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**A comparison of sea lice on individually caught adult Pacific salmon in the coastal waters of British Columbia in August of 2004 and 2005.**

by

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## Abstract

Adult Pacific salmon were individually captured in Queen Charlotte Strait using troll gear to provide accurate estimates of the species and stages of sea lice on each fish.

Samples were collected in the same area and at the same time as a similar study in 2004. The prevalence of sea lice in both years indicated that virtually all adult Pacific salmon have sea lice. In 2005, the intensity and abundance of sea lice was lower than in 2004 as there were smaller numbers of non mobile (chalimus) stages and fewer *Caligus clemensi*. However, the abundance of mobile *Lepeophtheirus salmonis* on all samples was larger in 2005 than in 2004. The percentages of the mobile female stages that were gravid were similar in both years.

## Introduction

In 2004 we determined the species and stages of sea lice that were on adult Pacific salmon that were in the coastal waters of British Columbia as part of their migration back to their spawning areas (Beamish et al. 2005). We showed in Beamish et al. (2004) that adult Pacific salmon captured in trawls retained sea lice. However, estimates of sea lice abundance for all stages were more reliable when fish were captured individually and landed in a container that retained any lice that were displaced from the skin of the fish. The sea lice counts made from troll caught fish in August 2004 (Beamish et al. 2004, 2005) represented the first study that accurately reported all species and stages of sea lice from samples of the variety of species of Pacific salmon species that were resident in a coastal marine ecosystem. We repeated the study in 2005 to estimate the interannual variability in sea lice species, stages and abundances. In this report we compare the species and stages of sea lice from the 2004 and 2005 studies.

## Methods

The methods used in 2005 were identical to those used in 2004 and reported in Beamish et al. (2005). The troller (F.V. Sans Peur) fished hook and line gear during day light hours in Queen Charlotte Strait. Salmon were landed directly into individual tubs and the species and stages of sea lice were determined from the surface of the fish and any that remained in the tub. An attempt was made to sample 100 fish of each of five

species of Pacific salmon. The sample of chinook salmon ranged in size from 303 – 960 mm and included subadults (Fig. 1). The same person inspected the fish for sea lice in 2005 as in 2004. An attempt was made to remove all sea lice from each fish and preserve them for identification in the laboratory by an expert in the taxonomy of sea lice. On occasion some sea lice were damaged or not recovered. In such cases it was necessary to rationalize the laboratory and field counts. This was achieved by assuming that field counts were accurate and all non mobile counts were accurate. A percentage adjustment was then made for the mobile stages determined in the laboratory. The terms prevalence, (the percentage of fish with sea lice); intensity, (the average number of sea lice on infected fish); and abundance, (the average number of sea lice on all fish sampled) were used according to Margolis et al. (1982).

## Results

The areas sampled in 2005 are shown in Figure 2. There were 342 fish sampled. Only one chum salmon was captured as the spawning migration in this study area occurs later in the year.

The prevalence of sea lice was virtually 100% (Table 1A). There were only four coho out of 100 and two chinook out of 100 that did not have any sea lice. Most sea lice were mobile stages of *Lepeophtheirus salmonis* (75% of total and 98% of mobile stages, Table 1A). Mobile stages of *Caligus clemensi* were only 2% of all mobile stages (Table 1A). Approximately 82% of all *L. salmonis* were mobile (Table 1A). Excluding the single

chum salmon, the percentages of adult *L. salmonis* ranged from 57% for sockeye salmon to 76% for coho salmon (Table 1B). There were slightly more adult female *L. salmonis* than adult male stages, and 63% of all adult female lice were gravid (Table 1B). The sex ratio of mobile male and female *C. clemensi* was virtually equal. Slightly less than one half of the adult female *C. clemensi* were gravid (Table 1B). Chalimus stages represented 24% of all sea lice. Chalimus stages of *L. salmonis* dominated except for coho salmon where *C. clemensi* were the dominant species (Table 1A). When *C. clemensi* was present, most were in the chalimus (non mobile) stage (Table 1A,B).

The prevalence of sea lice on adult Pacific salmon was similar in 2004 and 2005 (Tables 2A, 1A). The intensities were lower in 2005, particularly for pink salmon which was about one half of that observed in 2004. Intensity for sockeye salmon and chinook salmon were similar in 2005 but slightly lower than 2004. In 2004, about one half of all sea lice were in the chalimus stage (Table 2A), whereas in 2005 only about one quarter of all sea lice were in the chalimus non mobile stage (Table 1A). In 2004, *C. clemensi* was the dominant chalimus stage compared to 2005 when *L. salmonis* was the dominant stage (Tables 2B, 1B).

## Discussion

The number of fish sampled in 2005 was smaller than 2004 and all salmon were captured in Queen Charlotte Strait. Only one chum salmon was sampled in 2005, but

sample sizes for three other species were comparable. The sockeye sample in 2005 was smaller than in 2004, but still was adequate.

The prevalence of sea lice in both years was virtually identical confirming that almost all adult Pacific salmon have sea lice in this coastal ecosystem. It is probable that a similar prevalence would be found in other coastal areas of British Columbia. The intensity and abundance of sea lice was lower in 2005 than in 2004, particularly for pink salmon. In 2005, sockeye salmon had the largest abundance of sea lice of all Pacific salmon species compared to 2004 when pink salmon had the largest abundances. The reduced abundances of sea lice in 2005 resulted from reduced numbers of *C. clemensi* and reduced numbers of chalimus or non mobile stages. The abundance of mobile stages of *L. salmonis* on all Pacific salmon species was actually higher in 2005 (14.3) than in 2004 (12.3). Abundances of mobile *L. salmonis* were higher on pink and sockeye salmon in 2005 than in 2004 (Table 3). The percentages of *L. salmonis* that were gravid females was similar in 2004 (23%) and 2005 (24%) as were the abundances in 2005 (4.1) and in 2004 (4.2). In 2004, 41% of all sea lice were in the chalimus stage compared to 24% in 2005. It is important to determine the interannual variability in sea lice abundance on adult Pacific salmon from one ecosystem, but it is also important to compare our results with observations from individually caught Pacific salmon in other areas.

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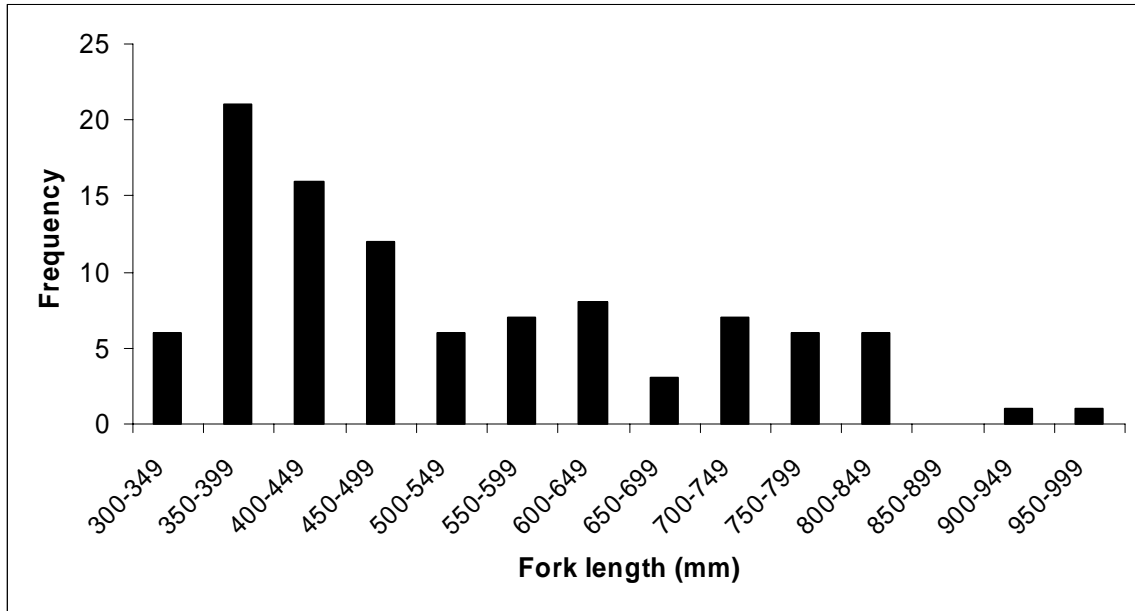


Figure 1. Length frequency for chinook salmon captured by hook and line gear in August 2005.

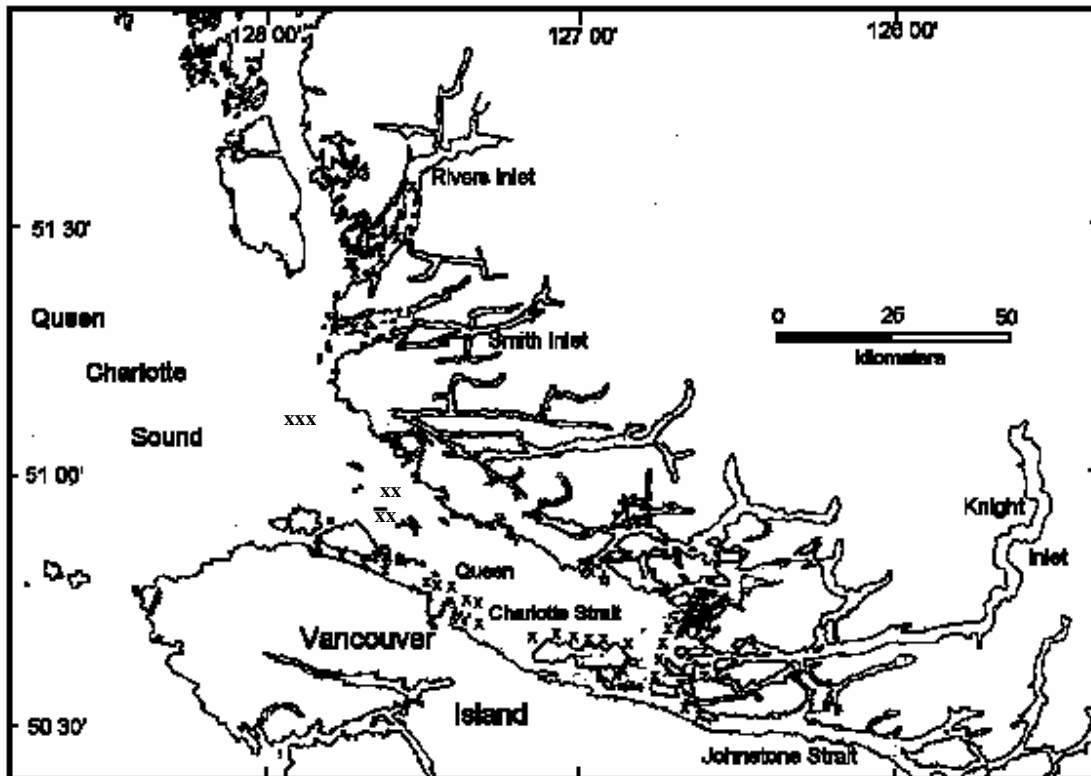


Figure 2. Area sampled showing the approximate fishing sites (X). The troller fished almost continuously. The extent of the fishing area depended on the species and abundances of catches.

Table 1A. Prevalence and intensity of sea lice on adult Pacific salmon sampled in August 2005.

Species	Number	Average length (mm $\pm$ SD)	Total lice	Prevalence	Intensity	Abundance	Range	Chalimus <sup>1</sup>			
								Mobile		Chalimus <sup>1</sup>	
								<i>L. salmonis</i>	<i>C. clemensi</i>	<i>L. salmonis</i>	<i>C. clemensi</i>
Pink Salmon	91	522 $\pm$ 22.3	2235	100	24.6	24.6	1-87	1732	42	320	141
Chum Salmon	1	749	5	100	5	5	-	5	0	0	0
Sockeye salmon	50	575 $\pm$ 28.3	1949	100	39.0	39.0	10-122	1347	16	536	50
Coho salmon	100	608 $\pm$ 81.4	1036	96	10.8	10.4	1-44	637	25	81	293
Chinook salmon	100	528 $\pm$ 163.0	1356	98	13.8	13.6	1-71	1186	6	134	30
Total	342		6581	98.2	19.6	19.2	1-122	4907	89	1071	514

<sup>1</sup>Numbers were adjusted using the species percentages in the laboratory sample.

Table 1B. Percentages of the life cycle stages for *L. salmonis* and *C. clemensi* from the 2005 survey.

	<u><i>L. salmonis</i></u>						<u><i>C. clemensi</i></u>				
	N	Chalimus %	Preadult %	Adult male %	Adult female <sup>1</sup> %	Gravid female %	Chalimus %	Preadult %	Adult male %	Adult female <sup>1</sup> %	Gravid female %
Pink Salmon	91	13	18	29	40	26	74	3	14	10	4
Chum Salmon	1	0	0	60	40	20	0	0	0	0	0
Sockeye salmon	50	26	18	26	31	18	73	0	14	14	7
Coho salmon	100	11	12	36	40	31	92	0	4	4	2
Chinook salmon	100	8	24	29	40	26	80	0	10	10	3

<sup>1</sup>Includes gravid females.

Table 2A. Prevalence and intensity of sea lice on adult Pacific salmon caught using troll gear in August 2004 (see Beamish et al. 2005 for data summary).

Species	Number	Average length (mm $\pm$ SD)	Total lice	Prevalence	Intensity	Abundance	Range	Mobile		Chalimus	
								<i>L. salmonis</i>	<i>C. clemensi</i>	<i>L. salmonis</i>	<i>C. clemensi</i>
Pink Salmon	132	488 $\pm$ 30.5	6910	100	52.3	52.3	2-203	1751	772	1044	2545
Chum Salmon	62	720 $\pm$ 46.3	2575	100	41.5	41.5	2-302	451	498	246	1163
Sockeye salmon	124	590 $\pm$ 40.5	5587	100	45.1	45.1	9-427	2491	121	1565	701
Coho salmon	208	638 $\pm$ 64.0	3855	99.0	18.6	18.5	2-106	1940	195	405	1043
Chinook salmon	140	503 $\pm$ 155.1	2227	99.3	16.1	15.9	1-104	1694	38	262	22
Total	679		21241	99.6	31.4	31.3	1-427	8327	1624	3522	5474

Table 2B. Percentages of the life cycle stages for *L. salmonis* and *C. clemensi* from the 2004 survey (Beamish et al. 2005).

	N	<u><i>L. salmonis</i></u>					<u><i>C. clemensi</i></u>				
		Chalimus %	Preadult %	Adult male %	Adult female <sup>1</sup> %	Gravid female %	Chalimus %	Preadult %	Adult male %	Adult female <sup>1</sup> %	Gravid female %
Pink Salmon	132	37	21	21	21	16	77	7	10	6	1
Chum Salmon	62	35	25	19	21	14	70	10	11	9	1
Sockeye salmon	124	39	16	19	26	20	85	6	3	6	3
Coho salmon	208	17	21	25	36	31	84	7	4	5	2
Chinook salmon	140	13	22	27	38	33	37	8	20	35	22

<sup>1</sup>Includes gravid females.

Table 3. Comparison of abundances of mobile *L. salmonis* in 2004 and 2005.

Species	2004		2005	
	Mobile	Gravid female	Mobile	Gravid female
Pink salmon	13.3	3.4	19.0	5.6
Chum salmon	7.3	1.6	5.0	1.0
Sockeye salmon	20.1	6.7	26.9	6.5
Coho salmon	9.4	3.5	6.6	2.3
Chinook salmon	12.3	4.6	12.1	3.3