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**Sea lice counts on Adult Pacific salmon caught in the Central Coast of
British Columbia using trawl and troll gear.**

by

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Abstract

In August 2003 we collected adult Pacific salmon from the central coast of British Columbia using a rope trawl fished from the surface down to 15m. In August 2004 we collected adult Pacific salmon from the same area using troll gear. All sea lice on the salmon collected in both of these surveys were counted using 10x magnification when necessary. There were 377 fish sampled in 2003 of which 96.0% had sea lice. The average number of sea lice on infected fish was 11.3. In 2004, a total of 682 salmon were sampled of which 99.6% were infected. The average number of sea lice was 31.7. The larger number of sea lice observed in 2004 most likely was related to the method of capture. It was apparent that sea lice are a common parasite on adult Pacific salmon. A direct comparison of sea lice counts on Pacific salmon caught in trawls and with troll gear was not possible, however, it does appear that trawl-caught salmon are a good indicator of the percentage of adult fish that have sea lice as well as the stages of sea lice.

Introduction

Aquaculture and salmon farming are important and developing industries in British Columbia. There are 126 salmon farms licensed in British Columbia and 86 farms in 2004 were growing salmon. In recent years the total production of farmed salmon in British Columbia has been about 70-80,000 t (Figure 1). This production of farmed salmon increased steadily since 1985 as the catch of wild salmon declined (Figure 2). The decline of wild salmon catches resulted from a natural decline in marine survival, management actions to protect stocks as a result of this decline, and low prices for species such as pink and chum salmon. Each salmon farm either directly or indirectly employs about 50 full time people. About 500,000 salmon are cultured over a two year period with most being Atlantic salmon (*Salmo salar*). The average weight of a fish at harvest is about 5kg and the product value may be 10-12,000,000 Canadian dollars for each farm. The current annual value of the farmed salmon exceeds the landed value of all wild fish fisheries combined.

One benefit of salmon farming is the jobs that are created in coastal communities. However, there is concern about salmon farming harming wild Pacific salmon. One concern is that sea lice produced on farmed salmon will infect wild salmon and increase their natural mortality (Morton et al. 2004). It is well known that sea lice are a common parasite of wild Pacific salmon, but the occurrence of sea lice on all species of adult Pacific salmon returning to a large

coastal ecosystem remains to be documented. Understanding the impact of sea lice produced on salmon farms requires an understanding of the natural production of sea lice. This report provides an assessment of natural sea lice production on adult Pacific salmon.

Methods

The study was conducted in the central coast area of British Columbia (Figure 3). The survey areas were in Queen Charlotte Strait and associated areas and in Rivers and Smith Inlets (Figure 3). Adult Pacific salmon were captured in August 2003 using a rope trawl (Beamish and Folkes 1998, Beamish et al. 2000) fished from a chartered trawler, the F.V. Frosti. Large floats were attached to the head rope to ensure that the net fished on the surface. The opening of the net was approximately 15 m deep and about 32 m wide. The net was towed at a speed of approximately 5 km and sets lasted 30 minutes. An 8 m liner with 1.3 cm square mesh was inserted from the cod end through to the extension piece. Transects were selected to sample as much of the area as possible in the time available. Sets were chosen along each transect so that the fishing operation lasted about 12 to 14 hours during daylight. Subadult as well as adult chinook salmon (*Oncorhynchus tshawytscha*) were sampled. All other salmon reported in this paper were adults.

A troller (F.V. Windrift II) was used in August 2004 to collect a sample of adult Pacific salmon. The hook and line gear fished during the day included flashers (rectangular metal plates used to attract Pacific salmon) and a variety of hook sizes, lure colours and types. Gear was fished at a variety of depths from the surface to bottom (about 80-120m).

All adult salmon from the trawl catches were emptied from the net into tubs and subsequently each fish was identified. In most cases the total sample was measured for fork length, and examined for sea lice using dissecting microscopes when necessary. If catches of adults were large, the end of the net was opened on deck and a stratified subsample was placed into tubs. Salmon captured using troll gear were taken off the hook without handling and placed directly into a tub. Each fish was subsequently measured and examined for sea lice. The tub was also examined for sea lice and any sea lice were added to the number observed on the fish. All sea lice were removed and preserved for identification in the laboratory. This report does not include the identification of species and stages of development. Sea lice reported in this paper were categorized according to chalimus and mobile stages which combined subadult and adult stages.

Results

We caught 1356 adult Pacific salmon in the central coast area of British Columbia, between July 30 and August 8, 2003 using the trawl net. All species

were mature and in pre-spawning condition except chinook salmon. Chinook salmon ranged from ocean age 1+ through to adults. A total of 616 adult Pacific salmon were measured (Table 1). We were able to sample 377 of these for sea lice (Table 2). The average prevalence (percentage of fish with sea lice) for all species was 96.0% and the average intensity (number of sea lice on infected fish) was 11.3 (Table 2). Sockeye (*O. nerka*), pink (*O. gorbuscha*), and coho (*O. kisutch*) salmon had the highest prevalence (100%, 98.6%, and 98.1% respectively) and sockeye salmon had the highest intensity of 20.3 (Table 2). Chinook salmon had the lowest prevalence and intensity. We observed a total of 4091 sea lice, 2742 (67%) of which were mobile and 1349 (33%) that were in the chalimus stage.

There were 682 Pacific salmon captured in the troll sample between August 4 and August 19, 2004 (Table 3). There were 434 Pacific salmon sampled in Queen Charlotte Strait and 248 sampled in Smith and Rivers inlets (Figure 1). All fish sampled were adult except for chinook which represented ocean ages 1+ and older. Not all troll caught fish were brought on board the troller. If there were more of one species than were needed, this species would be shaken off the hook and returned alive to the ocean.

The counts of sea lice were combined for the samples from the two sampling areas (Table 4). Virtually all Pacific salmon had sea lice and the prevalence was virtually 100% for all species. The average number of sea lice (intensity) was

largest for pink salmon (51.9) and lowest for coho and chinook salmon (18.7 and 17.4 respectively). Chum (*O. keta*) and sockeye salmon had approximately the same numbers of sea lice of 42.4 and 44.1 respectively. There were some fish that had exceptional numbers of sea lice such as 302 for chum salmon and 427 on a sockeye salmon from Rivers Inlet. There were slightly more mobile stages (average 53.9%) compared to the attached chalimus juvenile stage (average 46.1%).

Discussion

Both studies clearly showed that sea lice are a common parasite of adult Pacific salmon returning to coastal marine areas prior to spawning. Both studies also showed that mobile and chalimus stages were common. This means that recent infections were occurring resulting in the presence of the juvenile chalimus stages. The maturing and mature stages were more common, indicating that sea lice on these returning adult Pacific salmon would produce young sea lice that would infect juvenile pink, chum, and sockeye salmon that were commonly found during the surveys. These infected ocean age 0 Pacific salmon would carry the parasite into the open ocean later in the year. It is not possible to compare the prevalence and intensity of sea lice between years because different sampling gear were used. However, it is possible to make some general observations that will facilitate the interpretation of sea lice levels on Pacific salmon caught in

trawls. There is no doubt that trawl caught fish will have some sea lice abraded off as the fish are landed and sorted.

We propose that the lower intensities of sea lice on the trawl caught fish compared to troll caught fish are primarily a result of the method of capture. We recognize that the comparison must be done at the same time, but this was not possible due to a lack of funds. We propose that our results do indicate that data from salmon captured in trawls can be used to approximate the prevalence of sea lice throughout the distribution of Pacific salmon and to show that all sea lice stages are present. This is important because the most common method of catching Pacific salmon in research surveys is with trawls. Reporting on sea lice on trawl caught Pacific salmon will help understand the natural distribution of sea lice as well as provide insights into the life history strategy of sea lice.

References

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- Beamish, R. J., D. McCaughran, J.R. King, R.M. Sweeting and G.A. MaFarlane. 2000. Estimating the abundance of juvenile coho salmon in the Strait of Georgia using surface trawls. N. Am. J. Fish. Mgmt. 20:369-375.
- Morton A., R. Routledge, C. Peet, A. Ladwig . 2004. Sea lice (*Lepeophtheirus salmonis*) infection rates on juvenile pink (*Oncorhynchus gorbuscha*) and chum (*Oncorhynchus keta*) salmon in the nearshore marine environment of British Columbia, Canada. Can. J. Fish. Aqua. Sci. 61:147-157.

Table 1. Average fork length (mm) and standard deviation (SD) of adult and Pacific salmon caught in trawl gear in August 2003.

		Pink salmon	Chum salmon	Sockeye salmon	Coho salmon	Chinook salmon	Total salmon
Queen Charlotte Strait	N	215	45	21	38	28	347
	Length	505	730	588	560	429	
	SD	34.7	52.5	48.7	63.0	54.0	
Smith and Rivers Inlets	N	139	63	41	19	7	269
	Length	525	727	599	605	365	
	SD	37.0	38.5	71.3	88.4	40.0	
Total	N	354	108	62	57	35	616
	Length	513	729	595	575	417	
	SD	36.7	44.7	64.3	74.8	57.3	

Table 2. Prevalence and intensity of sea lice on adult and subadult Pacific salmon caught in trawl gear in August 2003.

Species	Number examined	Total sea lice	Prevalence	Intensity	Range	Mobile	%	Chalimus	%
Pink salmon	214	2249	98.6%	10.6	1-51	1724	76.7%	525	23.3%
Chum salmon	30	237	83.3%	9.5	1-26	128	54.0%	109	46.0%
Sockeye salmon	60	1223	100%	20.3	1-63	550	45.0%	673	55.0%
Coho salmon	52	323	98.1%	6.3	1-24	284	87.9%	39	12.1%
Chinook salmon	21	59	71.4%	3.9	1-18	56	94.9%	3	5.1%
Total	377	4091	96.0%	11.3	1-63	2742	67.0%	1349	33.0%

Table 3. Average fork length (mm) and standard deviation (SD) of adult Pacific salmon sampled using troll gear in August 2004.

		Pink salmon	Chum salmon	Sockeye salmon	Coho salmon	Chinook salmon	Total salmon
Queen Charlotte Strait	N	102	4	122	122	84	434
	Length	485	721	590	638	503	
	SD	29.2	24.6	40.5	64.0	155.1	
Smith and Rivers Inlets	N	30	57	5	100	56	248
	Length	500	709	600	636	504	
	SD	32.0	47.9	72.0	71.8	170.9	
Total	N	132	60	127	222	140	682
	Length	488	710	590	637	503	
	SD	30.4	46.7	41.0	67.2	161.1	

Table 4. Prevalence and intensity of sea lice on adult and subadult Pacific salmon caught using troll gear in August 2004.

Species	Number examined	Total sea lice	Prevalence	Intensity	Range	Mobile	%	Chalimus	%
Pink salmon	132	6853	100%	51.9	2-203	3108	45.4%	3745	54.6%
Chum salmon	61	2585	100%	42.4	2-302	1175	45.5%	1410	54.5%
Sockeye salmon	127	5599	100%	44.1	9-427	2608	46.6%	2991	53.4%
Coho salmon	222	4158	99.5%	18.7	0-106	2826	68.0%	1332	32.0%
Chinook salmon	140	2434	98.6%	17.4	1-18	1937	79.6%	497	20.4%
Total	682	21629	99.6%	31.7	0-427	11654	53.9%	9975	46.1%

List of figures.

Figure 1. Production (t) of farmed salmon in British Columbia from 1985 to 2004.

Figure 2. Total Canadian landings (t) of Pacific salmon from 1920 to 2004 (thin line) and farmed salmon production (t) in British Columbia from 1985 to 2004 (thick line).

Figure 3. Location of the study area off the Central Coast of British Columbia. The trawl survey in 2003 and troll survey in 2004 were conducted in Queen Charlotte Strait and associated areas and in Rivers and Smith inlets.

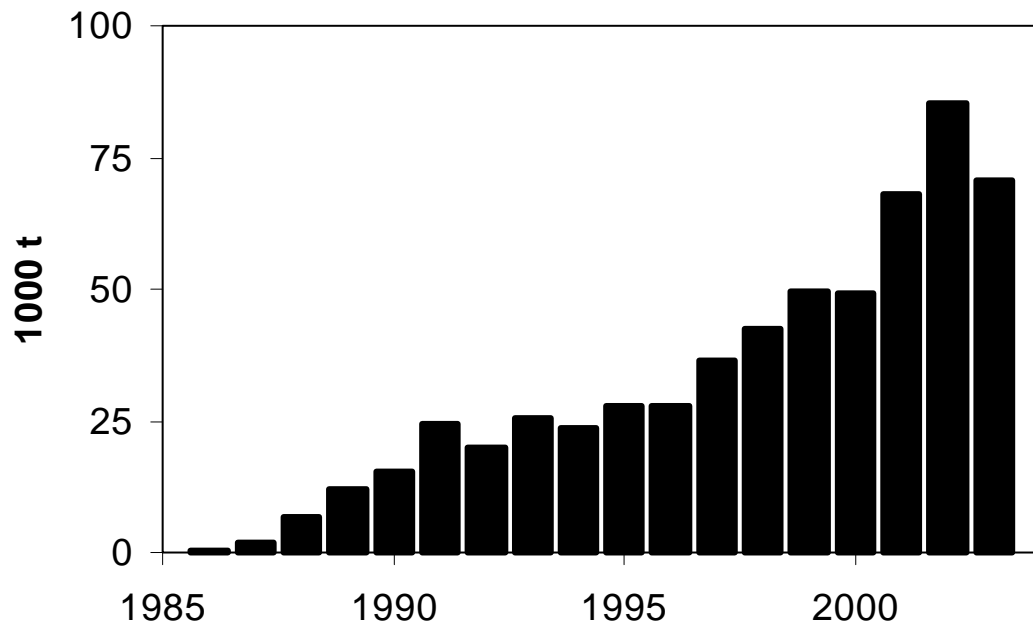


Figure 1.

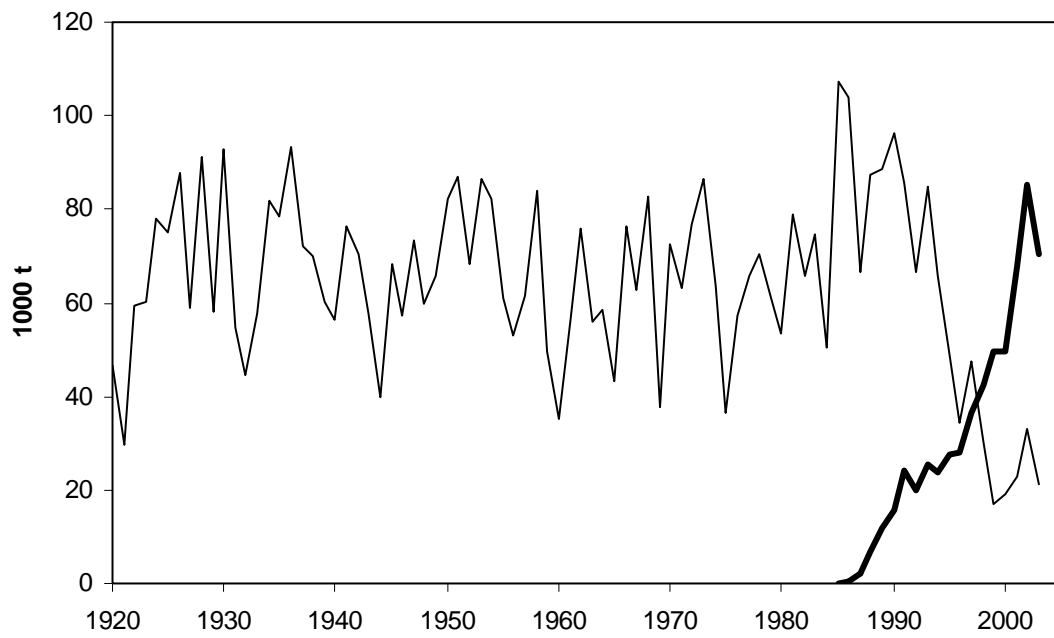


Figure 2.

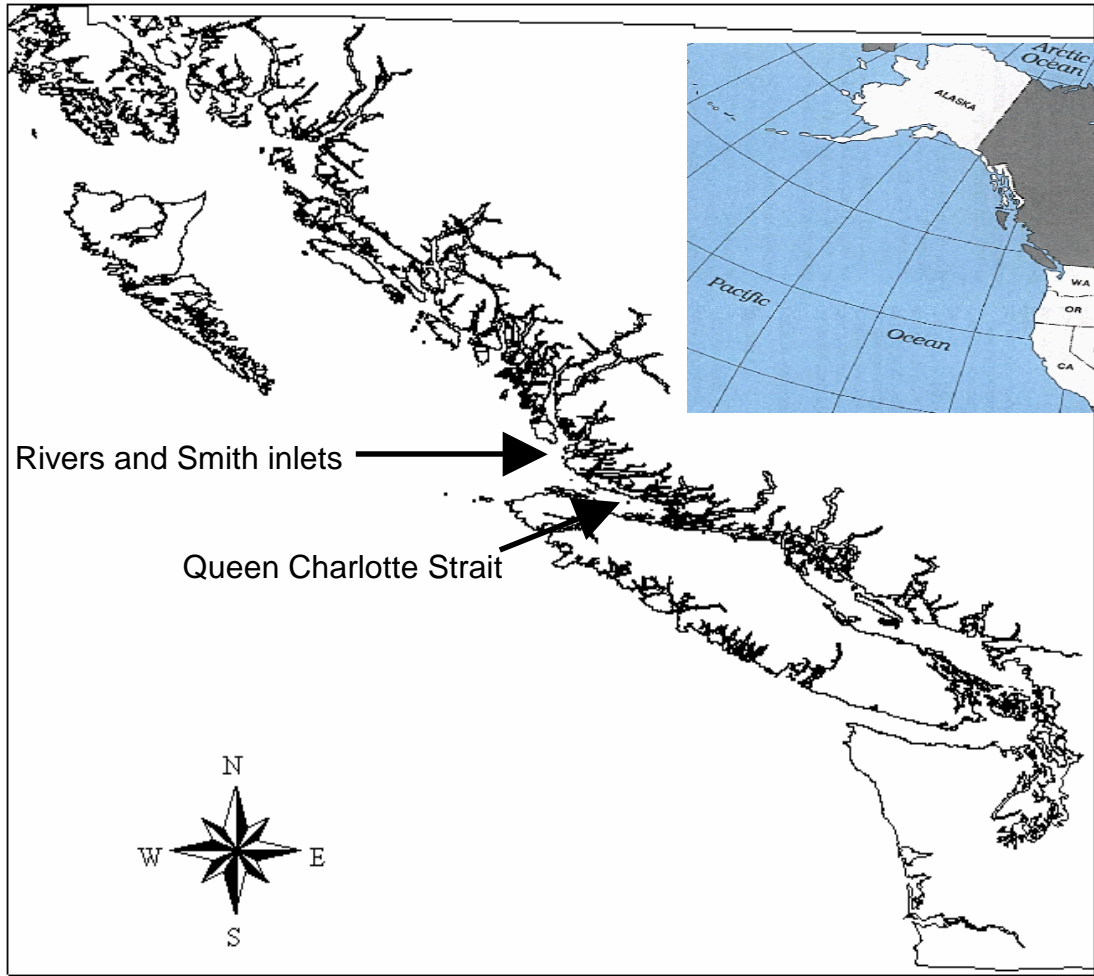


Figure 3.