tolmie Channel where there are currently no farm sites.

In total, 1,230 juvenile salmon were collected and examined for sea lice: 64% were identified as Pink Salmon, 28 % were Chum Salmon and 2 fish were identified as a Chinook and 3 were identified as Coho Salmon.

Of the all the juvenile salmon examined in 2015, 55.5% weighed below 1 gram (61.5% of the Pink Salmon and 42.2% of the Chum Salmon). In June only 5% of all salmon captured weighed below 1 gram. In 2014, 32% of the fish weighed less than 1.0 g in June.

Fish were examined for two species of sea lice: 1) *Lepeophtheirus salmonis* (*L. salmonis*) sometimes referred to as the 'salmon louse' as it is most commonly found on salmon in the ocean, and 2) *Caligus clemensi (C. clemensi)* found on many different fish species in the ocean. 2015 proved to be a year of high sea lice prevalence. Of 1,230 fish examined for lice, 56% of the juvenile Pink Salmon and 65% of the Chum Salmon examined had *L. salmonis*. Overall, similar infestation levels of *L. salmonis* (i.e. abundance) were found between Chum and Pink Salmon in 2015 with the Pink Salmon having a slightly higher infestation level. There was no difference in *C. clemensi* abundance levels observed between the species (14.8% and 13% of the Pinks and Chum respectively with *C. clemensi*).

C. clemensi prevalence on sampled fish in April was higher in the control zone than the other sites, with the new sites having the lowest occurrence. No differences were found in *C. clemensi* prevalence between near farm and control zones in May for both Pink

and Chum Salmon. In June, the upstream sampling area had lower levels than the other areas with almost no infection.

Water temperature and salinity are important factors in growth of fish as well as development and survival of sea lice. The average water temperature in April was 9.3°C which was higher than previous years where temperatures were less than 9°C. May and June of 2015 had water temperature of11.4°C. Water temperatures in the upstream sites (11.3C) were higher than other sites (10.0C) for April - May. Overall, water salinity was similar between the sampling zones and did not vary over the sampling season except for the upstream zone where it was lower in April and June (average 24.1ppm) and higher in May (28.7ppm)..

The prevalence data collected during the 2015 season showed a different pattern than data collected in previous years, with *L. salmonis* levels in April as high as 0.8% (on Pinks) in 2015 whereas in previous years, *L. salmonis* prevalence was less than 0.3%. It is noteworthy that the levels remained elevated, throughout May ranging from 0.4%-0.8% .

2015 would appear to be an anomaly regarding the prevalence of sea lice infestation of wild salmonids. Environmental conditions may have played a large role in the high prevalence of lice seen in this year. High salinity and higher temperatures throughout the winter and spring may have contributed to high survival rates of lice. Lice levels in April were considered high in all areas sampled. In May, levels in the control and new site zones decreased while levels upstream and near farms remained elevated. Downstream sites had higher levels of sea lice prevalence on wild salmonids in June than in May. Other areas were not sampled in June; no conclusion can be made on these other zones. As well, on fish sampled near fish farms, sea lice levels in 2015 showed an increased abundance relative to fish from control areas but only *for L. salmonis* and not *C. clemensi*.

Introduction

In 2005, the Kitasoo/Xaixais First Nations established a program to monitor sea lice levels on migrating wild juvenile salmon in their traditional territory. Sea lice are parasitic copepods found on fish in the marine environment. There are two species of sea lice that have commonly been reported on wild and farmed salmon in British Columbia (BC) – *Lepeophtheirus salmonis* (*L. salmonis*) and *Caligus clemensi (C. clemensi). L. salmonis* is considered to have a limited host range, primarily salmonids, and is sometimes referred to as the 'salmon louse'. Recently, the species of *L. salmonis* occurring in the Pacific Ocean has been found to be genetically different from the species found in the Atlantic Ocean (Yazawa et al., 2008). The other species of sea louse *(C. clemensi)*, is found on many different species of marine fish including herring (*Clupea harengus pallasi*) and salmon. *C. clemensi* is sometimes referred to as 'herring louse'.

A published report (Saksida et al., 2011) summarized the data collected 2005-2008 in the Kitasoo/Xaixais territory. The authors found both *L. salmonis* and *C. clemensi* on fish, however prevalence was low with over 91% of the fish free of lice infestation and that the amount of lice on the fish varied both by year and by region. Mean prevalence of *L. salmonis* in the channels with salmon farms ranged from 2% to 9%, which is lower than levels published for the same region in different years and for areas without salmon farms. *C. clemensi* prevalence on wild Pink Salmon (*Oncorhyunchus gorbuscha*) was associated with sampling zone and the size of Pink Salmon; larger juvenile fish were more likely to be infested than smaller fish. Follow-up reports were prepared and submitted for each year 2009-2014 for the Kitasoo/Xaixais First Nations.

In contrast to the early studies where sampling began in May, the 2010 - 2013, sampling was started in April to enable a better assessment of sea lice levels on smaller salmon shortly after they emerge from rivers. Prior knowledge has shown that only very small salmon below 1 gram in weight are vulnerable to the effects of sea lice. Research studies have shown that juvenile salmon and in particular, Pink Salmon, quickly develop resistance to sea lice, which is likely associated with the development of scales (Jones et al., 2008). Further, Jones and Hargreaves (2009) proposed a threshold of lethal infection of 7.5 *L. salmonis* g^{-1} for Pink Salmon weighing fewer than 0.7 grams. Above this size, Jones et al. (2008) found little to no lethal effects associated with sea lice infestations, while Nendick et al. (2011) found that there was little to no sub lethal affects once Pink Salmon reach 1 gram. In these studies, sampling was also limited to primarily Pink and Chum Salmon (*O. keta)*. The following summarizes the data collected in 2015 and includes other salmonid species captured.

Methodology

Wild juvenile salmon were sampled by beach seine from near-shore areas at sites in the region of Mathieson and Finlayson Channels where salmon farming is present and in Laredo Inlet, located to the west where there are no salmon farms (control) Figure 1. In 2015, four new sites were added in Laredo Inlet where there are presently no salmon farms but is an area being considered for new farms. Between 10 and 100 juvenile salmon were collected from each beach seine set and were placed in a small bucket containing seawater using a dip net. Individual salmon from the bucket were placed in a bag and were euthanized then frozen for later evaluation in the laboratory to determine if lice were present on the sample. Salinity and temperature data were recorded at the time of collection (2011-2015). In 2015 sampling began in April, a few weeks into the wild salmon seaward migration and went until May except sites in the upstream and downstream sites where sampling continued into June.

All frozen wild juvenile salmon collections were transported to the BC Centre for Aquatic Health Sciences (BC CAHS) in Campbell River, BC in the summer of 2015 and were stored at -20°C. The received samples were of good quality.

For examination, juvenile salmon were thawed, identified by species (Pink, Chum and other salmon), and fork length (mm) and weight (g) were measured and recorded. Each fish and the bag in which the fish had been stored were examined under a stereo dissecting microscope and all lice present were counted. Lice were identified to life-stage and species using criteria outlined in Jones et al. (2006). To avoid bias evaluation, samples were examined without indication of their sampling zone and location (i.e. blinding). The data were coded to later reflect the zones of collection: control region, upstream to a farm, near farm and downstream, near to a farm and near new sites. The complete dataset is available for review upon request.

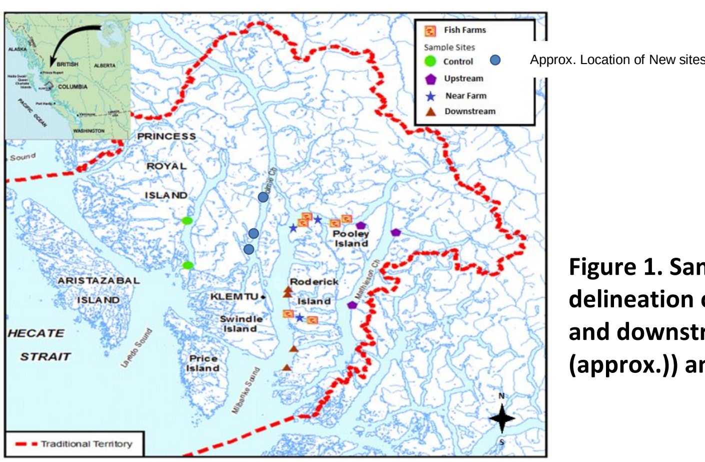

Figure 1. Sampling sites used in 2015, including delineation of zones (control, upstream, near farms and downstream and new site, Tolmie Channel (approx.)) and proximity to fish farms.

Table 1. Sampling period and sampling sites categorized by zone for 2009 to 2015.

Year	Sample Period	Control	Upstream	Near Farm	Downstream
2009	May 6 - June 30	Lower Laredo, Upper Laredo	Kynoch, Windy Bay	Goat Cove, Jackson Pass	Suzy Bay, Mary's Cove
2010	Apr 4 - June 25	Lower Laredo, Upper Laredo, Meyers Pass	Hird Point, Kynoch, Windy Bay	Goat Cove, Jackson Pass, Carter Bay	Suzy Bay, Arthur Island, Mary's Cove
2011	Apr 28 – July 6	Lower Laredo, Upper Laredo, Meyers Pass	Hird Point, Kynoch, Windy Bay	Goat Cove, Jackson Pass, Carter Bay	Suzy Bay, Arthur Island, Mary's Cove
2012	Apr 26 – June 27	Lower Laredo, Upper Laredo, Meyers Pass	Hird Point, Kynoch, Windy Bay	Goat Cove, Jackson Pass, Carter Bay	Suzy Bay, Arthur Island, Mary's Cove
2013	Apr 14 – June 24	Lower Laredo, Upper Laredo, Meyers Pass	Hird Point, Kynoch, Windy Bay	Goat Cove, Jackson Pass, Carter Bay	Suzy Bay, Arthur Island, Mary's Cove
2014	May 5 – June 27	Lower Laredo, Upper Laredo, Meyers Pass	Hird Point, Kynoch, Windy Bay	Goat Cove, Jackson Pass, Carter Bay	Suzy Bay, Arthur Island, Mary's Cove
2015	April 14 – June 15	Lower Laredo, Meyers Pass	Hird Point, Kynoch, Windy Bay	Goat Cove, Jackson Pass, Carter Bay	Suzy Bay, Mary's Cove
	* Sites near new proposed farms	Cougar Bay, Tolmie Ch2, Lower Tolmie, Upper Tolmie			

Table 1 provides a summary of sampling periods and sites for the 2009 to 2015 collections. In 2015 new sampling sites were added in Tolmie Channel.

Table 2. Summary of the number of salmon captured in the control zone (Laredo Inlet), upstream of salmon farms, near salmon farms and downstream of salmon farms and new sites (Tolmie Channel) that were analyzed for sea lice (2009-2015).

		2009		2010		2011		2012		2013		2014		2015	
		Pink	Chum	Pink	Chum	Pink	Chum	Pink	Chum	Pink	Chum	Pink	Chum	Pink	Chum
	Upper Laredo	92	56	75	24	25	74	88	21	16	109	79	19		
Control	Lower Laredo	198	13	109	16	79	61	151	0	118	31	125	2	107	0
	Meyers Pass			137	14	24	51	134	42	99	101	159	5	25	18
	Hird Pt.			59	40	24	170	88	88	101	98	59	3	61	15
Upstream	Kynoch Pass	115	127	147	30	74	129	115	85	143	58	115	60	62	59
	Windy Bay	51	82	83	88	20	187	114	86	13	138	8 6	89	48	77
	Goat Cove	151	32	140	36	118	84	158	42	84	66	147	53	102	23
Near Farms	Jackson Pass	110	31	152	49	155	12	177	24	152	48	78	48	108	16
	Carter Bay			118	60	42	133	99	76	43	144	94	105	56	42
Down stream	Suzy Bay	208	37	93	56	81	69	133	42	165	62	150	24	92	20
	Arthur Island			102	48	57	119	138	37	147	78	54	46		
	Mary's Cove	156	32	101	23	68	80	184	16	51	124	173	54	30	33
New Sites	Cougar Bay													41	9
	Lower Tolmie													4	21
	Willby Point													25	0
	Upper Tolmie													1	5
	Tolmie Ch2													43	7

The numbers of fish captured and analyzed for lice in 2009–2015 are summarized in Table 2. The total numbers of fish analyzed has decreased over the past few years but the number of areas sampled in 2015 increased.

Results and Discussion

Summary of the wild salmon collected

A total of 1,230 fish were collected and assessed for sea lice infestation in 2015. This number is lower than evaluated in prior years (average) however, more sites were sampled than previously. Comparatively, over 5,500 fish were captured and released in 2015; 7,000 fish in 2014; 9,779 in 2012, and 7,800 in 2013. In 2015, 69% (n=851) were identified as Pink Salmon, 30.0% were Chum Salmon (n=374), two fish were identified as a Chinook Salmon and three fish were identified as Coho Salmon. The Chinook and Coho did not have any lice on them. These proportions for percentage of lice infestation between Pink and Chum were very similar to 2014. As well, there were 50 fish collected that had no site or date information included with them. These results are included in overall calculations, but not in month- specific calculations.

In 2015, half of the fish examined were captured in May (52.8%),. For the previous two years, over 50% of the fish were sampled in May. For 2015 the proportion of fish caught in June was 4.1% of the total number caught.

Table 3 summarizes the weights and lengths of fish sampled in 2015. Data from 2012 - 2014 are included for comparison. Overall, the average weight and length of Pink Salmon were much larger than observed in any of the previous years. The Chum were larger in April and May than in 2014, and in June, the Pink and Chum were larger than in previous years at this time.

Table 3. Summary of the mean weight (g) and length (mm) of Pink and Chum Salmon captured 2012 - 2015. (Superscripts denote significant differences.)

Species	Month	N	2012	2013	2014	2015	2012	2013	2014	2015
		2012/13/14/15	Weight (g)				Length (mm)			
Pink	April	89/68/0/329	0.28^{A}	0.47^{B}		0.66	33.7	35.9		40.6
	May	953/614/778/456	0.58^{A}	0.91^{B}	0.80^{C}	1.31	38.9*	42.9*	41.7	48.5
	June	232/612/541/20	1.01^{A}	1.80^{B}	1.55^{C}	1.61	45.6^{A}	53.7^{B}	52.2^{B}	53
	April	108/57/0/119	0.49	0.61		0.73	38.8	38.9		41.6
Chum	May	628/275/395/196	0.72^{A}	0.89^{B}	0.90^{B}	1.39	41.1^{A}	42.9^{A}	43.7^{A}	49.6
	June	408/238/173/169/30	1.11^{A}	1.45^{B}	1.33^{C}	1.78	47.2^{A}	49.4^{A}	48.9^{A}	53.3

Summary of sea lice on salmon

In 2015, lice abundance in juvenile Pink and Chum Salmon was higher than any of the previous years (Tables 4-10) with the number of fish with no *L. salmonis* at fewer than 50%. No significant difference in *L. salmonis* or *C. clemensi* levels were observed between the salmon species; infestation by either louse could not be predicted based on species of salmon. Intensity is defined as the number of sea lice on a single salmon and is the quotient calculated of **total# of lice/ #fish with lice**. Overall, the intensity of infection on Pink Salmon was 4.0 lice/fish which did not differ between fish that weighed below or above 1g (4.0 lice/fish). For those Pink salmon with *C. clemensi* present, the infection level was the same for all fish above 1g in weight (1.4 and 1.2, respectively; no significant difference). For Chum Salmon, the infection intensity was higher than in Pink. Chum Salmon had 6.1 *L. salmonis* per fish in 2015, and 3.5 lice per fish for fish weighing below 1 gram.

		Pink (n=1081)		Chum (n=410)		Coho (n=2)	
		L. salmonis %	*C. clemensi %*	*L. salmonis %*	*C. clemensi %*	*L. salmonis %*	*C. clemensi %*
2009	no lice	94.6	98.6	94.9	98.0	50.0	100.0
	1 louse	4.3	1.2	4.4	2.0	50.0	0.0
	2 lice	0.8	0.0	0.5	0.0	0.0	0.0
	3 lice	0.3	0.1	0.0	0.0	0.0	0.0
	4 lice	0.0	0.1	0.2	0.0	0.0	0.0

Table 4. Summary of the percentage (%) of *L. salmonis* and *C. clemensi* recorded on Pink, Chum and Coho Salmon in 2009.

		Pink (n=1316)		Chum (n=484)		Coho (n=2)	
		L. salmonis %	*C. clemensi %*	*L. salmonis %*	*C. clemensi %*	*L. salmonis %*	*C. clemensi %*
2010	no lice	85.3	90.3	89.0	93.4	50.0	100.0
	1 louse	9.8	7.4	6.2	6.0	50.0	0.0
	2 lice	3.4	1.7	2.3	0.6	0.0	0.0
	3 lice	0.9	0.4	1.7	0.0	0.0	0.0
	4 lice	0.3	0.2	0.4	0.0	0.0	0.0
	5 lice	0.2	0.0	0.4	0.0	0.0	0.0
	6 lice	0.1	0.0	0.0	0.0	0.0	0.0

Table 5. Summary of the percentage (%) of *L. salmonis* and *C. clemensi* recorded on Pink, Chum and Coho Salmon in 2010

		Pink (n=788)		Chum (n=1241)	
		L. salmonis %	*C. clemensi %*	*L. salmonis %*	*C. clemensi %*
2011	no lice	96.4	93.1	93.4	89.0
	1 louse	3.3	5.3	5.7	6.4
	2 lice	0.4	1.3	0.7	2.7
	3 lice	0.0	0.0	0.7	1.0
	4 lice	0.0	0.0	0.0	0.4
	5 lice	0.0	0.0	0.7	0.3
	>6 lice	0.0	0.26	0.0	0.2

Table 6. Summary of the percentage (%) of *L. salmonis* and *C. clemensi* recorded on Pink, Chum and Coho Salmon in 2011

2012	Pink (n=1633)		Chum (n=570)	
	L. salmonis %	*C. clemensi* %	*L. salmonis* %	*C. clemensi* %
no lice	92.1	97.1	90.2	96.3
1 louse	6.6	2.7	8.8	3.0
2 lice	1.0	0.2	0.7	0.7
3 lice	0.2	0.0	0.0	0.0
4 lice	0.1	0.0	0.2	0.0
5 lice	0.1	0.0	0.2	0.0
>6 lice	0.0	0.0	0.0	0.0

Table 7. Summary of the percentage of *L. salmonis* and *C. clemensi* on salmon in 2012.

	Pink (n=1132)		Chum (n=1057)	
	L. salmonis %	*C. clemensi* %	*L. salmonis* %	*C. clemensi* %
no lice	86.8	89.4	75.0	91.3
1 louse	4.9	7.3	7.0	5.2
2 lice	4.0	1.3	3.4	1.5
3 lice	1.4	1.1	2.5	0.9
4 lice	1.4	0.3	2.0	0.5
5 lice	1.0	0.4	1.4	0.5
>6 lice	0.5	0.2	8.7	0.3

Table 8. Summary of the percentage of *L. salmonis* and *C. clemensi* on salmon in 2013.

2014	Pink (n=1132)		Chum (n=1057)	
	L. salmonis %	*C. clemensi* %	*L. salmonis* %	*C. clemensi* %
no lice	92.9	94.7	89.5	97.7
1 louse	6.3	4.7	8.9	1.5
2 lice	0.6	0.4	1.7	0.0
3 lice	0.1	0.2	0.0	0.0
4 lice	0.0	0.1	0.0	0.0
5 lice	0.0	0.0	0.0	0.2
>6 lice	0.0	0.0	0.0	0.0

Table 9. Summary of the percentage of *L. salmonis* and *C. clemensi* on salmon in 2014.

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		Pink (n=805)		Chum (n=345)	
		L. salmonis %	*C. clemensi* %	*L. salmonis* %	*C. clemensi* %
2015	no lice	40.6	86.2	35.1	87.0
	1 louse	17.9	9.8	15.9	5.5
	2 lice	10.9	2.9	8.7	2.0
	3 lice	4.3	0.6	30.7	0.9
	4 lice	7.0	0.2	5.8	0.3
	5 lice	3.9	0.1	4.1	0.0
	>6 lice	15.4	0.1	0.2	3.5

Table 10. Summary of the percentage of *L. salmonis* and *C. clemensi* on salmon in 2015

L. salmonis prevalence on juvenile salmon by sampling zone

Prevalence is defined as the proportion of fish infected with lice. Figures 2 and 3 show the prevalence *of L. salmonis* by sampling zone for periods from 2009 to 2015 for Pink and Chum Salmon, respectively. The common trend of increased *L. salmonis* levels as the sampling season progressed was observed in 2015 as in other years for both Pink and Chum Salmon. Also as seen in the previous years, there was no trend of elevated lice levels in any one zone irrespective of their location.

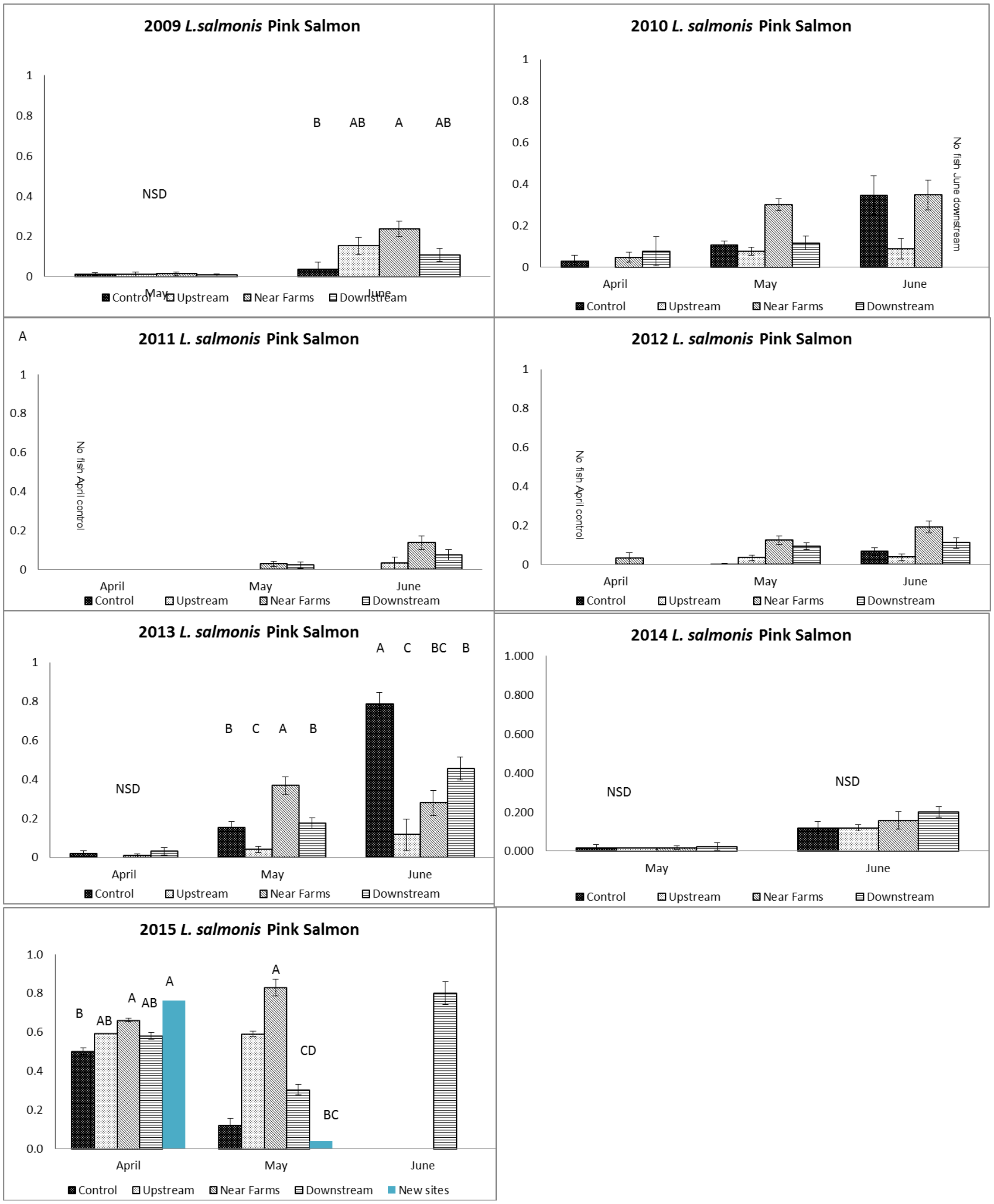
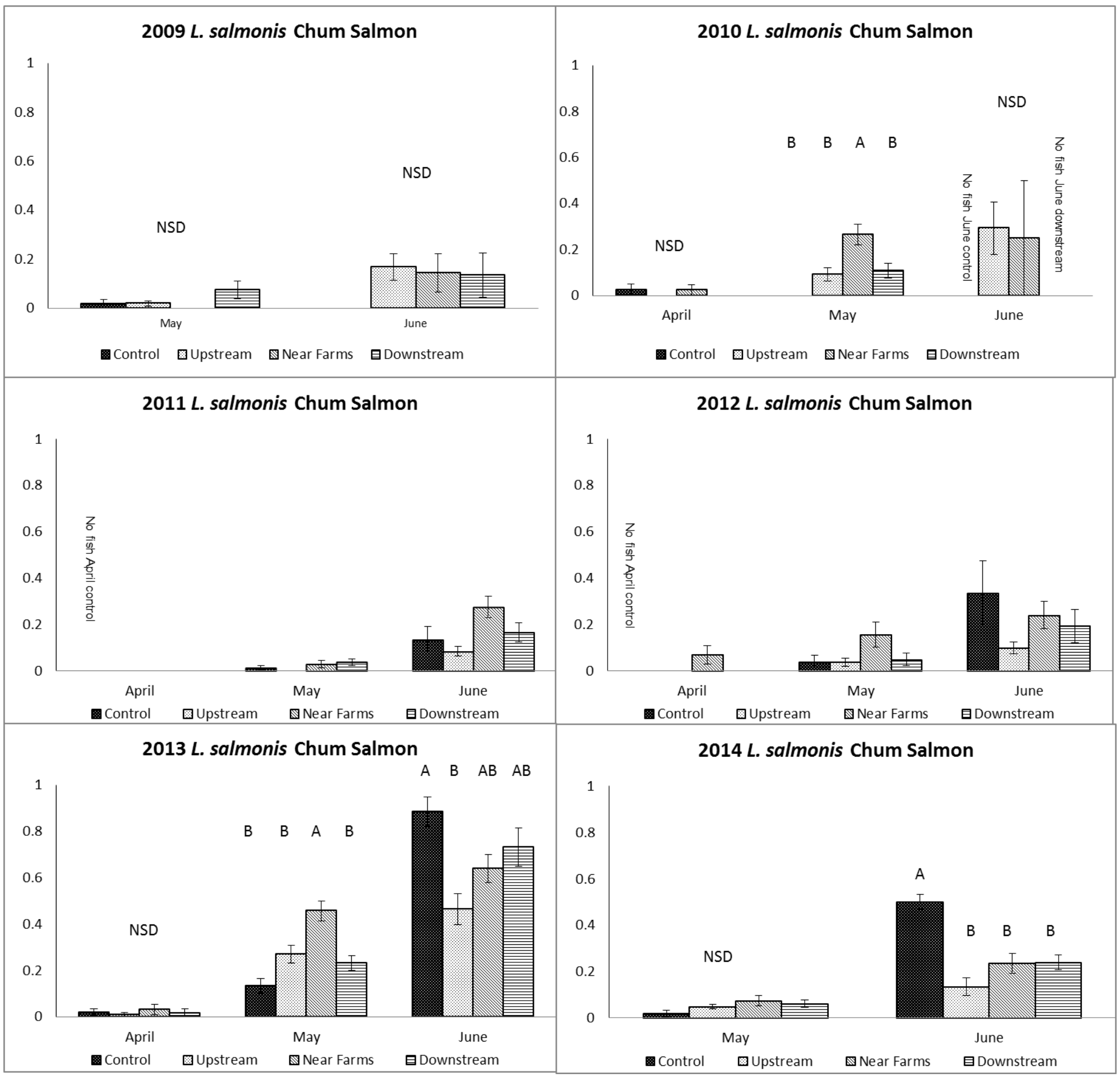


Figure 2. Prevalence (mean with SE) of *L. salmonis* on Pink Salmon sampled from control, upstream, near farm and downstream and new sites zones. The significant differences (ANOVA p<0.05) are shown by letters, NSD=no significant differences. No fish suggests either no fish captured or not sampled.

Figure 2 shows the prevalence of *L. salmonis* on Pink Salmon caught in all zones. In previous years there has been a trend of increasing lice in May and June overall. In 2015 the lice levels are higher than previously seen in April but did not decrease in all zones in May. Instead, the prevalence decreased in the both the control sites and the new sites (Zone 4) but remained elevated in the upstream and downstream sites with the near farm sites remaining the highest.



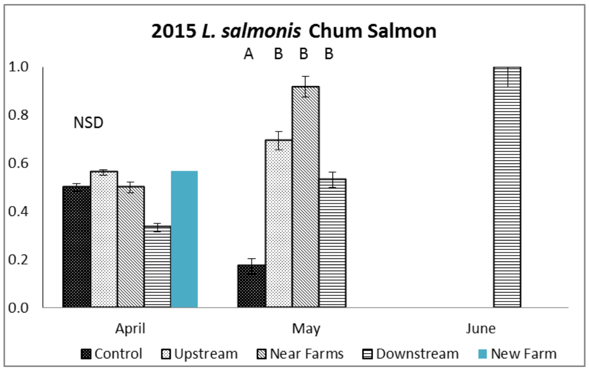


Figure 3. Prevalence (mean with SE) of *L. salmonis,* on Chum Salmon sampled from control, upstream, near farm and downstream zones and new sites. Significant differences (ANOVA p<0.05)are shown by letters, NSD=no significant differences. No fish suggests either no fish captured or not sampled.

Figure 3 shows the prevalence *of L. salmonis* on Chum salmon sampled from the four zones including the new sites. There is no significant difference in prevalence between zones in April although the prevalence is higher in 2015 than previous years . Prevalence increased in the upstream, downstream and near farms in May but decrease significantly in the control area in comparison to April's prevalence. The downstream zone was the only area to be sampled in June and the prevalence remained high through this sampling period.

C. clemensi prevalence on juvenile salmon by sampling zone

Figures 4 and 5 show *C. clemensi* prevalence on Pink and Chum Salmon by sampling zone and month for 2009 to 2015. As in years previous to 2014, *C. clemensi* prevalence is lower than *L. salmonis* prevalence. However, these levels were still higher than observed in years prior to 2014. The highest lice load level in April was in the control zone for both Pink and Chum and decreased through May and June as it has been seen in previous years; The load levels remained low. There was no significant difference in prevalence between zones in May. Downstream sites were only sampled in June.

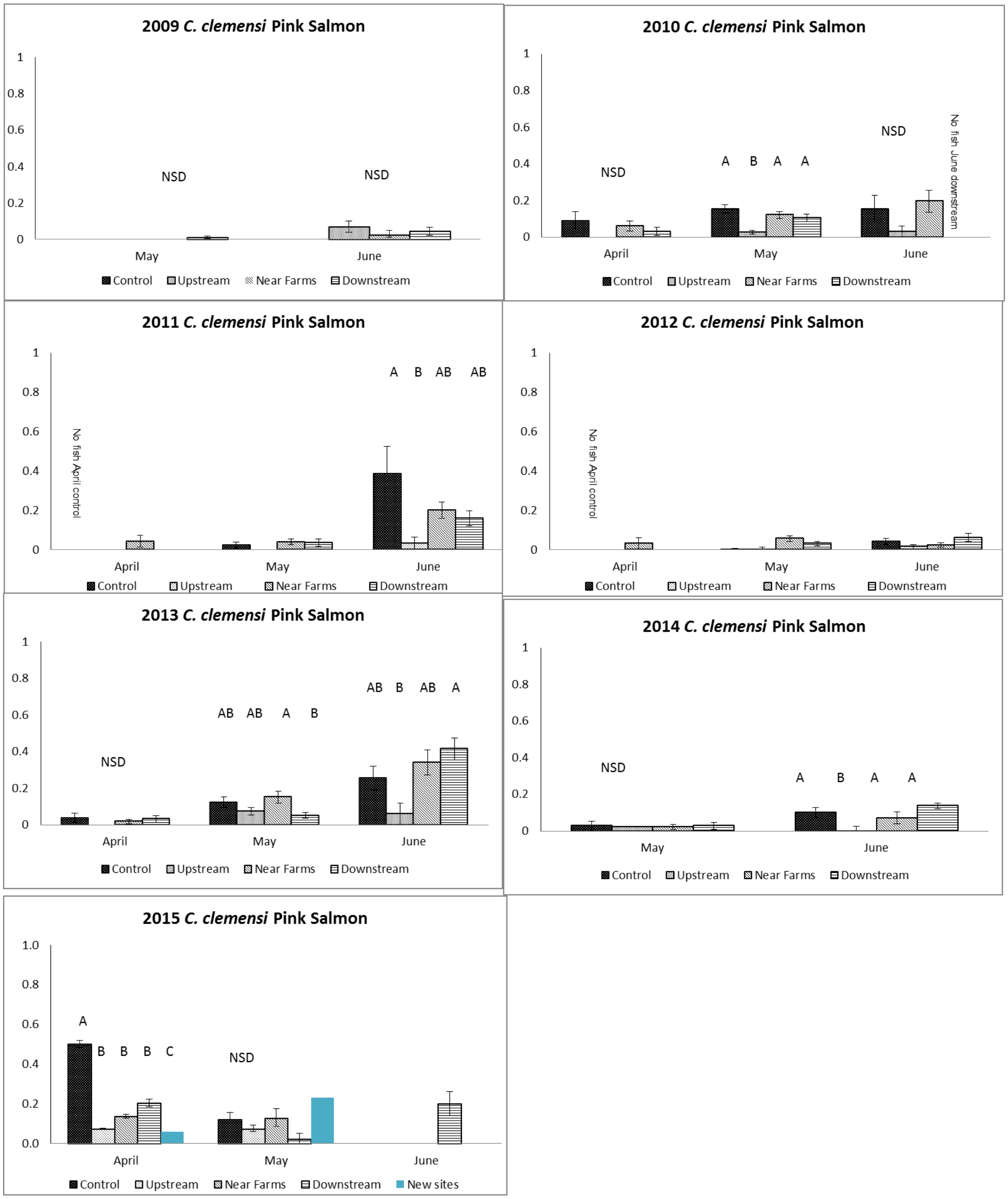


Figure 4. Prevalence (mean with SE) of *C. clemensi* on Pink Salmon sampled from control, upstream, near farm and downstream, and new sites zones. Significant differences (ANOVA p<0.05)are shown by letters, NSD=no significant differences. No fish suggests either no fish captured or not sampled.

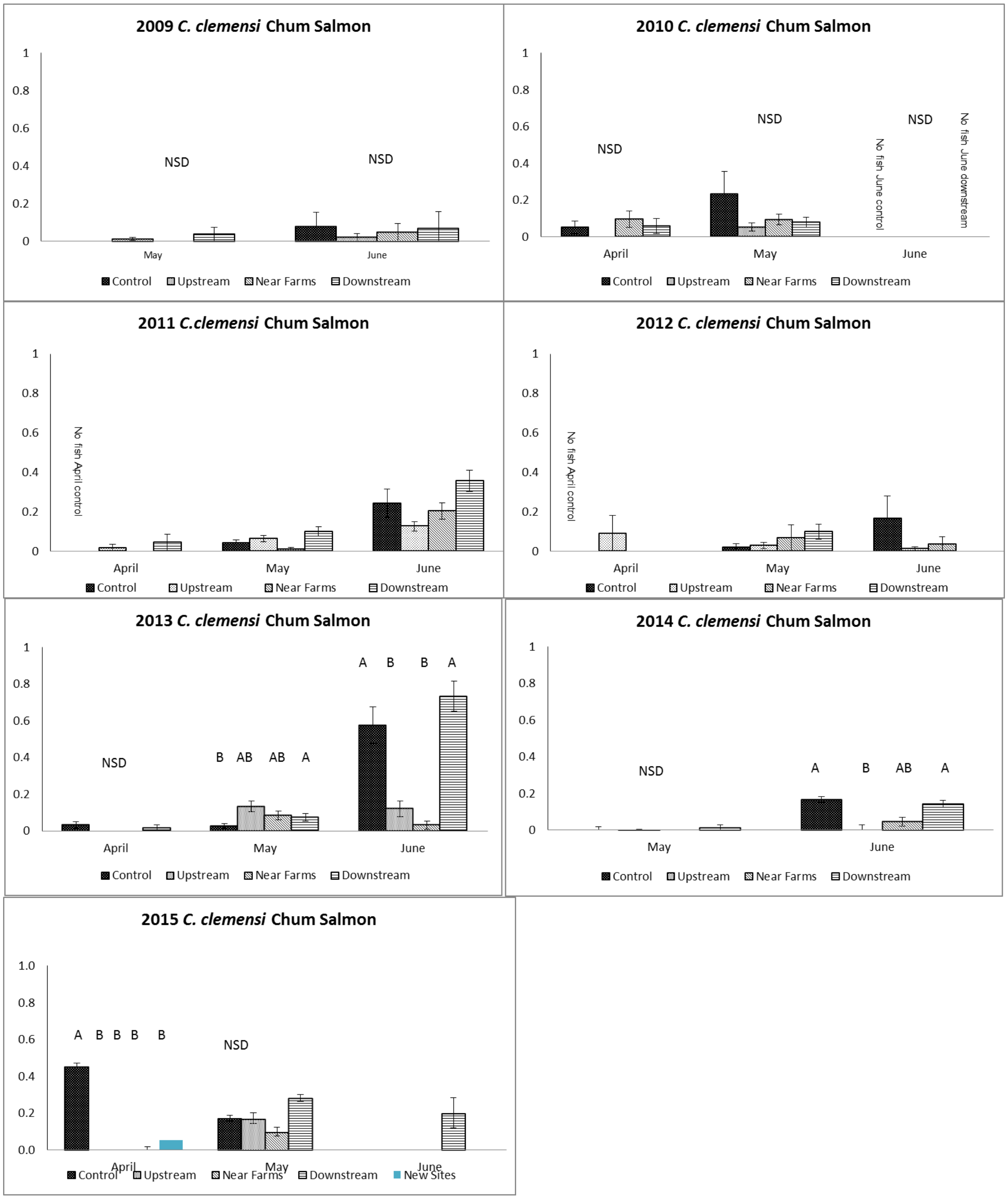


Figure 5. Prevalence (mean with SE) of *C. clemensi* on Chum Salmon sampled from control, upstream, near farm and downstream and new site zones. Significant differences (ANOVA p<0.05)are shown by letters, NSD=no significant differences. No fish suggests either no fish captured or not sampled

Summary of the Environmental Data

Salinity and water temperature were measured during each seining event starting in 2009. The data collected over the seven year period are summarized by month in Table 9. Most notable is that the ranges of temperature and salinity in 2015 were higher than in previous years. Table 11 summarizes the temperature and salinity in each zone during 2015. The environmental data for April were only provided for the Upstream and Downstream zones and the temperatures here were similar to other areas, but the salinity in the Upstream site was much lower than the Downstream zone. In May, the temperatures and salinity were similar between all zones. In June, the Upstream zone had higher average temperature and lower salinity than the other zones.

Table 11. Summary of the mean and 95% confidence interval of temperature and salinity from sites sampled in 2009 - 2015 by month.

		April		May		June	
		Temp. (°C)	Salinity (ppm)	Temp. (°C)	Salinity (ppm)	Temp. (°C)	Salinity (ppm)
2009	Mean	N/A	N/A	9.5	26.8	11.7	27.1
	95% CI			[9.1 - 9.9]	[25.2 - 26.8]	[11.1 - 12.3]	[25.3 - 28.8]
2010	Mean	8.7	28.6	10.3	28.3	13	26.4
	95% CI	[8.1 - 9.3]	[27.6 - 29.5]	[10.0 - 10.6]	[27.6 - 28.9]	[11.6 - 14.4]	[22.8 - 29.9]
2011	Mean	8.3	28.5	10.3	26.3	12.1	26.5
	95% CI	[8.0 - 8.7]	[27.0 – 29.4]	[9.9 – 10.8]	[24.6 – 28.0]	[10.8 – 13.5]	[23.9 – 29.1]
2012	Mean	8.8	20.2	10.7	25.4	12.1	23.1
	95% CI	[7.8 – 9.7]	[14.1 – 26.3]	[10.3 – 11.1]	[23.6 – 27.2]	[11.3 – 13.0]	[20.6 – 25.6]
2013	Mean	8.8	26	10.8	24.7	12.1	24.8
	95% CI	[8.8-8.9]	[25.9 – 26.3]	[10.7 – 10.9]	[24.4 - 24.9]	[12.0 – 12.2]	[24.4 -25.0]
2014	Mean			10.5	25.1	11.8	26.6
	95% CI			(9.2 – 11.7)	(24.9 – 25.3)	(11.7 – 11.9)	(26.5 – 26.8)
2015	Mean	9.3	27.2	11.4	26	11.4	26.9
	95% CI	[8.8-10.0]	[22.1-28.8]	[8.6-14.9]	[20.5-29.0]	[9.8-13.0]	[24.6-29.1]

Table 12. Summary of the mean temperature and salinity (3.0m) from zones by sample month in 2015

	April		May		June	
	Temp. (°C)	Salinity (ppm)	Temp. (°C)	Salinity (ppm)	Temp. (°C)	Salinity (ppm)
Control			9.7	28.5	11.5	28
Upstream	9.8	23.6	11.1	28.7	13	24.6
At Farms			9.2	27.2	10.8	26
Downstream	9.1	28.1	9.8	28.3	9.8	29.1
New Sites	9.1	28.6			12.2	28.4

Summary of lice data from 2005-2015

Figure 6 summarizes lice prevalence on Pink Salmon for years 2005 to 2015 by sampling zone and Figure 7 shows annual prevalence of sea lice on Chum Salmon for the years 2009-2015 by sampling zone. *L. salmonis* prevalence in 2015 was higher than any of the previous years on both species of salmon. Pink Salmon escapement often follows a two year cycle, and in the Kitasoo/Xaixais traditional territory, Pink Salmon that return in odd numbered years (e.g. 2007, 2009) are the dominant runs. Research done in the Broughton Archipelago showed a high correlation between the number of wild adult Pink Salmon returning to the area the previous autumn and lice prevalence the following spring (Marty et al. 2010). In general, our data reveal a pattern of higher levels of lice during the spring following an odd year return (see Reports: 2006, 2010, 2012) although not in 2008 nor 2014 where *L. salmonis* prevalence levels were lower during these years. The 2015 data on lice counts appear to vary from all previous years where data has been collected. The environmental conditions (e.g.: salinity) in 2015 were different than previous years due to lower rainfall, and warmer temperatures both in the water and in the atmosphere. The oceanographic anomaly of static warm water known as the ‘Blob’ has contributed to observed warmer water temperatures in the North Pacific that persisted all winter. With the warmer water temperatures, lower freshwater input and fewer high wind events, conditions appeared optimal for sea lice to hatch and thrive. This likely had the greatest impact on the elevated lice numbers seen in all the zones this year.

The *C. clemensi* prevalence observed on salmon in 2015 trended, but was not significantly higher than past years. Overall, the 2015 data appears to add to the considerable variation in the annual prevalence of both sea lice species that would appear to be unpredictable by current analysis owing in part to changing environmental conditions.

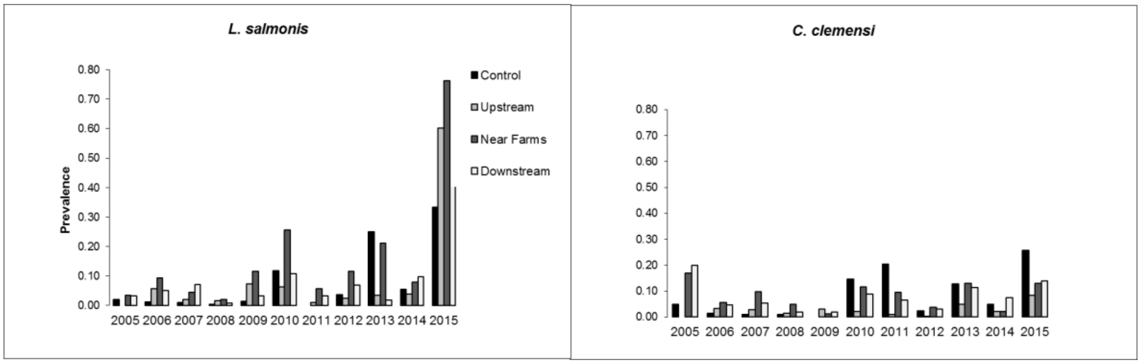


Figure 6. Prevalence of *L. salmonis* and *C. clemensi* on Pink Salmon sampled from control, upstream, near farm and downstream zones between 2005 and 2014. In 2005, no upstream sites were sampled.

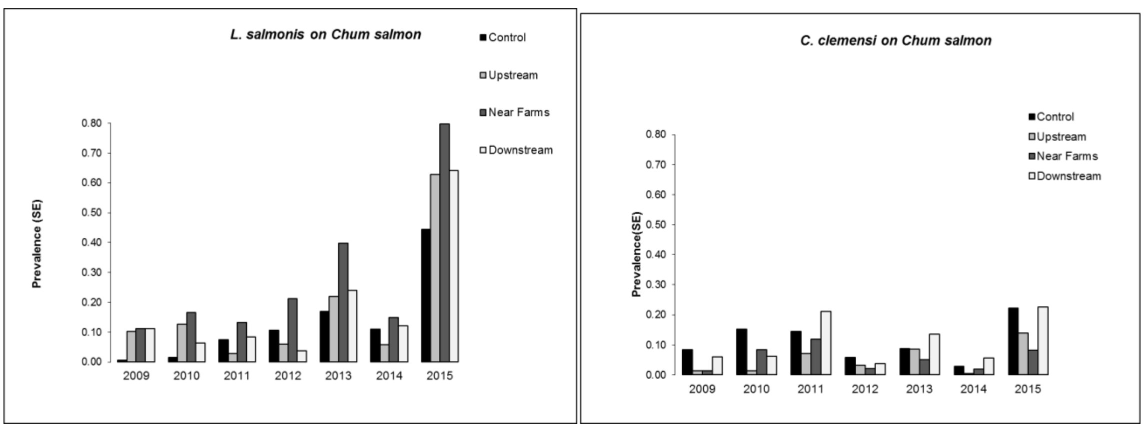


Figure 7. Prevalence of *L. salmonis* and *C. clemensi* on Chum Salmon sampled from control, upstream, near farm and downstream zones between 2009 and 2014.

Summary of Data collected in 2015

Several trends in the 2015 data appear different than those observed in previous years. These include:

- Both Pinks and Chum Salmon were larger and heavier;
- The majority of salmon examined had at least one louse with a high percentage of fish having more than 6 per fish;
- Both *L. salmonis* and *C. clemensi* were on Pinks and Chum.
- Levels of *L. salmonis* levels found on Pink and Chum Salmon were similar.
- *L. salmonis* detection did not increase over the sampling season;

- Environmental conditions differed compared to previous years; water temperatures and salinity was higher than observed in previous years.
- The unusual environmental conditions likely played a role in the elevated levels of *L. salmonis* observed throughout the sampling region.

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Further Reading

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